Water Resources Management Plan

Annual Review 2019-20

June 2020

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Executive Summary

Introduction and purpose of this report

1. Water companies are required to produce a Water Resources Management Plan (WRMP) every five years which sets out how the company intends to provide a secure and sustainable supply of water to their customers, whilst protecting the environment.

2. In August 2014, following approval from government, we published our Water Resources Management Plan 2014 (WRMP14) which set out how we planned to provide a secure and sustainable water supply for the 25-year period from 2015 to 2040.

3. We monitor our progress against the commitments in WRMP14 and provide an annual performance report. We do this for the first 5-year period of the plan, aligning with the 5-year business plan. The annual report is sent to the Environment Agency and Ofwat, and is published on our website www.thameswater.co.uk/wrmp for customers and stakeholders.

4. This document, called the Annual Review 2020 (AR20), presents our performance for the period from 1 April 2019 to 31 March 2020. It is the final annual review of our WRMP14 and has been prepared in accordance with regulators' guidance.

5. In April 2020 we published our next WRMP, called WRMP19, which covers the 80-year period from 2020 to 2100. In this document, AR20, we have also included information on our actual position in April 2020 in relation to our forecast start position for WRMP19, information on our forward plan to develop a multi-sector, resilient plan for the south east region, working with our neighbouring companies and wider water users across the region, and progress to examine potential future solutions.

Overview of our performance for 2019-20 and for the 5-year period from 2015 to 2020

We have successfully delivered a secure water supply for our customers

6. The supply demand balance, and the associated regulatory metric called the Security of Supply Index (SoSI), are designed to show if there are sufficient water supplies to meet demand for water and therefore the water supply is secure. We are pleased to report that this year we have successfully achieved our SoSI regulatory target of 100 for all Water Resource Zones (WRZ) in our area, indicating that there is sufficient water in London and across the Thames Valley for our customers.

We have ensured a secure and sustainable water resource base

7. We have exceeded our targets for developing new water resources and have delivered schemes to ensure our existing abstractions are sustainable.

   - **We have developed new water sources.** We have increased the amount of water available for supply by over 47 Ml/d since 2015, exceeding our target for new resource development. The resources include a new groundwater source at Tottenham, extension to a commercial agreement with RWE Generation UK and amendments to a water sharing agreement with Essex and Suffolk Water. We deferred the development

of some proposed new schemes, such as a groundwater scheme at Honor Oak, and considered them for WRMP19.

- **We have continued to work with the Environment Agency to ensure our abstractions are sustainable.** In consultation with the Environment Agency, we have reduced our abstractions in the Letcombe Brook and River Wye catchments and have implemented a restoration scheme to improve the River Cray. We have undertaken investigations on our abstractions at Hawridge and at Bexley, in the River Chess and River Cray catchments respectively, to understand the potential impact of our groundwater abstractions on the rivers to inform the decision on what action is needed to protect these rivers.
- **Maintaining the availability of our sources of water**. We have an on-going programme to improve the operational performance of our sites. This year we discussed operational issues at the Gateway Desalination plant with the Environment Agency, we agreed to reduce the average output at the plant from 150 Ml/d to 100 Ml/d and implement an improvement programme to improve the resilience of future output. We reported outage of 197 Ml/d this year which is lower than the outage reported in 2018/19.

We have reduced leakage and encouraged the efficient use of water

8. We have successfully reduced the amount of water lost through leaks on our pipe network and on our customers' pipes, and worked with our customers to ensure we are making the best use of available water resources.

- **We have achieved a substantial reduction in leakage since 2015.** Over the last couple of years our efforts have intensified on all aspects of our leakage management programme to recover and drive down leakage to our 2019/20 leakage target. Our programme has involved the recruitment of a higher number of detection and repair gangs, installation of acoustic loggers to enhance our detection capability, an increased focus on innovation and a higher level of monitoring and assurance activity. We are delighted to report that we have exceeded our regulatory target of 606 Ml/d, reducing leakage to 595 Ml/d (ODI) and final position for WRMP as a shadow uplifted 596 Ml/d.
- **We have continued to roll out the smart metering programme.** This year we installed a further 49,791 smart water meters as part of our progressive metering and optant metering programmes. Since 2015, we have installed over 331,000 smart meters, exceeding our revised 5-year target for the progressive metering programme, and over 424,000 household meters in total. Over 45% of our customers now have a household meter. We have also worked hard to make the most of the installation of smart meters, helping our customers to understand and reduce their water consumption and pinpoint leaks both on our water network and our customers' pipes.
- **We have continued to support our customers and encourage efficient use of water.** We have continued to expand our programme to encourage the efficient use of water, focusing on smarter home and business visits, new incentive schemes, school and community projects to raise awareness of the need to use water efficiently and to achieve sustained behaviour change. This year we saved over 16 Ml/d - nearly three times our forecast - and since 2015 we have nearly doubled our target, saving over

63 Ml/d. We continue to evolve our approach to promote the efficient use of water, working with partners and stakeholders.

WRMP19 – confirming our start position

9. In April 2020 we published our WRMP19, this looks forward over the next 80 years from 2020 to 2100. We developed WRMP19 based on insights from customers and we also engaged extensively with stakeholders and regulators throughout the development of the plan. We also worked collaboratively with other water companies from across the south east of England, through Water Resources south east (WRSE) to understand the challenges facing the whole region and to identify opportunities and shared solutions. We designed our plan to satisfy three main objectives:

   - to provide a secure supply of water for our customers addressing the supply demand deficits that we forecast in our region;
   - to improve resilience to a one in 200 year severe drought event; and
   - to look beyond the needs and opportunities of our supply area alone and consider the growing needs of the wider south east of England.

10. Our plan is a best value plan and includes ambitious leakage and demand reduction in combination with the development of new water resources to ensure a secure water supply and environmental resilience. We recognise there are uncertainties in our plan, which is not unexpected with the long planning horizon; as such we have used an adaptive planning approach which provides flexibility to adapt to changes and new information as they emerge across the long term planning period.

11. We have checked our actual position in April 2020 against a suite of key metrics and our forecast start position in WRMP19 and can confirm that the foundation of WRMP19 is robust and remains valid as a basis for future planning.

12. It is noteworthy that the supply demand position in Slough, Wycombe and Aylesbury (SWA) WRZ is tighter than anticipated. We have undertaken a review of the SWA water supply system and have identified a series of potential solutions to improve our supply capability and its resilience. The scope and programme of the investments required are in the process of being reviewed to ensure the WRZ remains in surplus and we are confident that we can maintain a secure water supply.

Forward look

13. In WRMP19 (section 11) we proposed a monitoring programme to ensure regulators and stakeholders have visibility of our performance on a range of metrics including performance on our programme to manage demand for water. We will report on the monitoring plan in AR21, and subsequent annual reports.

14. We have committed to a substantial programme of measures to make the best use of resources and we will also need to develop new water resources. Between 2020 and 2025 we have committed to develop five new water resource schemes in London and Guildford WRZs and to improve connectivity in our distribution system. We will report on progress in AR21.

15. Over the longer term we will need more water resources and are exploring a wide range of options as part of the regional planning process including catchment solutions, third party options and solutions which can provide resilience for public water supply and other sectors. These will be examined and considered in the regional plan and our WRMP24.

16. We are also progressing work on strategic resource options, in collaboration with other water companies and regulators, which were funded by Ofwat as part of the Final Determination on our Business Plan. This work is overseen by the Regulatory Alliance to Progress Infrastructure Development (RAPID), comprising the Environment Agency, Ofwat and Drinking Water Inspectorate (DWI). We are following a new regulatory gated process that has been introduced and provide quarterly progress reports to RAPID and submissions at the specified gates, with Gate 1 in July 2021. The five options Thames Water is involved with are:

- South east Strategic Reservoir Option (SESRO)
- Severn-Thames Transfer
- Wastewater re-use in London
- Transfers to Affinity Water
- Transfers to Southern Water

Working across the South East region

17. In line with the National Framework and focus on regional planning, we are working closely with WRSE, and the other water companies located in the south east, to develop a multi-sector resilience plan for the south east region.

18. In March 2020 WRSE published “Future Water Resource Requirements for south east England”. This set out the initial picture of the region’s future water resource requirements, drawing on existing published data and the National Framework published by the Environment Agency. It confirmed that the south east region is expected to face some of the most significant challenges to water resources in the future, forecasting a shortfall of around 1 billion litres of water per day by 2050, rising to over 1.7 billion litres by 2100.

19. The focus of work to 2021 is to develop technical methods, approaches and tools with the aim of developing a draft regional plan for consultation in early 2022 and a draft WRMP24 in autumn 2022. We will continue to share information in a timely way with stakeholders and provide the opportunity to input and participate in the work.

Part A – Introduction

A.1 Background

20. Water companies in England and Wales are required[1] to produce a Water Resources Management Plan (WRMP) every five years. The WRMP is a strategic plan which sets out how the company plans to maintain the balance between supply and demand for water for a minimum planning period of 25 years.

21. In August 2014 we published our Water Resources Management Plan 2014, hereafter referred to as the plan or WRMP14. It set out a range of measures to ensure we could continue to provide a secure supply of water to all our customers in London and the Thames Valley over the 25-year period from 2015/16 to 2039/40.

22. Water companies are required[2] to produce an annual review of their plan which provides a report on progress, highlights any changes to the plan, reports on actions requested by regulators and presents an overall summary of the supply demand situation. The Environment Agency and Natural Resources Wales publish guidance[3] for companies to use as a framework in completing the review.

23. This document presents the annual review of progress and achievements for the period from 1 April 2019 to 31 March 2020 (2019/20), the fifth and final year of the five year period. It is referred to as Annual Review 2020 (AR20). We have prepared AR20 in accordance with the regulators' guidance.

24. We will send the AR20 to the Secretary of State, the Environment Agency and Ofwat. We will also publish it on our website for interested customers and stakeholders www.thameswater.co.uk/wrmp.

25. In response to AR19[4], Defra, in collaboration with Ofwat and the Environment Agency[5], raised concerns in respect of the security of water supply to our customers. The concerns raised are summarised in the table below, with a summary of our response. These issues are all covered in this report. Defra also requested that we provide a quarterly security of supply report to ensure visibility and confidence in our water supply position. We asked that this be revisited after submission of this report.

[1] Water Industry Act 1991, Sections 37A to 37D (as amended by the Water Act 2003)
[2] Water Industry Act 1991 Section 37A (5)
[3] EA and NRW (May 2019) Water resource management plan annual review and annual data return: Guidance for water companies in England and Wales
[4] Thames Water Annual Review 2019 submitted June 2019
[5] Letter from Defra, Ofwat and the Environment Agency 30 October 2019

Table 1: AR19 Queries

Defra, EA and Ofwat comment (October 2019)	Thames Water response (January 2020)
Gateway desalination plant – Re-assess the deployable output of the plant and of the London resource zone in light of the long-term outage, and provide information on the remedial actions.	We completed a capability and resilience review in November 2019. The results were reviewed and discussed with the Environment Agency. The outcome was the capability of the plant was reduced from 150 Ml/d to 100 Ml/d, with the ability to achieve higher outputs for short periods of time as required, and a forward work programme of measures at the plant.
Leakage performance – Provide information on the actions to assess, forecast and manage the under-performance reported on leakage in AR19, and the preceding two years.	We provided an update on performance which presented our end of year annual average forecast was 627 Ml/d (November 2019), with further good progress reported in December 2019. We also committed to achieve our annual average target of 606 Ml/d through improvements to process and increased work activity, along with an on-going review of the water balance.
Security of supply index (SoSI) – Revise the SoSI, noting the concerns set out above and provide an update to Defra, Ofwat and the EA.	We completed the review using updated information. This confirmed the SoSI position of 100. We also confirmed that our forecast calculation for AR20 and future SoSI scores for the London WRZ remain in surplus.

26. We published our final Water Resources Management Plan 2019, hereafter referred to as WRMP19, in April 2020 following approval to publish from the Secretary of State for the Environment, Food and Rural Affairs. We developed WRMP19 over the past 4 years, with extensive engagement with regulators, stakeholders and customers. The plan covers the 80-year period from 2020 to 2100 and sets out the range of measures that are required to manage demand and ensure sufficient resources to continue to provide a resilient supply of water to our customers. This is available on our website www.thameswater.co.uk/wrmp. We have included information in this report on the starting position in April 2020 relative to that forecast for WRMP19 to identify any changes.

27. Our WRMP19 is adaptive and we committed to an on-going programme of studies to inform the selection of strategic options that will be promoted as part of the best value investment programme for the south east regional plan and WRMP24. In order to enable the strategic schemes to be delivered within their respective lead times, without risk to the overall robustness of the plan, a decision will need to be made in 2022/23 which finalises the strategic water supply schemes for promotion and delivery. The timing of this decision point in 2022/23 aligns with one chosen by Affinity Water to confirm the strategic options that it will promote as part of its own WRMP. We have included information in this report on the framework to monitor progress against the commitments set out WRMP19 to give visibility of our progress. We are continuing our engagement programme to provide the opportunity for stakeholder involvement in the on-going work to shape our future plans.

A.2 Purpose of this document

28. This document is the final annual review of our WRMP14 for the period from 1 April 2019 to 31 March 2020, noted as 2019/20. It provides an assessment of actual events and performance in the past year and compares these against the forecasts in the plan. It also includes information on our next plan, WRMP19, in respect of any deviations from the forecast start position, the further work that is planned and on-going engagement as we deliver on committed activities and continue to develop our future plans.

29. This document is structured in five main Parts:

30. **The remainder of Part A** provides contextual information. It describes:

- Our supply area, divided into Water Resource Zones (WRZs) for planning purposes
- Our Levels of Service we provide to our customers

31. **Part B** focuses on our performance commitments. It includes:

- Our performance against the supply and demand related customer outcomes and performance commitments set out in the WRMP14 and PR14 Business Plan.
- Confirmation of the supply and demand related customer outcomes and performance commitments for the next 5 years as set out in the WRMP19 and PR19 Business Plan.

32. **Part C** looks at the out-turn year. It presents:

- An overview of the weather
- The 2019/20 water balance and movements from the previous year.
- Progress with delivery of demand management, resource development schemes, environmental investigations and sustainability reductions
- Source availability during the year
- Actual Outage

33. **Part D** covers the WRMP19 Monitoring Plan. It covers:

- Current position versus forecast position
- Updates on strategic resource options
- Updates on the on-going collaborative work with Regional Plans
- Updates on environmental activities
- WRMP19 validity statement

34. **Part E** takes a look ahead. It considers:

- The key risks and challenges for the coming year
- Our forward plans for engagement

35. We have also included a number of Appendices to provide supporting information or extra detail where necessary.

A.3 Water Resource Zone boundaries

36. Our water supply area consists of six Water Resource Zones (WRZ); London, Swindon and Oxfordshire (SWOX), Henley, Kennet Valley (KV), Slough/Wycombe/Aylesbury (SWA) and Guildford. These are illustrated in Figure 1. The WRZs outside London are collectively referred to as the Thames Valley WRZs.

37. We plan water resources based on these six WRZs. There have been no changes to the WRZs between AR19 and AR20.

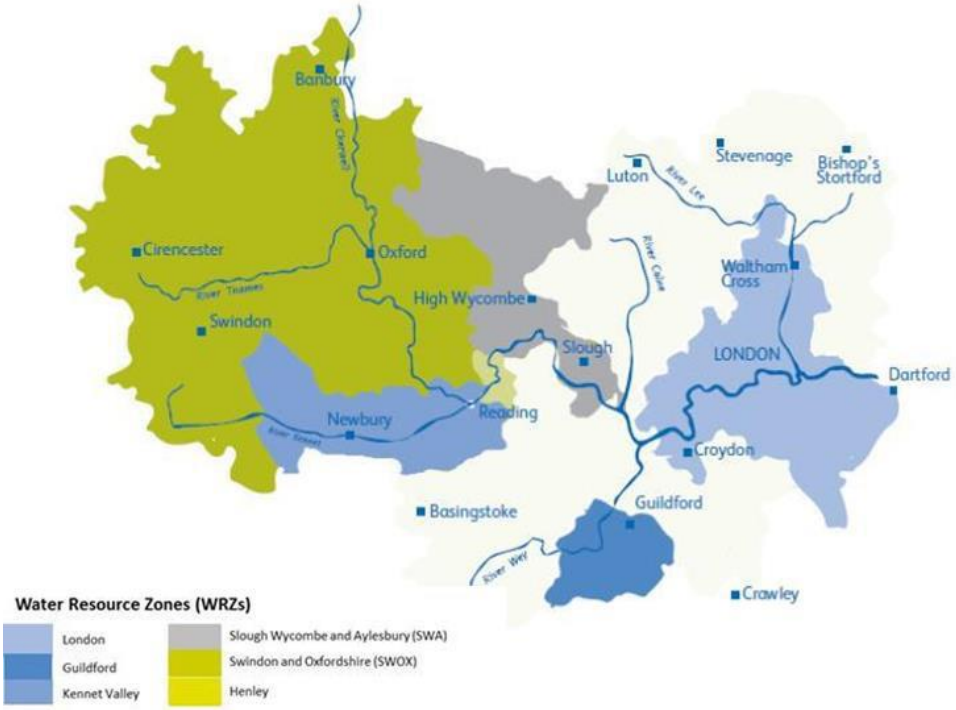


Figure 1: Our Water Resource Zones

A.4 Levels of Service

38. Our levels of service set out the frequency we expect to act to reduce our customers' use of water during prolonged periods of dry weather. Our levels of service, as set out in the table below, are agreed with customers and are published within our WRMP.

Table 2: Levels of Service

Restriction Level	Frequency of Occurrence	Water use restrictions
Level 1	1 year in 5 on average	Intensive media campaign
Level 2	1 year in 10 on average	Sprinkler/unattended hosepipe ban, enhanced media campaign
Level 3	1 year in 20 on average	Temporary Use Ban (formerly Hosepipe ban), Drought Direction 2011 (formerly non-essential use bans) requiring the granting of an Ordinary Drought Order
Level 4	Never	If extreme measures (such as standpipes and rota cuts) were necessary, their implementation would require the granting of an Emergency Drought Order

39. There have been **no changes** to any levels of service this year.

40. 'Never' for a Level 4 event effectively represents a 1 in 100 drought return period, i.e. the length of our observed historical dataset.

Part B – Performance Commitments

B.1 AMP6 Performance commitments (2015-20)

23. Customer research for PR14 resulted in the identification of key priorities for our customers. These outcomes were then organised into a series of performance commitments across our business. Four of these performance commitments are relevant to this document.

24. Performance commitments associated with the supply demand balance include Security of Supply Index (WB6), Leakage (WC2), Customer Side Leakage (WA5), and Water Efficiency (WA4).

25. This year we achieved the committed performance and our end of AMP targets were met. Consequently, no further ODI penalties will be incurred on top of the £56.7m leakage and £13.59m Security of Supply penalties for earlier annual breaches.

Table 3: AMP6 Supply demand performance commitments

Reference	Measure	Commentary
PR14TMSWSW_WB6	WB6: Security of Supply Index	Our Security of Supply Index for the annual average and critical peak period in 2019/20 is 100, delivering our committed performance (see section C.4). All WRZs are in surplus under both annual average and critical conditions. The SoSI score of 100 this year results in no financial penalty for the year with a penalty of £13.59m for earlier annual breaches in AMP6.
PR14TMSWSW_WC2	WC2: Leakage	This year we have outperformed our leakage target of 606 Ml/d, with annual average leakage at 595 Ml/d. (See section C.2.7). This is slightly above the reward deadband, so there will be no reward or penalty for this year, but a penalty of £56.7m for earlier breaches over AMP6. During 2019/20 we continued to make significant progress in reducing leakage, following on from the reduction delivered in the previous year. This improved performance has been driven by a number of factors and company wide effort. We increased our repair and maintenance resources to the highest numbers since 2015 and have implemented new, innovative tools, to improve leak detection and repair productivity, along with the further optimisation of network water pressures. The Executive Steering Group of the Leakage Task Force (LTF) have met fortnightly to monitor

Reference	Measure	Commentary
		performance and review progress of improvement initiatives. We have also put in considerable effort to improve many of the components of demand, for example, finding and fixing broken meters and updating assessments of customer wastage, to ensure we are reporting as accurately as possible, which in turn improves our ability to better target those areas of high leakage. It is also noted that this year we have been assisted by the milder weather conditions experienced during the winter months, that has meant that we have not experienced the usual number of visible leaks breaking out. More detail on our current leakage performance is available on our website https://www.thameswater.co.uk/help-and-advice/leaks/our-leakage-performance
PR14TMSWSW_WA4	WA4: Reduced water consumption from issuing water efficiency devices to customers	This measure has an end of AMP target; the 2019/20 figure is reported cumulatively from the beginning of the AMP and is based on an assumed savings methodology. We achieved a saving of 34.42 Ml/d compared to a target of 15.45 Ml/d (see section C.2.9) due to completing a higher number of water efficiency visits to residential customers. Additional savings of just under 29 Ml/d have been delivered through water efficiency visits to business customers.
PR14TMSWSW_WA5	WA5: Provide a free repair service for customers with a customer side leak outside of the property	During 2019/20 we delivered significantly more free repairs (6,841) than the target of 890 properties (over a 10,000-property threshold). This is predominantly due to the higher volume of repair work being undertaken as part of our leakage recovery plan, where we have fixed increased numbers of both customer side leaks and other leaks in order to ensure we achieved our leakage reduction target.

B.2 AMP7 Performance commitments (2020-25)

26. Customer research for PR19 resulted in the identification of key priorities for our customers. These outcomes were then organised these into a series of performance commitments across our business. Six of these performance commitments are relevant to this document.

27. Performance commitments associated with the supply demand balance include:

- Security of Supply Index (DW02)
- Risk of Severe Restrictions in a Drought (DW01)
- Leakage (BW04)

- Per Capita Consumption (BW05)
- Installing new smart meters in London (M01)
- Replacing existing meters with smart meters in London (M02)

28. Our Performance commitments for AMP7 are set out in the table below.

Table 4: AMP7 Supply demand outcomes

Reference	Measure	Commentary
CSD005-DW02	Security of Supply index (SoSI)	A continuation of our AMP6 performance commitment, with our aim being that we should achieve a SoSI score of 100 every year through AMP7. The system of penalties has changed, but commits us to a performance level that is the most cost-beneficial for us to achieve. The system reflects the fact that SoSI is capped at 100 and provides no system of outperformance incentive, such that we are not rewarded for over-investing and providing a level of resilience beyond what our customers think is economically efficient. The underperformance penalty payment is £0.224m per SoSI point. In the longer-term, our plan is to increase our resilience to drought from a 1 in 100-year drought to being resilient to a 1 in 200-year drought. Linked to this we have another PR19 performance commitment (CSD005-DW01) that is also aimed at drought resilience, see below.
PR19TMS_DW01	Risk of severe restrictions in a drought.	This performance commitment is to measure our resilience to severe restrictions in a 1 in 200 drought and incentivise improvement in resilience in the short and longer term. The performance measure is defined as the percentage of the population at risk of severe drought to one decimal place. This is measured on an annual basis and is limited to ensure no more than 77% of the population is at risk of severe drought in AMP7. There is no financial ODI incentives associated with this performance commitment. It is measured and reported annually and incentivised through reputational risk.
PR19TMS_BW04	Leakage	This performance commitment is to incentivise leakage reduction. Leakage reduction is measured as the movement in the three year average leakage values. Three year average values are

Reference	Measure	Commentary
		calculated from annual average values for each reporting year and the two preceding years (so the 2019/20 baseline position is the three year average of 2017/18, 2018/19 and 2019/20). Performance commitment levels are set as a percentage reduction from the 2019/20 baseline value of 619.7 Ml/d. This is a change from AMP6 which specified leakage reduction targets in megalitres per day (Ml/d). The AMP7 leakage performance commitment applies annually to result in a cumulative leakage reduction of 20.4% by 2024/25 (493.3 Ml/d). Underperformance and over-performance relate to performance changes expressed in Ml/d. For AMP7, the underperformance rate is -0.389 £m/Ml/d/year and over-performance is 0.307 £m/Ml/d/year.
PR19TMS_BW05	Per Capita Consumption	This performance commitment is to incentivise us to help customers reduce their consumption. It is new for AMP7. Per capita consumption is defined as the sum of measured household consumption and unmeasured household consumption divided by the total household population. The performance commitment is expressed as litres/person/day (to one decimal place) and based on three year average values, calculated from annual average values for the reporting year and two preceding years. The performance commitment levels are expressed as a percentage reduction from the 2019/20 baseline (146 l/person/d), which is also a three-year average. The difference between this value and the three year average PCC (to one decimal place) is used to calculate ODI incentives and penalties. For AMP7, the performance commitment applies annually to achieve a cumulative PCC reduction of 6.3% in 2024/25. The AMP7 reduction will also contribute to longer term reductions that are expected from the industry. The National Framework for Water Resources specifies that an assumption of 110 litres per person per day is achieved by 2050 should be included in future planning. To achieve this target, the Framework expects interventions from water companies and the Government will be required (Environment Agency, 2020, 'Meeting our Future Water Needs: a National Framework for Water Resources').

Reference	Measure	Commentary
		For AMP7, the underperformance rate is -0.696 £m/litres/person/day and over-performance is 0.760 £m/litres/person/day.
PR19TMS_M01	Installing new smart meters in London	This performance commitment is to incentivise an increase in the number of smart water meters that are installed at customer properties. Smart meters reduce the cost of meter readings and allow for more regular readings to be taken. This improves the quality of data for the customer to better control their use, and the company to optimise its actions in response to effectively manage demand. This performance commitment measures the total number of residential smart meters installed annually in London from 1 April 2020. A smart meter is defined as a new meter installation that uses Advanced metering infrastructure (AMI) technology to enable remote consumption reads. For the performance commitment a residential meter is defined as: • Meter installed at a residential property that previously paid unmetered charges. This could be a compulsory or voluntary (optant) meter request. • Small Bulk Meters that provide additional benefit to meters already installed (i.e. not replacements of bulk meters) The ODI incentive for this performance commitment is applied at the end of AMP7. The performance commitment is to install 399,749 new smart meters in London with an underperformance rate of -0.000037 £m/unit. There is no over-performance rate for this performance commitment.
PR19TMS_M02	Replacing existing meters with smart meters in London	This performance commitment is to incentivise the replacement of basic water meters with smart water meters at customer properties. Existing meters are defined as meters that were installed prior to 1 April 2020 without smart meter capability. Smart meters are defined as per PR19TMS_M01. The ODI incentive for this performance commitment is applied at the end of AMP7. The performance commitment is to install 130,000 new smart meters in London with a underperformance rate of -0.000018 £m/unit. There is no overperformance rate for this performance commitment.

Part C – The out-turn year 2019-20

29. In Part C we report on the weather conditions experienced in the reporting year and how it has impacted our annual water balance.

30. We particularly look for whether there has been a cold winter, which would cause an increase in the volume of water lost through leakage and also whether the summer has been dry and hot, which results in higher consumption.

31. Importantly the annual water balance enables us to compare the out-turn year with the normalised dry year and peak week forecasts used within the WRMP.

C.1 Overview of the weather 2019-20

32. The summer of 2019 was not quite as extreme as that of 2018 but was still hot and dry with temperatures rising to a peak of 37°C on the 25th July 2019. This resulted in high levels of demand over the summer period.

33. The winter of 2019/20 was particularly mild. The mild weather was a contributory factor in there being very little increase in demand due to leakage over the winter.

34. The graph below illustrates change in weather components and demand over the year.

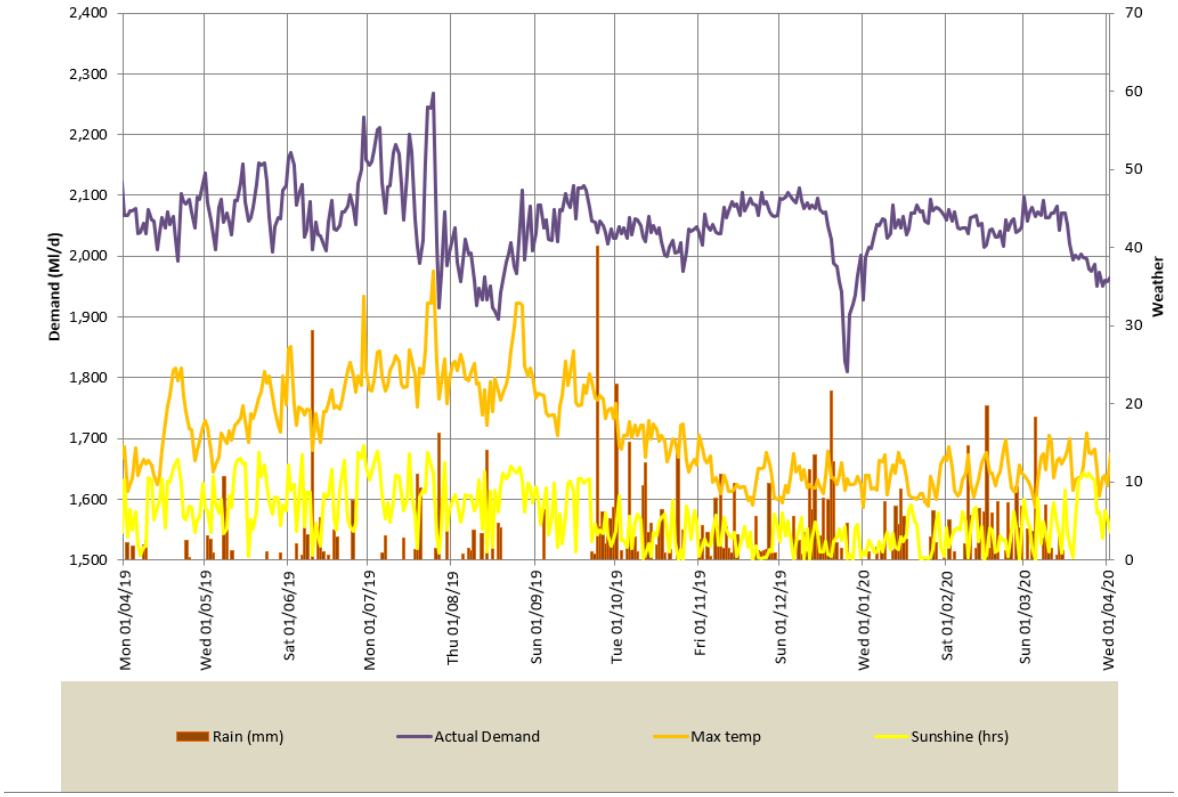


Figure 2: 2019-20 weather components and demand

35. Rainfall in the Thames catchment over the reporting year was wetter than average, 122% of the long-term average. There was approximately average rainfall during the summer period (April to September), before a wet winter during which there was significantly more than average rainfall. Monthly rainfall totals relative to the long-term average are shown in the graph below.

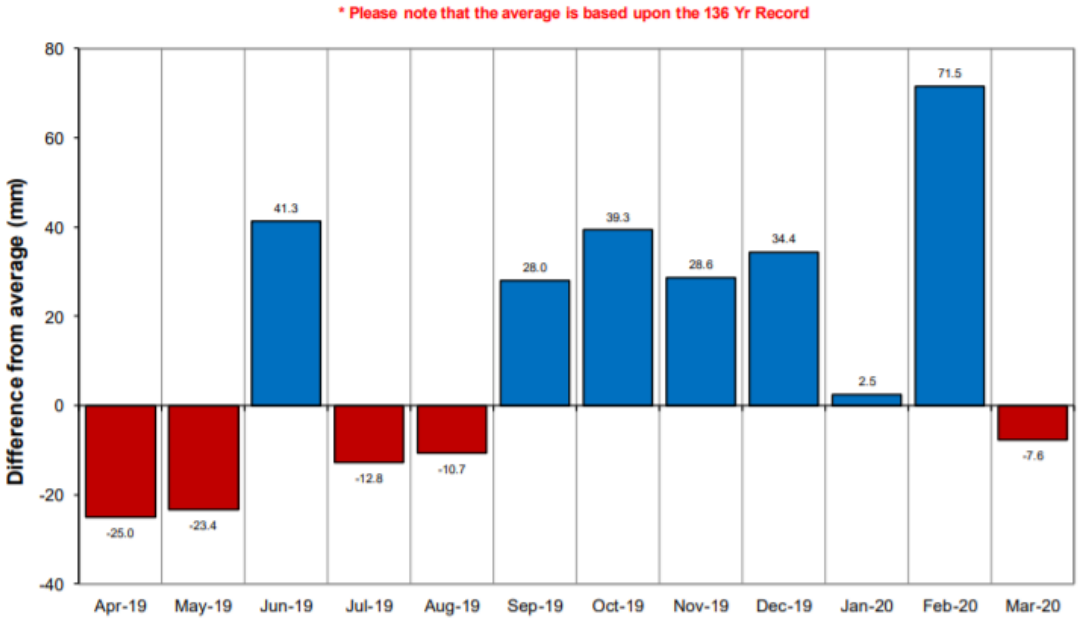


Figure 3: Monthly Rainfall Total (mm) above or below long-term average for 2019-20

36. The droughts that drive the dry year scenarios for our water resources modelling are 1920/21, 1933/34 and 1975/76. The drought during 1920/21 was approximately 17 months long, with rainfall from August 1920 to December 1921 being 62% of the long-term average. The drought of 1933/34 was around 20 months long, with rainfall from April 1933 to November 1934 being 67% of the long-term average. The drought of 1976 was around 16 months long, from May 1975 to August 1976, with rainfall over this period being 55% of the long-term. Rainfall over the 18 months ending in March 2019 was 110% of average, which is significantly more than the rainfall that occurred during the dry year scenarios that drive our water resources planning.

37. Consequently, we have not needed to introduce any restrictions on water use this year.

C.2 The Water Balance 2019-20

38. To understand how water is used across our supply area in a reporting year, we use a water balance.

39. The water balance is split into the following components:

- Distribution input – the amount of water put into our supply network
- Household Use - water used in the home and garden
- Non-household Use - water used by businesses
- Minor components – including operational water we use to maintain the network, water used without charge either legally (e.g. fire hydrant use), or illegally (e.g. usage in a property declared as void (empty)).
- Leakage - water lost from the distribution system, trunk mains, service reservoirs and customer side leakage.

40. We calculate and report these components on an annual basis.

41. In the following sub-sections we will explore each of these components and how they have changed compared to last year at company level. The full breakdown of the out-turn water balance for 2019/20 by WRZ is provided in Appendix A (Annual Average) and Appendix B (Critical Period).

C.2.1 Methodology

42. The methods used to produce the water balances undertaken for this review have been reviewed and endorsed by an independent external auditor.

43. They are unchanged from AR19, save our method for estimating unmeasured household and assessed property water usage, which we have had to adapt due to the impact of the rollout of the metering programme (see household use section below).

C.2.2 Summary of changes in key components of the water balance

44. The main changes from last year at company-level are:

- A decrease in distribution input of 94 Ml/d
- A decrease in unmeasured household consumption of 56 Ml/d
- An increase in measured household consumption of 48 Ml/d
- A decrease in the measured non-household consumption of 16 Ml/d
- A decrease of leakage of 96 Ml/d

45. Overall the water balance discrepancy at company-level (the difference between distribution input and the independent calculation of its components) has increased from 1.16% last year to 2.29% this year. It is still comfortably within acceptable limits.

46. The water balance discrepancy is apportioned across the components of demand using the Maximum Likelihood Estimation (MLE) technique. The confidence intervals applied remain the same as last year.

C.2.3 Distribution Input

47. DI refers to the volume of water required to meet demand. DI is calculated from the sum of our treatment works output, the net balance between bulk imports and exports and the removal of demand from insets. Adjustments are made for meter error where the discrepancy with the test meter is greater than 5% and for on-site operational use where the off take is downstream of the distribution input meter.

Distribution Input (Ml/d)	2018/19	2019/20	Variance
Water delivered: distribution input	2,696.56	2,602.17	-94.39

48. The DI during AR20 has decreased significantly by around 94 Ml/d, due to a combination of lower demand which is reflective of the prevailing weather conditions, but primarily driven by reduction in leakage. This has been achieved by an enhanced active leakage programme and a mild winter.

C.2.4 Household Use

Measured Properties

49. Water delivered to measured properties is reported from our customer information systems. Most properties are now billed in the new SPRING billing system as migration of properties has continued during AR20.

Household Water Use (Ml/d)	2018/19	2019/20	Variance
Water delivered billed measured households.	544.65	592.73	48.08

50. The reported volume delivered to measured households has increased by 48 Ml/d compared with AR19. This can be attributed to the progressive metering programme (PMP) where more homes have been moved to the measured household category; further optant metering where customers have opted for a metered bill; additional new build properties; and further deregistration of household properties from the non-household market.

51. The average number of metered household properties has correspondingly increased.

Unmeasured Properties

52. The Domestic Water Use Study (DWUS) is used as a base to determine water consumption for unmeasured and assessed household accounts. DWUS examines the water use in volunteer households that have a meter fitted, but who are billed on the unmeasured tariff. This means they behave more like an unmeasured customer, but their water use is captured by the DWUS meter.

53. This panel has been shrinking over the AMP6 period with the roll out of the PMP. As a result, this year we have introduced two other data sources to supplement the DWUS panel: the unmeasured period from the properties metered under the PMP prior to the household paying on a metered tariff (the metering journey for these properties meaning that there is a period of recorded consumption billed as unmeasured, before they are switched to metered billing), and; a panel of bulk metered areas (BMAs) to capture use in blocks of flats.

54. The method used for the BMAs is in line with guidance on Per Capita Consumption from Small Area Monitors.

55. The DWUS, BMA and PMP results are weighted by property type, occupancy and ethnicity to determine the overall value for unmeasured household consumption.

Household Water Use (Ml/d)	2018/19	2019/20	Variance
Water delivered billed unmeasured households	1,057.02	1,001.41	-55.61

56. The reported volume of water delivered to unmeasured households has decreased by 56 Ml/d compared with AR19. This can be attributed to properties moving to measured billing through the PMP and optant metering programmes.

57. The average number of unmetered household properties has correspondingly decreased.

C.2.5 Non-household Use

58. Billing for non-household properties was migrated to the non-household Retail Market in 2017. Billed consumption is now provided by the market operator system, CMOS, including estimates of consumption for unmeasured and assessed non-household properties.

59. We have no direct control over the estimation of consumption of commercial properties, nor meter reading, but liaise with the Retailers if we have concerns. For example, we understand that Retailers can make properties void where meters have not been read for long periods. If meters are not read, but the property is actually occupied then this may lead to an over-estimation of void properties and inaccurate allocation of water used. In AR19, we increased the uncertainty in the non-household data for the MLE process, to make allowance for this.

Non-Household Water Use (Ml/d)	2018/19	2019/20	Variance
Water delivered billed measured non-household	469.82	454.30	-15.52
Water delivered billed unmeasured non-household	16.22	16.78	0.56

60. Measured non-household water delivered is lower than AR19, by 15.5 Ml/d. Unmeasured non-household water delivered is marginally higher by 0.56 Ml/d.

61. The movement in measured usage may be attributed to the less extreme weather in AR20, but also due to the ongoing re-allocation exercises between households and non-households (related to the classification of blocks of flats) and the movement between voids and occupied properties (related to meter reading, as discussed above.

C.2.6 Minor components

62. Minor components include operational water we use to maintain the network, water used without charge either legally (e.g. fire hydrant use), or illegally (e.g. usage in a property declared as void (empty)).

Minor components Water Use (Ml/d)	2018/19	2019/20	Variance
Distribution system operation use	22.94	24.30	1.36
Water taken legally	25.71	25.39	-0.32
Water taken illegally	57.55	63.10	5.55

63. The movements in the minor components this year are not material, the increase in water taken illegally is linked to usage in void properties.

C.2.7 Leakage

64. Leakage reduction is an extremely important part of our plans to manage the balance between supply and demand and consequently we had challenging targets to deliver significant leakage reductions throughout the AMP6 period. These reductions are principally in London, but at the same time we have targets to reduce leakage levels in other WRZs, whilst our supply network and the number of properties and associated demand we supply increases.

65. Over the last couple of years our efforts have intensified on all aspects of our leakage management programme to recover and drive down leakage to our 2019/20 leakage target. Further details of the effort, and the associated activities, are provided in the sections below.

66. In our June 2014 Business Plan Performance Commitment Response, we said that we will ensure our performance metrics represent our underlying performance. To achieve this, we report leakage on a "like for like" basis for comparison with our company leakage performance commitments using methodology consistent with the WRMP base year 2011/12 (referenced as "data only" update).

67. On this basis annual average leakage for 2019/20 is 594.83 Ml/d. This means that we have outperformed our Company level leakage target for 2019/20 of 606 Ml/d.

Business Plan and Annual Review reporting

68. In this report we include leakage calculated using three different methodologies.

- Standard Reporting – Calculated using our standard leakage reporting method (minus the large movements associated with changing our methodology to make it consistent with the 2018 Ofwat guidelines).
- ODI Reporting – Based on our Standard leakage reporting method but includes methodological changes to keep it consistent with our AMP6 performance commitments at company level. This is therefore our AMP6 ODI leakage reporting method.
- Shadow Reporting – Consistent with WRMP19 forecast and the March 2018 Ofwat leakage reporting guidelines. The 2018 Guidelines include methodology changes such as the movement to a fixed hour nightly minimum and updates to commercial and domestic night use models. The assessment of our "Shadow reporting" will vary from year to year with data and methodology updates as we improve our compliance with the Ofwat guidelines. This is therefore our AMP7 ODI reporting with "Shadow reporting" referring to using AMP7 ODI reporting methodology on AMP6 data.

69. For the 2019/20 report year, at company level we report leakage as:

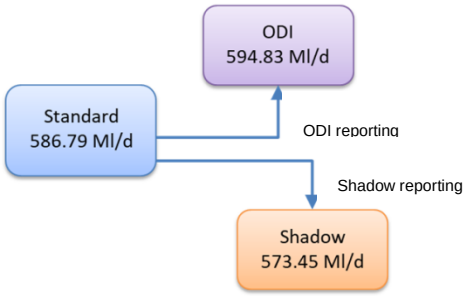


Figure 4: Reporting Leakage at Company Level

70. Unlike previous years, for this year there is a reduction in leakage when moving from ODI to Shadow leakage reporting. Previously (up to AR19) we have been including significant increases associated with the night flow analysis and updates for commercial night use along with minor updates. This year we have been able to up our estimates of domestic night use (both for measured and unmeasured properties). This draws on the newly available smart meter data in London and the bulk metering of blocks of flats. As the smart meter data is only

presently available in London we have only applied the new night use allowances to the London WRZ. This coming year we are working on ways to extrapolate the London data to the other WRZs for inclusion in our AR21 reporting. With Thames Valley still using old night use allowances, and the sensitivity of reported leakage to this number, we are presently still carrying a Red RAG status for compliance against the Ofwat reporting guidelines for leakage.

71. In this section, in order to be consistent with our presentation of results last year, we report using the Standard approach at WRZ level and ODI at Company level. In Part D, we report using Shadow. In future annual reviews all reporting will be consistent with the shadow methodology.

72. Total leakage by WRZ over AMP6 is presented in the table below.

Table 5: Leakage by WRZ over AMP6

Leakage (Ml/d)	AR15	AR16	AR17	AR18	AR19	Variance	AR20	Variance	2019/20 WRMP14
London	516.5	502.11	524.45	534.82	527.41	-88.13	439.28	-35.16	474.44
SWOX	62.5	61.39	61.32	64.47	66.17	4.55	70.72	11.73	58.99
SWA	36.4	35.22	42.81	45.42	46.26	-11.99	34.27	-0.89	35.16
Kennet Valley	24.9	23.22	24.1	24.13	23.91	-0.29	23.62	-0.72	24.34
Guildford	13.9	11.73	12.16	13.18	15.28	0.45	15.73	3.06	12.67
Henley	3.1	2.8	3.01	3.37	3.85	-0.15	3.71	0.40	3.31
Company *(Ofwat ODI consistent)*	653.96	642.46	677.15	694.65	690.39	-95.56	594.83	-11.17	606

73. Leakage has significantly improved in London and SWA, with leakage below our WRMP14 leakage targets. London has benefited from the rollout of smart meters, although this technology is yet to be available in other WRZs. In SWA we have been applying a holistic approach to leakage management with local focus to recover leakage levels in the area. Leakage has also been reduced in Henley and Kennet Valley.

74. Regretfully leakage has deteriorated in Guildford and SWOX, where the level of activity has fallen short of that needed to offset leakage recurrence. These areas are a complex mix of urban towns/cities surrounded by large rural areas where customer demands fluctuate in the summer. These areas will need further focus in the coming year to restore leakage levels to those required.

75. Our performance in London WRZ in 2019/20 has been the result of increased focus on leakage detection and repair productivity as well as the mild weather over the winter and lower resulting levels of visible leaks allowing us to maintain focus on repairing non-visible and customer side leaks.

76. We increased the number of teams dedicated to fixing leaks by 21% in 2018/19, which delivered a 22% increase in fixed leaks. Since April 2019, we recruited even more repair

teams, peaking at 200 teams, and changed the way we work to improve the productivity of those teams, meaning that in 2019/20 we fixed an average of almost 1,400 leaks every week.

77. This meant that we were able to bring down our backlog of repairs to mains pipes to around 115 jobs – the lowest level in over a decade. In turn, this helped us reduce the time we take to repair non-visible leaks to the best performance in the last 8 years.

78. We repaired 8% more leaks than we originally planned to repair in 2019/20 with almost 58,000 non-visible and customer leaks fixed during the year. This represents a 13% increase over the number of leaks repaired in 2018/19. These numbers include repairs undertaken inside customers' homes.

79. In 2018/19, we found that a mixture of recording inaccuracies meant that overall, we were overestimating the amount of leakage reduction expected by 15%. We have continued to audit and assure our leak repairs and have implemented improvements to the way repairs are captured on our systems. As a result, the error rate has reduced to 7% on average over the year and to less than 2% in the last quarter.

80. Although we repaired more leaks that planned, we did not realise as much leakage benefit as forecast. This was due to the mix of work including more lower value leaks that we forecast that we would detect and repair. However, other activities in our leakage plan (notably benefits from our Progressive Metering Programme) outperformed our planning assumptions with the result that the overall shortfall against our plan was less than 8 Ml/d (or 1.7%).

81. Overseeing the increased audit and assurance activities is one of the responsibilities of our dedicated LTF. The LTF reviews our performance and reduction plans every two weeks to ensure we retain control over the way in which our leakage reduction plan is carried out. The LTF includes internal subject matter experts from across Thames Water, including our innovation and digital divisions, and reports to the Executive and Board.

Activities being undertaken to manage leakage

82. As part of our Section 19 (S19) Undertakings (a package of financial and non-financial commitments agreed with Ofwat in August 2018 under S19 of the Water Industry Act 1991), we prepare a six monthly monitoring report to Ofwat. This report details our progress on leakage reduction and outlines areas where we have acted and plan to act to ensure ongoing compliance with the Section 19 Undertakings.

83. We have reviewed the S19 undertakings and developed a programme of work to deliver and assure our compliance in two areas: financial measures and leakage reduction undertakings. We have summarised progress on the operational component of the leakage reduction undertakings in this section. Further detail about these actions and the financial measures can be found in the report.[6]

84. We have continued to have a constructive dialog with Ofwat over the course of the year in respect of our compliance with the undertakings and our plans to achieve the leakage target. Having exceeded our 2019/20 leakage target of 606 Ml/d we are now in the process of

[6] Thames Water, 26th April 2019, 'Thames Water Utilities Limited Section 19 Undertakings Six-Monthly Monitoring Report, May 2020', Undertakings Compliance Officer report to Ofwat.

reviewing our overall compliance with the S19 undertakings and will report on this in the next monitoring report that is due before 1 November 2020.

Operational oversight

85. In November 2018, we established our multi-disciplinary LTF to maximise the certainty of delivering our leakage performance targets on a sustainable basis. The LTF is doing this by:

- Leading a cross-functional team solely dedicated to work on leakage.
- Ensuring a comprehensive understanding of leakage within the Executive team.
- Co-ordinating the effort of key internal and external subject matter experts.
- Focussing on key business areas to deliver new insights through advanced data analytics, leading to the implementation of initiatives and tasks that will deliver sustainable improvement in leakage performance.
- Reporting to our full Executive team on results.
- Strengthening our governance

86. Fixing leaks is part of a chain of activities we undertake to reduce leakage. To improve our leakage detection activity, the task force has overseen:

- **'Fingerprinting' our water zones:** We're using key data about each of our water zones to begin to create unique fingerprints for each of them. That in turn will help us to understand the drivers of leakage performance and burst mains through various analysis methods.
- **Temperature analysis:** Working with a number of other water companies, we're in the early stages of developing an innovative leak detection method that aims to use temperature data to pinpoint areas with larger leaks that are difficult to detect.
- **Leak analysis:** We're starting to look at how soil conditions can cause visible leaks, so that we can build up a better understanding of the environmental conditions that lead to leaks.
- **Digital detection tools:** We've been developing two core products to help us detect leakage more quickly and efficiently by first targeting the right areas of our network, and then focussing on the right streets within those areas.
- **Job Closure Audits**: This work is aimed at improving the quality of the data we hold and use to inform our short and long-term leakage planning tools. Weekly audits are undertaken by the Water Networks Compliance Manager against the guidance contained in our Job Closure Handbook to ensure that our service providers are consistent in the way that leak repair jobs are closed in our system. Regular feedback is provided to our partners and the LTF on compliance levels.

Leakage performance reports and customer engagement

- Since September 2018, we have published a leakage performance report on our website, by the end of each month, which covers the previous month's performance. A link to our leakage report is prominently displayed on our homepage. We present the information specifically required by our undertakings via the webpage report. This includes:
    - Our monthly performance against our plan.

- A comparison of the estimated monthly volume of leaks found and fixed (expressed in Ml/d) against what we planned to achieve and an explanation of the reasons for any differences.
- Material risks to the delivery of our plan and the steps we are taking to manage them.

- We also undertook regular customer engagement programmes to engage with our customers in ongoing customer research activities, engagement as part of revising our Business Plan and WRMP and through engagement specifically focussing on the topic of leakage.
- Regular reporting and customer engagement in this manner ensured we were regularly held to account for our leakage reduction progress throughout 2019/20.

C.2.8 Metering

87. The AMP6 metering programme included two workstreams, optants and progressives. The optant programme installs meters at the request of the customer. The progressive programme involves the installation of meters on a compulsory basis as part of our ongoing programme of activity to make the most efficient use of water. These customers have a meter installed at their property and are moved to a metered tariff after a year (originally 2 years, see below).

88. All meters installed are 'smart' and are able to communicate with our fixed network. Currently, we are receiving more than 10.4 million reads per day through the fixed network, benefiting the wider business with increased data on water consumption and thus delivering wider usage and leakage saving benefits.

89. The total number of meters installed under each of these programmes in AMP6 is provided in the table below, compared to WRMP14 targets.

Table 6: Meter installations – AMP6

Metering		2015/16	2016/17	2017/18	2018/19	2019/20	AMP6 Total
Progressive Metering	Target	81,000	110,000	110,000	70,270	70,000	441,270*
	Actual	42,083	103,428	98,053	56,453	31,110	331,127
Optant Metering	Target	34,089	34,089	34,089	34,089	34,089	170,445
	Actual	18,689	19,798	16,559	19,283	18,681	93,010
TOTAL	Target	115,089	144,089	144,089	104,359	104,089	611,715
	Actual	60,772	123,226	114,612	75,736	49,791	424,137

*Revised to 300,000 2017/18

90. Overall, we installed fewer meters than forecast in the WRMP14, however we were able to maintain the level of savings predicted in the supply demand balance for progressive meters by re-optimising the programme mid-AMP.

Progressive Metering

91. In the WRMP14 we planned to install 441,270 domestic water meters in AMP6 as part of the progressive metering programme. This was forecast to contribute a 27.6 Ml/d reduction in customer usage in response to moving to a metered tariff.

92. Progressive metering was prioritised in London WRZ due to the supply demand need. No PMP meters were installed in the Thames Valley WRZs.

93. A revised programme was established mid-way through AMP6 that included a lower total of 300,000 meter installations but achieving the same overall forecast level of demand reduction.

94. We have met this revised target, delivering a total of 331,127 installations.

95. We were able to achieve the same savings with a reduced programme using the experience gained during the first few years of delivery and by reducing the customer metering journey to one year (from 2 years).

96. The customer metering journey is the time between the meter installation and a customer being charged on a metered tariff. Customers have shown some savings following the installation of a meter due to more visibility of their water use. Larger savings are made by customers at the end of their metering journey once they are transferred to a metered tariff. Reducing the metering journey to 1 year meant that customers were moved to a metered tariff one year earlier than assumed in the WRMP14.

Optant Metering

97. The number of customers opting to have a meter installed has remained below AMP6 forecasts. In the WRMP14, it was assumed there would be an increase in the number of customers wanting to opt to have a meter installed during AMP6 (compared to AMP5) due to increased awareness of the benefits of metering following the roll-out of the progressive metering programme. This has not occurred and optant installation assumptions have been reduced for WRMP19.

98. The table below provides the WRZ-level breakdown of optant metering installations.

Table 7: Optant metering installations by WRZ

Optant Metering	2019/20	AMP6 Total	WRMP14 Forecast	Variance
London	11,909	59,687	129,256	-69,569
SWOX	2,975	15,380	19,859	-4,479
SWA	1,810	7,525	9,436	-1,911
Kennet Valley	1,427	7,135	8,018	-883
Guildford	404	2,382	2,817	-435
Henley	156	901	1,059	-158
Total	18,681	93,010	170,445	-77,435

C.2.9 Water efficiency

99. Reducing water use across our region is a core priority for our business, that's why we've continued to deliver the UK water sector's largest water efficiency programme through to the end of AMP6.

100. During 2019/20 we saved 16.57 million litres of water a day (based on a combination of measured savings data and the Ofwat assumed savings methodology), helping to drive our long-term purpose of building a better future for our customers and our local environment.

Table 8: Water efficiency savings (Combined wholesale and retail) – AMP6

Water Efficiency Savings (Ml/d)		2015/16	2016/17	2017/18	2018/19	2019/20	AMP6 Total
Water Efficiency	WRMP14 Forecast	6.63	7.50	7.33	6.05	6.61	34.12
	Actual	7.05	11.82	11.23	16.41	16.57	63.07
Variance		+0.42	+4.32	+3.90	+10.36	+9.96	+28.95

101. During 2019/20 we've focussed on innovative customer engagement through home and business visits to install devices and fix internal wastage leaks, household and business incentive schemes, online Water Calculator, innovative customer marketing and communications initiatives, plus data and insight sharing with industry groups.

102. Specific details on these activities can be found in Appendix K: Water efficiency

103. We outperformed our WRMP14 targets by a total of 28.96 Ml/d, nearly double the original target. Whilst our performance in AMP6 is undoubtedly a success, there are a number of reasons for our targets being exceeded.

- We continued to use Ofwat assumed savings methodology for Smarter Home Visits (SHV) throughout the AMP. It is likely that the savings from this activity would be lower if measured by a smart meter, however, our own modelling and shadow reporting would suggest a modest reduction in Ml/d, and we would still have achieved the ODI (Wholesale HH) performance commitment, and outperformed our combined savings.
- Savings from wastage fixes on SHV properties were higher than anticipated (due mainly to leaky loos), as was the take up rate of fixes of approx. 9% of total SHVs
- Smarter Business Visit (SBV) savings were far greater than anticipated, and we also grew the programme to meet internal needs and to offset capital expenditure. This programme received additional funding in AMP6, but due to economies of scale and the increased level of savings, it became by far the most cost-effective water efficiency programme in the AMP period.

- We carried out more activities and used water efficiency in more innovative ways than initially planned for. This includes offsetting capital expenditure by delivering 5 Ml/d of savings to offset the deferral of delivery of increased output from Horton Kirby to AMP7, through increased delivery of SBVs. We also responded to the 2018 dry weather event by moving delivery of activities to demand-stressed areas, creating additional savings and initiating work on discretionary water use.
- We successfully employed economies of scale and efficient project delivery to increase the cost effectiveness of our SHV programme.

104. Our programme continued to build upon the successful AMP5 and AMP6 initiatives, and took on board recommendations and results obtained from regulators, non-government organisations (NGOs) and customers to help shape our programme. Our plan also aligns to the Water Efficiency Strategy for the UK produced by Waterwise, delivering several core actions from this document.

105. We're now championing water efficiency across the entire business, including in our boardroom, regulators, stakeholder partnership meetings, UK water efficiency strategy steering group, customer care contact centres and Customer Challenge Group. We have delivered large-scale programmes to save water on both household and business sites, while continuing to inspire the next generation through exciting educational activities, customer engagement and community partnerships.

106. We also provided our insight and recommendations into the Government's public consultation on Personal Water Use Targets, plus the follow-up expert workshops.

C.3 Supply performance

107. In the annual water balance, the 'supply-side' of the water balance is covered by DI. However, in this section we discuss source availability throughout the year, actual outage (when we are not able to use a source), progress with new resource delivery and licence reductions under the AMP6 environment programme.

C.3.1 Source Availability during the Year

108. During 2019/20 we maintained sufficient sources in supply to flexibly meet demand and to cover planned and unplanned outages.

109. Following feedback on WRMP14 AR19, we have been working with the Environment Agency on a number of technical aspects relating to source availability. In particular we have clarified how we consider sources to be available when they are intentionally out of use, but can be brought into supply if required at short notice, and as such are not considered to be outages. Also we have identified sites that have longer term outages and discussed with the Environment Agency the point at which a temporary loss of supply, usually considered as an outage, should instead be considered as a reduction in deployable output.

110. A number of sources have had their deployable outputs reviewed and reduced. Details of the reductions can be found in Appendix C. Ongoing outages without DO reduction are shown in Appendix E.

London Gateway Desalination Plant

111. The London Gateway Desalination Plant hasn't been used for supply in 2019/20. However, the site remained available for supply if required with 50 days' notice.

112. A reassessment of the treatment capability of the plant has been carried out during the reporting year. Presentations by our Executive to the Environment Agency have stated that its deployable output should be considered as 100 Ml/d, given current plans for required investment to maintain the plant at its designed operational capacity. This is a reduction from the 150 Ml/d capability previously assumed, meaning a DO loss of around 50 Ml/d.

C.3.2 Actual Outage

113. In this report we present "Actual Outage" that has occurred in the past year and also provide an update to our "Outage Allowance" for the WRMP, which is based on an outage risk assessment (see Part D)

114. The total Actual Outage across London and the Thames Valley this year is 196.7 Ml/d, compared with 248.8 Ml/d reported in 2018/19 (see table below). This reduction is the result of actions and investment to remove the root cause of the outages, or the acceptance of reductions in deployable output.

Table 9: Actual Outage by WRZ (Ml/d)

WRZ	2018/19	2019/20	Variance
London	218.8	157.4	-61.4
SWOX	9.5	13.8	4.3
SWA	18.7	14.9	-3.8
Kennet Valley	0.4	3.1	2.8
Guildford	1.6	1.0	-0.6
Henley	0.0	6.4	6.3
Total	**248.8**	**196.7**	**-52.1**

115. Further details are available in Appendix E: Outages.

C.3.3 AMP6 Supply enhancement

116. In 2019/20 there has been no further development of new water resources.

117. Our AMP6 target for new water resource development was 42.83 Ml/d, all of which was to benefit annual average supply demand deficit in London WRZ. There were no supply side enhancements proposed for delivery in AMP6 within Thames Valley.

118. The total of resource development delivered in AMP6 is 47.2 Ml/d, this is above target, as set out in the schedule below.

Table 10: AMP6 New water resource development schedule

LONDON - AMP6 Increase in WAFU	WRMP14	Actuals	Actual delivery (X)		AMP6 Delivery Schedule (X - planned, X - delayed/deferred)					Actual Delivery
	Ml/d	Ml/d	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	
GW Tottenham BH	1.4	5.2			X	X				Benefit claimed
GW Honor Oak	1.48	0							X	Deferred
GW ELRED	0.95	0			X					Deferred
BT RWE Didcot Stage 1	17	17	X							Benefit claimed
BT RWE Didcot Stage 2	0	3						X		Benefit claimed
ASR Darent Valley (Horton Kirby)	5	0							X	Deferred
BT ESW Chingford reduction	17	17		X	X					Benefit claimed
Additional ESW reduction		5				X				Benefit claimed
Total AMP6 Actuals	42.83	47.2	17	17		10.2		3		
Cumulative total (target)			0	0	36.35	36.35	36.35	36.35	42.83	
Cumulative total (actual)			17	34	34	44.2	44.2	47.2	47.2	

119. Over AMP6 the following new water resource schemes have been developed: groundwater development at Tottenham (5.2 Ml/d); Bulk Transfer (BT) agreement with RWE Generation UK (20 Ml/d, in two stages) and revision to the BT with Essex and Suffolk Water at Chingford (22 Ml/d, also in two stages). These schemes have provided 47.2 Ml/d, exceeding our AMP6 target of 42.83 Ml/d.

120. Groundwater ELRED and Honor Oak were deferred because of increased resource delivered by the groundwater scheme at Tottenham.

121. The new groundwater scheme at Honor Oak was subsequently included in the WRMP19 planning process as a feasible option. It has not, however, been selected for inclusion in the WRMP19 preferred programme for the London WRZ.

122. ASR Darent Valley (Horton Kirby) was also deferred, being replaced by additional water efficiency savings. This scheme was included in the WRMP19 planning process as a feasible option and is included in the current WRMP19 preferred programme for the London WRZ for delivery in Year 5 of AMP7.

C.3.4 AMP6 Environment Programme

123. Our AMP6 Environment Programme comprised four investigations, five options appraisals/catchment reviews and three sustainability reductions.

124. The three sustainability reductions, to improve the river environment of the River Cray, Letcombe Brook and River Wye are discussed below, with further information on the investigations and options appraisals in Appendix D.

125. In London WRZ a sustainability reduction of 9 Ml/d at North Orpington (in the catchment of the River Cray) was included in WRMP14 for introduction in 2019/20. The options appraisal undertaken on this scheme, completed in July 2013 and signed off by the Environment

Agency in November 2013, indicated that reducing abstraction at this site was not a cost efficient solution when assessed using the relevant Environment Agency guidance. It was therefore agreed at the time with the Environment Agency that this reduction was no longer required. Instead, river restoration schemes were agreed to be implemented to improve the fluvial environment of the River Cray.

126. Reductions in abstraction in the Cray catchment are included in our AMP7 WINEP programme. See Part D.2.7 for further details.

127. In SWOX WRZ we have implemented one planned licence reduction in AMP6, at Childrey Warren to benefit the Letcombe Brook. The solution to enable the licence reduction was to develop a network improvement to bring in more water from Gatehampton near Goring.

128. The Childrey Warren licence was reduced to zero from 1 April 2020. This resulted in a reduction of DO of 3.7 Ml/d average and peak for future reporting.

129. We are retaining an emergency licence at the site to cover emergency situations such as a trunk main burst.

130. In SWA WRZ we have implemented a licence reduction at Pann Mill due in 2019/20. This involved a partial licence transfer from Pann Mill to Medmenham. This was implemented from 1st April 2020 and results in a 1.3 Ml/d reduction in overall peak licence for future reporting.

131. There was no identified requirement for infrastructure modification to enable this scheme.

132. We worked with the Environment Agency to agree a peak licence volume to be retained at Pann Mill which was greater than anticipated when the scheme was planned. Consequently, the loss of DO in the zone is less than stated in the WRMP14 and WRMP19.

133. The Pann Mill average licence volume was reduced from 22.7 Ml/d to 9.5 Ml/d average with a reduction in average DO from 16.8 Ml/d to 9.5 Ml/d. The 7.3 Ml/d of DO reduction at Pann Mill was transferred to the Medmenham licence which was increased at average from 45 Ml/d to 52.3 Ml/d.

134. The peak licence reduction at Pann Mill was from 22.7 Ml/d to 15.5 Ml/d. This represents a reduction of peak DO from 16.8 Ml/d to 15.5 Ml/d. This represents a loss of 1.3 Ml/d for the SWA WRZ as we are not able to transfer the peak to Medmenham where the peak licence remains at 55 Ml/d with no increase.

C.4 WRMP14 Security of Supply performance

135. The Security of Supply index (SoSI) describes a company's ability to meet its planned levels of service for average demand in a dry year (DYAA) and during the peak critical period (DYCP). An index of 100 indicates surplus in all WRZs.

136. SoSI for the annual average and critical peak period in 2019/20 as shown in Table 4 is 100. This is an improvement on the 98 reported in 2018/19 and brings us back in line with our WRMP14 target.

137. The SoSI score of 100 results in no financial penalty for annual performance but a total projected penalty of £13.59m for performance over the whole of AMP6 (as discussed earlier in Part B).

Table 11: SoSI compared to WRMP14 Forecast

SoSI		2015/16	2016/17	2017/18	2018/19	2019/20
Annual Average	Target	100	100	100	100	**100**
	Actual	100	99	97	98	**100**
Critical Period	Target	100	100	100	100	**100**
	Actual	100	99	97	98	**100**

138. The improvement in SoSI this year reflects reductions in dry year distribution input, outage allowance and target headroom for the London. The reduction in distribution input was driven primarily by our enhanced active leakage programme that significantly reduced leakage and also due to the mild winter which reduced the number of bursts. All Thames Valley WRZs remain in surplus this year under both annual average and critical conditions, as forecast.

139. As set out in the WRMP19 and earlier in Part B2, we plan to keep SoSI at 100 going forward.

Part D – WRMP19 Update

140. In this section we present how activity in the out-turn year compares to our WRMP19 forecasts. We have structured this section in line with our WRMP19 Monitoring Plan, which we use to track progress with key elements of the plan.

D.1 WRMP19

141. We published our final WRMP19 in April 2020 following approval to publish from the Secretary of State for the Environment, Food and Rural Affairs.

142. We developed WRMP19 over the past 4 years, with extensive engagement with regulators, stakeholders and customers. The plan covers the 80-year period from 2020 to 2100 and sets out the range of measures that are required to manage demand and ensure sufficient resources to continue to provide a resilient supply of water to our customers. This is available on our website www.thameswater.co.uk/wrmp.

143. We worked collaboratively with water companies from across the south east of England, through the Water Resources in the south east (WRSE) group, to understand the challenges facing the whole region and to identify opportunities for shared solutions and ensure we plan to secure water supplies for the whole region.

144. We took a long-term view in recognition of the scale and complexity of the challenges that we face. We designed our plan to satisfy three main objectives:

- to provide a secure supply of water for our customers addressing the supply demand deficits that we forecast in our region;
- to improve resilience to a severe 1 in 200 year drought; and
- to look beyond the needs and opportunities of our supply area alone and consider the growing needs of the wider south east of England.

145. We have proposed in our WRMP19 a twin track approach, aiming to make the most effective use of the water resources that we have available, with a focus on leakage reduction and supporting our customers to use water efficiently through smart metering and innovative engagement, in combination with the development of new resources to ensure a secure water supply and environmental resilience.

146. We have built our plan to adaptive planning principles. This provides flexibility to adapt to changes and new information as they emerge across the long term planning period. Taking an adaptive approach ensures we can be confident that we can continue to provide a secure and sustainable supply of water despite the challenges of an ever-changing world.

147. We've committed to an on-going programme of studies to inform the selection of strategic options that will be promoted as part of the best value investment programme for the south east regional plan and WRMP24. In order to enable the strategic schemes to be delivered within their respective lead times, without risk to the overall robustness of the plan, a decision will need to be made in 2022/23 which finalises the strategic water supply schemes for

promotion and delivery. The timing of this decision point in 2022/23 aligns with one chosen by Affinity Water to confirm the strategic options that it will promote as part of its own WRMP.

148. We have included in this part of the report, the Monitoring Plan we will use to track progress against the commitments set out WRMP19. Alongside this, we are also continuing our engagement programme to provide the opportunity for stakeholder involvement in the on-going work to shape our future plans.

D.2 WRMP19 Monitoring Plan

149. Our WRMP19 Monitoring Plan is incorporated into this Annual Report to give regulators and stakeholders' visibility of our progress delivering our AMP7 programme. This will help to facilitate stakeholder input and engagement and includes:

- Progress against our demand management programme (reduction in leakage and PCC and progressive metering);
- Actual population growth compared to forecast growth;
- Progress on industry workstreams, coordinated through Water UK and Waterwise, to facilitate mandatory water labelling on water using products, changes to fitting standards and building regulations;
- Delivery of water supply schemes, including several groundwater schemes against the investment programme (scheme milestones, associated yield and quality against expectations), and;
- Progress with resource development studies underway as part of the Strategic Resource Option development programme. This work is being undertaken in collaboration with other water companies, engagement with regulators and interested stakeholder organisations. The findings will be taken into account in the regional plan for the south east and in development of WRMP24.

150. We will continue to report progress through our Water Resources Forum and the associated technical stakeholder meetings. The forums will be held jointly with both Affinity Water and WRSE.

151. Our Monitoring Plan elements are summarised in the table below. Each Assessment Area is then discussed separately in the sub-sections below.

Table 12: Monitoring Plan elements

Assessment Area	Monitoring Activity	Metric	Purpose and relationship with decision point
Water balance Summary	SDB/SOSI	Ml/d	Actual vs predicted – Confirm if movement is within Headroom expectations
	DI		
	WAFU		
Growth	Population	000s	Actual vs predicted and updates to projections
	Properties		
	PCC	l/hd/d	
AMP7 Delivery - Demand options	Leakage	Ml/d	Actual vs predicted[7] – assumptions and impact assessment
	Metering	Activity	Meters installed – assumptions and impact assessment
	Water Efficiency		Activity delivered – assumptions and impact assessment
AMP7 Delivery – Supply options	New River Head	Delivery progress update	Delivery vs WRMP19
	Horton Kirby		
	Southfleet & Greenhithe		
	RWE Didcot		
	Ladymead		
Option Studies*	Effluent Re-use (Deephams)	Progress updates	Readiness for 2022/23 decision point (2030 scheme delivery)
Strategic Regional Option studies	Effluent Re-use (LON)	Progress update	Readiness for 2022/23 decision point (2030 scheme delivery)
	SESRO		Readiness for 2022/23 decision point (2037 scheme delivery)
	Severn-Thames Transfer		
	Transfers to Affinity		
	Transfers to Southern		
Regional need	WRSE	Progress Update	Regional modelling update
Environmental need	Water Industry National Environment Programme (WINEP)	Update	• Progress with current investigations / delivery • Likelihood and magnitude of further sustainability reductions in the future • West Berkshire Groundwater Scheme
Resilience required	Regulators	Design drought	Update return period and DO

* Options not part of the Strategic Regional Options studies but important to WRMP19 preferred plan

[7] WRMP19 leakage forecasts use Shadow reporting

D.2.1 Water Balance Summary

152. The water balance for the out-turn year differs from that for the WRMP19 because it is normalised to reflect a dry year or a critical period scenario. In practice this means that total demand for water, distribution input, is factored up or down to a level of demand that would be experienced 1 year in 10, which reflects our level of service.

153. Having uplifted DI, this is compared to water available for use (WAFU) from our sources (net of imports and exports, outage and climate change) and an allowance for uncertainty (Headroom), to form the supply demand balance.

Supply Demand Position

154. Supply demand balances by WRZ are presented in the tables below for dry year annual average and critical period conditions, respectively (For each WRZ, the planning condition which is driving investment is shown **in bold**).

Table 13: Annual Average Supply Demand Balance position by WRZ

Surplus/Deficit (Ml/d) - Annual Average	2019/20 (Actual Uplifted)	2019/20 WRMP19 (Forecast)	Variance
London	49.95	-24.36	74.31
SWOX	12.28	15.35	-3.07
SWA	18.07	27.76	-9.69
Kennet Valley	35.80	32.67	3.13
Guildford	12.50	14.02	-1.52
Henley	11.12	11.78	-0.66

Table 14: Critical Period Supply Demand Balance position by WRZ

Surplus/Deficit (Ml/d) – Critical Period	2019/20 (Actual Uplifted)	2019/20 WRMP19 (Forecast)	Variance
London	N/A	N/A	N/A
SWOX	**10.54**	**9.10**	1.44
SWA	**4.38**	**14.07**	-9.69
Kennet Valley	**22.66**	**23.21**	-0.55
Guildford	**3.70**	**2.73**	0.97
Henley	**5.92**	**5.55**	0.37

155. The supply demand position in London has improved markedly compared to the WRMP19 forecast. This is due to improved leakage performance and because the uncertainties included in the WRMP19 target headroom projection have not all been realised. Starting AMP7 in a position of surplus is very helpful as we prepare to deliver significant continued programmes of demand management to deliver ongoing resilience. At this early stage we do not intend to change our plans in the zone.

156. The supply demand position in SWA is tighter than forecast in our WRMP19. This is mainly due to a fall in deployable output (see Appendix C) and an increase in outage (See Appendix E). We have undertaken a review of the SWA water supply system and have identified a series of potential solutions to improve our supply capability and its resilience. The scope and programme of the investments required are in the process of being reviewed to ensure the WRZ remains in surplus and we are confident that we can maintain a secure water supply.

157. The minor variances in SWOX, Kennet Valley, Guildford and Henley WRZs are not material and there are no concerns regarding the validity of the WRMP19 preferred programme for these zones.

158. A breakdown of the key components of the supply demand balance can be found in Appendix L.

Security of Supply Index

159. The security of supply index (SoSI) describes a company's ability to meet its planned levels of service for average demand in a dry year (DYAA) and during the peak critical period (DYCP). An index of 100 indicates surplus in all WRZs.

160. The supply demand balance tables above show that we are in surplus in all WRZs in 2019/20, so our SoSI is 100.

161. This is an improvement compared to our WRMP19 forecast position for 2019/20. At the time we forecast for a deficit to persist in the London WRZ, which would have resulted in a SoSI of 98.

162. The reasons for the improvement are as discussed in Part C.4

Table 15: SoSI compared to WRMP19 forecast

SoSI		2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Annual Average	Forecast/Target	98	100	100	100	100	100
	Actual	100					
Critical Period	Forecast/Target	98	100	100	100	100	100
	Actual	100					

163. The forecast SoSI position of 100 across all our WRZs in AMP7 is challenging but achievable.

Distribution Input

164. The dry year DI is estimated as the 1 in 10 year demand, with the uplift factor being made up of two components, 'customer use' and 'leakage'. The 1 in 10 estimate is taken as the joint impact of a coincident 1 in 5 return periods for usage and leakage.

165. For details of the Dry Year uplift process, refer to Appendices G, H and I.

166. The tables below detail the Dry Year DI for each WRZ for annual average and critical period conditions.

Table 16: Dry Year DI – Annual Average

Dry Year Annual Average Distribution Input (Ml/d)	2019/20 (Actual Uplifted)	2019/20 WRMP19 (Forecast)	Variance
London	2044.70	2056.84	-12.14
SWOX	279.72	270.96	8.76
SWA	142.15	137.44	4.71
Kennet Valley	100.75	101.92	-1.17
Guildford	47.90	46.19	1.71
Henley	13.37	12.92	0.45

Table 17: Dry Year DI – Critical Period

Dry Year Critical Period Distribution Input (Ml/d)	2019/20 (Actual Uplifted)	2019/20 WRMP19 (Forecast)	Variance
London	N/A	N/A	N/A
SWOX	327.88	329.82	-1.94
SWA	167.10	169.66	-2.56
Kennet Valley	116.34	122.30	-5.96
Guildford	60.13	62.66	-2.53
Henley	18.10	19.26	-1.16

167. The observed variances to the WRMP19 forecast are within expectations.

Water Available for Use (WAFU)

168. Water available for use (WAFU) in 2019/2020, uplifted to the dry year and critical period scenarios suitable for comparison to WRMP19 are presented in the tables below:

169. WAFU is calculated from assessments of:

- Deployable Output (DO) – water available to be abstracted and treated.
- Climate change – the impact of climate change on DO.
- Outage – reductions in the amount of water available due to planned and unplanned events
- Raw and treated (potable) water is also transferred to and from our supply area as bulk imports and exports.

170. Each component is updated on an annual basis and is discussed in comparison with WRMP19 forecasts in Appendix F.

Table 18: Annual Average Water Available for Use (Ml/d)

Dry Year Annual Average WAFU (Ml/d)	2019/20 (Actual Uplifted)	2019/20 WRMP19 (Forecast)	Variance (Ml/d)
London	2152.06	2154.68	-2.62
SWOX	299.4	298.13	1.27
SWA	163.58	170.61	-7.03
Kennet Valley	140.37	139	1.37
Guildford	61.49	62.08	-0.59
Henley	24.85	25.29	-0.44

Table 19: Critical Period Water Available for Use (Ml/d)

Dry Year Critical Period WAFU (Ml/d)	2019/20 (Actual Uplifted)	2019/20 WRMP19 (Forecast)	Variance (Ml/d)
London	N/A	N/A	N/A
SWOX	352.96	354.83	-1.87
SWA	180.66	189.89	-9.23
Kennet Valley	145.44	151.06	-5.62
Guildford	67.52	67.96	-0.44
Henley	25.1	25.54	-0.44

171. The variance in Annual Average WAFU, particularly in London which is the only WRZ with an annual average supply demand driver, is not seen as material to the WRMP19 forecast.

172. The variance in Critical Period WAFU in Thames Valley is more noteworthy with reductions compared to WRMP19 forecast in all WRZs. This is primarily due to the movements in Deployable Output. Some sources have seen reductions due to updated drought performance information from recent high demand events and others where DO has been reduced due to the impact of long-term outages.

173. Further details on changes DO are provided in Appendix C and Outage in Appendix E.

D.2.2 Growth

Population

174. Population numbers are based on the mid-year estimates published by the Office for National Statistics. These figures are updated annually to include base population and growth projections and estimated clandestine and hidden populations. This provides the total population in our water supply area.

175. The table below presents the total population in our supply area broken down by WRZ, compared with the WRMP19 forecast.

Table 20: Population by WRZ

Total Population (000s)	2019/20 (Actual)	2019/20 WRMP19 (Forecast)	Variance
London	7874.515	7894.263	-19.748
SWOX	1068.943	1117.056	-48.113
SWA	542.395	575.487	-33.092
Kennet Valley	412.661	425.311	-12.650
Guildford	164.395	172.630	-8.235
Henley	49.425	53.463	-4.038
TOTAL	**10112.334**	**10238.210**	**-125.876**

176. Total population is lower than forecast in all WRZs, but not materially. This may reflect a reduction in migration in the build up to Brexit. It is 4% higher than forecast in the WRMP14.

Properties

177. The tables below present the number of billed household properties and billed non-household properties, respectively, by WRZ.

Table 21: Billed Household Properties by WRZ

Billed Household Properties (000s)	2019/20 (Actual)	2019/20 WRMP19 (Forecast)	Variance
London	2835.462	2860.804	-25.342
SWOX	414.031	453.464	-39.433
SWA	204.356	228.386	-24.030
Kennet Valley	155.521	163.919	-8.398
Guildford	60.108	64.235	-4.127
Henley	20.543	21.937	-1.394
TOTAL	**3690.019**	**3792.745**	**-102.726**

Table 22: Billed Non-Household Properties by WRZ

Billed Non-Household Properties (000s)	2019/20 (Actual)	2019/20 WRMP19 (Forecast)	Variance
London	136.050	154.620	-18.57
SWOX	22.644	25.243	-2.599
SWA	9.391	10.807	-1.416
Kennet Valley	7.189	7.885	-0.696
Guildford	3.437	3.833	-0.396
Henley	1.027	1.146	-0.119
TOTAL	**179.738**	**203.534**	**-23.796**

178. As observed with population, the number of billed household and non-household properties is also lower than forecast in the WRMP19.

179. Our household property forecasts are Local Authority Plan-based. Many of these plans anticipated a rebound in property building that has been depressed in recent years by the financial crisis. It may be that the market has not yet recovered and thus house building remains lower than planned by the Local Authorities.

180. Our billed non-household properties are also decreasing. This is likely to reflect movements in and out of voids and also re-allocation of domestic use flats into households.

Per Capita Consumption

181. Per Capita Consumption refers to the volume of water used per person per day. It reflects population demographics, the type of property occupied and whether customers have been billed on a metered tariff (i.e. they are more likely to save water) or undertaken any water efficiency activity.

182. The table below shows the average per capita consumption by WRZ. Both the actual and WRMP19 forecast reflect "dry year" demand.

Table 23: Per Capita Consumption (Average) by WRZ

Average PCC (l/hd/d)	2019/20 (Uplifted Actual)	2019/20 WRMP19 (Forecast)	Variance
London	146.23	141.58	4.65
SWOX	147.81	135.67	12.14
SWA	145.70	138.05	7.65
Kennet Valley	145.95	132.62	13.33
Guildford	153.31	145.80	7.51
Henley	160.51	140.72	19.79

183. AR20 average PCC uplifted for dry year conditions is higher than that forecast in the WRMP19 in all WRZs.

184. This year there have been changes in the derivation of household consumption compared to previous years, and large movements between unmeasured to measured billing, driven by the PMP programme with lots of customers coming to the end of their customer journeys.

185. At the same time there are significant numbers of bulk metered blocks of flats being de-registered from the non-household market, to align with the new Ofwat definitions for household and non-household. This has resulted in increases reported in measured PCC.

186. We have also enhanced the reporting of unmeasured household consumption. In London, where we have smart meters for customers on the PMP journey we have used their consumption data at the time of meter install but prior to the start of the customer metering journey (where they receive comparison bills for both unmeasured and measured tariffs and smart home visits). For properties outside of London increases are also the result of

improvements in the assessment of property types, resulting in an increase in reported numbers of detached houses compared to that assumed at the time the WRMP19 forecast was developed.

187. Further work is now being undertaken to better understand these movements and, from the wealth of PMP journey data we now have, better assess the benefits of metering and water efficiency activity to better inform the programme going forward. A key part of this work is also to understand better those properties that are not able to be metered as part of the present approach to PMP metering.

188. This increase in average PCC hasn't materially impacted overall distribution input because of a re-balancing between usage/wastage and leakage.

189. Our PMP and bulk meter installation programmes have significantly improved our understanding of household water use and we are reviewing the level of activity to be undertaken during AMP7. We remain committed to the demand management activities that we set out in our WRMP19 to deliver ongoing sustainable reductions in household water use. Refer also to section E1. Challenges and Risks, Challenge 1 – Impact of COVID-19.

D.2.3 AMP7 Demand Management

Leakage

190. The table below presents AR20 leakage by WRZ against the forecast from WRMP19. Leakage is calculated using Shadow reporting as discussed in Section C2.7 (573 Ml/d at company-level) and uplifted to dry year (596 Ml/d at company-level). We will fill in this table over future annual returns in order to monitor our progress.

Table 24: AMP7 Leakage Performance tracker

Total Leakage (Ml/d) (uplifted to Dry Year)		AR20	AR21	AR22	AR23	AR24	AR25
London	Actual	438.65					
	Forecast	530.62	483.56	465.80	445.03	424.27	408.20
	Variance	-91.97					
SWOX	Actual	74.35					
	Forecast	63.4	59.74	58.19	56.64	55.08	53.56
	Variance	10.95					
SWA	Actual	37.3					
	Forecast	37.4	37.40	37.40	37.40	37.40	37.40
	Variance	-0.1					
Kennet Valley	Actual	25.45					
	Forecast	26.2	26.20	26.20	26.20	26.20	26.20
	Variance	-0.75					
Guildford	Actual	16.33					
	Forecast	13.4	12.63	12.30	11.98	11.65	11.32
	Variance	2.93					

Total Leakage (Ml/d) (uplifted to Dry Year)		AR20	AR21	AR22	AR23	AR24	AR25
Henley	Actual	3.98					
	Forecast	3.58	3.58	3.58	3.58	3.58	3.58
	Variance	0.4					
Company	Actual	596.05					
	Forecast	674.60	623.11	603.47	580.83	558.18	540.26
	Variance	-78.55					

191. As set out in Part B.2, our AMP7 performance commitment for leakage is based on a percentage reduction from a 2019/20 base position, not the Ml/d value from the WRMP19.

192. In future annual reviews we will include a leakage tracker, that shows variance to both the WRMP19 forecast and rebased 2019-20 position.

Metering

193. The AMP7 metering programme includes two workstreams, progressive meters and optant meters. Progressive meters refer to household meters installed as part of our progressive metering programme. These customers are put on a one year journey between their meter installation and being moved to a metered tariff. Optant meters are meters that customers choose to have installed, usually because they are a low water user and can save money by being moved to a metered tariff.

194. The table below shows how we will track the total number of meters to be installed under each of these programmes during AMP7 and how this compares with the WRMP19 forecast.

Table 25: AMP7 Metering tracker

Metering (No.)		AR21	AR22	AR23	AR24	AR25	AMP7
Progressive	Actual						
	Forecast	64,741	88,974	89,006	89,048	88,973	420,741
	Variance						
Optant	Actual						
	Forecast	16,814	16,814	16,814	16,814	16,814	86,489
	Variance						
TOTAL	Actual						
	Forecast	81,555	105,788	105,820	105,862	105,787	507,230
	Variance						

195. The table below splits the progressive metering programme to WRZ level.

Table 26: AMP7 Progressive metering tracker

Progressive Metering (No.)		AR21	AR22	AR23	AR24	AR25	AMP7
London	Actual						
	Forecast	56,253	77,159	77,202	77,228	77,165	365,007
	Variance						
SWOX	Actual						
	Forecast	7,077	9,853	9,840	9,855	9,851	46,475
	Variance						
Guildford	Actual						
	Forecast	1,411	1,962	1,964	1,965	1,957	9,259
	Variance						
TOTAL	Actual						
	Forecast	64,741	88,974	89,006	89,048	88,973	420,741
	Variance						

Per Capita Consumption

196. In AMP7 we have a performance commitment for PCC that effectively replaces the water efficiency commitment from AMP6. The forecasts for AMP7 are currently being re-considered in light of the PR19 Business Plan Final Determination and the 2019/20 base position, from which performance will be measured (as discussed in Part B.2).

197. Our PMP and bulk meter installation programmes have significantly improved our understanding of household water use and we are reviewing the level of activity to be undertaken during AMP7. We remain committed to the demand management activities that we set out in our WRMP19 to deliver ongoing sustainable reductions in household water use. Refer also to section E1. Challenges and Risks, Challenge 1 – Impact of COVID-19.

198. In future annual reviews we will include a PCC tracker, that shows variance to both the WRMP19 forecast and rebased 2019-20 position.

D.2.4 AMP7 Supply enhancement

199. Our supply enhancement programme for AMP7 comprises five schemes in two WRZs and is summarised in the table below:

Table 27: AMP7 Supply enhancement schedule

Scheme	WRZ	Resource Type	WRMP19	AMP7	AMP7 Delivery				
			Target (Ml/d)	Forecast (Ml/d)	20/21	21/22	22/23	23/24	24/25
New River Head	London	Groundwater	3	3	3				
ASR Horton Kirby	London	Aquifer Recharge	5	5					5
Southfleet & Greenhithe	London	Groundwater	8	0					X
RWE Didcot	London	Licence Trade	18	18	18				
Ladymead WTW	Guildford	Groundwater / Constraint release	4.6	4.6					4.6
		AMP7 Totals	38.6	30.6	21	21	21	21	30.6
		Cumulative AMP7 Delivery Target			21	21	21	21	38.6

200. The temporary licence trade agreement with RWE Didcot was signed and came into force from 1st April 2020. The deployable output benefit to London WRZ will be reported in the next Annual Review.

201. Preparatory work to brief the groundwater enhancements at New River Head and Ladymead and the Aquifer Recharge scheme at Horton Kirby is underway and delivery is anticipated as per the forecast.

202. We are currently reviewing delivery of the Southfleet and Greenhithe scheme. The option was brought forward in the WRMP19 preferred programme to meet a local resilience need in south east London, which is currently being reassessed. The scheme is not critical to maintaining the overall supply demand balance in AMP7.

Guildford WRZ Internal Interconnection

203. Preparatory work is also underway to progress the Shalford to Netley internal transfer main that will improve our ability to transfer water across Guildford WRZ. The first full update of this scheme will be provided in the next Annual Review.

D.2.5a Option Studies

204. In this section we provide an update on progress with options that are important to the WRMP19 preferred plan but are not part of the scope of the Strategic Regional Options Studies (see D.2.5.b).

Effluent Reuse - Deephams

205. The Deephams Reuse option was identified as a preferred option within our WRMP19. It has a potential benefit to the supply demand balance of around 45 Ml/d with a lead-time of around six years and is a cost effective scheme, offering potential for environmental improvement.

206. The scheme would actively manage returns of highly treated wastewater effluent to water courses above abstraction points. Treated effluent from the Deephams Sewage Treatment Works is to be subjected to an advanced treatment process to produce a high purity water stream. The treated water will then be pumped to a proposed discharge location on the River Lee Diversion with the opportunity to discharge into the William Girling or King George V Reservoir. This water will supplement the raw water supply in the Lee Valley reservoirs. The proposed site for the treatment will be within the Deephams STW site boundary.

207. We continue to actively discuss this option with the Environment Agency to understand and address their concerns about the potential viability of the scheme before we begin to develop our WRMP24 and ahead of a key decision point for the scheme in 2022/23.

208. A working group is in place overseeing a programme of environmental work aiming to assess overall Water Framework Directive (WFD) compliance, undertake an environmental monitoring programme, to collect evidence to identify potential mitigation measures and to support the development of biodiversity net gain opportunities within the River Lee Western Channel.

D.2.5b Strategic Regional Option Studies

209. In August 2018, Defra, Ofwat, the Environment Agency (EA) and the Drinking Water Inspectorate (DWI) wrote to water companies setting out their expectation for increased ambition in water resources planning to transcend boundaries, enhance resilience and increase efficiency. A number of water companies responded putting forward joint solutions for new infrastructure development.

210. To facilitate this work Ofwat proposed development funding[8] to enable water companies to work collaboratively and jointly investigate new strategic regional water resource solutions, such as storage reservoirs and strategic transfers. The approach is intended to ensure all new strategic resource options are examined on a consistent basis and to provide transparency in decision making across water company plans.

211. The development work involves nine water companies and 17 potential solutions, see Figure below. The additional water that could be provided by these regional solutions is in excess of 1,500 Ml/d. These specific studies will inform WRMP24 and the regional plans (e.g. WRSE).

[8] https://www.ofwat.gov.uk/publication/pr19-final-determinations-strategic-regional-water-resource-solutions-appendix/

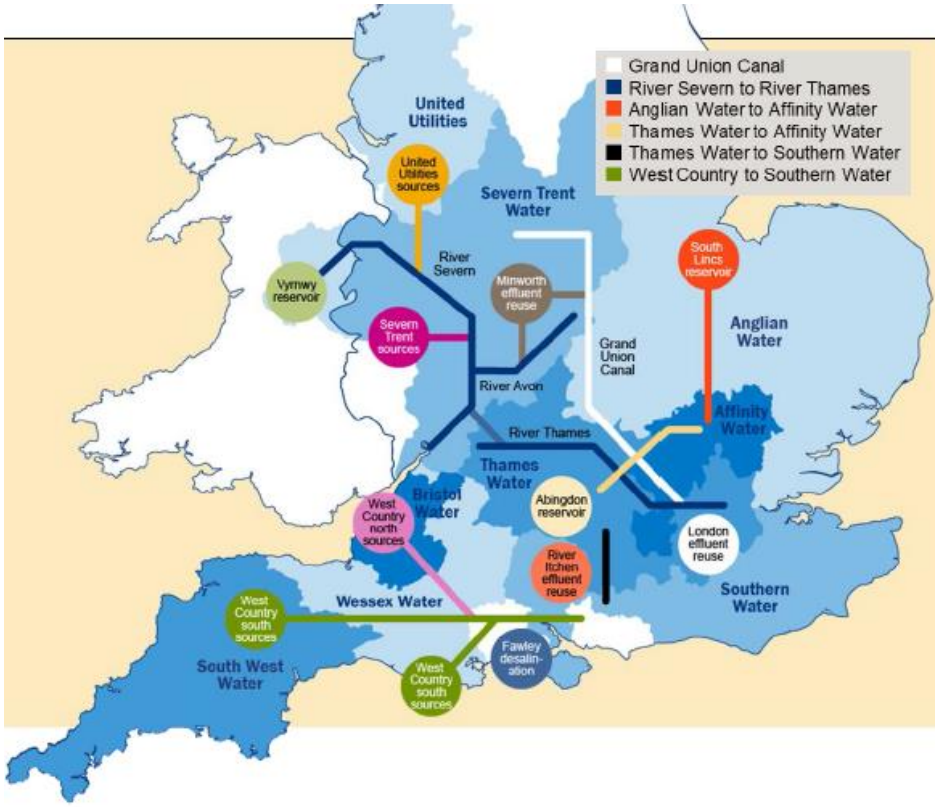


Figure 5: Strategic water resources solutions map

212. A new organisation, called the Water Regulatory Alliance for Progressing Infrastructure Development or RAPID[9], has been established to oversee progress of the strategic resource solutions. RAPID has representation from Ofwat, the EA and the DWI. It will be the primary reviewer and will provide recommendations to the boards of the constituent regulators.

213. All strategic resource solutions will have to follow a gated regulatory process. It aims to provide a clear and transparent process and timely decisions, as well as protecting customers from unnecessary spend. The gates are review points to track and formally assess the progress to examine the solutions. For each gate, the activities and deliverables will be agreed in advance and based on this information a decision will be made whether a solution is viable and progressed to the next stage of activity with confirmation of further funding, or not viable and the work is concluded.

Table 28: Strategic regional options – development gates

Gate	Date	Activities include
1	5 July 2021	Initial concept design and decision making
2	October 2022 (Draft WRMP24)	Detailed feasibility, conceptual design and multi-solution decision making

[9] https://www.ofwat.gov.uk/regulated-companies/rapid

Gate	Date	Activities include
3	Summer 2023 (Final WRMP24)	Developed design, finalised feasibility, pre-planning investigations and planning applications
4	Summer 2024	Planning applications, procurement and land purchase
5	2025-30	Land purchase and finalising develop consent orders

214. During AMP7 we are undertaking joint technical studies into five potentially regionally significant regional resource developments, which are:

- South East Strategic Reservoir Option (SESRO)
- Severn-Thames Transfer
- Effluent Re-use in London
- Transfers to Affinity Water
- Transfers to Southern Water

215. We set out in the sub-sections below an overview of the progress with each of these options in turn.

216. The following summary comments apply to all:

- Independent project managers have been appointed or are in progress
- Programmes of work have been developed and early start activity such as water quality and ecology monitoring has been scoped and initial discussions held with the Environment Agency.
- Discussions are on-going regarding engagement with the Environment Agency and Natural England and the establishment of a National Appraisal Unit that, once formed, will provide guidance during development and environmental endorsement in a consistent fashion across all options, and throughout the gated process.
- Quarterly progress reports are submitted to RAPID, the latest in May'20, and there is regular engagement with RAPID on the technical and engagement work to inform the development of the schemes.

SESRO

Scheme name	South East Strategic Reservoir Option (SESRO)
Collaborators	Affinity Water, Thames Water
Description	The SESRO is a fully bunded reservoir located 5km south-west of Abingdon in Oxfordshire. During periods of high flow in the river, water would be abstracted from the River Thames at Culham and transferred to the reservoir by tunnel. The water would then be stored in the reservoir. During periods of low flow in the river, water would be released back to the River Thames, through the same tunnel, for re-abstraction further downstream for treatment and then supply to customers.
Scheme yield	150 Mm^3 - 294 Ml/d (maximum)
Lead time	15 years

Location	The reservoir is located 5km south-west of Abingdon in the Vale of White Horse District Council area in Oxfordshire.
Sub-options	Note there are a range of scheme sizes under consideration
Illustration of the scheme	

Recipients of the water	Thames Water, Affinity Water and potentially the wider south east region, both water companies and water users
Inter-relationship with other schemes	• The scheme could be operated in conjunction with an inter-regional raw water transfer such as the Severn-Thames Transfer. • Thames to Affinity Regional Transfer scheme • Thames to Southern Regional Transfer scheme
Exclusivity or dependency with other schemes	None

Progress

217. The scheme is on-track to meet Gate 1. The two parties 'Programme Management Board' (PMB) continue to meet monthly to further governance, investigations and stakeholder engagement, albeit this is all undertaken remotely due to COVID-19 workplace restrictions.

218. A Programme Manager has been appointed (from the start of April 2020) and the work breakdown structure (WBS), baseline programme and Programme Management Plan have been developed for the period up to Gate 1.

219. Work is well underway to scope and procure the initial environmental investigations for both schemes, with the initial work packages forecast to be let to existing framework suppliers in May. Initial stakeholder workshop for this monitoring work held with the Environment Agency in April 2020. Stakeholder engagement plan now developed, in conjunction with WRSE programme, with procurement of support for Customer Preference Surveys planned for May.

220. A Non-Disclosure Agreement has been agreed between both parties, Memorandum of Understanding and a Procurement Side Letter are nearly completed (95% agreed) and a common procurement process has been established using the STT SRO as the lead.

Environmental studies

221. Work well underway to develop and implement the hydrology, water quality and ecology studies programme to assess the impact of the reservoir on the River Thames, including for establishing how best we work with the EA to efficiently deliver the projects for the RAPID Gates. A stakeholder workshop was held on 24 April 2020 to discuss scope and extent of planned surveys, with comments being built into tender scope. Surveys cover aquatic invertebrates, INNS, fish, macrophytes, algae, water quality parameters and sediment. The recently confirmed WBS includes all of the associated studies identified in WRMP19, including opportunities for delivering net environmental gain beyond those associated with the reduction in abstraction from various chalk streams and other sensitive water courses.

Interaction with regions

222. Good engagement with WRSE and an integrated stakeholder engagement plan is being developed. Latest programme builds in required interactions with WRSE, particularly outline data on scheme scope, costs and environmental impacts at end September 2020 and costs updated in March 2021. Awaiting methodologies on environmental appraisal (expected June 2020) and on consistent cost methodology (under direction of ACWG). The All Company Working Group (ACWG) is working with the regions to develop a number of key subjects. These include the consistency measures in the Ofwat SRO Final Determination, being option yield & DO, costs consistency, water quality & environment methodologies. The ACWG will commission work to develop these subjects. Mott MacDonald are currently delivering the cost consistency methodology. Further subjects requiring funding are also under discussion, such as regional planning where the work is for the benefit of the SROs. This will be raised for discussion with RAPID.

Engagement activity

223. We are continuing to engage with stakeholders on work to inform regional and company water resource plans, this includes the projections for future water need for public water supply, other sectors and the environment as well as potential options which will ensure a resilient and sustainable water supply. We have also progressed with plans for engaging with customers to understand their views and preferences. We have regular conversations with RAPID and other water companies to provide updates on progress and to share learning and good practice. Key activities this quarter include:

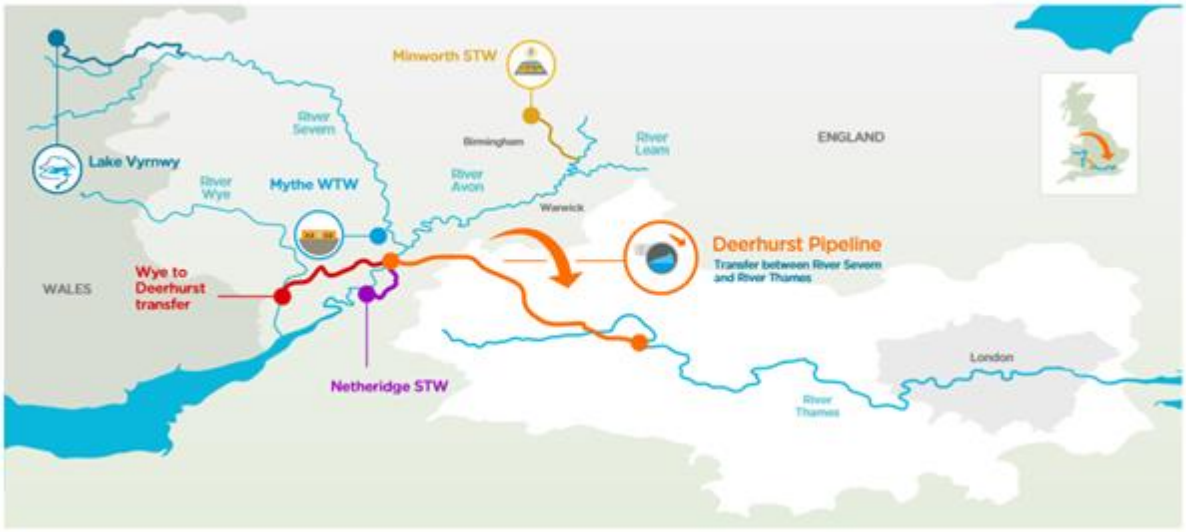
- Water Resources Forum held in February 2020, jointly hosted by Affinity Water and Thames Water, a key topic discussed was how to determine the level of environmental ambition for the regional plan and assess environmental and social benefits and impacts of the plan and potential solutions.
- Development work for an online platform to support engagement and consultation to ensure a continuum of engagement during the current COVID pandemic, and also to provide an accessible mechanism to share information and enable engagement at formative stages of the policy and technical work.
- Start-up meeting with the Environment Agency on a water quality and ecology monitoring programme required for SESRO, and other SROs. (24 April 2020)

- Definition of the scope of work for phase 1 research and engagement with customers. This work will take place between July-October 2020. This has been shared with the regional planning groups, and other SROs, to help facilitate a common and coordinated approach.

Severn-Thames Transfer

Scheme name	Severn to Thames Transfer (STT)
Collaborators	United Utilities, Severn Trent, Thames Water
Description	During periods of drought in the south east, the Severn to Thames Transfer (STT) would convey raw water from the River Severn into the River Thames via an interconnector. The primary option for the interconnector is a pipeline with pumping and raw water treatment facilities which would abstract flows from the lower freshwater River Severn at Deerhurst, near Gloucester, and discharge into the middle River Thames near Culham, Oxfordshire. A current alternative to the pipeline option would be re-constituting the disused Cotswold Canals. The source of the water would primarily be derived from additional 'supported flows' released in the River Severn from: Lake Vyrnwy; Minworth WwTW effluent re-use via the River Avon; other sources from Severn Trent region including potentially releasing current licensed water treatment abstraction capacity used by Mythe WTW; as well as the opportunity to supplement this in the future from other sources.
Scheme yield	Current interconnector capacity sized from 300 Ml/d up to 500 Ml/d to include for future-proofing.
Lead time	10-15 years
Location	The indicative, conceptual design location for the interconnector pipeline runs from the River Severn at Deerhurst (north of Gloucester) to Culham (between Abingdon and Didcot) on the River Thames, with treatment sited at Deerhurst. (For the Cotswold Canals see sub-option below.)
Sub-options	The Cotswold Canals alternative abstracts water from the River Severn at Gloucester Docks into the Gloucester and Sharpness Canal. Water would then be pumped in stages to the Sapperton Tunnel. The canal would be rehabilitated to enable transfer flows to be conveyed to Lechlade. At Lechlade the water would be abstracted from the canal, treated and pumped to a discharge location at Culham. To mitigate any adverse effects of Lake Vyrnwy discharges into the River Vyrnwy an option for a circa 22km long pipeline from the Vyrnwy Aqueduct upstream of Oswestry WTW to the River Severn is being considered, along with other options to release licensed flow within the Severn.

Illustration of the scheme



NB. Welsh Water River Wye Transfer currently not in scope. Source / support options (e.g. Vyrnwy, Minworth, Mythe, Netheridge) are provided by separate SRO schemes

Recipients of the water	Thames Water, Affinity Water and potentially the wider south east region, both water companies and water users.
Inter-relationship with other schemes	• The scheme could be operated in conjunction with the Abingdon Reservoir (SESRO) scheme. • Thames to Affinity Regional Transfer scheme • Thames to Southern Regional Transfer scheme
Exclusivity or dependency with other schemes	The STT is dependent on source SROs upstream of the interconnector: United Utilities Sources; Vyrnwy Aqueduct (UU); Minworth Effluent Reuse (STW/Affinity); Severn Trent Sources. Not all support options may be required, depending on the capacity of the STT that is selected. For clarity, the River Wye supply option would provide benefit to the interconnector. Currently under review with Welsh Water, as outside the SROs scope.

Progress

224. The scheme is on-track to meet Gate 1. Progress in the period included:

- Executing of three-way company MoU, NDA and procurement agreements;
- Establishment of a project plan, budgeting, processes and roles and responsibilities across three companies;
- Establishing workstreams with scope and brief preparation commenced; and initial STT procurements made for Severn losses contracts (see environment).

225. Establishing a National Assessment Unit is critical and could impede progress on the 'put and take' decision, which has a direct impact on the viability of this scheme.

226. Discussions are ongoing with RAPID to confirm the breadth of the scope.

Environmental studies

227. A programme of river studies and investigations has been planned in Gate 1 to examine losses, ecology and water quality on the Rivers Vyrnwy, Severn and Avon. A river environmental gap analysis draft report has been undertaken.

228. Contracts have been let to undertake releases from Lake Vyrnwy over Summer 2020 to estimate River Severn losses between Lake Vyrnwy and the interconnector abstraction point. Preparatory planning, stakeholder engagement and permitting applications are now underway in advance of the planned releases.

229. Delays and additional cost from extended environmental investigations is a key risk.

Interaction with regions

230. Ongoing engagement with WRW and WRSE. Consistency of regional timescales, terminology and appraisal methods and templates are being discussed. WRSE has identified a 'hand-off point' at the upstream end of the interconnector where they will require STT 'system yields' and appraisal characteristics for the 'STT system'. This will require system modelling to calculate the yield for varying options and a system appraisal of cost, resilience and environmental effects associated within these yields. This system scope was unfunded. The All Company Working Group (ACWG) is working with the regions to develop a number of key subjects. These include the consistency measures in the Ofwat SRO Final Determination, being option yield and DO, costs, water quality and environment methodologies. The ACWG will commission work to develop these subjects.

Engagement activity

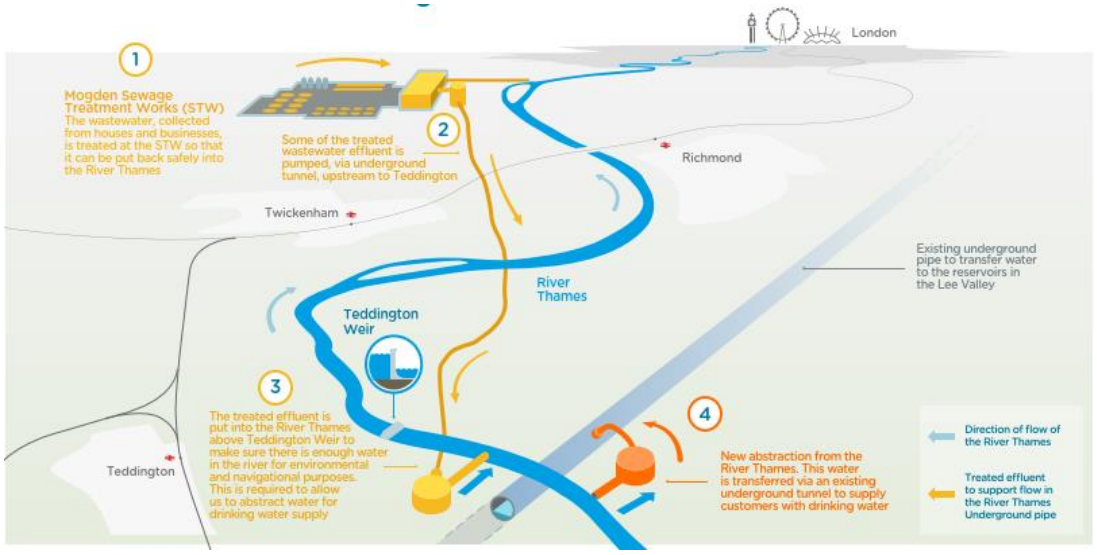
231. The STT team is continuing to engage with stakeholders including environmental regulators (EA, NRW, NE), WRW/WRSE (with a particular emphasis on consistency of approach), Welsh Government, monthly River Severn Working Group, RAPID quarterly review, ACWG and most recently Welsh Water. We are progressing plans for engaging with customers and stakeholders to understand their views and preferences, this will include alignment across different Regional approaches.

Effluent Re-use

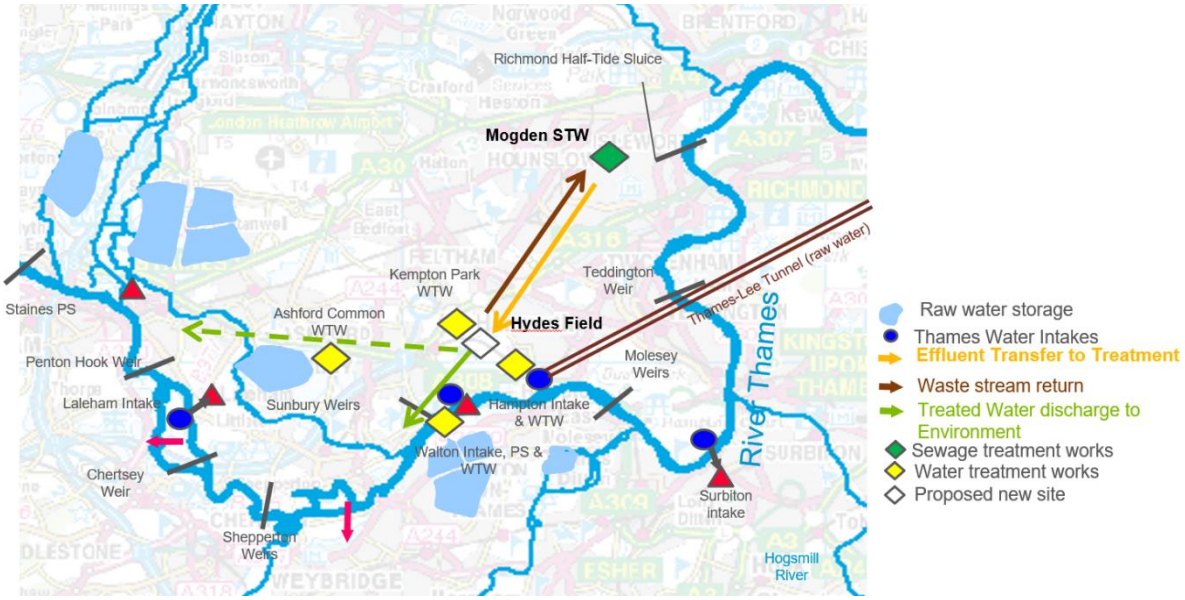
Scheme name	London Effluent Reuse
Collaborators	Thames Water
Description	London Effluent Reuse comprises 4 potential schemes: **Teddington DRA**: Mogden effluent would be subject to tertiary treatment at Mogden Sewage Treatment Works (STW). The treated water would be transferred to a discharge location upstream of Teddington Weir. A new abstraction from the River Thames, upstream of the new effluent transfer discharge location, would pump water into the nearby Thames Lee Tunnel for transfer to the Lee Valley reservoirs in East London. **Mogden Reuse:** Final effluent from Mogden STW will be pumped to a new reuse treatment plant location at Hydes Field, south west of Kempton Water Treatment Works (WTW). The treated water would be discharged into the River Thames upstream of the existing Thames Water Walton intake. The waste streams would be conveyed back to the Mogden STW. **Mogden South Sewer:** Sewage would be abstracted from the South Sewer

	which runs close to Kempton Park WTW and pumped to a new reuse treatment plant located at Hydes Field, for treatment. Treated water would be discharged into the River Thames upstream of the existing Thames Water Walton intake. The waste stream would be discharged back to the South Sewer. **Beckton Reuse:** Beckton STW is located on the north side of the tidal reach of the River Thames in Newham on the A1020 close to the A13. Final effluent from the Beckton Sewage Treatment Works would be treated at a reuse treatment plant within the Beckton STW boundary to the north of the operational area. The treated water would then be pumped to a proposed discharge location on the River Lee Diversion above the inlet for King George V Reservoir to supplement the raw water supply to the Lee Valley reservoirs.
Scheme yield	Teddington DRA: <300 Ml/d Mogden Reuse: up to 200 Ml/d Mogden South Sewer: 50 Ml/d Beckton Reuse: up to 300 Ml/d Note there are a range of sizes under consideration for each scheme and the Teddington and Mogden schemes are mutually exclusive.
Lead time	8 years
Location	**Teddington DRA:** The discharge and abstraction points are located approx. 1.5km upstream of Mogden Sewage Treatment work in Isleworth, West London. **Mogden Reuse & Mogden South Sewer:** The proposed new site is located at Hydes Field, Hampton, West London **Beckton Reuse:** The effluent is treated at the Beckton STW site in the London Borough of Newham, East London. The discharge location is the King George V Raw Water Reservoir in Enfield, North London.
Sub-options *Details such as alternative sources or transfer routes.*	The west London options could potentially provide a resource to Affinity Water by discharging further upstream on the River Thames, this has not yet been developed and is being considered as part of the options appraisal work for the TW to Affinity Transfer SRO.
Illustration of the schemes	

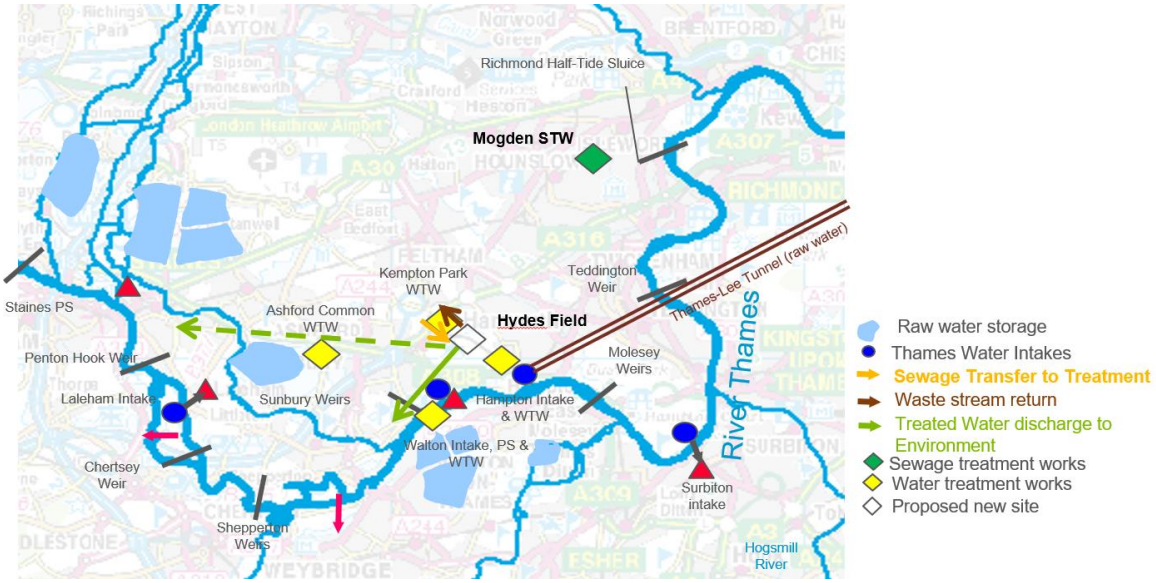
Teddington Direct River Abstraction Overview:



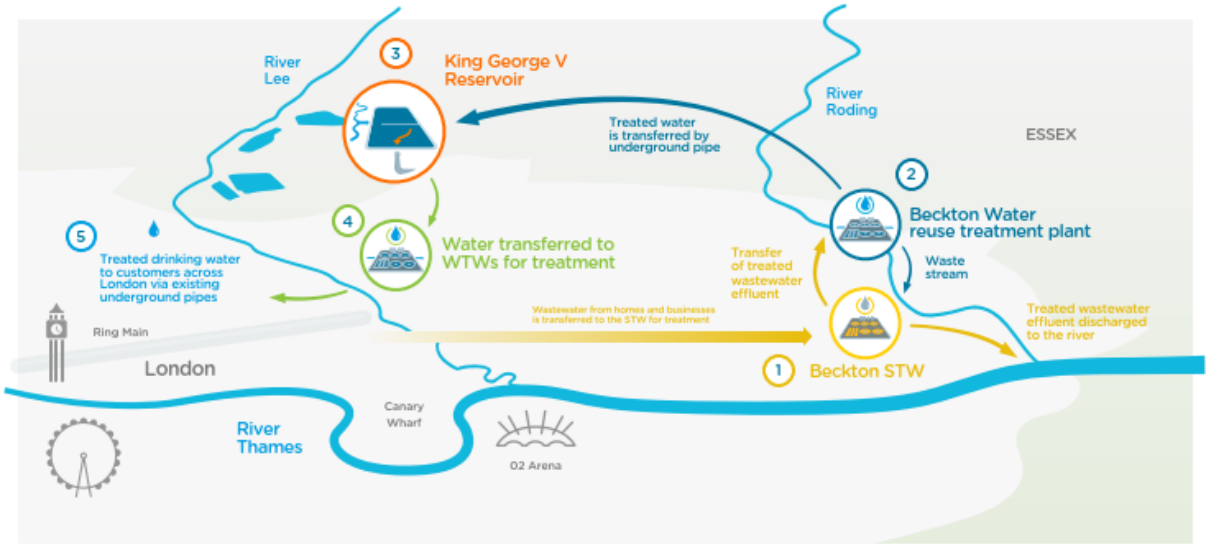
Mogden Reuse Overview:



Mogden South Sewer Overview:



Beckton Reuse Overview:



Recipients of the water	Thames Water (Potential for Affinity Water for Mogden and Teddington options but this is yet to be developed)
Inter-relationship with other schemes	Could provide a resource for Thames to Affinity Regional Transfer
Exclusivity or dependency with other schemes	Teddington DRA, Mogden Reuse and Mogden South Sewer are all dependent on sewage flows to Mogden STW and therefore there is a limit to the total yield of these options in combination.

Progress

232. The scheme is on-track to meet Gate 1. Work is in progress on the development of the reuse safety plan; procurement has commenced for the surveys to support the assessment of water quality and ecology in the River Thames and Lee. Work is on-going to review any potential impacts on environment and navigation from the reduction in flow from the Mogden outfall. Engagement with the EA and Port of London Authority to seek feedback on the proposed investigations has commenced and is ongoing.

233. A Project Manager has been appointed, with development of a first Project Delivery Plan in progress.

Environmental studies

234. Work is ongoing to develop and implement the water quality and ecology studies programme, including for establishing how best we work with the EA to efficiently deliver the projects for the RAPID gates.

Initial contracts for ecological surveys have been awarded and procurement for other environmental investigations is in progress.

Interaction with regions

235. The All Company Working Group (ACWG) is working with the regions to develop a number of key subjects. These include the consistency measures in the Ofwat SRO FD, being option

yield and DO, costs consistency, water quality and environment methodologies. The ACWG will commission work to develop these subjects, with Mott MacDonald currently delivering the cost consistency and environmental methodologies. Further subjects requiring funding are also under discussion.

Engagement activity

236. We are continuing to engage with stakeholders to inform regional and company water resource plans, this includes the projections for future water need for public water supply, other sectors and the environment as well as work on potential options which will ensure a resilient and sustainable water supply. We are also progressing our plan for engaging with customers to understand their views and preferences. We have regular conversations with RAPID and other water companies to provide updates on progress and to share learning and good practice. Key activities this quarter include:

- Water Resources Forum held in February 2020, a key topic discussed was how to determine the level of environmental ambition and assess environmental and social benefits and impacts of the plan and potential solutions.
- Development work for an online platform to support engagement and consultation to ensure a continuum of engagement during the current COVID pandemic, but also to provide an accessible mechanism to share information and enable engagement at formative stages of the policy and technical work.
- Start-up meeting held with the Environment Agency on a water quality and ecology monitoring programme required for reuse, and other SROs (24 April 2020)
- Meeting held with Port of London Authority to provide an update on planned work on reuse in London and seek feedback on issues and concerns to input to the programme of work (12 May 2020)
- Definition of the scope of work for phase 1 research and engagement with customers. This work will take place between July-October 2020. This has been shared across the regional planning groups, and other SROs, to help facilitate a common and coordinated approach.

Thames to Affinity transfers

Scheme name	Thames to Affinity Regional Transfer
Collaborators	Affinity Water, Thames Water
Description	A new raw water abstraction from the River Thames and transfer to Affinity Water for treatment and distribution. The transfer sub route(s) and infrastructure requirements will depend on the regional source of water that supports the new abstraction from the River Thames. The potential sources of water are: • South East Strategic Reservoir Option (SESRO) • London reuse • Water trading (Severn Thames Transfer (STT))
Scheme yield	50 Ml/d and 100 Ml/d
Lead time	Dependent on the supporting scheme
Location	The proposed abstraction point is referred to as the Sunnymeads intake, which is an abstraction point on the River Thames in Berkshire The transfer routes under consideration are shown below.
Sub-options	There are potentially a number of strategic regional sources of raw water

	as such there will be variants to the scheme both in terms of source water and the transfer route to the receiving WRZ.
Illustration of the scheme Two potential transfer sub routes, which are included in Affinity Water's preferred WRMP19 are: 1) source water is SESRO and the raw water transfer is to a new water treatment works 'Iver 2' (in the Affinity Water WRZ4) 2) source water is SESRO and the raw water transfer is to a new water treatment works at Harefield (in the Affinity Water WRZ1)	
Recipients of the water	Affinity Water
Inter-relationship with other schemes	SESRO, London reuse and the STT (through water trading) are the potential sources of water.
Exclusivity or dependency with other schemes	A regional source of water is required to support the new abstraction and transfer at the River Thames.

Progress

237. The scheme is on-track to meet Gate 1. The two parties 'Programme Management Board' (PMB) continue to meet monthly to further governance, investigations and stakeholder engagement.

238. A Programme Manager has been appointed (from start April 2020) and the work breakdown structure (WBS), baseline programme and Programme Management Plan have been developed for the period up to Gate 1.

239. Work well progressed to develop brief and scope for initial scheme concept development work, to identify a preferred solution / option for each variant of this SRO. Planning to procure external support to progress in May, aimed initially to WRSE submission in September 2020.

240. Work is well underway to scope and procure the initial environmental investigations for abstraction points, in conjunction with London re-use and SESRO SROs, with the initial work packages forecast to be let to existing framework suppliers in May. Initial stakeholder workshop for this monitoring work held with the Environment Agency in April. Stakeholder engagement plan now developed, in conjunction with WRSE programme, with procurement of support for Customer Preference Surveys planned for May.

241. An NDA has been agreed between both parties, Memorandum of Understanding and a Procurement Side Letter are nearly completed (95% agreed) and a common procurement process has been established using the STT SRO as the lead.

Environmental studies

242. Work well underway to develop and implement the hydrology, water quality and ecology studies programme to assess the impact of the reservoir on the River Thames, including for establishing how best we work with the Environment Agency to efficiently deliver the projects for the RAPID Gates. Stakeholder workshop held on 24 April 2020 to discuss scope and extent of planned surveys, with comments being built into tender scope. Surveys cover aquatic invertebrates, INNS, fish, macrophytes, algae, water quality parameters and sediment. Work also to be progressed to identify the preferred concept for each alternative source for the T2A transfer (SESRO, STT, London Re-use options) to ensure that environmental issues are understood and coherent suite of options provided into WRSE.

Interaction with regions

243. Good engagement with WRSE and integrated stakeholder engagement plan being developed. Latest programme builds in required interactions with WRSE, particularly outline data on scheme scope, costs and environmental impacts at end September 2020 and costs updated in March 2021. Awaiting methodologies on environmental appraisal (expected June 2020) and on consistent cost methodology (under direction of All Company Working Group, ACWG). The ACWG is working with the regions to develop a number of key subjects. These include the consistency measures in the Ofwat SRO FD, being yield and DO, costs consistency, water quality and environment methodologies. The ACWG will commission work to develop these subjects, with Motts currently delivering the cost consistency methodology. Further subjects requiring funding are also under discussion.

Engagement activity

244. We are continuing to engage with stakeholders on work to inform regional and company water resource plans, this includes the projections for future water need for public water supply, other sectors and the environment as well as potential options which will ensure a resilient and sustainable water supply. We have also progressed with plans for engaging with customers to understand their views and preferences. We have regular conversations with RAPID and other water companies to provide updates on progress and to share learning and good practice

Thames to Southern transfers

Scheme name	Thames Water to Southern Water Transfer
Collaborators	Thames Water, Southern Water
Description	This option involves a bulk transfer from Thames Water to Otterbourne WSW from the proposed south east Strategic Reservoir Option (SESRO). Two sub options are for a 50 Ml/d and an 75 Ml/d transfer to allow potable water transfer into the Hampshire Andover and Kingsclere Water Resource Zones's and avoid the need for additional treatment at Otterbourne WSW. Southern Water will manage the pipeline work and will collaborate with Thames, who will manage SESRO, or any alternative sources for this transfer. Southern has agreed with Thames that both parties will consider whether additional options are available beyond that described here.
Scheme yield	50 to 75 Ml/d.
Lead time	15 years (TBC, dependent on SESRO and/or Severn Thames Transfer).
Location	The Western Area catchment stretches from Kingsclere in the north to Southampton and the Isle of Wight in the south. Current water sources for the catchment are the River Test and River Itchen. The reservoir is located 5km south-west of Abingdon in the Vale of White Horse District Council area in Oxfordshire
Sub-options	Two options are being assessed: 1. 50 Ml/d bulk transfer from Thames Water to Otterbourne. 2. 75 Ml/d bulk transfer from Thames Water to Otterbourne.
Recipients of the water	**Southern Water (Western catchment).**
Inter-relationship with other schemes	south east Strategic Reservoir Option (SESRO).

Exclusivity or dependency with other schemes	south east Strategic Reservoir Option (SESRO).

Progress

245. Meetings have been held between Southern Water and Thames Water to set out the project need and agree a memorandum of understanding for joint development of the solution. The solution has been defined as a circa 50-75 Ml/d southerly transmission main from Thames Water to Southern Water's Hampshire water supply zone (Andover WSZ or Otterbourne WSW).

246. The next task is to agree resourcing and procurement support to progress the Gate 1 deliverables, this is forecast to be complete in June 2020 (notwithstanding potential COVID-19 impacts).

Environmental studies

247. Southern Water's WRMP19 SEA highlighted that the bulk transfer is not considered to result in any WFD risks as it is a transfer only scheme and no WFD waterbodies are involved. Risks were posed for the route crossing a number of floodplain SACs, numerous SSSIs and rural areas including for the North Wessex Downs AONB.

248. The scope of the environmental studies will be developed in consultation with the EA/NE and specified as part of the Gate 1 activity.

Interaction with regions

249. Both Southern Water and Thames Water continue to work with WRSE on the development of the regional resilience plan to inform WRMP24, and to ensure the gate timelines and activities are aligned as closely as possible with the Water Resources National Framework timetable published by the Environment Agency in March. Southern Water and Thames Water are also working with the All Company Working Group (ACWG) to support the development and implementation of consistent methodologies for cost, yield and deployable output, water quality and environmental appraisal across the SROs.

Engagement activity

250. The scope of the engagement plan will be specified as part of the Gate 1 activity.

D.2.6 Regional Need – WRSE

Regional Planning

251. A regional dimension to water resources planning in the south east of England has been in place for well over a decade, however ahead of WRMP24, regional planning will take centre stage.

252. The Environment Agency's National Framework for Water Resources[10] (2020) makes it clear that in order that the required investment can be made to reduce demand, increase supplies, increase resilience to drought and to make sure that the nation's water supplies and environment are able to cope with an uncertain future, planning will need to be done at a regional level and include all sectors of water users.

253. The National Framework focuses on the regional plans that will be developed over the coming years by the five regional water resources groups that are now in place. The strategic direction of these plans has been shaped by a senior steering group representing government, regulators, the water industry, bodies representing other major water users, environmental non-governmental organisations (NGOs) and academia. It is considered that this shift to collaborative regional planning, within an agreed framework, will allow a step change in water resources.

254. The WRSE group, one of the 5 regional groups, is developing a regional water resources strategy (which is not statutory) to integrate with water company WRMPs (which are statutory).

255. To enable the schemes to be delivered within their respective lead times without risk to the overall robustness of the plan, a decision is required to be made in 2022/23 which finalises the regional strategic water supply schemes for promotion and delivery.

256. The 2022/23 date aligns extremely well with the regulatory timetable for the next WRMP, i.e. WRMP24, and as such facilitates stakeholder and customer engagement and input to the decision making process through the statutory consultation process associated with the next set of WRMPs.

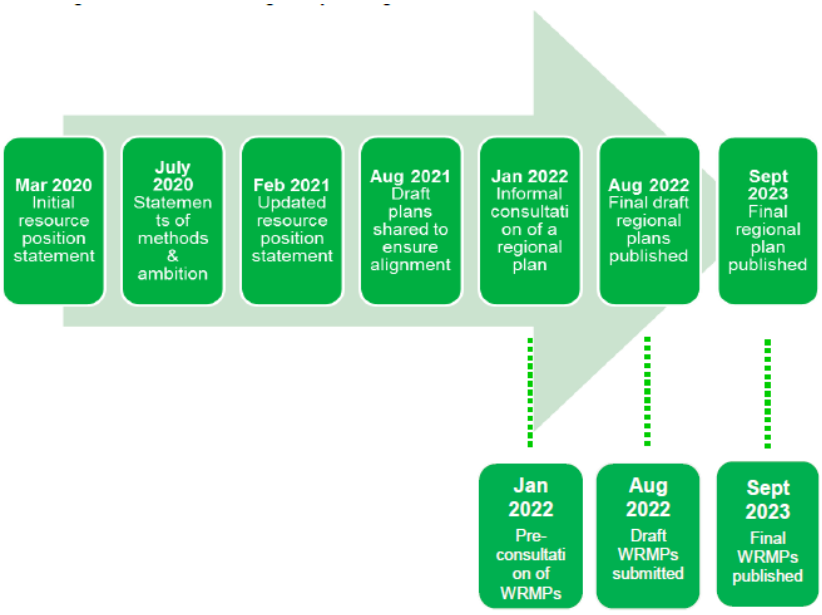


Figure 6: Regional planning timeline and WRMP key dates

[10] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources

257. The timeline allows for programme appraisal at WRSE regional level, as well as at the individual water company plan level for both Affinity Water and Thames Water, and other potential water partners.

258. Ongoing progress with the development of the WRSE regional strategy is discussed below.

WRSE Progress

259. WRSE has acknowledged that its current investment modelling approach is too simple for the robust analysis of the complex planning problem faced in the south east region. As such it is developing a water resources system simulation model of the south east region together with an enhanced investment model and visualisation tool to facilitate more robust water resources analysis and programme appraisal at a regional level.

260. Together with resilience and deployable output assessment for a range of droughts, the regional simulation model will be used to assess potential enhancement of the conjunctive use of water supplies across the south east region.

261. This work is being undertaken in parallel to the Strategic Regional Options development work discussed in the previous sub-section. The results of an ongoing programme of studies will inform the selection of strategic options as part of the best value WRSE regional investment programme.

262. Additional work is being undertaken at a regional level to include multi-sector water supplies in the regional resilience assessment, together with increased environmental ambition, and to facilitate enhanced stakeholder and customer engagement.

WRSE Resource Position Statement

263. In March 2020 the WRSE Group published “Future Water Resource Requirements for south east England”[11]. This set out the initial picture of the region’s future water resource requirements, drawing on existing published data and the National Framework. published by the Environment Agency.

264. It confirmed that the south east region is expected to face some of the most significant challenges to water resources in the future

265. A shortfall of around 1 billion litres of water per day by 2050 is forecast, rising to over 1.7 billion litres by 2100. The deficits vary across the south east and at different times of the year

266. The Environment Agency reported a significantly higher shortfall for the south east of 1,765 Ml/d by 2050 based on their assumptions around per capita consumption, drought interventions, and environmental ambition.

[11] https://www.wrse.org.uk/media/anbhm2cb/wrse-future-water-resource-requirements-march-2020-3.pdf

D.2.7 Environmental Need – WINEP

AMP7 Environment Programme

267. Our AMP7 Environment Programme comprises 10 investigations and two potential sustainability reductions.

268. The sustainability reductions, to improve the fluvial environment of the River Cray and River Wye are discussed below, with further information on the investigations, that could develop into options appraisals, in Appendix D.

269. The WRMP19 includes allowance for two sustainability reductions by the end of 2024/25. One at Bexley in London WRZ, the other at Hawridge in SWA WRZ.

270. Both sources are currently undergoing options appraisal and the licence reductions will be subject to cost benefit assessment, meaning the final position on the reduction has not yet been confirmed.

271. The licence reduction at Hawridge would be from the current licence of 9.1 Ml/d to zero (a loss of 6.9 Ml/d of DO).

272. The reduction at Bexley (31.8 Ml/d to 22.7 Ml/d, a loss of 9 Ml/d of DO) is likely to be moved to upstream to North Orpington. The options appraisal concluded that the best option to address the impact of abstraction on the River Cray is to close the North Orpington source as this will have a greater overall benefit through reducing abstraction impact along the whole length of the river.

Likelihood and magnitude of further sustainability reductions in the future

273. In our WRMP19 we included scenarios looking at the potential impact of no deterioration and further scenarios to explore potential further sustainability reductions to address the potential impact of abstraction on vulnerable chalk streams.

274. These scenarios highlighted that future sustainability reductions remain a significant uncertainty in our medium to long-term plan, which could result in material change to the forecasts.

275. We continue to work with the Environment Agency and WRSE to examine potential scenarios.

West Berkshire Groundwater Scheme (WBGWS)

276. In the WRMP19 we included ‘What-if’ scenarios to demonstrate what the impact would be of losing or reducing benefit of the WBGWS from 2031, in line with communication with the Environment Agency. This showed a significant impact on our DO in London and Kennet Valley WRZs and so any loss or reduction of the WBGWS would be a significant adverse impact on the supply demand balance going forward.

277. We have been discussing testing the WBGWS with the Environment Agency and will be taking this forward when Covid19 restrictions are eased to allow us to pick up on the potential testing of the scheme.

D.2.8 Resilience Need

278. Our WRMP19 included for increased drought resilience from 1:100 to 1:200 in year 2030/31. We also included scenarios for 1:500 drought resilience.

279. Since publication, there has been a clear signal from government that greater drought resilience would be preferred and possibly even considered to be the norm for future planning.

280. The National Framework states that regional plans (and thus WRMPs) should be based on achieving a level of drought resilience so that emergency drought order restrictions, such as providing water only at certain times of the day (rota cuts) or through temporary taps (standpipes) in the streets, are expected to be implemented no more often than once in 500 years on average. This should be achieved during the 2030s and regional groups should determine a date within that range by considering the costs and benefits of alternative approaches to find an optimum.

281. This planning assumption is in line with the recommendation from the National Infrastructure Commission. Government is due to respond to this recommendation as part of its forthcoming National Infrastructure Strategy.

282. The increased level of public water supply drought resilience translates into an annual chance of no more than 0.2%, or a 5% chance of these restrictions being used over a 2 year period.

283. Increased resilience should not rely on the increased use of drought measures to boost supplies by, for example, allowing additional abstraction during drought, where this is environmentally damaging. Also, the planned implementation of non-essential use bans should not become more frequent to achieve the reduction in the use of more extreme restrictions such as standpipes and rota cuts.

284. As we develop our WRMP24, we will continue to examine alternative drought resilience thresholds and timings.

D.2.9 Summary and Statement of Validity

285. On the basis of the updates described above we consider the status of our WRMP19 is:

Table 29: WRMP19 Validity Statement

Status	WRMP19 Validity
✔	**The WRMP19 remains valid as a basis for future planning**

286. At WRZ level, the following changes and mitigating actions have been made as a result of variances identified via the Monitoring Plan.

Table 30: WRZ-level RAG status

WRZ	RAG Status	AMP7 Programme
London		No changes
SWOX		No changes
SWA		The supply demand balance in SWA is tighter than anticipated in the WRMP19. We have undertaken a review of the SWA water supply system and have identified a series of potential solutions to improve our supply capability and its resilience. The scope and programme of the investments required are in the process of being reviewed to ensure the WRZ remains in surplus and we are confident that we can maintain a secure water supply.
Kennet Valley		No changes
Guildford		No changes
Henley		No changes

Part E – Forward Look

E.1 Challenges and Risks

287. WRMPs involve long-term forecasts, subject to significant uncertainty. We have identified below, the key risks and challenges that focus on the period 2020-25.

Challenge 1 – Impact of COVID-19

288. On 23 March 2020 the UK was put into lockdown in an unprecedented step to limit the spread of coronavirus. This had the impact of reducing non-household demand but increasing household demand, as businesses were closed, and people were asked to work at home where possible. However, given this only affects the last 8 days of the report year, and the impact on the annual average is minimal (0.2% reduction on DI) no special reporting has been introduced to account for this for 2019/20.

289. Lockdown poses a number of challenges to us for Annual Review 2021, including:

- **Household consumption** - Customers will be at home for longer than usual and being vigilant about observing hygiene habits (i.e. washing hands, cleaning groceries and surfaces). Additionally, the period of confinement coincides with the time of year where we expect demand to peak. An extended period of home working is likely to significantly increase our observed household demand and may mean that in early AMP7 our demand management programmes serve to mitigate the impact of COVID-19 increased household consumption rather than realise a net demand reduction compared to the WRMP19 baseline.
- **Population** - During the summer we expect household consumption to decrease due to people travelling abroad. Due to restrictions on travel, household consumption is likely to remain higher for longer as people holiday more locally. More broadly, travel restrictions may reduce the number of tourists entering the UK for holidays, particularly during the summer and Christmas peaks. Worldwide uncertainty may also impact immigration numbers and together, this will reduce population and increase per capita consumption.
- **Demand management activity –** Lockdown restrictions are likely to impact our demand management activities. For example, meter installations may be constrained due to limited staff availability, restrictions on street works and undue risk to customers' water supply at a critical period. Also, water efficiency activity is likely to be impacted due to restrictions on entering a customers' home to undertake a Smarter Home Visit or wastage repair.

290. The impact of COVID-19, both in moving consumption from non-household to household properties and changing short and long term population, highlights the reactive nature of PCC as a measure of customer demand. PCC does not account for customer demand at business

properties or include business water use. Population is also not a parameter that can be influence but it has a significant impact on PCC.

291. We will work to limit the impact of lockdown on our customers and our staff for the duration of the outbreak and report the impacts on the water balance in next year's Annual Review. We will also reflect on the impact of using PCC as a measure of customer demand and consider more inclusive alternatives.

Challenge 2 - Delivering leakage reduction

292. In line with the preferences of our customers and stakeholders we have also set ambitious targets to reduce leakage further as an essential building block of WRMP19, with a 20% reduction in AMP7 from our 2019/20 target of 606 Ml/d and 50% by 2050. Delivering this ambitious level of further reduction will be challenging, but necessary.

293. We have a strong reputational and financial incentive to achieve our leakage reduction targets. In our PR19 business plan we have included a performance measure, with an associated financial penalty/reward, called an Outcome Delivery Incentive (ODI) for leakage in AMP7. This is a significant incentive for the company to continue to focus and sustain its efforts to achieve the leakage reduction targets.

294. The most effective way of reducing leakage is asset replacement. However, in the short term this method is an expensive option compared to alternatives such as 'find and fix' and household metering. However, find and fix measures do not improve the state of the assets and to reduce leakage sustainably will require asset replacement in addition to household metering. A challenge will be how we transition between find and fix measures and asset replacement.

295. Our network is also vulnerable to extremes of weather, particularly freeze-thaw events as experienced in 2018. Under these conditions we need to work even harder to prevent leakage levels increasing to such an extent that annual average leakage targets cannot be achieved.

296. Our adaptive planning approach within WRMP19 has highlighted what would need to be done should leakage reduction be lower than anticipated. We will monitor activity through the Annual Review process.

Challenge 3 – Achieving reductions in usage

297. Our Plan anticipates significant reductions in per capita consumption over the planning period. Water companies are not in direct control of how customers use water, but we are important enablers to provide customers with tools and information to help them make informed decisions regarding water use. We do this primarily though our metering and water efficiency programmes. Other stakeholders have equally critical roles in setting new development standards, water using appliances labelling requirements and driving efficient practices.

298. Whilst the principle of a low PCC target has many positives, how a target value is delivered, and responsibilities and accountabilities are transferred to all relevant stakeholders will be critical. A unified approach will be required. In WRMP09 we championed a government-led Knowledge Integration Community-type approach to drive usage reduction to meet an

aspirational target of 130 l/h/d. This is a group of end-to-end stakeholders (academics, industry, government and others) who craft, own and run an integrated programme of education, multidisciplinary research and outreach on a topic that goes to the heart of future UK prosperity.

299. The concept could provide a vehicle to drive knowledge exchange and research in a co-ordinated way, and to ensure widespread engagement to deliver common outcomes. The figure below illustrates how the range of stakeholders might integrate around a common vision to share knowledge and drive the process forward.

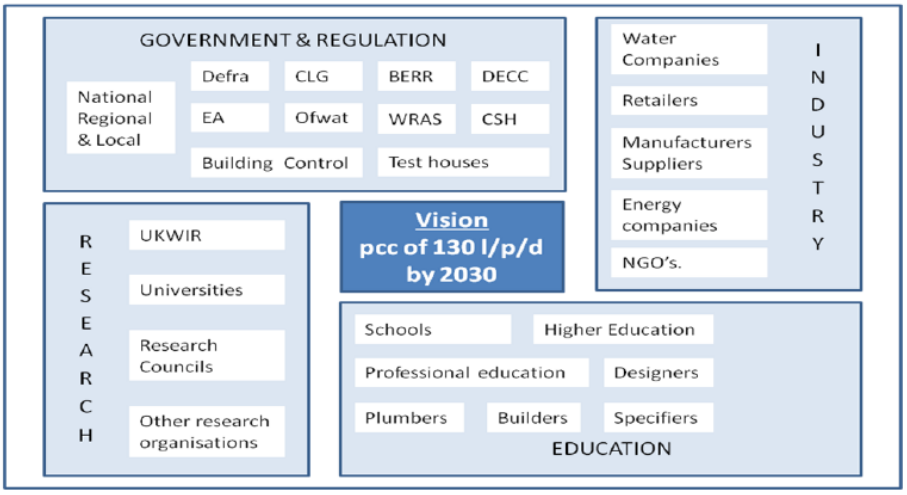


Figure 7: An example Knowledge Integration Community

300. As with leakage reduction, we are managing the potential for lower levels of usage reduction though our adaptive planning approach set out in our final WRMP19. We will monitor activity through the Annual Review process.

Risk 1 - Resilience to drought

301. Supply systems in the UK are not designed to be resilient to all potential droughts as the cost to do so would be prohibitive. WRMPs are developed to meet levels of service for supply restrictions that are agreed with customers and stakeholders. WRMP19 sets out that until 2030 our system is resilient (i.e. avoidance of the most serious supply restrictions) to the worst historic drought on record (~1:100 return period).

302. We are delivering a programme of investment to increase resilience to a severe drought (1:200 return period). As an industry we have also been exploring the impact of increasing resilience to extreme drought (1:500 return period).

272. As such, each year there is the inherent risk that any year could have extreme drought conditions that are outside our planned levels of service.

Risk 2 - Timetable for WRMP24

273. For WRMP24, water company plans will be developed from the new regional-level plans and within a new national-level framework. The overall timescale for the development of Business

Plans has also been shortened by 6 months for this planning round. Consequently, we will enter the development of WRMP24 much earlier than in previous regulatory cycles. This is a risk because there is little time to judge the effectiveness of AMP7 demand management activity.

274. The new framework and timescale brings with it risk and opportunity. The main opportunity is around consistent messaging and the potential to facilitate a much needed round of co-ordinated national water supply infrastructure development. The risks relate to the uncertainty of the sustained delivery of demand management savings given current restrictions on meter installation and the reduced time to determine the sustainable reduction achieved.

E.2 Stakeholder Engagement

275. There is interest in water resources from a diverse range of stakeholders, from those organisations who are interested in a specific geographical area, watercourse or single option to organisations that have a broad interest in the sustainable management of resources for the long term.

276. We engaged extensively with regulators and stakeholders throughout the development of WRMP19. We organised a programme of meetings with stakeholders and local communities to share technical work in a timely, open manner providing opportunity for challenge and input to the development of the plan, and held two stages of public consultation.

277. We also sought the views and preferences of our customers on our planning principles, the approach followed and the solutions. This was coordinated with feedback on our business plan, and was used to shape our plan.

278. We received positive feedback on our approach and committed to apply the learning to the ongoing programme of work. We will continue to work closely with regulators and stakeholders as we deliver the commitments set out in WRMP19 and progress work to develop the regional plan for the south east, and in turn our WRMP24.

Our engagement programme

279. We have designed our approach to share information with stakeholders and provide opportunities for input at formative stages in the development of the regional plan. The approach is designed to ensure we engage fully with all sectors that use water in the region, to ensure the plan delivers long-term environmental improvement across the region meeting the expectations of the Environment Agency and other stakeholders as far as possible, and takes account of the views of the wider stakeholder community across the region. We will also engage with customers to ensure we understand their priorities and preferences, and feed these into the development of the plan. The engagement comprises a combination of WRSE-led and company-led activity, and will be delivered through forums and meetings, both in person and virtual noting the current Covid-19 pandemic, and using an interactive web-based platform. The engagement process is summarised in the Figure below.

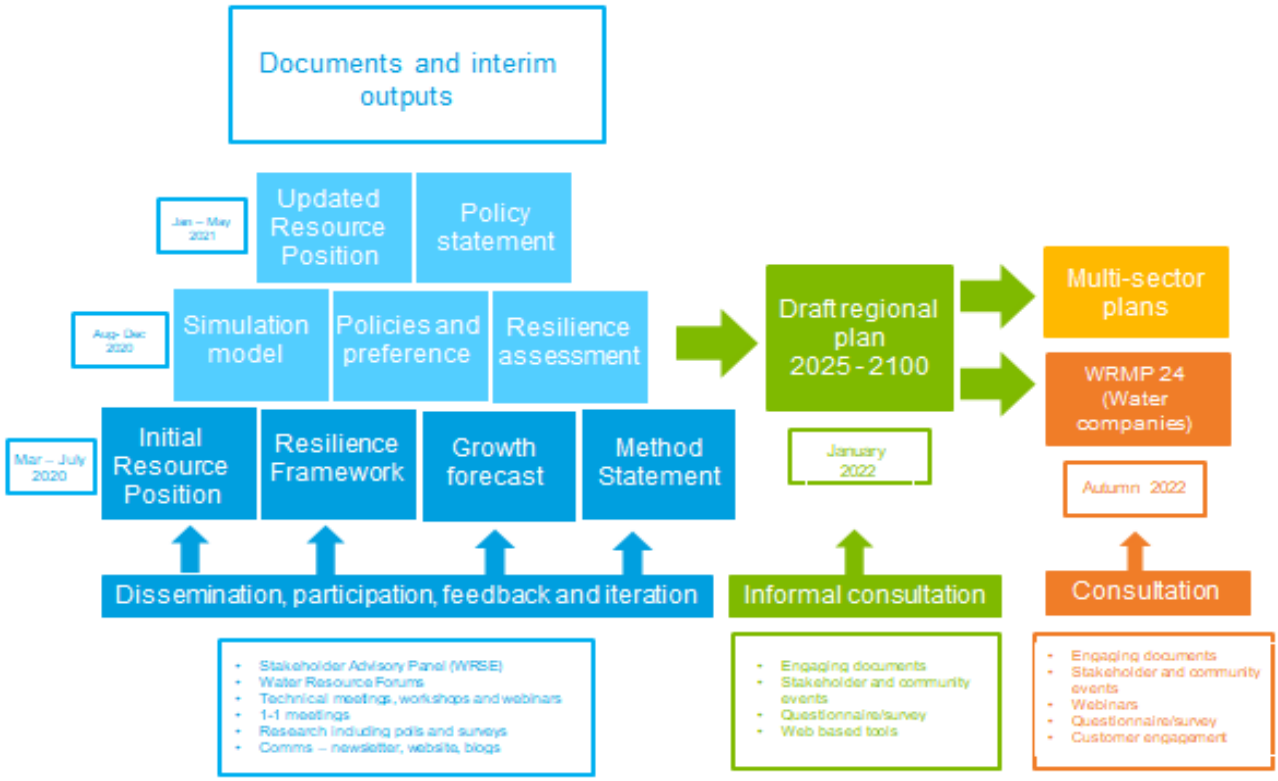


Figure 8: Engagement process to inform the regional plan and WRMP24s

280. An important part of the development of the regional plan is to identify and appraise potential solutions to meet the water resources challenge. These solutions include measures to manage demand, nature recovery, catchment management, resilience options and new sources of water. We will identify and appraise options through a range of channels and will involve stakeholders throughout drawing on their local knowledge and seeking their comment and challenge. This work includes the collaborative work underway to examine the Strategic Resource Options (SRO) identified and funded by Ofwat as part of the Price Review process.

281. We are engaging with the Environment Agency, and other stakeholders, on the technical studies to assess these options as part of the first tranche of work to ensure these options are feasible and can be progressed, following which the engagement activities will be expanded to involve a broader range of stakeholders and the local communities who have an interest in, or may be affected by the proposals.

282. As presented in WRMP19 (Section 11) we intend to complete the work on the regional plan and strategic resource options to enable a decision to be made by 2022/23 on the resource options that need to be progressed. We have set out a monitoring plan to give regulators and stakeholders visibility of our progress delivering this work, this is presented in Part D of this report.

Appendices

Appendix A: Out-turn Tables – Annual Average

Table 31: EA Tables – Annual Average Out-turns

Row numbering in line with WRMP structure	Component	Units	DP	Data requirement	Guildford	Henley	Kennet Valley	London	SWA	SWOX	Water Company Total Data
	SUPPLY										
	Resources										
1AR	Raw water abstracted	Ml/d	2dp	Required	51.60	13.48	109.33	2242.65	149.43	279.93	2846.43
2AR	Raw water imported (in the reporting year)	Ml/d	2dp	Required	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3AR	Potable water imported (in the reporting year)	Ml/d	2dp	Required	0.00	0.00	0.00	0.00	0.00	2.31	2.31
5AR	Raw water exported (in the reporting year)	Ml/d	2dp	Required	0.00	0.00	0.00	92.60	0.00	0.00	92.60
5.1AR	Non potable water supplied	Ml/d	2dp	Required	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6AR	Potable water exported (in the reporting year)	Ml/d	2dp	Required	1.79	0.00	0.26	6.59	3.42	1.77	13.84
7AR	Deployable output	Ml/d	2dp	Required	65.30	25.65	144.05	2302.00	183.56	318.55	3039.11
12AR	Water Available For Use (own sources)	Ml/d	2dp	Required	64.33	19.23	140.21	2110.23	166.32	302.54	2802.85
13AR	Total Water Available For Use	Ml/d	2dp	Required	62.06	19.23	139.95	2091.78	163.12	302.72	2778.85
	Process Losses										
9AR	Treatment works losses and operational use	Ml/d	2dp	Required	1.55	0.11	8.20	82.26	5.54	0.90	98.56
10AR	Outage experienced	Ml/d	2dp	Required	0.97	6.42	3.11	157.43	14.91	13.82	196.66
	DEMAND										
11AR	Distribution input (in reporting year)	Ml/d	2dp	Required	47.26	13.16	99.40	2025.33	140.51	276.46	2602.13
	Consumption										
23AR	Measured non household - consumption	Ml/d	2dp	Required	5.86	1.14	13.66	361.44	24.39	43.04	449.53
24AR	Unmeasured non household - consumption	Ml/d	2dp	Required	0.16	0.04	0.22	13.85	0.22	0.65	15.15
25AR	Measured household - consumption	Ml/d	2dp	Required	11.06	4.77	27.18	388.69	35.61	85.74	553.05
26AR	Unmeasured household - consumption	Ml/d	2dp	Required	13.26	3.22	32.39	732.89	43.46	68.55	893.77
29AR	Measured household - pcc	l/h/d	0dp	Required	147	162	134	126	139	142	130
30AR	Unmeasured household - pcc	l/h/d	0dp	Required	162	163	159	155	155	159	155
31AR	Average household - pcc	l/h/d	0dp	Required	155	163	147	143	147	149	145
32AR	Water taken unbilled	Ml/d	2dp	Required	1.14	0.27	2.06	66.56	2.03	7.12	79.19
33AR	Distribution system operational use	Ml/d	2dp	Required	0.56	0.11	0.65	19.38	0.90	2.63	24.24
	Leakage										
34AR	Measured non household - uspl	Ml/d	2dp	Required	0.16	0.04	0.22	3.30	0.33	0.71	4.77
35AR	Unmeasured non-household - uspl	Ml/d	2dp	Required	0.03	0.01	0.03	1.58	0.04	0.08	1.77
36AR	Measured household - uspl	Ml/d	2dp	Required	1.14	0.44	2.05	26.50	2.90	6.30	39.33
37AR	Unmeasured household - uspl	Ml/d	2dp	Required	2.42	0.51	3.91	85.93	6.19	8.29	107.24
38AR	Void properties - uspl	Ml/d	2dp	Required	0.19	0.05	0.38	7.68	0.48	0.85	9.63
39AR	Distribution Losses	Ml/d	2dp	Required	11.28	2.57	16.64	317.53	23.95	52.51	424.48
40AR	Total leakage	Ml/d	2dp	Required	15.21	3.62	23.24	442.52	33.90	68.73	587.22
41AR	Total leakage	l/prop/d	2dp	Required	231.38	162.57	137.31	142.03	153.25	152.26	145.15
	CUSTOMERS										
	Properties										
42AR	Measured non-household - properties	000's	3dp	Required	3.108	0.944	6.627	106.338	8.783	21.235	147.035
43AR	Unmeasured non-household - properties	000's	3dp	Required	0.329	0.083	0.561	29.711	0.608	1.409	32.702
44AR	Void non households - properties	000's	3dp	Required	0.600	0.175	1.384	30.698	1.865	4.164	38.887
45AR	Measured household - properties	000's	3dp	Required	32.204	14.014	87.559	1221.332	109.277	269.613	1733.999
45.7AR	Measured void household - properties	000's	3dp	Required	0.154	0.041	0.402	24.792	0.361	0.658	26.408
46AR	Unmeasured household - properties	000's	3dp	Required	27.904	6.528	67.962	1614.129	95.079	144.418	1956.021
47AR	Unmeasured void household - properties	000's	3dp	Required	1.453	0.470	4.742	88.734	5.209	9.916	110.524
48AR	Total resource zone properties (inc voids)	000's	3dp	Required	65.751	22.256	169.237	3115.736	221.183	451.412	4045.574
	Population										
49AR	Measured non-household - population	000's	3dp	Required	7.468	0.271	6.791	51.443	5.281	32.589	103.843
50AR	Unmeasured non-household - population	000's	3dp	Required	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51AR	Measured household - population	000's	3dp	Required	75.297	29.364	202.699	3085.022	256.622	604.884	4253.888
52AR	Unmeasured household population	000's	3dp	Required	81.631	19.790	203.171	4738.050	280.491	431.470	5754.602
53AR	Total resource zone population	000's	3dp	Required	164.39	49.425	412.661	7874.515	542.995	1068.943	10112.334
	Metering										
57AR	Total measured household metering penetration (incl. voids)	%	2dp	Required	52.18%	66.56%	54.50%	41.42%	52.05%	63.50%	45.31%
57.1	Total households with a meter installed	%	2dp	Optional							0.00
	Total numbers of household meters installed	000's	3dp	Required	0.404	0.156	1.427	43.019	1.810	2.975	49.791
	SUPPLY-DEMAND BALANCE										
16AR	Target headroom	Ml/d	2dp	Required	1.10	0.36	3.82	57.40	3.36	7.39	73.43
18AR	Observed supply-demand balance (in reporting year)	Ml/d	2dp	Required	13.70	5.70	36.73	9.04	19.25	18.87	103.29

Appendix B: Out-turn Tables – Critical Period

Table 32: EA Tables – Critical Period Out-turns

Row numbering in line with WRMP structure	Component	Units	DP	Data requirement	Guildford	Henley	Kennet Valley	London	SWA	SWOX	Water Company Total
	SUPPLY										
	Resources										
1AR	Raw water abstracted	Ml/d	2dp	Required	59.41	15.88	125.53	2242.65	164.97	307.16	2915.60
2AR	Raw water imported (in the reporting year)	Ml/d	2dp	Required	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3AR	Potable water imported (in the reporting year)	Ml/d	2dp	Required	0.00	0.00	0.00	0.00	0.00	3.03	3.03
5AR	Raw water exported (in the reporting year)	Ml/d	2dp	Required	0.00	0.00	0.00	92.60	0.00	0.00	92.60
5.1AR	Non potable water supplied	Ml/d	2dp	Required	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6AR	Potable water exported (in the reporting year)	Ml/d	2dp	Required	1.98	0.00	0.26	6.59	4.01	1.77	14.61
7AR	Deployable output	Ml/d	2dp	Required	71.33	25.90	150.57	2302.00	201.58	372.71	3124.09
12AR	Water Available For Use (own sources)	Ml/d	2dp	Required	70.36	19.48	145.32	2110.23	184.45	355.58	2885.42
13AR	Total Water Available For Use	Ml/d	2dp	Required	68.09	19.48	145.02	2091.78	180.20	356.28	2860.85
	Process Losses										
9AR	Treatment works losses and operational use	Ml/d	2dp	Required	1.30	-1.23	10.90	82.26	4.38	6.39	104.00
10AR	Outage experienced	Ml/d	2dp	Required	0.97	6.42	3.11	157.43	14.91	13.82	196.66
	DEMAND										
11AR	Distribution input (in reporting year)	Ml/d	2dp	Required	55.74	17.07	111.76	2025.33	155.00	315.03	2679.94
	Consumption										
23AR	Measured non household - consumption	Ml/d	2dp	Required	7.17	2.22	7.29	361.44	20.53	34.26	432.91
24AR	Unmeasured non household - consumption	Ml/d	2dp	Required	0.20	0.07	0.12	13.85	0.18	0.51	14.93
25AR	Measured household - consumption	Ml/d	2dp	Required	13.77	6.24	34.66	388.69	42.81	108.50	594.66
26AR	Unmeasured household - consumption	Ml/d	2dp	Required	17.24	4.45	43.08	732.89	53.90	90.53	942.09
29AR	Measured household - pcc	l/h/d	0dp	Required	183	212	171	126	167	179	140
30AR	Unmeasured household - pcc	l/h/d	0dp	Required	211	225	212	155	192	210	164
31AR	Average household - pcc	l/h/d	0dp	Required	198	217	192	143	180	192	154
32AR	Water taken unbilled	Ml/d	2dp	Required	1.42	0.35	2.57	66.56	2.30	8.89	82.10
33AR	Distribution system operational use	Ml/d	2dp	Required	0.56	0.11	0.65	19.38	0.90	2.63	24.24
	Leakage										
34AR	Measured non household - uspl	Ml/d	2dp	Required	0.16	0.04	0.22	3.30	0.33	0.71	4.77
35AR	Unmeasured non-household - uspl	Ml/d	2dp	Required	0.03	0.01	0.03	1.58	0.04	0.08	1.77
36AR	Measured household - uspl	Ml/d	2dp	Required	1.14	0.44	2.05	26.50	2.90	6.30	39.33
37AR	Unmeasured household - uspl	Ml/d	2dp	Required	2.42	0.51	3.91	85.93	6.19	8.29	107.24
38AR	Void properties - uspl	Ml/d	2dp	Required	0.19	0.05	0.38	7.68	0.48	0.85	9.63
39AR	Distribution Losses	Ml/d	2dp	Required	11.45	2.58	16.79	317.53	24.43	53.48	426.27
40AR	Total leakage	Ml/d	2dp	Required	15.38	3.63	23.39	442.52	34.38	69.70	589.01
41AR	Total leakage	l/prop/d	2dp	Required	233.89	163.22	138.23	142.03	155.41	154.41	145.59
	CUSTOMERS										
	Properties										
42AR	Measured non-household - properties	000's	3dp	Required	3.108	0.944	6.627	106.338	8.783	21.235	147.035
43AR	Unmeasured non-household - properties	000's	3dp	Required	0.329	0.083	0.561	29.711	0.608	1.409	32.702
44AR	Void non households - properties	000's	3dp	Required	0.600	0.175	1.384	30.698	1.865	4.164	38.887
45AR	Measured household - properties	000's	3dp	Required	32.204	14.014	87.559	1221.332	109.277	269.613	1733.999
45.7AR	Measured void household - properties	000's	3dp	Required	0.154	0.041	0.402	24.792	0.361	0.658	26.408
46AR	Unmeasured household - properties	000's	3dp	Required	27.904	6.528	67.962	1614.129	95.079	144.418	1956.021
47AR	Unmeasured void household - properties	000's	3dp	Required	1.453	0.470	4.742	88.734	5.209	9.916	110.524
48AR	Total resource zone properties (inc voids)	000's	3dp	Required	65.751	22.256	169.237	3115.736	221.183	451.412	4045.574
	Population										
49AR	Measured non-household - population	000's	3dp	Required	7.468	0.271	6.791	51.443	5.281	32.589	103.843
50AR	Unmeasured non-household - population	000's	3dp	Required	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51AR	Measured household - population	000's	3dp	Required	75.297	29.364	202.699	3085.022	256.622	604.884	4253.888
52AR	Unmeasured household population	000's	3dp	Required	81.631	19.790	203.171	4738.050	280.491	431.470	5754.602
53AR	Total resource zone population	000's	3dp	Required	164.395	49.425	412.661	7874.515	542.395	1068.943	10112.334
	Metering										
57AR	Total measured household metering penetration (incl. voids)	%	2dp	Required	52.18%	66.56%	54.50%	41.42%	52.05%	63.50%	45.31%
57.1	Total households with a meter installed	%	2dp	Optional							
	Total numbers of household meters installed	000's	3dp	Required	0.404	0.156	1.427	43.019	1.810	2.975	49.791
	SUPPLY-DEMAND BALANCE										
16AR	Target headroom	Ml/d	2dp	Required	3.69	1.08	6.45	57.40	9.17	14.54	92.33
18AR	Observed supply-demand balance (in reporting year)	Ml/d	2dp	Required	8.66	1.33	26.81	9.04	16.03	26.70	88.58

Appendix C: Deployable Output Update

284. An update of Deployable Output (DO) for AR20 has been calculated by the Water Resources Modelling Team, which reflects the latest information from a variety of sources across the Company.

285. The Groundwater Source Deployable Outputs (SDOs) have been subject to the annual internal review. In order to continually improve the SDO assessments the source constraints, as well as water treatment works capabilities and process losses derived from mass balance models, have been reviewed where available information indicates this is appropriate. The changes resulting from this review are summarised at the end of this Appendix.

286. The Conjunctive Use Deployable Outputs for the London and SWOX Water Resource Zones (WRZ) are calculated using WARMS2. Updates to SDOs in both London and the Thames Valley, corrections to information contained within WARMS2, as well as updates to water treatment works capability and process loss assumptions are contained within this update.

London WRZ

287. The review has assessed a number of scenarios for London as shown below, with the Annual Return 2019 DO of 2305 Ml/d as the starting point for this update. Note: Any step change in WRZ DO will not necessarily correspond exactly with changes to schemes or assumptions. This is because the analysis is dependent upon the steps of the demand forecasts, the level of demand, the assumptions within the Lower Thames Operating Agreement and other factors used to produce the DO.

Table 33: London DO - Changes from AR19 to AR20

Steps		DYAA DO (Ml/d)	Description
1	AR19	2305	Annual Review 2019
2	Reassessment of Thames Gateway WTW (Desalination Plant) capability	2255*	See explanation below
3	Reassessment of Effluent Returns from Affinity Water under a fully licensed abstraction scenario	2305*	See explanation below
4	Updating demand profile	2322*	Considering extended dry period in 2018, demand profile amended to reflect more recent conditions
5	Reassessment of DO including updated SDOs and process losses	2302	Annual Review 2020

* Denotes estimated deployable output for this step (i.e. no explicit calculation necessary)

288. A reassessment of the treatment capability of the Thames Gateway desalination plant has been carried out during the reporting year. Presentations by the Thames Water Executive to the Environment Agency have stated that its deployable output should be considered as 100 Ml/d, given current plans for investment in this WTW. This is a reduction from the 150 Ml/d capability previously assumed, meaning a DO loss of around 50 Ml/d.

289. The way that effluent returns from 'abstraction control nodes' are considered in WARMS2 has been updated. These abstraction control nodes ensure that we make a conservative assumption regarding Affinity Water's abstraction in our modelling, i.e. Affinity Water abstract up to their full licence limit. Previously no allowance was made for any effluent returns from Affinity's customers via these abstraction control nodes, resulting in an overly conservative representation of Affinity Water's abstractions in the Lower Thames. This has been updated and independently reviewed by Mott MacDonald. This change gives an increase in London's DO of around 50 Ml/d.

290. The demand profile used in WARMS2 has been updated. This demand profile was previously based on demand seen during the dry period of 1995/96. This was previously chosen due to it being an extended dry period, during which demand restrictions were not imposed. Considering there was an extended dry period during 2018 in which no demand restrictions were implemented, it was felt that it would be advisable to update the profile used to better reflect more recent patterns of demand. The new demand profile is based on demand from 2018, but has excluded peaks in demand that occurred during and after the freeze-thaw event during 2018 and has also excluded a trough in demand caused by a wet August which would otherwise have made the profile not representative of a drought scenario.

291. The Process Modelling and Groundwater Resources teams have reviewed and updated source deployable outputs, water treatment works capabilities and process losses. These changes result in a reduction of around 20 Ml/d to London's DO.

292. As a result of these changes, the combined impact is a 3 Ml/d overall decrease in London's AR19 DO, meaning that the AR20 DO for London is now 2302 Ml/d.

SWOX WRZ

293. The impact of changes on the SWOX WRZ DO can be seen in the table below. The DOs as submitted in the Annual Review 2019 are the starting point for the update.

Table 34: SWOX DO - Changes from AR19 to AR20

Steps		DYAA DO (Ml/d)	DYCP DO (Ml/d)	Description
1	AR19	322.14	376.25	Annual Review 2019
2	SDO Updates, process loss, WTW capability updates	318.55	372.71	Annual Review 2020

294. The Groundwater Resources team reported the review of SDOs for Thames Valley and the Process Modelling team have updated WTW capability and process loss assumptions. For the SWOZ WRZ, these changes resulted in a reduction of 3.59 Ml/d for DYAA DO and a reduction of 3.54 Ml/d for DYCP DO.

Summary for all WRZs

295. A comparison at WRZ level of the AR19 and AR20 DO for both the Dry Year Annual Average (DYAA) and the Dry Year Critical Period (DYCP) scenarios are presented in the tables below.

Table 35: Summary of Dry Year Annual Average DO

DYAA DO (Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
AR19	2305	322.14	185.05	143.87	65.50	25.65
AR20	2302	318.55	183.56	144.05	65.30	25.65
Variance	-3	-3.59	-1.49	+0.18	-0.2	0

Table 36: Summary of Dry Year Critical Period DO

DYCP DO (Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
AR19	N/A	376.25	214.40	155.44	71.33	25.90
AR20	N/A	372.71	201.58	150.57	71.33	25.90
Variance	N/A	-3.54	-12.82	-4.87	0	0

Table 37: Groundwater Source Deployable Output Review – London WRZ - April 2020

Resource Zone	Site	Average (Ml/d)			Peak (Ml/d)			Comments
		AR19 SDO	AR20 SDO Update	Difference	AR19 SDO	AR20 SDO Update	Difference	
London								
Thames Valley	Langley Vale	4.49	2.52	-1.97	4.60	2.52	-2.08	Limited by new crypto filters.
	Battersea	6.89	6.82	-0.07	7.40	6.82	-0.58	Current programme of work will lead to an ability to treat average licence (6.98Ml/d), but not peak licence. Further reduction associated with revised process modelling outputs
	Honor Oak	1.74	0.00	-1.74	1.74	0.00	-1.74	Potential WTW redevelopment unlikely to be delivered in less than 24 months, so SDO reduction.
	Streatham	4.99	4.99	0.00	8.98	7.03	-1.95	Flow capped at 7.1Ml/d due to turbidity. Motive water requirements further reduce peak SDO
	Brixton	9.11	5.84	-3.27	12.50	6.80	-5.70	SDO reduced based on observed output Dec 2018-Jan 2019. Potential WTW refurbishment unlikely to be delivered in less than 18 months.
			Total	-7.05		Total	-12.05	
Lee Valley	Wanstead	3.18	3.26	+0.08	3.76	3.88	+0.12	New process losses for pressure filters resulting in an SDO increase.
	Empress Avenue	2.12	2.18	+0.06	2.50	2.58	+0.08	New process losses for pressure filters resulting in an SDO increase.
	Thames Gateway (Desalination)	150.00	100.00	-50.00	150.00	100.00	-50.00	Reassessment of sustainable treatment capability
	Hoddesdon Transfer Scheme	12.50	0.00	-12.50	12.50	0.00	-12.50	Site not available in AR20. Potential refurbishment unlikely to be delivered in less than 14 months, so SDO reduction.
			Total	-62.36		Total	-62.30	
New River	No SDO Changes	No SDO Changes			No SDO Changes			
			Total	0.00		Total	0.00	
South East	Wansunt	13.20	13.60	+0.40	14.60	15.00	+0.40	Reassessment of process losses
	Westerham	0.88	0.88	0.00	1.20	1.34	+0.14	Correction of previous error.
	Dartford	3.63	3.63	0.00	4.09	4.04	-0.05	Treatment constraint due to carrier water.
	Southfleet	2.17	2.22	+0.05	2.40	2.66	+0.26	Reassessment of process losses
			Total	+0.45		Total	+0.75	
Total London				-68.96			-73.60	

Table 38: Groundwater Source Deployable Output Review – Thames Valley WRZs - April 2020

Thames Valley								
SWOX								
North Oxon	Farmoor & Swinford	137.56	136.28	-1.28	179.60	178.88	-0.72	Revised due to changes in other source deployable outputs. This SDO is back-calculated, based on WARMS2 output and other SDOs
			Total	-1.28		Total	-0.72	
Swindon	Bedwyn	1.54	1.55	+0.01	1.73	1.74	+0.01	New treatment process - losses removed.
	Lower Swell	0.40	0.39	-0.01	0.40	0.39	-0.01	Reassessment of process losses
	Blockley	1.22	1.50	+0.28	1.22	1.50	+0.28	Correction of error in time variant yield spreadsheet
			Total	+0.28		Total	+0.28	
South Oxon	Woods Farm	4.99	2.59	-2.40	5.50	2.59	-2.91	Review of treatment capability using Mass Balance model
	Watlington	1.31	1.12	-0.19	1.31	1.12	-0.19	Review of process losses using Mass Balance model
			Total	-2.59		Total	-3.10	
Total SWOX				-3.59			-3.54	
Kennet Valley	Bishops Green	11.00	10.40	-0.60	15.40	10.40	-5.00	Previously long term outage. Study on root cause and potential solution yet to commence.
	East Woodhay	6.10	6.70	+0.60	9.00	9.00	0.00	DO Revised due to reduction in Bishops Green DO (aggregate licence)
	Playhatch	7.16	7.22	+0.06	8.10	8.11	+0.01	Reassessment of process losses
	Speen	7.18	7.30	+0.12	8.44	8.56	+0.12	Reassessment of process losses
			Total	0.18		Total	-4.87	
Henley		No change			No change			
			Total	0.00		Total	0.00	
Slough, Wycombe & Aylesbury	Taplow	38.70	38.70	0.00	49.30	40.80	-8.50	Peak SDO reduced based on observed performance, but also with consideration of drought output.
	Dorney	17.10	17.10	0.00	22.70	22.80	+0.10	Minor change due to apportioning of GAC losses using reduced flows from Taplow.
	Dancers End	1.49	0.00	-1.49	1.64	0.00	-1.64	New treatment processes yet to be commissioned, with current plan to return the site to supply for Spring 2021. SDO reduced to 0 Ml/d.
	Hampden	2.00	2.00	0.00	4.78	2.00	-2.78	Upgraded run to waste facility required to enable combined return to supply of both boreholes. Upgrade deferred to AMP7 , so SDO reduced.
			Total	-1.49		Total	-12.82	
Guildford	Dapdune	8.00	7.80	-0.20	10.40	10.40	0.00	Revised losses due to new PALL plant
			Total	-0.20		Total	0.00	
Total Thames Valley				-5.10			-21.23	

Appendix D: Environment Programme Investigations, Options Appraisals

AMP6 2015-2020

Investigations

296. Several investigations have been undertaken in the AMP6 period, including for the Lower Lee abstraction (Lower River Lee), Bexley (River Cray) and Hawridge (River Chess) and Sundridge (Darent).

297. These were completed by the dates shown in the table below.

298. The Sundridge investigation concluded that an options appraisal was not needed. The other three went forward for options appraisal.

Options Appraisals

299. Catchment reviews or options appraisals were required in the AMP6 period following previous investigations at Waddon (River Wandle) and in the Darent Catchment (River Darent).

300. Therefore in total, including the three investigations that required further assessment on the Lower Lee, Bexley and Hawridge, five options appraisals/catchment reviews were carried out in AMP6.

301. These were completed by the dates shown in the table below.

302. The outcome of these investigations and options appraisals has resulted in the requirement for sustainability reductions at Hawridge on the River Chess and at North Orpington (instead of Bexley) on the River Cray. For the Wandle, Darent, Cray, Chess and River Lee we will be implementing river restoration in AMP7. For the River Lee we will also implement a package of improvements identified in the Options Appraisal.

Table 39: AMP6 Environmental Investigations and Options Appraisals

Investigation name	Waterbody	WRZ	EA Area	Completion Date
Sundridge	Darent	London	KSL	31/04/2018
Lower Lee	River Lee	London	HNL	31/04/2018
Hawridge	River Chess	SWA	HNL	31/08/2018
Bexley	River Cray	London	KSL	31/03/2019
Catchment Review/ Options Appraisal	**Waterbody**	**WRZ**	**EA Area**	**Completion Date**
Darent Catchment	Darent	London	KSL	31/12/2018
Lower Lee	River Lee	London	HNL	31/12/2018
Waddon	Waddon Ponds	London	KSL	31/03/2019
Bexley	River Cray	London	KSL	31/05/2019
Hawridge	River Chess	SWA	HNL	31/07/2019

AMP7 2020-2025

Investigations

303. We are also required to undertake investigations in AMP7 for the Upper Kennet, The River Hogsmill, the Upper Lee and Bedford Ouse groundwater body and for a number of locations to address the requirement for 'no deterioration' (ND) assessment; these are shown in the table below.

304. These investigations are due to be completed by the end of March 2022 in order to provide a view to inform WRMP24. However, it is recognised that this is a very tight timescale in which to deliver these investigations which in some cases will involve a significant degree of complexity and so further time may be required to deliver a comprehensive investigation.

Options Appraisals

305. There are no options appraisals carried forward from AMP6. However, if the AMP7 investigations show that abstractions are causing an adverse impact on the environment or that increase up to full licence for no deterioration investigations will cause WFD deterioration, then options appraisal will be required.

Table 40: AMP7 Environmental Investigations and Options Appraisals

Investigation name	Waterbody	WRZ	EA Area	Completion Date
Upper Kennet	River Kennet	KV	Thames	31/03/2022
Hogsmill	River Hogsmill	London	KSL	
Ampney Brook and Lower Churn ND	Ampney Brook and Lower Churn	SWOX	Thames	
River Coln and Dikler ND	Coln and Dikler	SWOX	Thames	
Thames at Reading ND	Thames	KV	Thames	
Tilingbourne ND	Tillingbourne	Guildford	Thames	
Chiltern Chalk scarp ND	Scarp streams	SWOX	Thames	
Pang ND	Pang	KV	Thames	
Upper Lee U Bedford Ouse Chalk INV and ND	River Lee	London	HNL	
Colne ND	Colne and Chess	SWA	HNL	
Catchment Review/ Options Appraisal	**Waterbody**	**WRZ**	**EA Area**	**Completion Date**
The investigations listed above may also require options appraisal in AMP7				

306. We are also considering scenarios of further reduction to address the impact of abstraction on chalk streams. The investigations in AMP7 will provide evidence to inform the requirement for chalk streams abstraction reduction in some cases but further work may also be required to address the environmental ambition related to chalk streams abstraction reduction being undertaken through WRSE.

Appendix E: Outage

307. In this Appendix we provide further details on “Actual Outage” that has occurred in the past year and also an update to our “Outage Allowance”, which is based on an outage risk assessment and is comparable to values in the WRMP19.

308. This Appendix is structured as follows:

- Actual Outage 2019-20
- Review of long-term outages
- Alterations to the Outage allowance model
- Outage allowance 2019-20 and Summary

Actual Outage 2019-20

London

309. The outage data collated for London over the twelve month period to the end of March 2020 are summarised in the table below. The impact of the outages of the major water treatment works (LPPs) on the London WRZ DO is assessed using WARMS2 and input as an impact across the year. The total London actual outage figure for AR20 is 157.4 Ml/d. This is less than for the last full reporting year of AR19, which was 218.8 Ml/d, with the reduction in the Thames Gateway WTW SDO being a significant component of this outage reduction.

Table 41: Recorded Outages - London WRZ

Site	Area	Cause	Days Lost	Outage (Ml/d)
Brixton	TV	System Failure	366	5.84
Battersea	TV	System Failure	366	2.49
Streatham	TV	System Failure	43	0.59
Langley Vale	TV	Turbidity	366	2.51
Waddon	TV	System Failure	55	1.14
Brantwood	TV	System Failure	5	0.16
Addington	TV	System Failure	21	0.31
Addington	TV	Pollution of Source	30	0.44
West Wickham	SE	Turbidity	366	1.30
West Wickham	SE	System Failure	27	0.59
North Orpington	SE	System Failure	366	2.85
Westerham	SE	System Failure	13	0.03
Green Street Green	SE	System Failure	1	0.01
Green Street Green	SE	Turbidity	3	0.04
Shortlands	SE	Turbidity	119	5.46
Shortlands	SE	System Failure	2	0.09
Southfleet	SE	System Failure	366	2.22
Sundridge	SE	System Failure	10	0.04
Bell Green	SE	System Failure	5	0.16
Ladywell Fields	SE	System Failure	6	0.16
Crayford	SE	System Failure	81	2.92

Site	Area	Cause	Days Lost	Outage (Ml/d)
Darenth	SE	System Failure	4	0.23
Deptford	SE	System Failure	1	0.06
Deptford	SE	Turbidity	9	0.52
Lullingstone	SE	Turbidity	186	2.28
Dartford	SE	System Failure	57	0.57
Horton Kirby	SE	System Failure	17	0.22
Orpington	SE	Planned Work	43	1.19
Wansunt	SE	System Failure	51	1.04
Wilmington	SE	System Failure	7	0.36
Wilmington	SE	Planned Work	3	0.16
ELReD	LV	System Failure	366	13.20
Wanstead WTW	LV	System Failure	366	5.44
Barrow Hill	LV	System Failure	366	1.72
Waltham Abbey	LV	Turbidity	7	0.11
Gateway	LV	Planned Outage	366	101.00
Chingford	NE	Planned Outage	171	0.00
Chingford	NE	System Failure	84	
Kempton	NW	System Failure	366	
Hampton	NW	System Failure	10	
Walton	SW	System Failure	178	
Ashford	NW	System Failure	20	
Coppermills	NE	System Failure	54	
			TOTAL	**157.43**

Thames Valley

310. The outage data collated for Thames Valley over the twelve month period to the end of March 2020 are summarised below.

Table 42: Recorded Outages- Thames Valley WRZs

Site	Area	Cause	Days Lost	Outage (Ml/d)
SWOX				
Bibury	Swindon	Treatment Process Issue	13	0.15
Latton	Swindon	Treatment Process Issue	1	0.05
Axford	Swindon	Water Quality Issue	5	0.08
Blockley	Swindon	Planned Maintenance	3	0.01
Syreford	Swindon	Planned Maintenance	1	0.00
Marlborough	Swindon	System Failure	2	0.01
Dovedale	Swindon	Treatment Process Issue	154	0.43
Farmoor WTW	NOX	Planned Maintenance	6	1.33
Farmoor WTW	NOX	Power Issue	3	0.67
Farmoor WTW	NOX	Treatment Process Issue	1	0.22
Swinford WTW	NOX	Water Quality Issue	1	0.15
Swinford WTW	NOX	Power Issue	3	0.45
Swinford WTW	NOX	Planned Maintenance	11	1.67
Swinford WTW	NOX	Treatment Process Issue	1	0.15
Chinnor	SOX	Water Quality Issue	129	0.75

Site	Area	Cause	Days Lost	Outage (Ml/d)
Chinnor	SOX	Treatment Process Issue	1	0.01
Watlington	SOX	Turbidity	131	0.40
Watlington	SOX	Turbidity	271	0.10
Witheridge Hill	SOX	Treatment Process Issue	366	1.08
Witheridge Hill	SOX	Water Quality Issue	3	0.02
Cleeve	SOX	Pollution of Source	73	2.77
Cleeve	SOX	System Failure	180	3.31
			TOTAL	**13.82**
SWA				
Hampden	SWA	Treatment Process Issue	73	0.40
Hampden	SWA	Power Failure	5	0.03
Hampden	SWA	Turbidity	46	0.25
Radnage	SWA	Operational Issue	14	0.08
Pann Mill	SWA	Treatment Process Issue	366	2.19
Pann Mill	SWA	Water Quality	57	2.62
Pann Mill	SWA	Planned Work	2	0.09
Eton	SWA	Treatment Process Issue	1	0.02
Eton	SWA	Water Quality	68	1.58
Eton	SWA	System Failure	42	0.98
Datchet	SWA	Operational Issue	366	1.39
Dorney	SWA	Operational Issue	199	1.09
Medmenham	SWA	Operational Issue	172	2.38
Marlow	SWA	Operational Issue	366	1.65
Hawridge	SWA	Operational Issue	15	0.15
			TOTAL	**14.91**
Kennet Valley				
Playhatch	KV	Treatment Process Issue	1	0.02
Playhatch	KV	System Failure	1	0.02
Ufton Nervet	KV	Treatment Process Issue	366	2.90
Fobney	KV	Water Quality	1	0.17
			TOTAL	3.11
Guildford				
Sturt Road	GUI	Treatment Process Issue	25	0.14
Millmead	GUI	System Failure	3	0.03
Mousehill & Rodborough	GUI	Water Quality Issue	275	0.66
Albury (SH)	GUI	System Failure	22	0.13
Albury (Brook)	GUI	System Failure	1	0.01
			TOTAL	0.97
Henley				
Sheeplands	HEN	Operational Issue	366	6.40
Harpsden	HEN	Operational Issue	1	0.02
			TOTAL	6.42

Review of long-term outages

311. In light of recent clarifications proposed by the Environment Agency to its guidelines regarding the classification of outages, we include below a selection of outages which are ongoing at the end of March 2020, and which have a duration of 3 months or more, but which have

justification for maintaining current deployable outputs. Those long term outages which have resulted in 'writing down' of DO as discussed in Appendix C are not included.

- Battersea has been experiencing a long-term outage of magnitude 1.93 Ml/d (DO=6.82 Ml/d), due to the unavailability of GAC vessels. There is, however, a plan in place to return this site to DO within 1 month. Some works have been completed, but as the site is currently not required to meet demand, testing has not been prioritised.
- Langley Vale was experiencing an outage of 2.54 Ml/d (DO=2.54 Ml/d), due to high turbidity. The site has since returned to a more sustainable output and water quality risk is being managed by switching the site off as it is not needed to meet demand.
- Lullingstone has been experiencing an outage of magnitude 4.49 Ml/d (DO=4.49 Ml/d). Capex has been approved for a programme to prevent turbidity at this site. Operations are aiming for this site to be returned to supply in July 2020.
- Thames Gateway desalination plant has been unavailable due to programme of maintenance and refurbishment. This plan is in progress with the aim of producing a reliable capability of 100 Ml/d.
- Chingford WTW was unavailable due to concerns regarding water quality, in particular pH. This WTW has, however, been returned to supply since 31 March 2020.
- Cleeve WTW has been experiencing outages for several months, initially due to a pump failure, and subsequently due to poor water quality in the boreholes remaining after this failure. COVID-19 has resulted in delays to replacing this pump, but it is expected that all issues will be resolved when this pump is installed.
- The Dovedale source, which feeds Sheafhouse WTW has experienced a long-term outage due to high nitrate concentrations and nitrate plant issues. It is expected that nitrate concentrations will decline as groundwater levels recess.
- Pann Mill has been experiencing an outage of 2.1 Ml/d (DO=16.8 Ml/d), due to microbiological issues in raw water. The DO has, however, now been reduced as a result of reducing the abstraction licence to a peak of 15.5 Ml/d. A new process has also been installed to remove microbiological contamination which will mean that treatment of licensed quantities will be possible
- Eton WTW has been experiencing an outage of 8.53 Ml/d (DO=8.53 Ml/d). Turbidity, crypto and E-coli issues were present due to high river levels during the winter. A subsequent outage occurred relating to abstraction infrastructure and treatment capability, due to a need for filter plant maintenance. The filter manufacturers (PALL) are due to visit the site to conduct a service of the treatment, but have been delayed due to COVID-19
- An outage has been experienced at Mousehill & Rodborough WTW, specifically relating to Rodborough BH4 due to high iron. Borehole cleaning is due soon, which will restore this borehole. An improved programme of boreholes cleaning will also be implemented to prevent future issues
- An outage of 6.4 Ml/d has been experienced at Sheeplands WTW (DO=15.3 Ml/d). Sheeplands BHs have been unavailable due to a lack of run to waste facilities. This run to waste facility has been commissioned during AR20 and is now available. However, in order to return boreholes to supply, recomissioning of the PALL filtration plant will be required. A plan to do this has been enacted and progress is being made.

Alterations to Outage Allowance Model

312. The calculation of Outage Allowance is based on a statistical analysis of historical outages. If there is investment in assets which eliminates or significantly diminishes the risk of an outage that has previously occurred from occurring again, then the outage model may be revised to reflect this. The outage model may also be revised if there are changes to SDOs that change the level of risk; for example, if an SDO is reduced to zero, then outages at this site should no longer be considered. Aside from minor SDO updates and the inclusion of outages during the AR20 reporting period, changes which have been made to the Outage Allowance model this reporting year are can be seen in Table 43 table below.

Table 43: Alterations to Outage Allowance Model

Source/WTW	Alteration Made	Justification
Hornsey WTW	Hornsey outages represented in 'LPP' outages – see below	Installation of UV Treatment has led to the removal of risk regarding treatment failures due to Cryptosporidium
London's large process plants (LPPs)	Revision of distribution type and parameters, due to above removal of Hornsey WTW outages	Outages recorded at Hornsey WTW, previously included in the calculation of outages associated with the London LPPs, have been removed. Outages associated with the LPPs during AR17, AR18, and AR19 have been reevaluated assuming that any Hornsey WTW outages associated with Cryptosporidium are removed. On reassessment of these outages, we have also reevaluted the distribution used to represent LPP outages in the outage allowance model. The gamma distribution previously used to represent these outages no longer appears suitable, and so have reverted to a triangular distribution, as used prior to AR18.
Ladywell Fields	Removed outages in AR09, AR11 and AR12 relating to a comms issue	A lease line is now being used which has resolved the optic fibre issue, removing the risk of these previous outages.
Bell Green	Removed outages in AR09 and AR10 relating to comms issue	Linked to outages at Ladywell Fields. A lease line is now being used which has resolved the optic fibre issue, removing the risk of these previous outages.
Shortlands	Removed 4 outages: AR09 relating to treatment issues AR18 and AR19 relating to turbidity AR19 relating to system failure	Work has been completed to remove the risk of low contact tank pressure – removing the AR09 outage. A main has been replaced which was the cause of turbidity in AR18 and AR19, this removes the risk. The system failure in AR19 was also linked to the main that was replaced and so this risk has been removed.
Waddon	Removed AR11 outage relating to engineering work for turbidity and AR17, AR18 and AR19 outages relating to turbidity and pollution of source	2 PALL filtration plants have been installed which remove the risk of microbiological and turbidity issues. The outage in AR11 was related to turbidity and so with the risk of turbidity removed, the risk from this engineering work is removed as well.

Source/WTW	Alteration Made	Justification
Honor Oak	Removed all outages	SDO has been changed to 0 Ml/d
Hoddesdon	Removed all outages	SDO has been changed to 0 Ml/d

Outage Allowance 2019-20 and Summary

313. The difference between the "Outage Allowance" and the "Actual Outage" that has occurred over AMP7 by WRZ is shown in the table below. The accompanying graph shows the difference between Actual Outage and Outage Allowance for the London WRZ over recent returns.

Table 44: Outage Allowance and Actual Outage by WRZ

Report	London	SWOX	SWA	Kennet Valley	Guildford	Henley
OUTAGE ALLOWANCE (Ml/d)						
AR16	81.72	16.73	10.75	2.80	1.25	0.44
AR17	84.55	17.50	9.99	2.59	1.33	0.40
AR18	93.03	17.73	10.35	2.53	1.40	0.36
AR19	111.49	17.32	10.65	2.65	1.60	0.33
AR20	97.15	17.14	14.45	2.69	1.54	0.80
Variance	-14.34	-0.18	3.80	0.04	-0.06	0.47
WRMP19	99.76	17.23	9.46	2.49	1.40	0.36
Variance	-2.61	-0.09	4.99	0.20	0.14	0.44
ACTUAL OUTAGE (Ml/d)						
AR16	77.56	3.77	1.68	0.00	4.14	0.05
AR17	80.53	4.72	4.84	0.01	2.07	0.00
AR18	222.31	4.97	14.18	0.32	2.08	0.04
AR19	218.77	9.48	18.66	0.35	1.57	0.01
AR20	157.42	13.82	14.91	3.11	0.97	6.42
Variance	-61.35	4.34	-3.75	2.76	-0.60	6.41

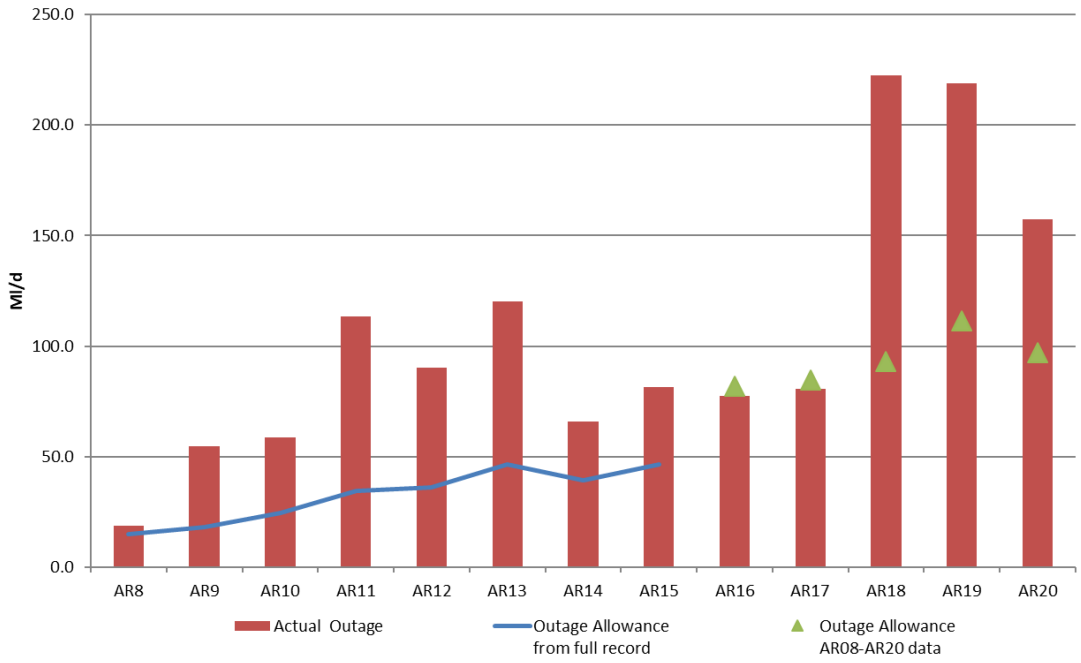


Figure 9: London Outage Allowance

Appendix F: WAFU by Water Resource Zone

314. This appendix summarises water available for use (WAFU) by water resource zone compared to forecast values from WRMP19. The assessment is carried out for investment driving scenarios only - dry year annual average in London WRZ and dry year critical period in the Thames Valley WRZs.

315. There are two definitions of WAFU used in water resources planning, one including transfers to and from a zone and the other without. Both are reported in the tables below.

WAFU = Deployable Output (DO)

– Changes to DO (Climate change, Constraints)

– Outage Allowance

[+/- Transfers (Imports and Exports)]

316. DO is taken from Appendix C.

317. Outage Allowance is taken from Appendix E.

318. Climate change impacts are largely unchanged from WRMP19 forecasts.

319. Transfers are those to other water companies (agreed dry year or critical period volumes) and to inset appointments (uplifted from out-turn values).

London WRZ

Annual Average

Table 45: London WRZ WAFU – Annual Average

Annual Average (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	
DO	2302	2302	0
Sustainability Reductions	In DO	+4	4
Climate Change Impacts	34.34	34.48	-0.14
Network Constraints	0	0	0
Outage Allowance	97.15	99.76	-2.61
WAFU (own sources)	2170.51	2171.76	-1.25
Total Exports	18.45	17.08	+1.37
Total Imports	0	0	0
Total WAFU	**2152.06**	**2154.68**	**-2.62**

320. Total WAFU is 2.62 Ml/d lower than forecast in the WRMP19. The minor variances are not material to the validity of the forecast.

321. The overall near 'status quo' position belies some larger offsetting movements within DO and Outage as discussed in Appendices C and E.

SWOX WRZ

Critical Period

Table 46: SWOX WRZ WAFU – Critical Period

Critical Period (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	
DO	372.71	385.38	-12.67
Sustainability Reductions	In DO	14.43	14.43
Climate Change Impacts	2.23	2.24	-0.01
Network Constraints	1.08	0.47	0.61
Outage Allowance	17.14	17.23	-0.09
WAFU (own sources)	352.26	351.01	1.25
Total Exports	2.09	1.18	0.91
Total Imports	2.79	5.00	-2.21
Total WAFU	**352.96**	**354.83**	**-1.87**

322. Total WAFU is 1.87 Ml/d lower than forecast in the WRMP19. The minor variances are not material to the validity of the forecast.

323. DO has reduced primarily because of sustainability reductions at Axford and Ogbourne which were previously forecast are now part of our 'current' DO. DO has also been impacted by reductions at Woods Farm and Watlington, which were not forecast in the WRMP. The reasons for these DO reductions are explained further in Appendix C.

324. Network constraints accounted for have increased slightly from those forecast in WRMP19. These network constraints are included to represent 'locked-in' DO (sources where the DO of a source is greater than demand in the local area, and where output cannot be transported out to the wider WRZ). Output from these sources has been assessed, and in some cases local demand is not high enough for these network constraints to be reduced.

325. Exports have increased slightly from the WRMP forecast. This is due only to increased volumes being exported to insets.

326. Imports have reduced from the WRMP forecast. This reflects a change in methodology made in accounting for inter-zonal Thames Water transfers, specifically from SWA to SWOX. This change is detailed further in Appendix J.

SWA WRZ

Table 47: SWA WRZ WAFU – Critical Period

Critical Period (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	
DO	201.58	214.4	-12.82
Sustainability Reductions	0	7.3	7.3
Climate Change Impacts	0.22	0.43	-0.21
Network Constraints	2.00	2.00	0
Outage Allowance	14.45	9.46	4.99
WAFU (own sources)	184.91	195.21	-10.3
Total Exports	4.25	5.32	-1.07
Total Imports	0	0	0
Total WAFU	**180.66**	**189.89**	**-9.23**

327. Total WAFU is 9.23 Ml/d lower than forecast in the WRMP19.

328. DO reductions make up the largest part of this change. Several sources, most notably Taplow and Dancers End, have had DO reductions applied to reflect observed performance and long-term outages at these sites.

329. Outage allowance has increased from WRMP19 to AR20, due to a large number of outages in the SWA WRZ between the time that WRMP numbers were produced and AR20 reporting.

330. Exports from SWA have decreased as a result of the change in methodology regarding inter-zonal transfers, as mentioned above for SWOX.

Kennet Valley WRZ

Table 48: Kennet Valley WRZ WAFU – Critical Period

Critical Period (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	
DO	150.57	155.40	-4.83
Sustainability Reductions	0	0	0
Climate Change Impacts	2.14	1.65	0.49
Network Constraints	0	0	0
Outage Allowance	2.69	2.49	0.2
WAFU (own sources)	145.74	151.26	-5.52
Total Exports	0.3	0.2	0.1
Total Imports	0	0	0
Total WAFU	**145.44**	**151.06**	**-5.62**

331. Total WAFU is 5.62 Ml/d lower than forecast in the WRMP19.

332. The most notable change to WAFU in Kennet Valley is the reduction in DO. This is associated with a DO reduction at a single source, Bishops Green, and reflects a DO reduction taken to reflect a long-term outage.

333. A correction was made in our climate change calculations, which has resulted in a slight increase in the climate change impact accounted for.

Guildford WRZ

Table 49: Guildford WRZ WAFU – Critical Period

Critical Period (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	
DO	71.33	71.70	-0.37
Sustainability Reductions	0	0	0
Climate Change Impacts	0	0.07	0.07
Network Constraints	0	0	0
Outage Allowance	1.54	1.40	0.14
WAFU (own sources)	69.79	70.23	-0.44
Total Exports	2.27	2.27	0
Total Imports	0	0	0
Total WAFU	**67.52**	**67.96**	**-0.44**

334. Total WAFU is 0.44 Ml/d lower than forecast in the WRMP19. The minor variances are not material to the validity of the forecast.

Henley WRZ

Table 50: Henley WAFU – Critical Period

Critical Period (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	
DO	25.90	25.65	0.25
Sustainability Reductions	0	0	0
Climate Change Impacts	0	0	0
Network Constraints	0	0	0
Outage Allowance	0.80	0.36	0.44
WAFU (own sources)	25.10	25.29	-0.19
Total Exports	0	0	0
Total Imports	0	0	0
Total WAFU	**25.1**	**25.29**	**-0.19**

335. Total WAFU is 0.19 Ml/d lower than forecast in the WRMP19. The minor variances are not material to the validity of the forecast.

Appendix G: Estimation of Dry Year Demand

336. As in previous years, Dry Year demand (both annual average and peak week) has been derived using analysis of the impact on demand of a range of weather scenarios using a long time-series of weather data. Models of how demand varies as a function of weather have been developed and calibrated using a number of years of weather and demand data.

337. The methodology of using the relative severity of the current AR to estimate dry year demand remains unaltered. In 2018/19 (AR19) the model for London was enhanced to include two new components:

- The impact of very cold weather on consumption (freeze-thaw as observed at the very end of 2017/18)
- The impact on pipe failures of the extremely dry summer in 2019.

338. In AR20 this improvement has been rolled-out to the other WRZs and all WRZs refitted to data spanning 2009-2020.

339. The models explain the weather dependent variability of both usage and leakage. The models have been levelled to match measured distribution input (DI) from 01/04/2019 to 31/03/2020. The models have then been used to estimate the amount of demand attributable to the prevailing weather conditions in 2019/20. The difference between this year's modelled demand and that of the reference year (sum of uplift to 1in5 usage and 1in5 leakage) is reported as the dry-year uplift.

340. Figure 9 shows the risk curve for overall effect of weather on London DI, then separated into the impact of weather on usage (Fig 10), leakage (Fig 11). The curve shows the relative position of the overall demand as modelled based on weather data from the last 72 years. Note in Figure 10 that the summer was relatively extreme (almost 1 in 5) while Figure 11 shows that the winter weather was very mild.

341. The equivalent annual average risk curves for the Thames Valley, are shown in Figures 12-14. Thames Valley's modelled AA for 2019/20 (labelled 2020) is the 48th centile (normal) of the 52 available years. These plots tell the same story as the London curves, with the summer of AR20 being relatively severe and the winter being very mild indeed.

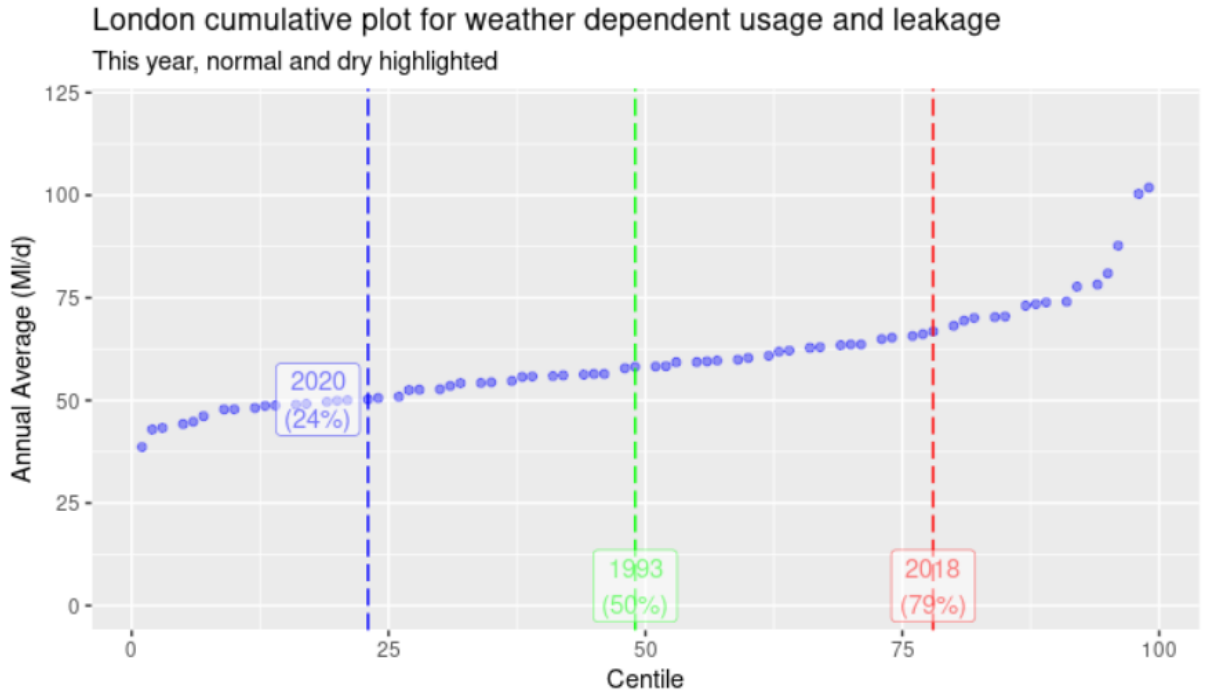


Figure 10: London annual average risk curve for weather dependent demand

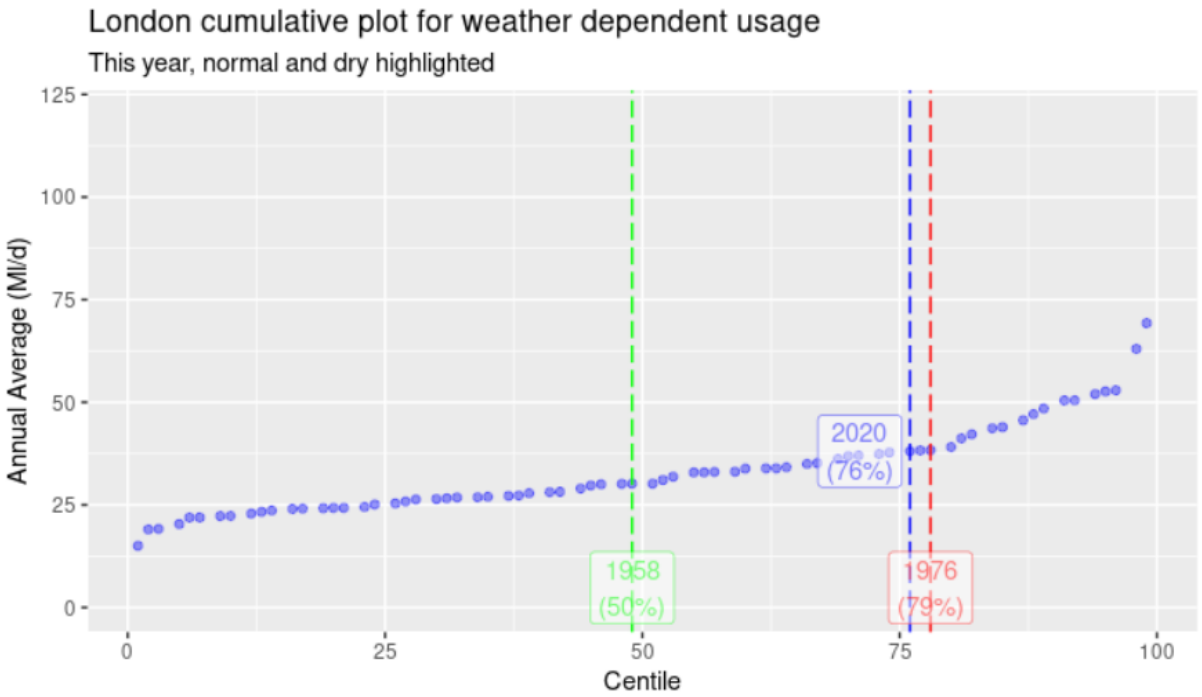


Figure 11: London annual average risk curve for weather dependent usage

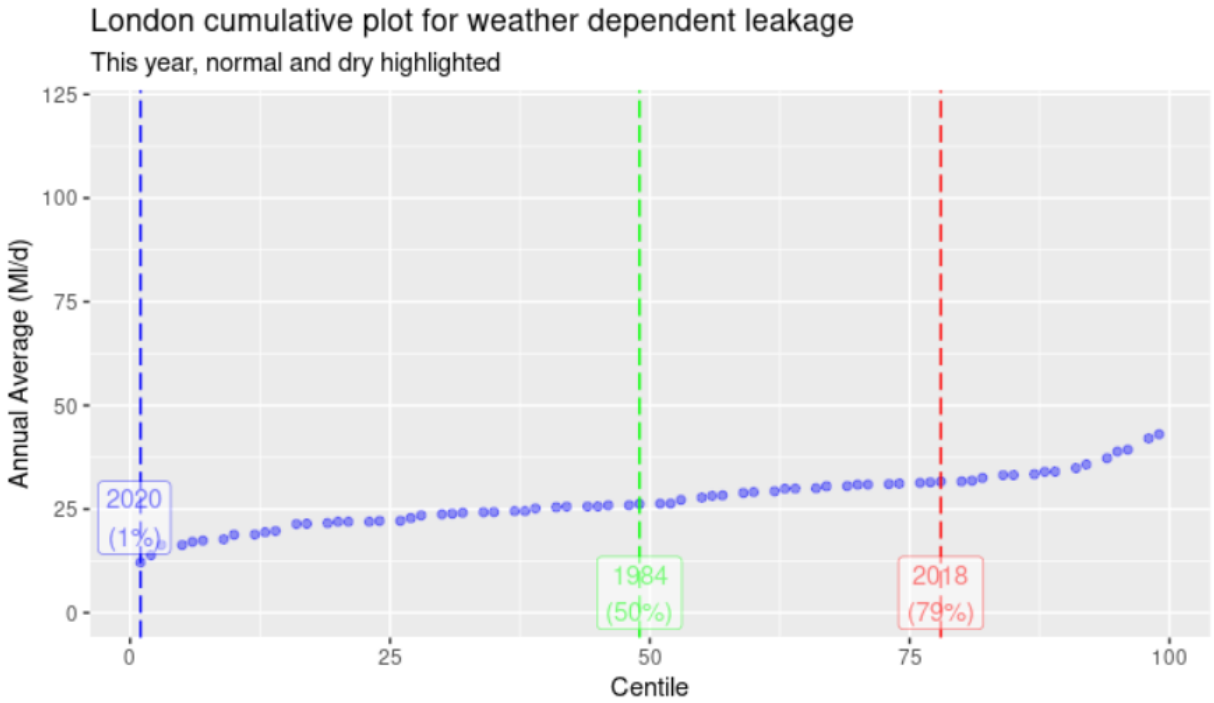


Figure 12: London annual average risk curve for weather dependent leakage

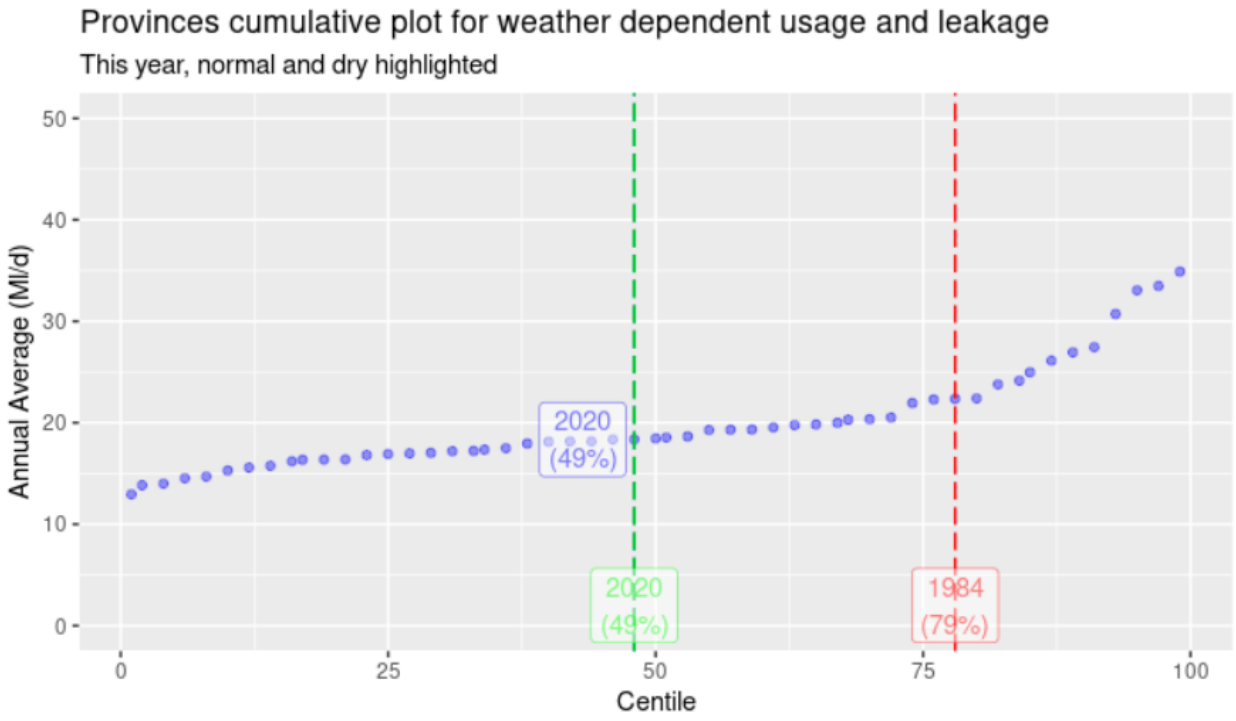


Figure 13: Thames Valley (Provinces) annual average risk curve for weather dependent demand

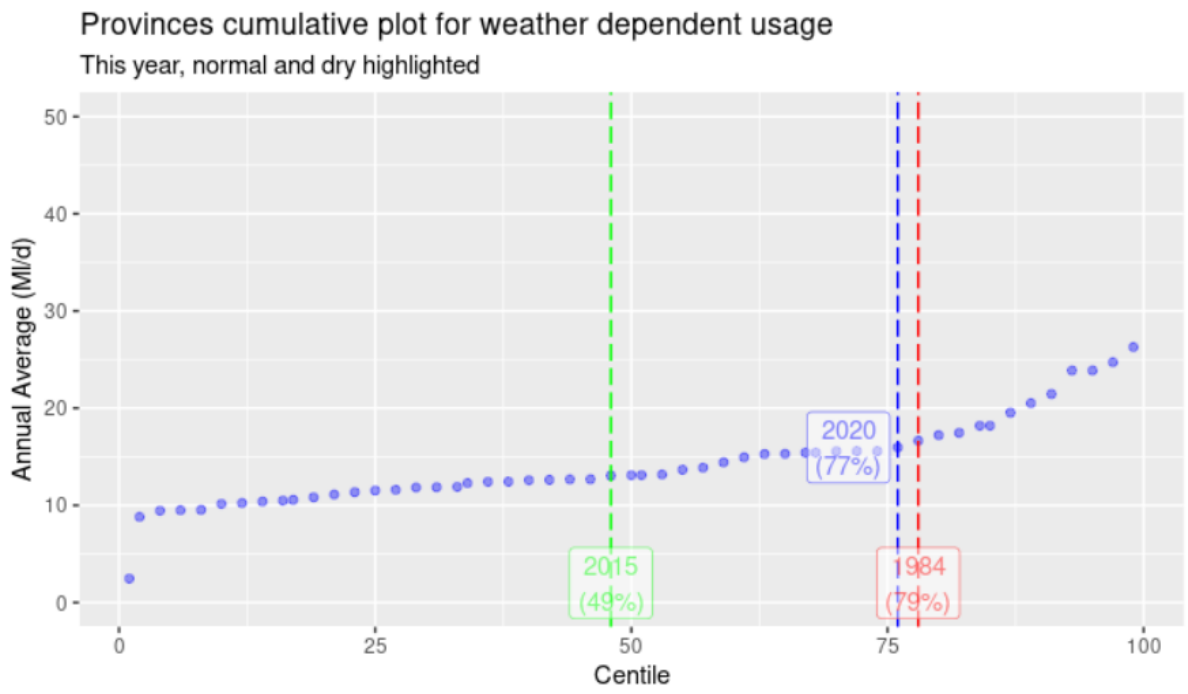


Figure 14: Thames Valley (Provinces) annual average risk curve for weather dependent usage

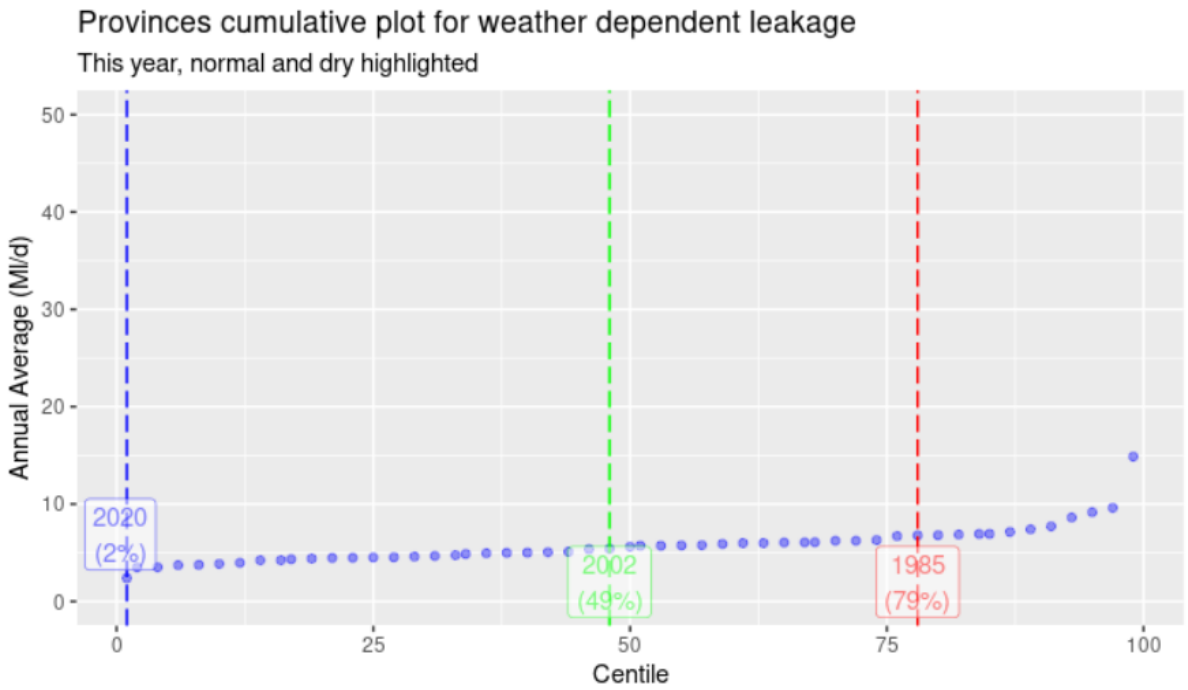


Figure 15: Thames Valley (Provinces) annual average risk curve for weather dependent leakage

Appendix H: Validation of "Dry Year" Uplift Method

342. We have continued to track and monitor the performance of the weather sensitive model.

343. Figure 15 shows a plot of the Observed DI signal for London along with the recalibrated model outputs and residual (Observed DI minus modelled DI). The plot shows the spike associated with the freeze-thaw in March 2018, a good fit on the peak in the very dry and hot summer of 2018 and the performance across AR20. Figures 16-20 show the equivalent information for the other WRZs.

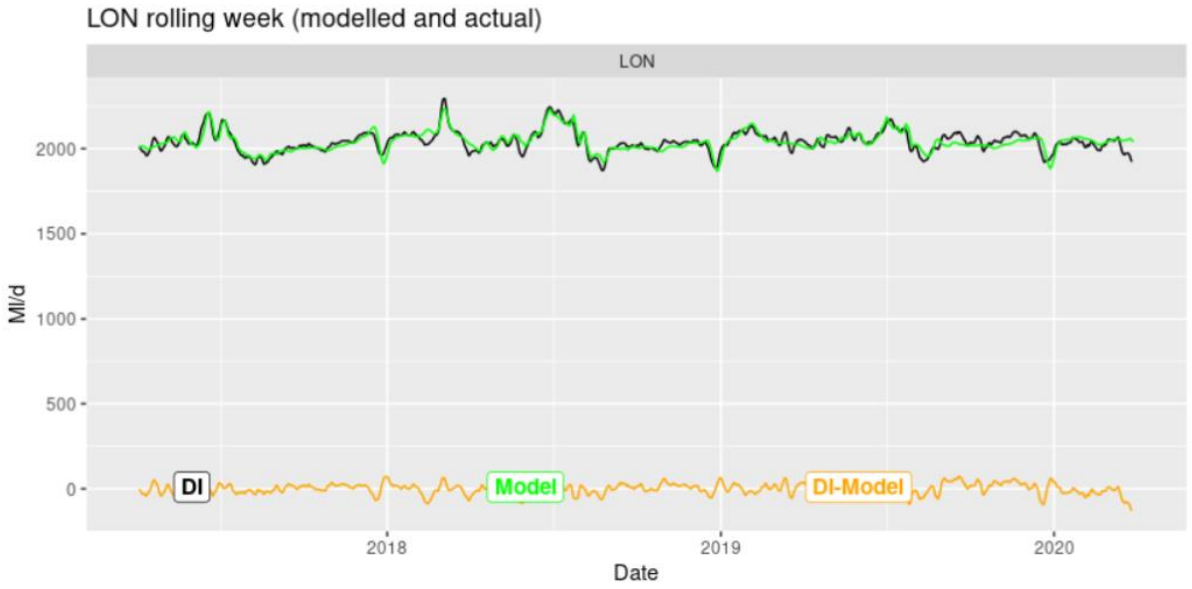


Figure 16: Plot of Observed DI, modelled DI and residual for London 2017-20

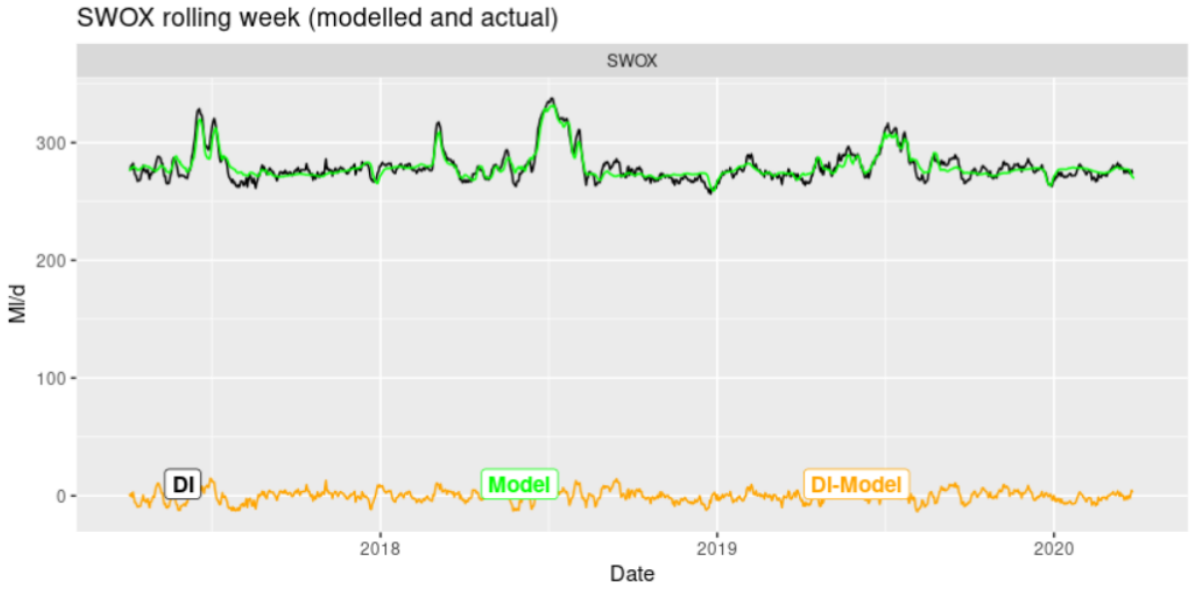


Figure 17: Plot of Observed DI, modelled DI and residual for SWOX 2017-20

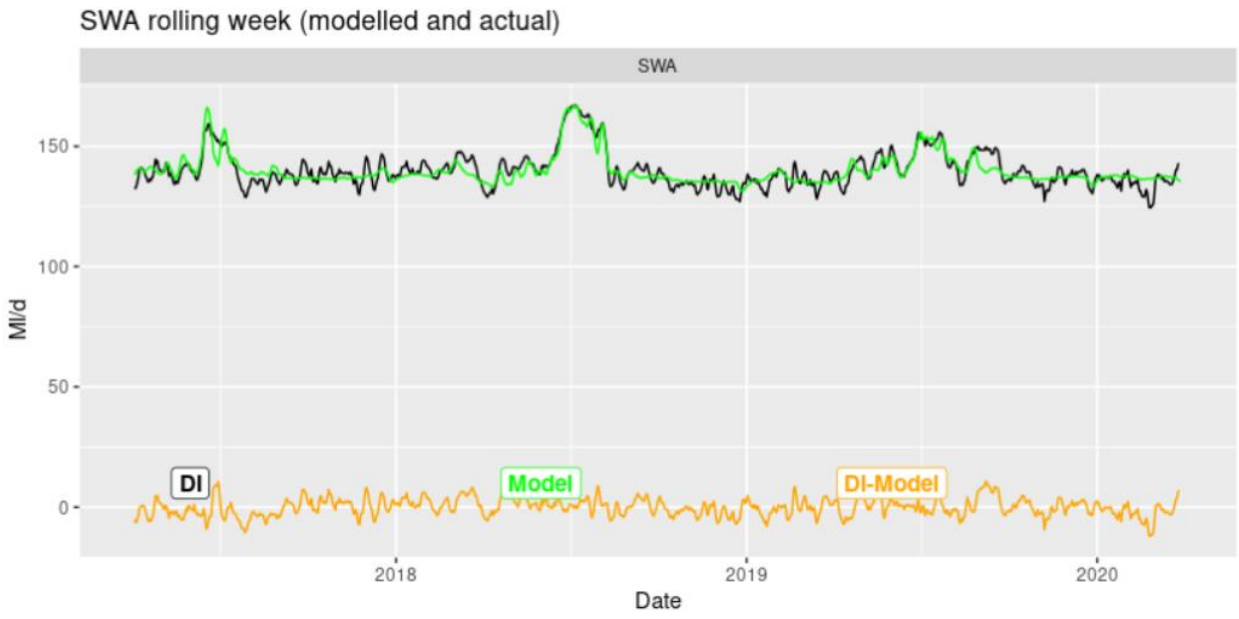


Figure 18: Plot of Observed DI, modelled DI and residual for SWA 2017-20

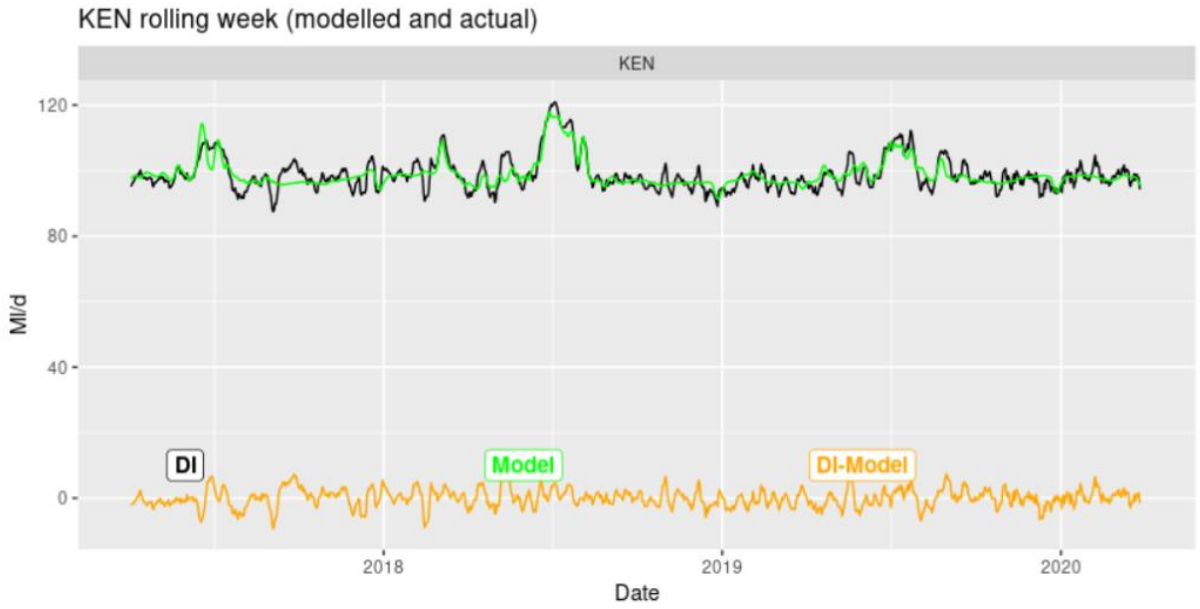


Figure 19: Plot of Observed DI, modelled DI and residual for Kennet Valley 2017-20

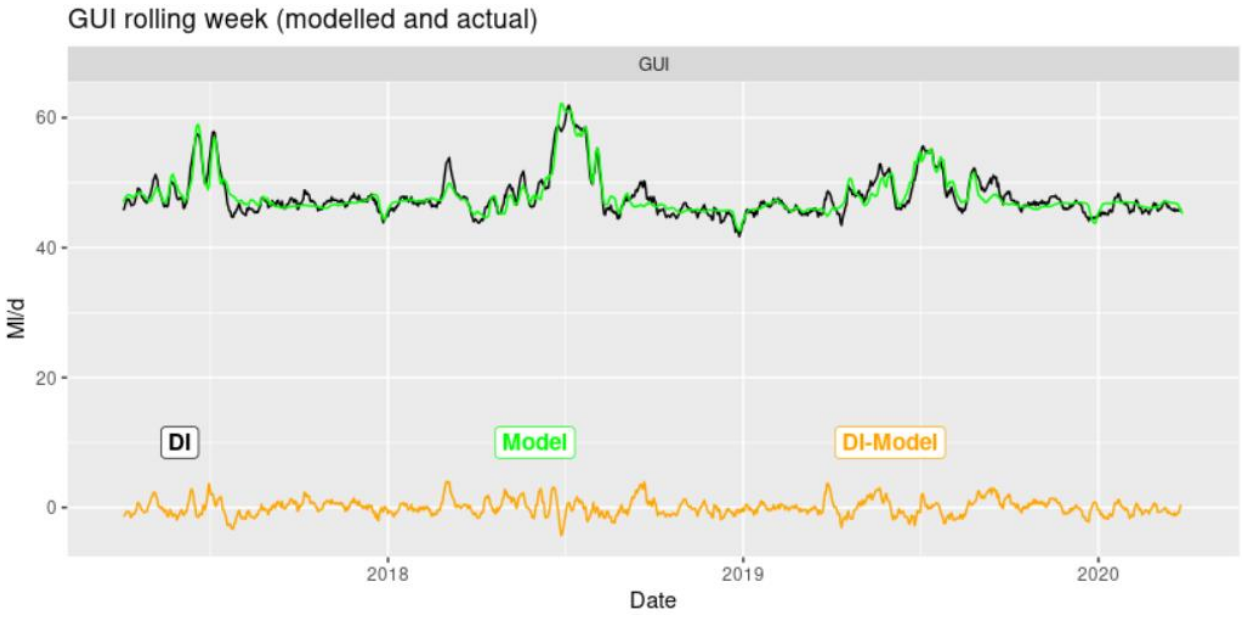


Figure 20: Plot of Observed DI, modelled DI and residual for Guildford 2017-20

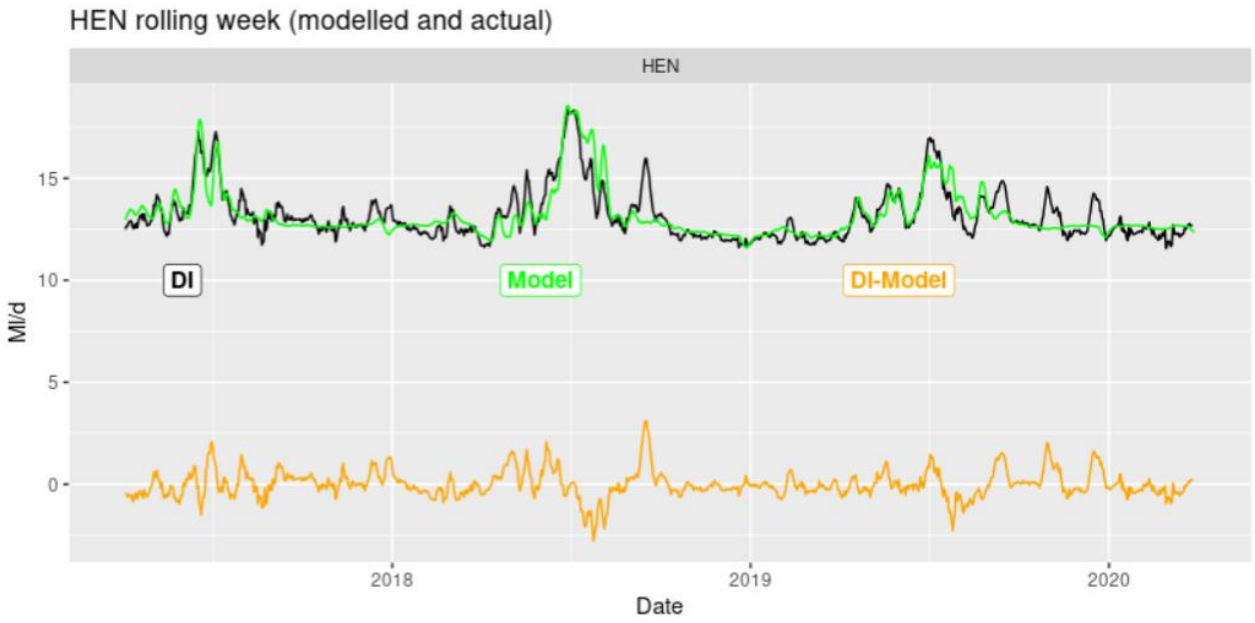


Figure 21: Plot of Observed DI, modelled DI and residual for Henley 2017-20

344. In most WRZs, the amplitude and timing of the summer peak-week for these three years looks good. The peak in Henley in AR20 (summer 2020) was not captured very well. We must continue to refine and improve the ability of the models to capture peak-week over the coming year.

345. The recalibration of the models after the introduction of summer dry-weather bursts and the impact of Freeze-Thaw events has subtly shifted the performance of each model. To try to

highlight these changes we have generated plots of the r-squared, the ability of the model to explain variability in DI for all WRZs for all available DI data. Each AR has been split into summer and winter to help highlight the two main components of the model, usage and leakage respectively. Figure 21 illustrates the general improvement in model performance across most seasons for most years. Points above the diagonal line are periods when the re-calibrated model better explains the variability in DI, while with points below the line, the model is less good at explaining variability. There is a general tendency for points to be above the diagonal, but with some variability. Most WRZs show examples of striking improvements. These plots will help guide further investigations and improvements.

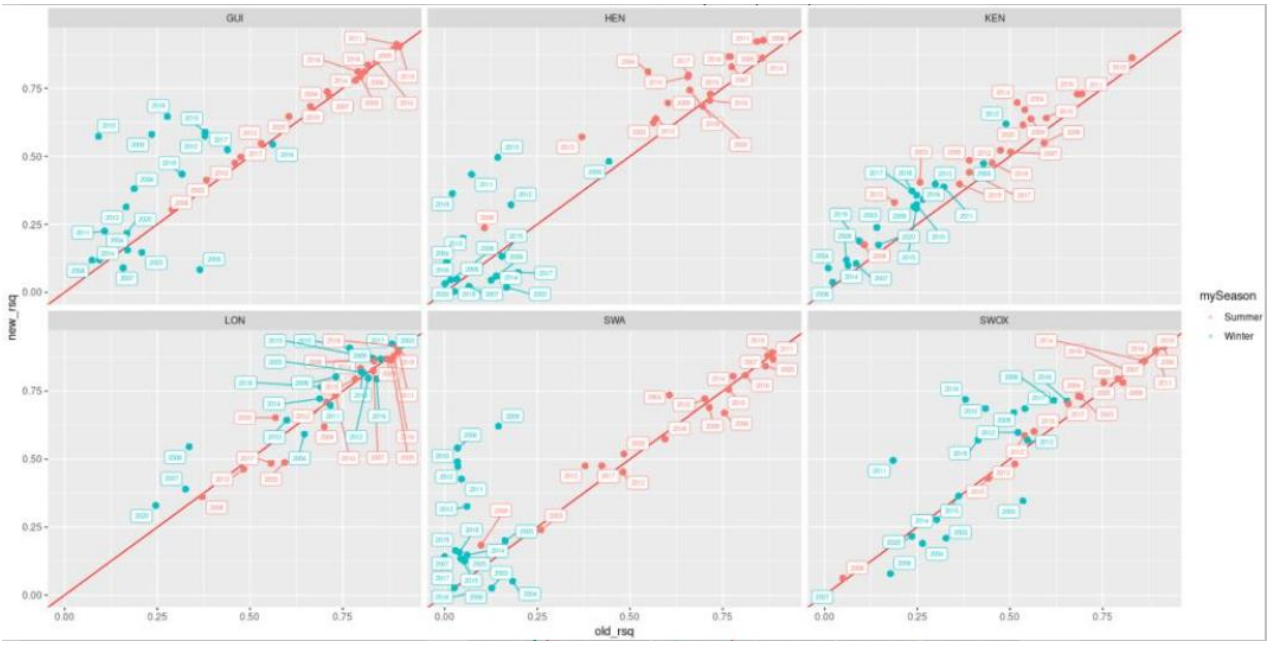


Figure 22: Improvements in model fit after recalibrating including freeze-thaw and summer bursts

346. Some time ago we disaggregated the modelling of demand in the Thames Valley area into a family of models, one for each of the Thames Valley water resource zones. This was done to improve our ability to model the spatial sensitivity of demand to regional rainfall patterns. During this process we developed a "RADAR" plot of the peakiness (the ratio of CP:AA) for each resource zone. These radar plots help present a number of characteristics of the areas and the prevailing weather conditions in each area over time.

347. The RADAR plot contains a lot of information relating to the impact of weather on demand:

- The area (size) of the plot indicates the relative severity of the summer weather conditions in any given year.
- Asymmetry in the shape of the plots indicates that some areas are more weather dependent than others.
- Crossovers indicate that the regions may have been exposed to weather with marginally different return periods from year to year.

348. Figures 22 and 23 show a comparison of the RADAR plots for (respectively) observed and modelled critical period peaking factors for our WRZs.

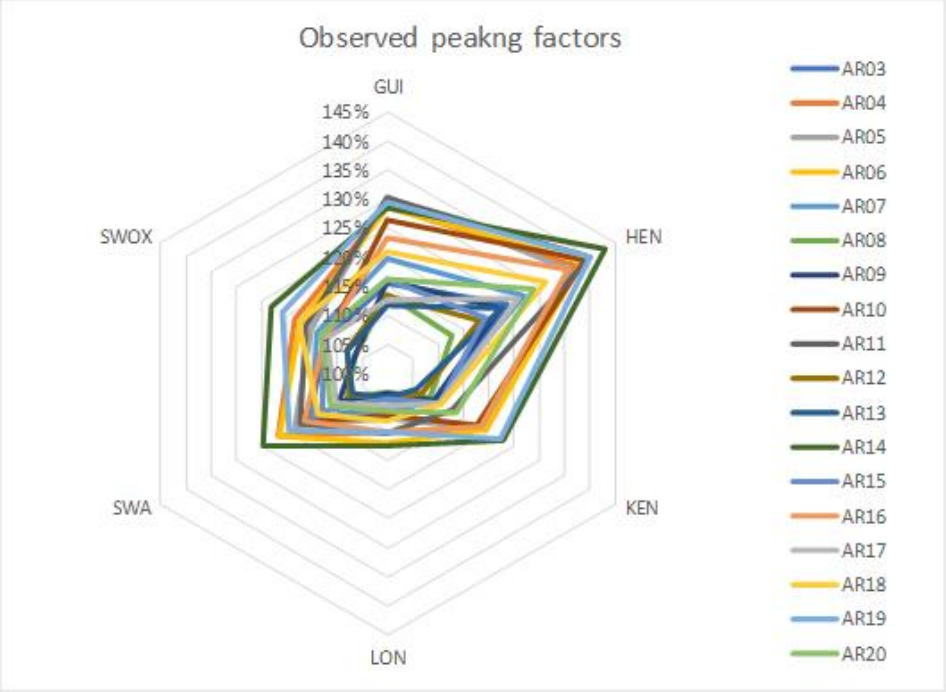


Figure 23: Observed peaking factors by WRZ

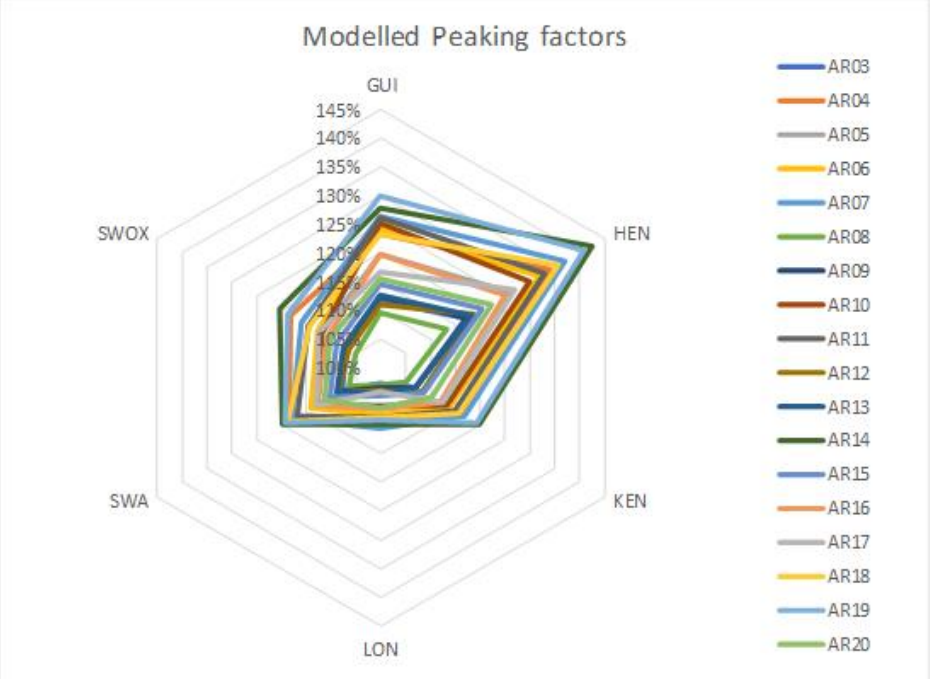


Figure 24: Modelled peaking factors by WRZ

349. The RADAR plots of observed and modelled ratio of Peak Week to Annual Average broadly agree in terms of the relative peakiness of the zones (based on the overall shape of the polygons) and the severity of the years (the size of the polygon for each year). There are some deviations in shape (both between modelled and observed, and from year-to-year). We will continue to investigate what these discrepancies may be telling us about the weather and the regions and the model.

350. In AR20 we have investigated bias in the estimate of critical period. Pre-calibration AR20 (i.e. in AR19) the bias was to overestimate peaks. After recalibration, the models have a smaller bias, but the bias is such that the peaks are slightly underestimated. At the time of writing it is recommended that the recalibrated models be adopted in the estimation of dry-year CP & AA and the known bias in CP be built into headroom as uncertainty. The range of bias in the peak weeks are shown in Figure 5.9.

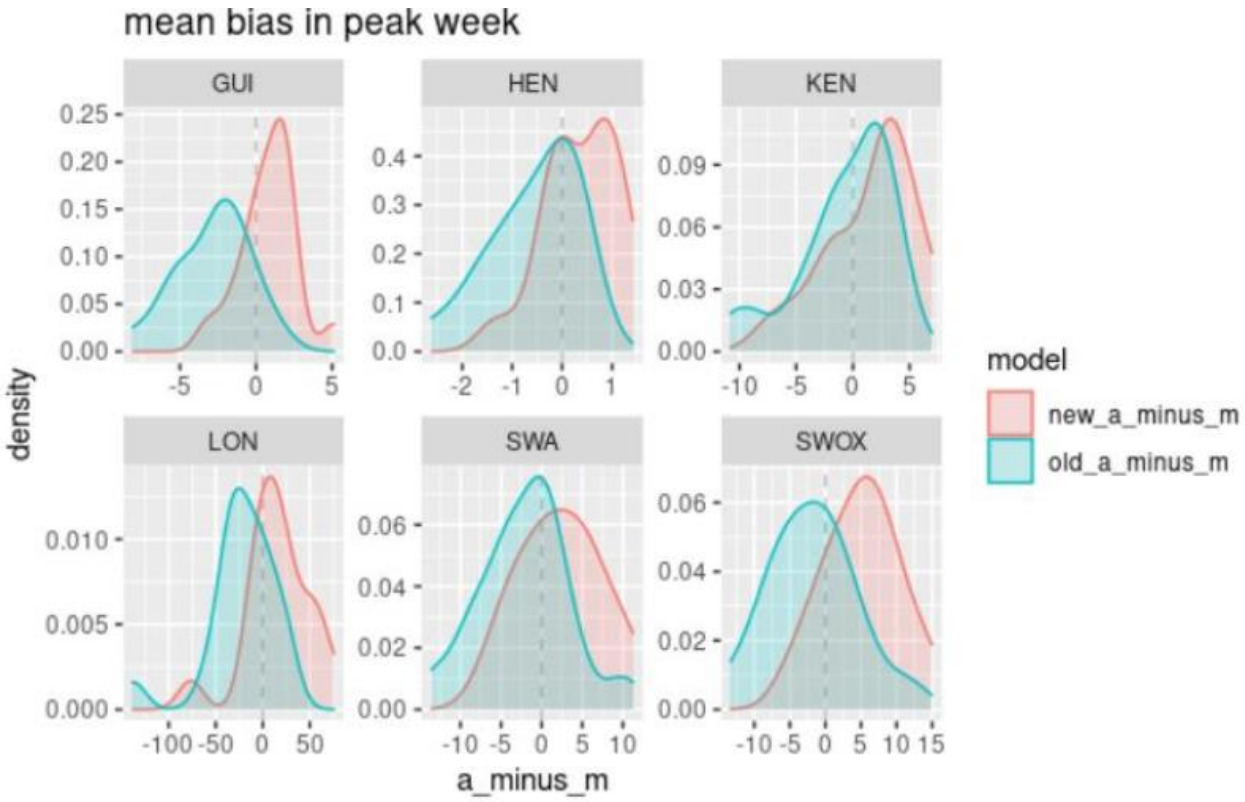


Figure 25: Bias in peak week estimates should be built into target headroom (actual – modelled)

Appendix I: WRZ-Level Annual Average and Peak Week Dry Year Uplifts

351. Below is a tabulated summary of the peaking factors applied in AR20 used to turn out-turn DI (shadow reporting) into dry year and peak week equivalents for comparison with WRMP19.

Table 51: AR20 Uplifts by WRZ

2019/20						
AR20 Dry and Normal Year Distribution Input Uplifts		Out-turn* DI (Ml/d)	Normal Year uplift (Ml/d)	Normal Year DI (Ml/d)	Dry Year uplift (Ml/d)	Dry Year DI (Ml/d)
London	AA	2024.97	6.12	2031.09	19.74	2044.71
	CP					
SWOX	AA	277.45	-0.02	277.43	2.28	279.73
	CP				50.43	327.88
SWA	AA	141.08	-0.02	141.06	1.07	142.15
	CP				26.02	167.10
Kennet Valley	AA	99.75	0.12	99.87	1.00	100.75
	CP				16.59	116.34
Guildford	AA	47.48	-0.1	47.38	0.42	47.90
	CP				12.65	60.13
Henley	AA	13.22	-0.05	13.17	0.15	13.37
	CP				4.88	18.10
* Shadiow reporting						

352. Critical Period is not calculated for London as the annual average is the critical period for this WRZ.

Appendix J: Target Headroom for AR20

353. Target Headroom is the minimum buffer that water companies are required to maintain between supply and demand in order to account for the current and future uncertainty in supply and demand. There have been no changes in the components of uncertainty since AR19 apart from those detailed below.

Outages

354. The update of the Actual Outage and Outage Allowance assessment is reported in the document "Summary of Actual Outage & Outage Allowance 2019-20". Outage data within the target headroom model has been updated accordingly.

Accuracy of Supply Side Data

355. Groundwater source deployable outputs (SDOs) have been reviewed. In some cases, this has changed the constraint defining some SDOs. Where DOs and/or constraints have changed, these have also been updated in the target headroom model.

Uncertainty around New Sources

356. The Northern New River (NNR) Wells in the Lee Valley, North London are subject to groundwater contamination by bromate. Previously, uncertainty around the DO caused by this bromate contamination focussed on whether Affinity Water's Hatfield scavenge pumping would continue to operate at a significant enough rate to support management of bromate at the NNR Wells. This type of uncertainty was considered in planning WRMP19, as well as WRMP14 and the associated annual returns, on the basis that the future operation of Hatfield was uncertain beyond the end of a Remediation Notice (RN) served on the polluters by the Environment Agency. Now, with either a 2nd RN to follow or perhaps a Voluntary Remediation Statement (VRS) in place, this secures the operation of Hatfield scavenge pumping, plus other remedial actions, over a period of at least 5-10 years. In addition, the trial of a reduced chemical treatment dose of the bromate contaminated groundwater abstracted at Hatfield has seen a significant and sustainable improvement in Hatfield abstraction rate to 4 Ml/d. As a result, consideration of the uncertainty on the NNR Wells DO associated with Hatfield abstraction is no longer appropriate. It is now considered more appropriate to assess bromate data uncertainty in quantifying the bromate impact on the NNR Wells DO.

357. By establishing conservative maximum bromate concentrations, which could reasonably be expected during drought, it has been shown that through the normal operational practice of blending NNR groundwater with river water in the Lee Valley, there is an insignificant impact on the DO of the NNR Wells. The predicted reduction in DO from the NNR Wells as a result of bromate contamination would range from 0.3 Ml/d to 1 Ml/d over a 4-month period, which equates to only a 0.2 Ml/d loss to the average DO across a simulated 12-month period. As a result of this conservative assessment, it is concluded that there is no significant data uncertainty or loss of DO that requires incorporation within the target headroom model.

Bulk Supplies

358. Assumptions for Bulk Supplies (BS) have been updated within the Target Headroom models to take account of inset arrangements within the Thames Water area.

359. We have also modified our assumptions for inter-zonal transfers between the SWA and SWOX water resource zones. During AR19 reporting, it was recognised that transfers between Thames Water WRZs during drought had not been continually re-assessed, resulting in the same transfer rates being used for many years. As a result, we have reviewed the data from the last 20 years to ascertain actual transfers, in order to inform reporting for AR20. Three transfers from SWA to SWOX made up the figure reported in our supply-demand balances. The volumes transferred recently all differ significantly from values reported in AR19, for example one transfer had not been used for 12 years. For each of the three transfers, we have concluded it is appropriate to report the DYAA transfer as the largest annual average transfer that has been made during AMP6, and the DYCP transfer as the largest seven-day rolling average transfer that has been made during AMP6. Building on this review of transfers between the SWA and SWOX WRZs, we plan to review all inter-zonal transfers that would be made during drought in order to have a more robust methodology for AR21.

Demand

360. The Distribution Input (DI) and Demand Uncertainty have been updated in the target headroom models.

361. An additional component of demand uncertainty has been included for those WRZs in which DYCP is assessed. An improved model for uplifting ‘measured DI’ to a ‘dry year DI’ has been developed in the last two years. For AR19, this model was applied to the London WRZ, but was not ready to be applied in the Thames Valley WRZs. This model is now ready for application in all WRZs for AR20. On assessing the results of this model run using historical weather data, and comparing predicted DI with measured DI, it has been found that the previous model generally overestimated peak demands, but that the new model generally slightly underestimates peak demands, although the magnitude of the underestimation by the new model is smaller than the magnitude of the overestimation by the old model. In order to be prudent, we have included an extra component of demand uncertainty, using a distribution defined by the difference between yearly modelled and measured peak DI. This has driven an increase in target headroom for all zones in which DYCP is assessed.

Climate Change

362. A correction was made to the Target Headroom models for the Henley, Guildford, Kennet Valley and SWA WRZs. This correction was implemented to ensure that climate change impacts were being considered in the correct way. Climate change impacts have not been recalculated since they were determined for WRMP19, during the AR17 reporting period. However, the Target Headroom models were comparing AR17 climate change DOs against current SDOs, which was in some cases implying increased or decreased climate change impacts compared to the WRMP, but this was due to SDO changes, rather than changes to the impact of climate change. This has been corrected so that AR17 climate change DOs are

being compared against AR17 SDOs, which is a more consistent approach. This issue did not exist for the London and SWOX WRZs.

Results

363. The dry year annual average (DYAA) supply demand balance is presented in Table 50 and the dry year critical period (DYCP) supply demand balance presented in Table 51. The results show that all WRZs are in surplus.

Table 52: AR20 Target Headroom analysis: DYAA output

Dry Year Annual Average (Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
S1 & S2 Vulnerable Licences	0.00	0.00	0.00	0.00	0.00	0.00
S3 Time Limited Licences	0.00	0.00	0.00	0.00	0.00	0.00
S4 Bulk Supplies	0.00	0.00	0.00	0.00	0.00	0.00
S5 Gradual Pollution	0.00	0.00	0.00	0.00	0.00	0.00
S6 Accuracy of Supply Side Data	12.25	2.56	1.02	1.89	0.46	0.17
S8 Climate Change	19.89	1.45	0.32	0.51	0.00	0.00
S9 Uncertainty around New Sources	8.95	0.00	0.00	0.00	0.00	0.00
D1-D4 Demand Uncertainty	16.32	3.38	2.02	1.42	0.63	0.19
Total AR20	**57.40**	**7.39**	**3.36**	**3.82**	**1.10**	**0.36**
Total AR19	**63.73**	**6.64**	**3.29**	**3.75**	**1.07**	**0.35**
Variance	**-6.33**	**0.75**	**0.07**	**0.07**	**0.03**	**0.01**

Table 53: AR20 Target Headroom analysis: DYCP output

Dry Year Annual Average (Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
S1 & S2 Vulnerable Licences	N/A	0.00	0.00	0.00	0.00	0.00
S3 Time Limited Licences	N/A	0.00	0.00	0.00	0.00	0.00
S4 Bulk Supplies	N/A	0.00	0.00	0.00	0.00	0.00
S5 Gradual Pollution	N/A	0.00	0.00	0.00	0.00	0.00
S6 Accuracy of Supply Side Data	N/A	3.58	1.87	2.10	0.55	0.20
S8 Climate Change	N/A	2.25	0.38	0.62	0.00	0.00
S9 Uncertainty around New Sources	N/A	0.00	0.00	0.00	0.00	0.00
D1-D4 Demand Uncertainty	N/A	8.71	6.91	3.73	3.14	0.87
Total AR20	**N/A**	**14.54**	**9.17**	**6.45**	**3.69**	**1.08**
Total AR19		**7.84**	**3.18**	**3.99**	**1.33**	**0.49**
Variance		**6.70**	**5.36**	**2.46**	**2.36**	**0.59**

Appendix K: Water Efficiency

364. During 2019/20 we've focussed on innovative customer engagement through home and business visits to install devices and fix internal wastage leaks, household and business incentive schemes, online Water Calculator, innovative customer marketing and communications initiatives, plus data and insight sharing with industry groups.

365. This has saved 16.57 million litres of water a day (based on measured savings data and the Ofwat assumed savings methodology), helping to drive our long-term purpose of building a better future for our customers and our local environment.

Helping customers save

In home/business retrofits

366. **Smarter Home Visits (SHVs**) is an award-winning, in-home initiative that offers customers free water saving device installations, free internal leak repairs and tailored water-saving advice. Our aim is to increase water-use awareness as well as maximise potential water, energy and money savings. During 2019/20 54,915 SHVs were carried out resulting in assumed water savings of 4.03 million litres a day. From the 4,622 internal leaks ('wastage') fixed following an SHV, we saved an additional 1.76 million litres a day

367. SHVs have been offered to all customers who had a smart meter fitted. During each visit, we identify leaking toilets, taps or showers, and arrange for a plumber to fix them for free. We also follow up every single visit with a personalised water savings report. In addition to this, we offer help to customers in vulnerable circumstances by adding them to our Priority Services Register, which gives them extra support in an emergency. Our in-house advisers also assist customers on whether they may be eligible for special bill tariffs and refer financially vulnerable customers to our specialist support partners, Auriga Services. Customers can save an average of £2,700 per year in unclaimed benefits due back to them because of this service.

368. **Housing Association Visits** has been a collaborative approach to include water efficiency retrofits and behaviour change advice into an existing energy efficiency or vulnerable customer initiative. We have partnered with Zap Carbon, Thinking Works, and Groundwork Green Doctor schemes, assisting local authority and housing association tenants. This 'bolt-on' initiative has enabled three external organisations to embed water efficiency within their own existing schemes, helping 5,634 families save a combined total of 380,000 litres a day.

369. **Smarter Business Visits (SBVs)** is our innovative and water industry-leading programme that has helped 3,797 businesses across the region save water in 2019/20. Our qualified plumbers improve the performance of everyday fittings by converting older single-flush toilets to dual-flush and installing urinal sensors for free. They also find and fix visible internal leaks like leaky loos or taps. This has saved 8.60 million litres per day (based on calculated savings from installed products and fixes).

Long term behaviour change

370. **Campaigns and communications**: Our water efficiency communications programme is all about what we can do to save water together and aims to improve water resources / efficiency awareness levels and change customer behaviours for good.

371. Following both proactive and reactive communications activities during the 2018 summer, we ran a number of innovative and proactive customer engagement initiatives 2019/20. These included the creation and publication of journalist articles in mainstream print/online newspapers, and the use of social media influencers to raise water use/efficiency advise linked to a variety of water use related topics, across multiple social channels.

372. During 2019/20 we co-created 12 articles as part of the media partnership, which were published in the Metro and Mailonline. These articles covered subject areas such as water use within daily lifestyles, links to environmental quality, and 'mythbusting' about UK water availability. In addition, we also had a glossy outer wrap, which ran across Metro in our key water resource zone areas. Examples of these articles are shown below.

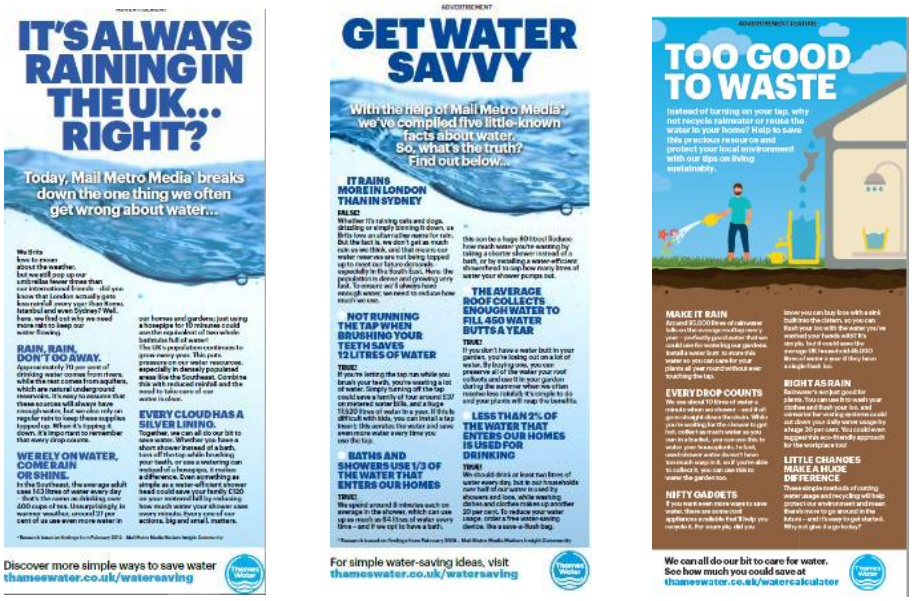


Figure 26: Water efficiency: Examples of print and online media articles

373. **Social Influencers** were engaged to write blog articles and posts on water resources, daily water use and efficiency savings, across a variety of lifestyle topics. These included gardening, fitness and cooking. The use of social influencers was a first for the UK water sector. Customer engagement rates and feedback responses were monitored. The insight gained will steer future customer engagement and education initiatives, as is being shared with the Environment Agency's 'Love Water' campaign initiative.

Figure 27: Water efficiency: Using social influencers (examples)

374. **Water and energy calculator** - Our free online calculator has continued to help thousands of households work out how much water they're using (see figure below). This interactive tool also links this to water and energy costs, displaying the most appropriate water-saving devices and pop-up tips that customers can use to save water, energy and money. Customers can even play around with the settings for the top five actions (like showering or washing the dishes) to see how much water and energy they could save in the future. This is also the first calculator of its kind to identify how much water a customer typically uses outside of their home, such as when they're showering at the gym. This means our customers can see exactly what impact they're having on water demand, and for the first time see their water use presented in Per Capita Consumption metrics.

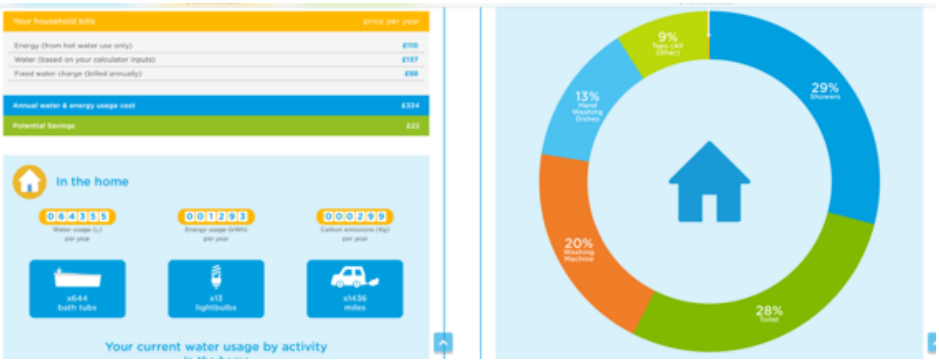


Figure 28: Water efficiency: Water and Energy Calculator

375. **Free water saving devices** - We offer all our household customers free water saving devices, which can be ordered online, over the phone and by post. In 2019/20 we sent out over 35,000 freebie orders to our customers and are using customer feedback to continually improve our service.

Innovation

376. **High Usage Analytics** - During 2019-20 we have used the extensive water use data gathered by our +300,000 smart meters to analyse the water savings delivered by our Smarter Home Visits across different consumption 'bands' i.e. segmenting customers into low, medium and high consumers and seeing if there is a correlation between how much water they use and how much water they save following one of our Smarter Home Visits. We found that 'high water users', using an average of more than 500 litres per property per day before the visit, saved a significant amount more water than an average household, saving potentially more than 100 litres of water per property day. We will use this analysis to shape the delivery of our Smarter Home Visits in AMP7.

377. **Discretionary Water Use** - During 2019/20, we initiated a new workstream focused on discretionary water use - primarily irrigation. This project targets non-household businesses which use large volumes of potable water for irrigation purposes, such as golf courses, plant nurseries, country estates and sporting venues, among others. After the 2018 record hot, dry summer, we saw record water consumption by sectors relying on mains water for irrigation. This project was initiated aiming to reduce demand for potable water for irrigation purposes, by encouraging water efficient practises and by offsetting mains water with an alternative non-potable source, such as surface water or groundwater abstraction. We are proactively worked alongside different sectors to help businesses increase resilience, reduce reliance on mains water for irrigation and improve awareness of present and future water resource challenges.

378. We worked with the Environment Agency to obtain data regarding abstraction licences for businesses in our supply area and are exploring the option for using treated effluent for golf course irrigation in Wisley. We collaborated with the Environment Agency, Waterwise and others on a golf industry irrigation guidance note, which was well received by the sector, and future collaboration will be continued through 2020.

379. **Household Incentives scheme** - In partnership with Greenredeem, we've continued to develop a pioneering and innovative online incentive scheme to reward customers when they save water. This scheme establishes baseline water use for participating households by using previous meter readings over a period of three months. If the household's ongoing water use is lower than their baseline, they're given online points each week, which they can spend on rewards like shopping vouchers and free coffees. They can also use these points to enter a monthly prize draw or donate money to charity. Whilst still a small scale initiative, the households involved so far have achieved water savings of approximately 2 to 5% against their baseline.

Figure 29: Water efficiency: Incentive schemes

380. **Retail incentives scheme:** We have worked closely with non-household retail water sector to pilot a water efficiency incentive scheme, aimed to reward retailers for providing evidence of water efficiency interventions on business sites.- using before and after meter readings, plus photographic evidence of the work. The results of this initiative will inform the newly form water efficiency sub-group (part of the Retailer-Wholesale Group) in response to a letter from Ofwat and the Environment Agency to the water sector, seeking improvements to water efficiency delivery within the non-household retail market. Data and insight from both our SBV and incentive activities will be the most comprehensive in the sector to date.

Partnerships and External Groups

381. **Action for the River Kennet (ARK)** - Since 2011, we've been working with ARK to show people just how valuable water really is. As part of an area-wide campaign, ARK has been running free 'Water Matters' activities and projects for schools and community groups in the Kennet catchment. This programme is all about hands-on education, whether that's raising trout and eels in special tanks in their classroom (ready for release into a local river) or hosting fun field trips and games. To further support the campaign, we've also delivered SHVs to homes supplied with water from the River Kennet.

382. **Chilterns** – through the second half of 2019/20, we worked with a number of environmental groups in the Chilterns region to provide water efficiency advice content and offer free Smarter Home Visits to local households. This offer was disseminated out through local partnership networks in an effort to help reduce local water demand in response to the low groundwater and flow through the local chalk streams.

383. **External Groups** - We continued to engage with several industry groups that influence water policy, regulations and national projects. As a lead supporter of Waterwise, we have continued to input into the Water Efficiency Strategy for the UK, as well as Water Efficiency Leadership and Network steering groups. We've also collaborated with key stakeholders and neighbouring water companies to set ambitious water-saving targets for the next business plan period. We have also presented results from our smart metering data analytics and water efficiency initiatives at national conference events.

Appendix L: Supply Demand Balance by WRZ

384. This appendix summarises the supply demand balance (SDB) by water resource zone compared to forecast values from WRMP19 tables. The assessment is carried out for investment driving scenarios only - dry year annual average in London WRZ and dry year critical period in the Thames Valley WRZs.

385. The SDB is calculated as follows:

SDB = WAFU – (DI + Target Headroom)

386. WAFU is taken from Appendix F.

387. Target Headroom is taken from Appendix J.

388. DI is taken from section D.2.2.

London WRZ

Annual Average

Table 54: London WRZ SDB – Annual Average

Annual Average (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	
WAFU	2152.06	2154.68	-2.62
Distribution Input	2044.70	2056.84	-12.14
Target Headroom	57.40	122.20	-64.80
SDB	**49.96**	**-24.36**	**74.32**

389. The SDB deficit forecast in WRMP19 has been resolved and an improvement of 74 Ml/d is reported. This is primarily due to rolling forward the target headroom calculation, replacing a forecast position from WRMP19 with a base year assessment for AR20 (i.e. not all the uncertainty allowed for in Headroom forecast has come about in the reported figures).

390. Distribution Input is also lower thanks to achieving a lower level of leakage than forecast.

391. Given the size of the ongoing AMP7 programme in London, including further significant reductions in leakage and usage we do not intend to amend the main components of WRMP19 preferred programme for London WRZ at this stage.

SWOX WRZ

Critical Period

Table 55: SWOX WRZ SDB – Critical Period

Annual Average (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	
WAFU	352.96	354.83	-1.87
Distribution Input	327.88	329.82	-1.94
Target Headroom	14.54	15.91	-1.37
SDB	**10.54**	**9.1**	1.44

392. The SD surplus is 1.44 Ml/d higher than forecast in the WRMP19. The minor variances are not material and there are no concerns regarding the validity of the WRMP19 preferred programme for this zone.

SWA WRZ

Table 56: SWA WRZ SDB – Critical Period

Annual Average (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	
WAFU	180.66	189.89	-9.23
Distribution Input	167.10	169.66	-2.56
Target Headroom	9.17	5.87	3.3
SDB	**4.38**	**14.07**	-9.69

393. The SD surplus is 9.69 Ml/d lower than forecast in the WRMP19. The supply demand balance in SWA is tighter than anticipated in the WRMP19. We will undertake a review of system performance and if necessary bring forward investment to ensure the zone remains in surplus.

Kennet Valley WRZ

Table 57: Kennet Valley WRZ WAFU – Critical Period

Annual Average (All figures in Ml/d)	2019/20		Variance
	AR20	WRMP19 Forecast	

WAFU	145.44	151.06	-5.62
Annual Average (All figures in Ml/d)	**2019/20**		**Variance**
	AR20	**WRMP19 Forecast**	
Distribution Input	116.34	122.30	-5.96
Target Headroom	6.45	5.54	0.91
SDB	**22.66**	**23.21**	-0.55

394. The SD surplus is 0.55 Ml/d lower than forecast in the WRMP19. The minor variances are not material and there are no concerns regarding the validity of the WRMP19 preferred programme for this zone.

Guildford WRZ

Table 58: Guildford WRZ SDB – Critical Period

Annual Average (All figures in Ml/d)	**2019/20**		**Variance**
	AR20	**WRMP19 Forecast**	
WAFU	67.52	67.96	-0.44
Distribution Input	60.13	62.66	-2.53
Target Headroom	3.69	2.57	1.12
SDB	**3.70**	**2.73**	0.97

395. The SD surplus is 0.97 Ml/d higher than forecast in the WRMP19. The minor variances are not material and there are no concerns regarding the validity of the WRMP19 preferred programme for this zone.

Henley WRZ

Table 59: Henley WRZ SDB – Critical Period

Annual Average (All figures in Ml/d)	**2019/20**		**Variance**
	AR20	**WRMP19 Forecast**	
WAFU	25.10	25.54	-0.44
Distribution Input	18.10	19.26	-1.16
Target Headroom	1.08	0.73	0.35
SDB	**5.92**	**5.55**	0.37

396. The SD surplus is 0.37 Ml/d higher than forecast in the WRMP19. The minor variances are not material and there are no concerns regarding the validity of the WRMP19 preferred programme for this zone.