Water Resources Management Plan

Annual Review 2021-22

June 2022

Contents

Figures

Tables

Table of Abbreviations

Abbreviation	Definition
AA	Annual Average
ACWG	All Company Working Group
AFW	Affinity Water
AMP	Asset Management Plan
AR	Annual Review
ASR	Aquifer Storage and Recovery
CMOS	Central Market Operating System
CP	Critical Period
DCO	Development Consent Order
DI	Distribution Input
DO	Deployable Outputs
DPC	Direct Procurement for Customers
DRA	Direct River Abstraction
DWI	Drinking Water Inspectorate
DWUS	Domestic Water Use Study
DYAA	Dry Year Annual Average
DYCP	Dry Year Critical Period
EA	Environment Agency
EIA	Environmental Impact Assessment
FD	Final Determination
GER	Green Economic Recovery
GUI	Guildford WRZ
HEN	Henley WRZ
HH	Household
HNL	Herts and North London
HRA	Habitats Regulation Assessment
KSL	Kent, South London and East Sussex
KV	Kennet Valley WRZ
LON	London WRZ
LPP	Large Process Plants
MLE	Maximum Likelihood Estimation
MOSL	Market Operator Services Limited
ND	No Deterioration
NGO	Non-Governmental Organisation
LON	London WRZ

Abbreviation	Definition
NHH	Non-household
NLARS	North London Artificial Recharge Scheme
NRW	Natural Resources Wales
ODI	Outcome Delivery Incentive
PCC	Per Capita Consumption
PMP	Progressive Metering Programme
PR	Price Review
RAPID	Regulators' Alliance for Progressing Infrastructure Development
SBV	Smarter Business Visits
SDB	Supply Demand Balance
SDO	Source Deployable Output
SEA	Strategic Environmental Assessment
SESRO	South East Regional Resource Option
SHV	Smarter Home Visits
SOSI	Security of Supply index
SPRING	Thames Water's customer database
SRO	Strategic Regional Option
STT	Severn Thames Transfer
STW	Sewage Treatment Works
SWA	Slough, Wycombe and Aylesbury WRZ
SWOX	Swindon and Oxfordshire WRZ
TLT	Thames Lee Tunnel
TW	Thames Water
UKCP	UK Climate Programme
UU	United Utilities
WAFU	Water Available for Use
WARMS	Thames Water's system simulation model
WBGWS	West Berkshire Groundwater Scheme
WFD	Water Framework Directive
WINEP	Water Industry Environment Programme
WRMP	Water Resources Management Plan
WRPG	Water Resources Planning Guidance
WRSE	Water Resources in the South East
WRZ	Water Resource Zone
WTW	Water Treatment Works

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 April 2020, following approval from the government, we published our Water Resources Management Plan 2019 (WRMP19) which sets out how we planned to provide a secure and sustainable water supply for the 80-year period from 2020 to 2100.
3. We monitor our progress against the commitments in WRMP19 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 Defra, the Environment Agency (EA) and Ofwat, and is published on our website www.thameswater.co.uk/wrmp for customers and stakeholders.
4. This document, called the Annual Review 2022 (AR22), presents our performance for the period from 1 April 2021 to 31 March 2022. It is the second annual review of our WRMP19 and has been prepared in accordance with regulators' guidance.
5. We have included information on the development of the resilience plan for the South East region. Here we are working with our neighbouring water companies, and water users across the region, to confirm the supply demand challenge and investigate potential future solutions due to be published in November 2022.
6. We have also included an update on the programme to develop the Strategic Resource Options alongside the WRSE and WRMPs, which is progressing successfully to Gate 2 in November 2022.

Overview of our performance for 2021-2022

We have successfully delivered a secure water supply for our customers

7. 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 and therefore if the water supply is secure. We are pleased to report that this year we have maintained 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 observed continued higher levels of water demand across Thames Valley

8. We maintained a secure supply of water throughout the COVID-19 pandemic. The COVID-19 restrictions changed how, and where, customers and businesses used our services, with notable reductions in the amount of water used in non-households and increases in household water use. We've continued to observe higher levels of household demand in the Thames Valley than we anticipated at WRMP19, which could be attributed to changed working patterns. We will continue to monitor this, and in

response we are planning additional demand management activity in the Thames Valley WRZs in the period to 2025.

We are committed to reduce leakage and encourage the efficient use of water

9. We have achieved our regulatory performance commitment to reduce the amount of water lost through leaks on our pipe network and on our customers' pipes. We repaired over 60,000 leaks this year and employed new tools to target leaks more effectively. To date, the leakage reduction activity has been mainly focused in London however we will extend this to the Thames Valley to address the increase in leakage. We remain committed to halve leakage (compared to 2017/18 levels) by 2050.

We have continued to roll out the smart metering programme

10. We are pleased that we have exceeded our metering targets for new and replacement meters. This year we installed a further 168,000 smart water meters and around 52% of our customers now have a household meter. We also plan to install an additional 200,000 smart meters by 2025 as part of the Government's Green Economic Recovery. Meters are a key enabler to the efficient use of water and we use the smart meter data to target our leakage reduction activity and work with customers to reduce demand.

We continue to support our customers and encourage efficient use of water

11. Average household water use continues to be higher than forecast at WRMP19. We believe that this is partly due to COVID-19 restrictions which impacted our delivery plan and working habits. We are continuing our award-winning 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.

We have ensured we have sufficient water sources

12. We have progressed new water sources to ensure we can maintain a resilient water supply, this includes:

    - Preparatory work for three new groundwater schemes in London as set out in WRMP19. These schemes have been deferred but when needed they can be swiftly mobilised.
    - There has been good progress with the development of a new transfer main, the Shalford to Netley transfer main in Guildford WRZ, which will improve our ability to transfer water across the zone.
    - In WRMP19 we proposed the development of Deephams water recycling and this scheme was key to achieve 1:200 resilience by 2030/31. We have progressed studies on this option and, following discussion with the EA, we have withdrawn the option from WRMP19, and have considered the option as infeasible until 2060 for dWRMP24, due to environmental risk to downstream habitats. We are currently looking at alternatives. We remain committed to increasing resilience to achieving 1 in 200-year drought resilience in the early 2030's.

- The North London Artificial Recharge Scheme (NLARS) is now available to be used in the event of drought and boreholes in Guildford WRZ have been refurbished, improving the supply resilience in the area.

We remain focused on protecting and improving the natural environment

13. Improving and protecting the environment is integral to managing and planning future water resources. The three core stands of activity are:
    - We are undertaking environmental investigations at 10 sites including the Upper Kennet, Upper Lee and the Hogsmill river and reduce abstractions on the River Cray (North Orpington) and River Wye (Hawridge) by 2024/25.
    - We are seeking opportunities for improvements to the environment as part of the feasibility, design and appraisal of new resource options.
    - We are working with the WRSE and the Environment Agency to identify the likely requirements for sustainability reductions to meet the environmental ambition in relation to chalk streams and other sensitive rivers in the region, and how to prioritise this activity.
14. The Environment Agency has also recently issued guidance on capping abstraction licences to protect water bodies from deterioration. This could have an impact on several sources across our supply area. We are liaising on this subject with the Environment Agency.

WRMP19 – confirming our position

15. In April 2020 we published our WRMP19, which looks forward over the next 80 years to 2100. We developed the WRMP19 based on insights from customers and engaged extensively with stakeholders and regulators throughout the development of the plan. We have 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 1 in 200-year severe drought event by 2030/31.
    - To look beyond the needs and opportunities of our supply area alone and consider the growing needs of the wider South East of England.
16. Our plan is a ‘Best Value’ plan, including 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 that 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 across the long-term planning period.
17. In the WRMP19 we proposed a monitoring plan 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 report on these metrics in this annual review and will also report on them in subsequent annual reports.

18. We have checked our actual position in April 2022 against a suite of key metrics and our forecast start position in the WRMP19 and can confirm that the foundation of the **WRMP19 is robust and remains valid** as a basis for future planning.

19. The supply demand position in the Swindon and Oxfordshire (SWOX) WRZ continues to be tighter than anticipated. In response, we have brought forward demand management activity and have identified a series of potential solutions to improve our leakage performance.

20. 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, options proposed by third parties, and solutions which can provide resilience for public water supply and other sectors. These will be examined and considered in the WRSE regional plan and our WRMP24.

21. We are progressing work on strategic resource options (SROs), in collaboration with other water companies and regulators, which were funded by Ofwat as part of the Final Determination on our 2019 Business Plan. All the SROs we are involved with successfully passed the first checkpoint, Gate 1, and we are working towards Gate 2. The five options we are involved with are:

    - Severn-Thames Transfer (STT).
    - Wastewater recycling in London, also known as London Effluent Reuse (LER).
    - South East Strategic Reservoir Option (SESRO).
    - Thames to Southern Transfer (T2ST).
    - Thames to Affinity Transfer (T2AT).

Working across the South East region

22. In line with the National Framework for Water Resources[1] and focus on regional planning, we are working closely with WRSE, and the other water companies located in the South East, to develop a regional resilience plan for the South East of England.

23. There are significant water resource challenges faced in the South East with a forecast shortfall of over 1 billion litres of water per day in the next 15 years, rising to 2.6 billion litres by 2060[2]. This is a significant challenge that needs careful forward planning to ensure a secure and sustainable future water supply for society, the economy and the environment.

24. Over the past year WRSE has progressed the technical work to inform the development of a best value plan for the region and has continued to engage with a wide body of stakeholders in an open and transparent way. In January 2022 WRSE published the Emerging Regional Plan for consultation. The Emerging Plan gave early sight of the big

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

[2] WRSE has produced a wide range of scenarios and will produce an adaptive plan recognising there are uncertainties in long-term planning

issues and solutions to gain initial feedback from stakeholders. Over 1,150 written responses were received to the consultation. WRSE has considered all responses and in May published a response to the consultation and is taking forward changes to the plan as a result. A further consultation will be held in Autumn 2022, with the publication of our Draft Water Resources Management Plan 2024.

Forward Look

25. We have identified the following challenges, risks and opportunities for the coming year:

26. Challenges:

- Maintaining our progress with leakage reduction and achieving sustained usage reduction.
- Environmental ambition – We are working with regulators and regional partners to investigate substantial future reductions in abstraction for environmental benefit. The scale and range of potential reductions far exceed those planned for in the past and could become the main investment driver in regional plans and our WRMP24.

27. Risks:

- Drought resilience: We need to work to find an alternative to Deephams re-use to meet the commitment to increase resilience to 1:200-year drought, and this in turn is likely to affect the WRMP19 delivery date of 2030/31 to allow a suitable replacement scheme to be agreed and constructed. In addition, supply systems in the UK are not designed to be resilient to all potential droughts as the cost to do so would be prohibitive. 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.
- WRMP24 and WRSE Regional Plan – Timescales and Consultations: There will be multiple submissions and consultations during Autumn 2022; in order not to confuse and overwhelm stakeholders we (and others) will need to ensure clear messaging around consultations, and support from regulators and government to do this.

28. Opportunities:

- WRSE Regional Plan – producing a fully adaptive, best value plan for the South East of England presents us with an opportunity to produce a plan which is efficient across a wide range of potential futures, and which delivers benefits to everyone in the South East.
- Understanding Future Patterns of Demand – With the relaxation of coronavirus restrictions the associated transition of working arrangements gives an opportunity for the water industry to understand potential future patterns of demand. Our adaptive planning approach means that our future plans should be robust against a range of future demand patterns.

- The continued development of multiple Strategic Resource Options against the timing for further water in the WRSE regional plan, and into our WRMP24, is able to provide improved resilience and flexibility for the longer term.
- The increased communication and dialogue for regional planning and WRMP24 with regulators and government has improved the understanding of our planning and has the opportunity to assist in expediting approval of WRMP24.

Part A – Introduction

A.1 Background

29. Water companies are required[3] 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.

30. In April 2020 we published our Water Resources Management Plan 2019, hereafter referred to as the plan or WRMP19. It is an adaptive plan and sets out a range of measures to ensure we can continue to provide a secure supply of water to all our customers over the 80-year period from 2020 to 2100. The plan is available on our website www.thameswater.co.uk/wrmp.

31. Water companies are required[4] 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[5] for companies to use as a framework in completing the review.

32. This document presents the annual review of progress and achievements for the period from 1 April 2021 to 31 March 2022 (2021/22), the second year of the five-year period. It is referred to as the Annual Review 2022 (AR22). We have prepared AR22 in accordance with the regulators' guidance.

33. The AR22 report builds on the six-month progress update report, shared with government and regulators in Autumn 2021, which covered the period to the end of September 2021.

34. As part of the annual progress report we have included an update on the programme of studies to inform the selection of strategic options that will be considered as part of the best value investment programme for the South East regional plan and WRMP24. 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.

35. We will send the AR22 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.

A.2 Purpose of this document

36. This document is the second annual review of our WRMP19 for the period from 1 April 2021 to 31 March 2022, noted as 2021/22. It provides an assessment of actual events and performance in the past year and compares these against the forecasts in the plan.

[3] Water Industry Act 1991, Sections 37A to 37D (as amended by the Water Act 2003)
[4] Water Industry Act 1991 Section 37A (5)
5 EA and NRW (March 2021) Water resource management plan annual review and annual data return: Guidance for water companies in England and Wales

It also sets out the further work that is planned and on-going engagement as we deliver on committed activities and continue to develop our future plans.

37. This document is structured in four main parts, Part A to Part D.

38. The remainder of Part A provides contextual information. It describes:
    - Our supply area, divided into Water Resource Zones (WRZs) for planning purposes.
    - The Levels of Service we provide to our customers.
    - Comments and actions from AR21.

39. Part B looks at conditions, performance and progress in the past year. It presents:
    - An overview of the weather.
    - The 2021/22 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.

40. Part C covers the WRMP19 Monitoring Plan. It details:
    - Updates on the key components of the supply demand balance vs WRMP19 forecast position.
    - Updates on strategic resource options.
    - Updates on the on-going collaborative work with the South East regional plan.
    - Updates on environmental activities.
    - WRMP19 validity statement.

41. Part D takes a look ahead. It considers:
    - The key challenges, risks and opportunities for the coming year.
    - Our forward plans for engagement.

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

A.3 Water Resource Zone boundaries

43. Our water supply area consists of six Water Resource Zones (WRZs); 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.

44. We plan water resources based on these six WRZs. There have been no changes to the WRZs between AR21 and AR22.

Figure 1: Our Water Resource Zones

A.4 Drought planning and Levels of Service

45. Our Water Resources Management Plan is aligned with our Drought Plan. Linking both plans are our levels of service, which set out the frequency with which we expect to act to restrict our customers' use of water during prolonged periods of dry weather.

46. Since the last Annual Review, we have been consulting on and amending our Drought Plan. We sent our revised draft Drought Plan to Defra on the 8th April following an 8-week consultation period that commenced in June 2021. We have updated our plan to address the requirements of revised regulatory guidance and to better align with neighbouring water companies in relation to levels of service and implementation of demand side measures. We have also improved our assessment of the risk of more severe droughts and the measures we would need to address them.

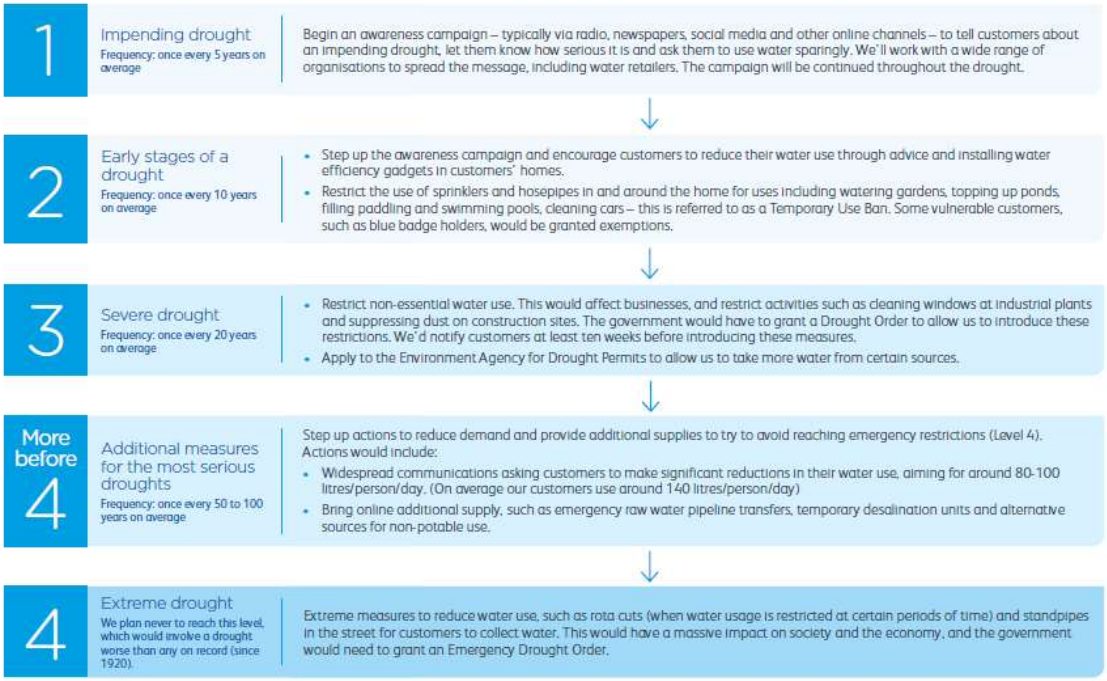
47. We have proposed changes to our Levels of Service in our Drought Plan as follows:

48. To implement a full Temporary Use Ban, formerly known as a Hosepipe Ban, at Level 2 with a level of service of 1:10 years. This is consistent with other water companies who operate in the South East.

49. To apply additional measures for the most serious droughts, referred to as "More Before Level 4 measures", these include significant reductions in water use and the use of additional emergency water sources.

50. We have four escalating levels of service, with a sub level at 'More before 4'. These levels and the actions that we'll take at each level, are presented in Figure 2.

Figure 2: Levels of Service as proposed in the revised draft Drought Plan (April 2022)



51. We have also improved all our Drought Permit Environmental Assessment Reports (EARs) to address the requirements of the Environment Agency, Natural England and other stakeholders. We have made amendments to improve the monitoring and mitigation plans for each EAR and clarified the impacts associated with some of our EARs, notably in relation to impacts on designated sites and impacts of our drought permits in the SWOX WRZ.

A.5 Comments and Actions from WRMP19 and WRMPAR21

52. Defra, in its WRMP19 permission to publish letter[6], set out its expectations for further work ahead of WRMP24. These work areas are summarised in the table below, with a summary of our response and where further information on each topic can be found in this report.

Table 1: Defra-defined areas of further work ahead of WRMP24

WRMP24 work area	Our update
Expectations for regional planning You should continue to actively participate in Water Resources South East regional group and neighbouring regional groups and respond positively to the expectations set out as part of the national framework.	We are a core member of the Water Resources in the South East Group and also active participants in neighbouring groups that link to our region. As well as providing data we have provided considerable technical support to the WRSE team, and embedded key resources in to assist in the technical development of this plan.

[6] Letter from Defra 31 March 2020

WRMP24 work area	Our update
	We are committed to ensuring a Regional Plan is developed that is adaptive and delivers best value. Further information on WRSE and the development of strategic regional options can be found in Part C.
Consider further environmental benefit In line with the expectations of regional planning, we expect your WRMP to be ambitious in protecting and improving the environment and demonstrate how you plan to do this. You should ensure that opportunities for improvements to the environment in the development of resource options has been considered in the feasibility, design and appraisal of these schemes.	We continue to work closely with the Environment Agency and our regional partners to improve the natural environment in our region. We have established a number of environmental objectives for use in regional planning and our own WRMP, that will keep environmental considerations centre-stage in developing a best value plan. We will continue to examine the environmental and social impacts and opportunities of all potential water resource and demand management options. Further information on the environment programme can be found in Part C.
Continue to work and engage with your stakeholders You received a significant number of responses on the strategic options in your plan from a number of local interest groups. Given the significant public interest in these options, maintaining dialogue is key and we welcome the commitment to continue your stakeholder engagement forums. You should also ensure that decisions made in your plan are clear and accessible to all stakeholders.	We expect our WRMP24 and the regional plan from which it will be reflected to receive considerable customer and stakeholder interest. Our overall the approach for WRMP19 was positively received by regulators and stakeholders and we intend to repeat and extend this for WRMP24, noting the links with regional planning. We are engaging with stakeholders throughout the development of WRMP24, sharing information in a timely, open manner and providing opportunity for challenge and input to inform the plan. We have also committed to undertake monitoring and reporting to give regulators and stakeholders visibility of our progress delivering the programme of studies for WRMP24 and facilitate stakeholder input and engagement to the overall work programme.

WRMP24 work area	Our update
	We are fully engaged with stakeholders and are working collaboratively with the relevant water companies in the development of the Strategic Resource Options. Further information on the stakeholder engagement programme can be found in Part D.2.

53. Additionally, the Environment Agency has raised[7] the following points in relation to our Annual Review in 2021, with two issues (S) and seven improvements (I) for update in this annual review.

Table 2: Environment Agency comments on WRMPAR21

EA Ref.	Comment on our Annual Review 2021	Our update
S1	**Drought resilience commitments** We need further details from Thames Water on how they plan to honour their commitment of achieving 1:200 resilience by 2030 [*given the potential WFD issues associated with its preferred re-use option at Deephams.]*	A statement of common understanding is being agreed with the Environment Agency. It has been established that a Deephams STW Reuse option does have potential environmental risk. As such, after detailed discussion of the findings with the Environment Agency, we have withdrawn Deephams STW Reuse as the preferred WRMP19 option and also as a feasible option from future WRMPs before 2060. We confirm our commitment to increasing the resilience of supplies to drought. As a part of the Water Resources in the South East Group we are looking at alternatives to the Deephams scheme as a part of regional water resources planning solution. This work will consider the best value way of achieving 1:200 and 1:500 drought resilience for our customers, including timing. Further information on the Deephams scheme can be found in Part C.2.5a, with more on resilience need in Part C2.8.

[7] Letter dated 12 November 2021

EA Ref.	Comment on our Annual Review 2021	Our update
S2	**Thames Gateway Desalination Plant** The company has written down the DO from the desalination plant following an assessment driven by operating difficulties. We expect the company to keep EA updated at strategic meetings how operations of this scheme progress.	We continue to have regular meetings with the Environment Agency at which the status of the Gateway desalination plant is discussed. After a first round of refurbishment in 2021 we were able to test the output of the plant to 100 Ml/d. We are now completing a second round of maintenance work to improve the resilience of that output. Further information of source performance in the year is available in Part B3.1.
I1	**Outage** We expect the company to ensure it reviews and addresses the impact of higher than planned outage on its WRMP. The company should consider options to reduce outage for WRMP24.	Outage remains higher than anticipated in the WRMP19, due to ongoing refurbishment work at the Gateway desalination plant and Queen Elizabeth II outage for tunnel rehabilitation. We anticipate outage will reduce for AR23. Further information on outage can be found in Part B.3.2 (actual outage) and Appendix E (actual outage and outage allowance.
I2	**Distribution Input (DI) and Covid** The company needs to monitor impacts of changed working patterns and how this will impact on demand in the future alongside considering impacts on measures to reduce distribution input in the future.	We continue to observe an impact on demand, particularly in the Thames Valley, that could be attributed to differing working patterns post-Covid lockdown. There is insufficient evidence to suggest that these changes will be permanent, nevertheless, we have taken steps to bring forward demand management activity in the Thames Valley WRZs in the period to 2025. Further information on DI and Covid can be found in Part B2.3 and C2.1.
I3	**Leakage** The company should ensure that it is still able to deliver its commitment to leakage reduction and take remedial action if necessary.	We are pleased to report that we have met our Ofwat performance commitment this year for leakage reduction as a three-year rolling average. Leakage levels have reduced by 10% compared to 2019/20 levels (re-based), on the glidepath to a 20.4% reduction by 2025.

EA Ref.	Comment on our Annual Review 2021	Our update
		However, dry-year uplifted leakage is 2 Ml/d higher than forecast at WRMP19. At WRZ level our leakage is lower than forecast in London WRZ and higher in the Thames Valley WRZs. This reflects a greater operational emphasis being placed on London in the early years of the AMP period. Further information on leakage can be found in Part B2.7 and C2.3.
I4	Metering penetration The company should set out how it plans to meet its metering targets for the rest of the AMP period, or identify other measures to recover the lost demand savings.	Metering continues to be a cornerstone of our WRMP. We are pleased to report that we met our metering targets for new and replacement meters this year (see Part B2.8). Company-wide household meter penetration has increased to 52%. Additionally, as a part of the Government's Green Economic Recovery (GER) programme, we have brought forward the roll out of 200,000 smart meters by 2025. Further information on our metering programme can be found in Part C2.3.
I5	PCC The company has seen an increase in household demand and change of location of this demand. Due to the challenges presented by Covid having potential longer-term impact (for example more people working flexibly from home) the company needs to ensure that it is able to meet its commitment of reduction of PCC and think of innovative ideas of how to do this for example through tailored messages. The company should confirm that it can deliver on its commitment of reducing PCC and set out the actions it plans to take to manage PCC.	Average PCC has dropped this year as anticipated, following the relaxation of Covid-19 measures. However, PCC continues to be higher than anticipated in the WRMP19. We are bringing forward demand management measures to help bring demand down further by the end of the AMP period. Further information on PCC can be found in Part B2.4 and C2.2. We note that DEFRA is consulting on a new environmental target for water demand. We support a move away from using PCC.
I6	Supply demand balance (SDB) We expect the company to report progress on its plans to address SDB in SWA and SWOX. The company should	We are pleased to report that we have maintained the supply demand balance in all WRZs this year.

EA Ref.	Comment on our Annual Review 2021	Our update
	report on the actions it proposes to take to address SWOX supply demand balance. The company needs to ensure that the actions identified for SWA are delivering results expected or identify alternative measures if required.	We continue to note a tighter SDB in the SWOX WRZ at peak periods than we forecast at WRMP19. We are bringing forward demand management measures to mitigate this impact, which is primarily due to higher demands. Further information on the SDB can be found in Part B.4 and C.2.2.
I7	Supply schemes We expect the company to provide explanation for the decision to postpone development of options put forward in their WRMP19 given the challenges of the resilience and balancing of supply and demand faced by the company.	We have deferred delivery of three groundwater enhancements in London as the need for them is less urgent than anticipated in WRMP19. The work completed on both options will shorten the delivery times of the schemes should the situation change in the future. Further information on supply-side schemes can be found in Part B3.3 and C2.4.

54.

Part B – The out-turn year 2021-22

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

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

57. 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.

B.1 Overview of the weather

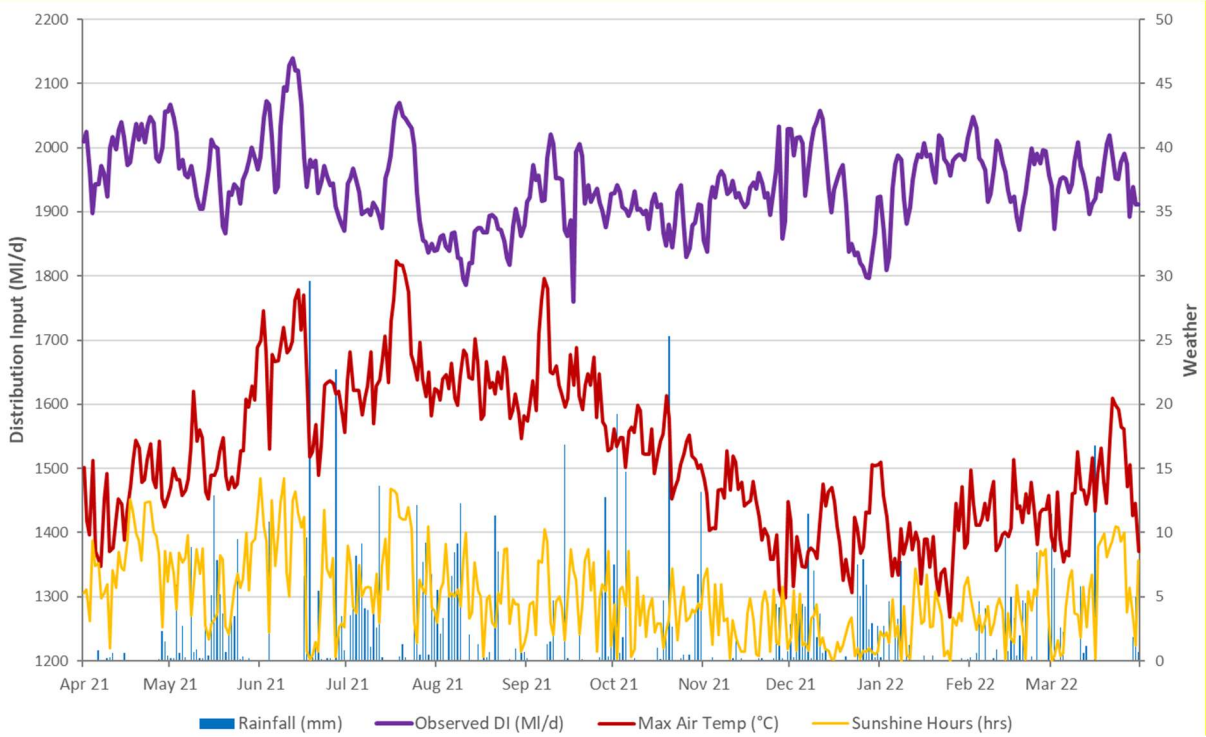
58. The weather is an important factor which affects demand for water. Cold winters tend to cause an increase in the volume of water lost through leakage from our, and our customers' water pipes, while dry hot summers tend to result in higher consumption.

- Summer (and its impact on usage):
  - The summer of 2021 was less extreme than 2020, but was warmer than average. June 2021 had much warmer than average temperatures[8]. Notably in mid to late July temperatures exceeded 30°C on several consecutive days with maximum of just above 32°C recording at Heathrow, West London[9]. Ahead of this period the Met Office had issued its first ever Amber Extreme Heat Warning[10]. This resulted in high summer demand, potentially compounded by amplification of weather-dependent demand due to continued Covid-19 effects.
- Winter (and its impact on leakage):
  - The winter of 2021/22 was also less extreme than 2020/21. The UK experienced the 8th mildest winter (provisional, based on temperature) since 1884[11], with unusually warm temperatures throughout the UK in December 2021[12]. This resulted in reduced freeze-thaw impacts on leakage compared to last year.

59. Figure 3 illustrates the increase in demand (as distribution input (DI), purple line) in the London WRZ during the hot, dry summer peaks in June and July. It also shows demand in January to March 2022 remaining relatively steady, without an obvious winter spike, as would be expected in a relatively mild winter.

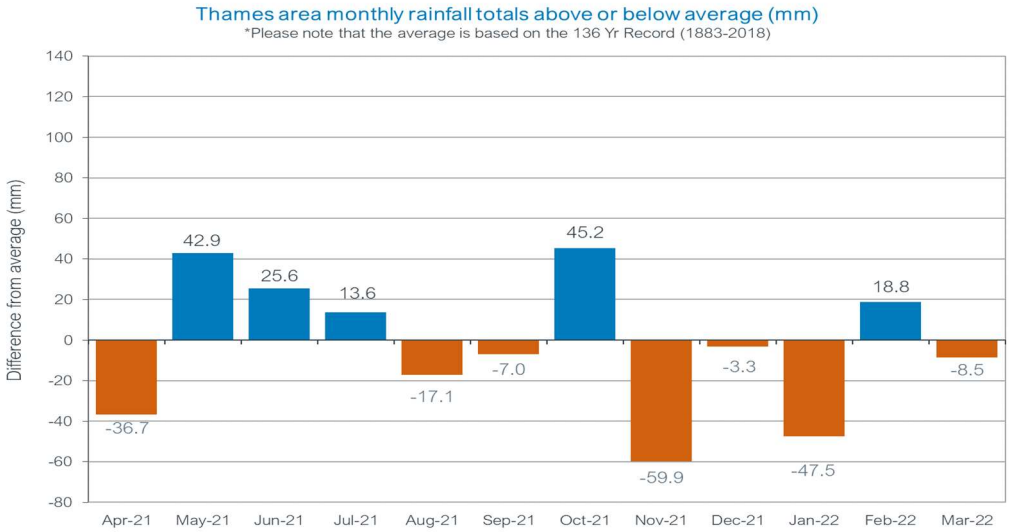
[8] https://blog.metoffice.gov.uk/2021/07/01/warm-june-heralds-start-of-summer-despite-recent-unsettled-weather/
[9] https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/summaries/uk_monthly_climate_summary_annual_2021.pdf
[10] https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2021/extreme-heat-warning-issued-for-western-areas
[11] https://blog.metoffice.gov.uk/2022/03/01/a-mild-winter-blows-out-at-the-end/
[12] https://blog.metoffice.gov.uk/2022/01/04/december2021weather/

Figure 3: Weather components and demand – London WRZ



60. Rainfall in the Thames catchment over the reporting year was slightly drier than average at 95% of the long-term average There was above average rainfall during the summer period (April to September) at 106% of the long-term average, before a slightly dry winter during which there was below average rainfall, 86%. November 2021 was the second driest November on our records receiving 21% of the long-term average rainfall. Monthly rainfall totals relative to the long-term average are shown in Figure 4.

Figure 4: Monthly Rainfall Total (mm) above or below long-term average



61. 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 average. Rainfall over the 18 months ending in March 2022 was 107% of average, which is significantly more than the rainfall that occurred during the dry year scenarios that drive our water resources planning.

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

B.2 The Water Balance

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

64. 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 (including the per capita consumption (PCC) measure).
- Non-household use – water used by businesses and institutions.
- 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.

65. 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 2021/22 by WRZ is provided in Appendix A (Annual Average) and Appendix B (Critical Period).

66. The water balance for this reporting year continues to be impacted by changes in water using behaviours as a result of Covid-19 lockdowns, however less so than in the previous year. At the moment we are able to note general trends but not the specific volumetric impacts.

67. These trends are primarily linked to changes in working practices, such as 'working from home', with higher than predicted household demands, lower non-household demand and the reduction in commuting resulting in higher overall demands in Thames Valley WRZs.

B.2.1 Methodology

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

69. This year we have updated our method for domestic and commercial night use and also re-examined our occupancy rates for measured households.

70. Due to the methodology changes and in order to show a like for like comparison, we have re-stated our water balance position for AR21. The impact is not material, with a 7.6 Ml/d change to DI in London and less than 0.2 Ml/d impact in all Thames Valley WRZs.

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

71. The main changes from last year at company-level are:
    - A decrease in distribution input of 50 Ml/d
    - An increase in measured household consumption of 15 Ml/d and a decrease in measured PCC of 14 litres per person per day
    - A decrease in unmeasured household consumption of 88 Ml/d and an increase in unmeasured PCC of 1 litre per person per day
    - An increase in the measured non-household consumption of 23 Ml/d
    - An increase in leakage of <1 Ml/d
72. Overall, the water balance discrepancy at company-level (the difference between distribution input and the independent calculation of its components) has decreased from -4.21% last year to 3.52% this year. This is within acceptable limits (of +/- 5%) and is indicative of the less unusual situation in this reporting year.
73. 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.

B.2.3 Distribution Input

74. Distribution Input (DI) refers to the volume of water put into our supply network 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)	Original AR21	Re-stated AR21	AR22	Variance
Distribution Input	2589.39	2,597.21	2,547.59	-49.62

75. Distribution Input this year has decreased by around 50 Ml/d. This is due to the prevailing weather conditions and our continued efforts to manage demand. The impact of COVID-19 on DI at company-level appears marginal, with the main changes being seen at WRZ-level and in terms of where water is used.

B.2.4 Household Use

Measured Properties

76. Water delivered to measured properties is reported from our customer information systems. Most properties are now billed in the new SPRING billing system. PCC is the water delivered per person.

Household Use - Measured	Re-stated AR21	AR22	Variance
Water delivered billed measured households (Ml/d)	704.45	719.79	+15.34
Measured household PCC (l/h/d)	140.41	126.56	-13.86

77. The reported volume delivered to measured households has increased by 15 Ml/d compared with AR21 and PCC has decreased by 14 l/h/d.

78. The increase in water delivered is expected can be attributed to an increase in the metered population, due to the following: 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 de-registration of household properties from the non-household market.

79. The decrease in PCC is also expected as the impact of Covid-19 restrictions lessens and people begin to go back to the previous working patterns.

80. We have also updated our measured occupancy rates this year. The last survey was undertaken in 2010/11 at a time when our measured property base was primarily new developments and optants. Now we have more information from our household water efficiency visits and the progressive metering programme which, as expected, indicates our measured occupancies have increased. This has rebalanced the population between measured and unmeasured properties and resulted in a drop in measured PCC and an increase in unmeasured PCC.

Unmeasured Properties

81. The Domestic Water Use Study (DWUS) is used as a base to determine water consumption for unmeasured and assessed household accounts. The DWUS comprises a panel of households and examines the water use in these 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.

82. This panel has been shrinking over the AMP6 period with the roll out of the PMP. As a result, two other data sources have been introduced 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 to capture use in blocks of flats.

83. The DWUS, bulk metering areas and PMP results are weighted by property type, occupancy and ethnicity to determine the overall value for unmeasured household consumption.

Household Use - Unmeasured	Re-stated AR21	AR22	Variance
Water delivered billed unmeasured households (Ml/d)	1,007.77	919.33	-88.44
Unmeasured household PCC (l/h/d)	163.46	164.17	+0.71

84. The reported volume of water delivered to unmeasured households has decreased by 88 Ml/d this year, whilst PCC has increased by 1 l/h/d.

85. A decrease in water delivered is to be expected as properties move to measured billing via the progressive and optant metering programmes.

86. The slight increase in unmeasured HH PCC is due to the updated measured occupancy rates as discussed above.

B.2.5 Non-household Use

87. 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.

88. We have no direct control over the estimation of consumption of non-household 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)	Re-stated AR21	AR22	Variance
Water delivered billed - measured	356.76	379.78	+23.02
Water delivered billed - unmeasured	14.86	15.55	+0.69

89. Measured non-household water delivered is higher than last year, by 23 Ml/d. Unmeasured non-household water delivered is also higher by 1 Ml/d.

90. The increase in usage in non-households is expected can be attributed to people gradually going back to workplaces following relaxation of COVID-19 restrictions.

B.2.6 Minor components

91. 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)	Re-stated AR21	AR22	Variance
Distribution system operation use	17.11	17.15	+0.04
Water taken legally	27.89	27.65	-0.24
Water taken illegally	42.48	41.95	-0.54

92. There are minimal movements this year which are primarily related the MLE balancing process rather than an underlying change in assumptions or volumes.

B.2.7 Leakage

93. Leakage reduction is an extremely important part of our plans to manage the balance between supply and demand. Consequently, we have challenging targets to deliver a 20% reduction in our base level of leakage (as a 3-year rolling average) by 2024/25 and a goal to reduce leakage by 50% (of 2017/18 levels) by 2050.

94. During 2021/22 we created a Leakage Reporting and Insight Improvement Programme (LRIIP) which was designed to improve confidence in our data and processes, improve resilience, provide greater accuracy and consistency of reporting through assurance and demonstrate how we will use insight to effectively deliver improved leakage performance expected by our customers and stakeholders.

95. As part of this we have improved our water balance processes and assumptions used to calculate leakage, this has meant we've had to revise our reported leakage last year from 589.6 Ml/d to 593.2 Ml/d. This is still ahead of our revised 2020/21 target of 616.3 Ml/d.

96. Our reported leakage for 2021-22 is 593.8 Ml/d, an increase of 0.6 Ml/d, as shown below:

Out-turn year Total Leakage (Ml/d)	Re-stated AR21	AR22	Variance
Total Leakage	593.2	593.8	+0.6

97. Over the next 5 years, the majority of our leakage reduction will principally be in the London WRZ. However, we are also targeting reductions in the SWOX and Guildford WRZs whilst maintaining leakage levels in remaining WRZs.

98. Further information on performance against the WRMP19 forecast and at WRZ-level is provided in Part C.

99. During 2021/22 our leakage reduction plan focussed on a mix of innovation, increased productivity and data-driven decision making. Benefitting from deployment of an award-winning mobile application to improve leakage detection performance by targeting

areas for leak location activity based on historic performance and the likelihood of a leak re-occurring due to network condition.

100. We faced a number of challenges during 2021/22 in part due to colder than average weather during the end of 202021 as well as resource challenges due to Covid-19 and market conditions. The colder than average weather in early 2021 caused a significant increase in leakage with repairs on visible leaks from our mains around 50% higher than expected levels between January and March 2021. This meant that our starting leakage position for 2021/22 was higher than we had initially planned. As a result, we reviewed our initial leakage delivery plan for 2021/22 and created an enhanced plan to deliver additional leakage activity to recover the leakage position over the year.

101. At the beginning of the year, one of the key risks was the level of increase in leakage detection resource that was required to deliver the plan. This was mitigated by purchasing additional leakage technology equipment to increase the acoustic logging capability and trialling new productions to provide insights into leak size to ensure that leak repairs could be prioritised more efficiently. Market conditions also had a considerable impact on repair resource, we worked with our partners through the year to review and increase team rates in line with industry benchmarks and supplemented resource by bringing in additional partners.

102. Due to the resource and performance challenges experienced we made the decision to transition away from the outsourcing delivery model over the coming year. Going forward, we'll be carrying out high volume repair and maintenance work and planning in-house. That means that we'll be self-delivering the work that most impacts our customers.

103. Overall leakage delivery through the year exceeded our initial plan but fell short of our enhanced leakage delivery plan, largely due to the resource challenges experienced through the first 9 months of the year. We repaired a total of 61,671 leaks during the year with an average of 1,186 leaks a week compared to a target of 1,414 leaks a week. Visible leak repairs, for the year as a whole, were lower than forecast, at 92%, aided by the milder weather conditions through the winter months of 2021/22.

B.2.8 Metering

104. The metering programme includes two main workstreams for new household installations, optants and the progressive metering programme (PMP). The optant programme installs meters at the request of the customer. The PMP 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.

105. There are two additional programmes relating to household metering, meter replacement and bulk metering. The meter replacement programme exchanges household meters at the end of their life with a new 'smart' meter. The bulk metering programme installs meters on our connections to blocks of flats.

106. The metering programme is a key enabler to help to identify leakage.

107. Our current strategy is to install only smart meters in our optant, selective and replacement programmes. However, there will be instances when a customer may request a 'basic' meter.

108. Smart metering allows meter reads to be collected remotely through our wide area network. We can receive daily a profile of either 15-minute or hourly read data. This rich source of data allows us to better understand water usage in our supply area and identify leakage and wastage, enabling us to work with customers to help reduce demand and leakage. Outside of our wide area network coverage (London WRZ only), the same meter is installed but operates in a 'walk-by or 'drive-by' reading mode.

109. The total number of meters installed under each of these programmes in 2021-22 is provided in Table 3 compared to the WRMP19 forecast where applicable.

Table 3: Meter installations in 2021-22

Meter Installations	Water Resource Zone						Total	WRMP19 Forecast	Variance
	LON	SWOX	SWA	KV	GUI	HEN			
Progressive Metering	94,067	0	0	0	387	0	94,454	88,974	+5,480
Optant Metering	14,149	3,117	1,404	1,834	502	0	21,006	17,280	+3,726
Smart Replacements – HH	41,008	2,845	1,651	1,382	2,399	0	49,285	33,895	+15,390
Small Bulk Meters	2,947	0	0	0	0	0	2,947		
Large Bulk Meters	734	0	0	0	0	0	734		
Total	152,905	5,962	3,055	3,216	3,288	0	168,426		

110. Overall, we have installed and replaced more meters this year than forecast in the WRMP19. This is helping us to catch up the numbers from last year that were lower than anticipated due to the impact of COVID-19 on working practices.

111. We are continually monitoring the benefits of metering and regularly reviewing the job mix to best balance the needs of both programmes.

112. Our meter and receiver deliveries continue to be impacted by the global microchip shortage restricting manufacturing in the supply chain. As a result, the replacement programme slowed, and all household proactive replacement activity was paused for February and March to mitigate potential stock shortages.

113. Our forecast for meter installations and replacement are totals over the 5-year period of our Business Plan and we expect to achieve our targets over the 5 years. See section C2.3.

Progressive Metering

114. In WRMP19 we forecasted that this year we would install 88,974 domestic water meters across London and the Thames Valley this year as part of the PMP.

115. We installed 94,454 meters, almost exclusively in the London WRZ due to the focus on reducing leakage in that zone.

116. A small number of meters were installed in the Guildford WRZ and we plan to gradually move into the Thames Valley over the remainder of the AMP7 period.

Optant Metering

117. In WRMP19 we forecasted that this year we would install 17,280 meters through our optant metering programme each year, based on historic take-up rates.

118. We installed 21,006 meters.

119. This increase may be due to people spending more time at home and having time to consider whether receiving a metered bill is right for them. It may also be linked to current increase in 'cost of living' and households looking for ways to economise.

Meter Replacement

120. In WRMP19 we forecasted that we would replace 33,985 meters in household properties through our meter replacement programme. These are meters identified for replacement are those more than 14 years old (proactive replacements), or those identified as inaccurate, defective, or stopped by customers or company / contractor personnel (reactive replacements).

121. We replaced a total of 25,850 meters this year 2020/21, the benefits of which are captured in our value for total leakage.

Bulk Metering

122. We have installed 734 large bulk meters and 2,947 small bulk meters in 2021/22. This is an increase on the previous year (1,375).

123. We have found the installation of large bulk meters to be particularly effective in helping us to discover and repair significant customer-side leakage and high usage issues. As a result, installation of these meters was prioritised this year.

B.2.9 Water efficiency

124. Reducing water use across our region is a core priority for our business, which is why we've continued to deliver a large water efficiency programme.

125. This year:

- Our Smarter Home Visits (SHV) activity achieved the target of 25,000 visits in 2021/22, delivering 1.56Ml/d of measured savings. Our use of smart meter data to assist targeting high usage and continuous flow households continues to maximise the demand reductions achieved per SHV.
- Our Smarter Business Visit (SBV) activity has proved to be the very effective demand reduction initiative. Our data and insight is being used to assist Defra in their development of a NHH water savings component of the proposed Nation Water Demand Target, and to MOSL and Ofwat as part of the Retailer-Wholesaler

Group's Water Efficiency Sub-Group outputs. Our SBVs are also being used in specific WRZs in response to supply-demand challenges.

- Our household wastage fixes are continuing to deliver consistent and useful water savings per visit, but the cumulative demand reduction progress is behind the original WRMP projection due to the long-standing impacts of Government Covid-19 restrictions in year 1, which resulted in months of no delivery. The insight from our wastage fix initiative is being supplied to Defra as part of their National Water Demand Target consultation, and the sector-wide efforts to address the manufacturing industry and product certification bodies to help address the UK's 'leaky-loo' issue.
- Our ability to expand our GreenRedeem household water efficiency incentive in line with WRMP projections, was impacted significantly by Government's Covid-19 restriction – resulting in a suspension of all in-home water efficiency and wastage fix activities. Our ability to digitally / electronically engage with customers to promote water efficiency incentives was also impacted by updated Privacy and Electronic Communication Regulations ruling under data protection laws, requiring greater levels of customer consent. In response, we are strengthening our GreenRedeem engagement activities and have also achieved a significant increase in customer recruitment through 2021/22 via our SHV programme.
- As per all water efficiency in-home visits, our legacy joint Thames-housing association visit initiatives we also impacted by Government Covid-19 restrictions. During this time and following consultation with our housing association delivery partners, we rolled these visits into the larger SHV programme. Going forward, the majority of water efficiency visits conducted in housing association properties will fall into the SHV delivery and reporting space.
- Innovation - We undertake a range of small pilots and trials on both water saving devices and customer engagement activities. In parallel to sharing these results with other water companies through the Water Efficiency Network, we will use these trials to expand our innovation activity into later AMPs. We are also exploring water savings opportunities through water efficiency incentives to non-household Retailers and water neutrality incentives with developers.

126. We continue to champion water efficiency across the entire business, including in our boardroom, with regulators, at stakeholder partnership meetings, at the UK Water Efficiency Strategy Steering Group and at customer care contact centres. 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.

B.3 Supply performance

127. 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), and progress with new resource delivery.

B.3.1 Source Availability during the Year

128. During 2021-22 we maintained sufficient sources in supply to flexibly meet demand and to cover planned and unplanned outages. A continuing programme of maintenance and operational management activities contribute to this, as illustrated in the following examples.

129. A major planned outage of the Queen Elizabeth II (QEII) reservoir was undertaken for inspection and refurbishment of its inlet and outlet tunnels, extending over an 8-month period from April to December 2021. The QEII reservoir contributes almost 10% of London's raw water reservoir storage and as such is a major source of water to our large water treatment works at Hampton and Walton in West London. As a result, such a major reservoir outage could not be undertaken during dry weather/drought years without significant risk to water resources and customer water supply. Working closely with the Environment Agency Area team in assessing operational and water resources risks, this major outage was delivered successfully and ahead of programme.

130. As previously agreed with the Environment Agency, the reduced capability of the London Gateway Desalination water treatment works remains at 100 Ml/d. The project in progress at the time of reporting last year has delivered a programme of refurbishment with a capability of 100 Ml/d being demonstrated, running to waste through the multi-stage treatment process, in June 2021. To ensure that the Gateway WTW can be placed reliably into maintenance and standby modes, further refurbishment is continuing to enhance asset resilience.

131. A programme of planned maintenance and recommissioning of the ELRED groundwater abstractions and associated East Ham WTW in North East London has been undertaken this year. The works were completed successfully, in the context of low customer demand in London, with the site being returned into supply in April 2022. Although not needing to deliver supply benefits in the 2021/22 reporting year, the improved availability of ELRED and East Ham WTW enhances supply resilience and provides supply contingency ahead of potential peak summer demands in 2022.

132. A similar programme of planned maintenance and recommissioning has also been undertaken and completed at the Brixton groundwater abstraction and treatment site. This work was completed, and the site returned into supply, in October 2021. The return of Brixton into supply has enhanced capability as well as supply resilience in South West London.

133. In the Henley WRZ, further benefits from asset refurbishment at the Sheeplands groundwater abstraction and treatment works have been delivered during the year. Increased groundwater abstraction has been achieved from the Sheeplands boreholes, treated and put into supply. This has resulted in recovery of previous average DO reductions, with both the average and peak DO now constrained by the treated water booster pumps.

B.3.2 Actual Outage

134. 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.

135. The total Actual Outage across London and the Thames Valley this year is 184.8 Ml/d, compared with 167.4 Ml/d reported in 2020/21 as presented in Table 4. This increase is the result of planned outage at QE2 reservoir in London and increased outage at London's large processing plants (LPPs).

136. The main single cause of outage in London is related to the ongoing refurbishment of the Gateway desalination plant.

Table 4: Actual Outage by WRZ (Ml/d)

WRZ	2020/21	2021/22	Variance
London	146.4	170.8	+24.4
SWOX	5.6	4.3	-1.3
SWA	10.2	6.1	-4.1
Kennet Valley	2.3	2.4	+0.1
Guildford	0.2	0.4	+0.2
Henley	2.6	0.8	-1.8
Total	**167.4**	**184.8**	**+17.4**

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

B.3.3 New resource development

138. No new resource developments were due to be delivered in 2021/22.

139. Further details and updates regarding of the AMP7 resource development programme and the ongoing studies into Strategic Regional Options can be found in C2.4 and C2.5.

B.4 Security of supply performance

140. 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 dry year critical period (DYCP). An index of 100 indicates surplus in all WRZs.

141. This year, we have met our SoSI target of 100, with all water resource zones (WRZ) in surplus under both annual average conditions and critical period conditions.

142. Details of the components of the SoSI calculation are provided in Part C.

Table 5: SoSI

SoSI		2020/21	2021/22
DYAA	Forecast	100	100
	Actual	100	100

DYCP	Forecast	100	100
	Actual	100	100

Part C – WRMP19 Review

143. 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.

144. Later this year we will be submitting our draft WRMP24, which will include re-forecast of activity in the final three years of this AMP. This re-forecast is necessary as it includes additional demand management activity under the Green Economic Recovery programme and the network enhancement programmes, which we highlighted as potential 'opportunities' last year.

145. A full update will be provided in the dWRMP24 consultation in the autumn, and progress will be tracked against WRMP19 and dWRMP24 in our Annual Reviews from next year.

C.1 WRMP19

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

147. We developed WRMP19 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.

148. 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.

149. 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.
- To look beyond the needs and opportunities of our supply area alone and consider the growing needs of the wider South East of England.

150. We have proposed a twin track approach in our WRMP19, 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.

151. We have built our plan following 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.

152. 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.

153. We have included in this part of the report, the Monitoring Plan we will use to track progress against the commitments set out in the 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.

C.2 WRMP19 Monitoring Plan

154. 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, 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).
- 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 considered in the regional plan for the South East and in development of WRMP24.

155. 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, where appropriate.

156. Our Monitoring Plan elements are summarised in Table 6. Each Assessment Area is then discussed separately in the sub-sections below.

Table 6: Monitoring Plan elements

Assessment Area	Monitoring Activity	Metric	Purpose and relationship with decision point
Supply demand 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/h/d	
AMP7 Delivery - Demand options	Leakage	Ml/d	Actual vs predicted – assumptions and impact assessment
	Metering	Activity	Meters installed – assumptions and impact assessment
	Water Efficiency		Activity now replaced as a measure by PCC
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	SESRO	Progress update	Readiness for 2022/23 decision point (2037 scheme delivery)
	Severn-Thames Transfer		
	Effluent Re-use (LON)		
	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

C.2.1 Supply demand balance summary

157. The supply demand balance differs from the out-turn year water balance (as presented in Part B) because it is normalised to reflect a dry year annual average (DYAA) or a dry year critical period (DYCP) scenario. This allows us to compare directly with WRMP19. 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.

158. Having uplifted DI[13], 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

159. Supply demand balances compared to WRMP19 forecasts are presented in the Tables below for DYAA and DYCP conditions, respectively.

Table 7: DYAA Supply Demand Balance compared to WRMP19 forecast

Surplus/Deficit (Ml/d) - DYAA		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast	2.38	13.65	15.33	42.86	61.44
	Actual	64.59	90.62			
SWOX	WRMP19 Forecast	17.11	18.93	20.96	25.53	27.04
	Actual	12.55	23.16			
SWA	WRMP19 Forecast	27.88	26.88	26.45	26.27	19.65
	Actual	13.86	12.75			
Kennet Valley	WRMP19 Forecast	31.61	30.08	29.27	29.24	28.76
	Actual	33.24	34.43			
Guildford	WRMP19 Forecast	14.19	14.49	14.63	15.08	15.27
	Actual	13.37	12.61			
Henley	WRMP19 Forecast	11.72	11.69	11.70	11.67	11.63
	Actual	4.35	6.39			

Table 8: DYCP Supply Demand Balance compared to WRMP19 forecast

Surplus/Deficit (Ml/d) - DYCP		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast					
	Actual					
SWOX	WRMP19 Forecast	10.41	10.71	12.69	16.01	18.67
	Actual	2.92	1.18			
SWA	WRMP19 Forecast	12.99	10.88	10.03	9.73	3.64
	Actual	9.78	6.44			
Kennet Valley	WRMP19 Forecast	21.84	20.39	19.44	18.99	17.90
	Actual	17.80	17.90			
Guildford	WRMP19 Forecast	2.81	3.11	3.10	3.18	7.76
	Actual	2.18	2.47			
Henley	WRMP19 Forecast	5.42	5.34	5.30	5.32	5.31
	Actual	4.71	2.39			

160. The supply demand position in London is better than predicted in the WRMP19. This is due to:

[13] If the reporting year was exceptionally dry or with high peak demands, beyond the 1 in 10 return period, the numbers would actually be deflated.

- Reducing uncertainty as we move through the planning period. i.e. we have not required as much of the buffer for uncertainties allowed for in the WRMP19 forecast.
- Making good progress with leakage reductions.
- The impact of COVID-19 measures moving demand away from London.

161. This puts us in a good position for AMP7. We remain fully committed to our demand management commitments in London, which, if the impacts are as expected, should leave us in a better position at the end of the AMP. The surplus has allowed us to defer some small resource developments, whilst keeping them available for delivery at short notice (see C2.4).

162. The supply demand position in Thames Valley is worse than predicted in the WRMP19. This is due to:

- Higher than predicted demand in all zones, despite lower population growth.
- The impact on demand exacerbated by lockdown measures meaning people are using more water at home in the commuter belt rather than at work in London.
- Unforeseen reductions in source performance and the need for some lengthy recommissioning works.

163. In response, we are re-examining the spatial distribution of our demand management programmes. We are using the Green Economic Recovery programme to bring forward the roll-out of metering in the Thames Valley.

164. A breakdown of the supply demand balance into its components (WAFU, DI and Target Headroom) can be found in Appendix J.

Security of Supply Index

165. The supply demand balance tables above show that we are in surplus in all WRZs in 2021/22. Therefore, our SoSI is 100, which is in line with our WRMP19 forecast.

Table 9: SoSI compared to forecast

SoSI		20/21	21/22	22/23	23/24	24/25
DYAA	Target	100	100	100	100	100
	Actual	100	100			
DYCP	Target	100	100	100	100	100
	Actual	100	100			

166. We forecast in WRMP19 to maintain a SoSI position of 100 throughout AMP7. This is challenging but achievable.

Distribution Input

167. 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-year estimate is taken as the joint impact of a coincident 1 in 5-year return periods for usage and leakage.

168. For details of the Dry Year uplift process, refer to Appendix G.

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

Table 10: DYAA Distribution Input compared to WRMP19 forecast

Distribution Input (Ml/d) - DYAA		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast	2018.22	1998.77	1973.62	1947.65	1927.10
	Actual	1997.10	1975.50			
SWOX	WRMP19 Forecast	267.41	264.44	261.20	258.07	254.97
	Actual	289.92	289.12			
SWA	WRMP19 Forecast	137.82	138.11	138.24	138.39	138.57
	Actual	144.46	144.20			
Kennet Valley	WRMP19 Forecast	102.46	102.84	103.12	103.32	103.48
	Actual	102.34	101.87			
Guildford	WRMP19 Forecast	45.57	45.28	44.93	44.68	44.48
	Actual	49.24	49.40			
Henley	WRMP19 Forecast	12.93	12.93	12.93	12.93	12.93
	Actual	13.82	14.04			

Table 11: DYCP Distribution Input compared to WRMP19 forecast

Distribution Input (Ml/d) - DYCP		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast					
	Actual					
SWOX	WRMP19 Forecast	326.92	323.97	320.62	317.38	314.16
	Actual	340.93	345.33			
SWA	WRMP19 Forecast	170.33	170.85	171.16	171.48	171.85
	Actual	169.16	171.70			
Kennet Valley	WRMP19 Forecast	123.11	123.68	124.14	124.49	124.79
	Actual	119.76	119.02			
Guildford	WRMP19 Forecast	62.11	61.83	61.48	61.24	61.08
	Actual	64.55	63.48			
Henley	WRMP19 Forecast	19.28	19.29	19.31	19.32	19.33
	Actual	17.62	19.78			

170. This year we have seen continued reductions in DI in London compared to forecast. In the Thames Valley WRZs, DI has remained broadly similar to last year, so remains notably higher in SWOX than originally forecast.

171. This regional movement is likely to have been influenced by the COVID-19 lockdown.

Water Available for Use (WAFU)

172. Water available for use in 2021/2022, uplifted to the dry year and critical period scenarios suitable for comparison to WRMP19 are presented in the tables below:

173. WAFU is calculated from assessments of:
    - Deployable Output (DO) – water available to be abstracted and treated.
    - Reductions to DO – the impact of climate change, sustainability reductions etc.
    - 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.
174. Each component of WAFU is updated on an annual basis.

Table 12: DYAA WAFU compared to WRMP19 forecast

WAFU (Ml/d) - DYAA		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast	2151.73	2144.81	2137.88	2130.96	2130.03
	Actual	2127.41	2139.40			
SWOX	WRMP19 Forecast	297.87	297.61	297.34	297.08	296.82
	Actual	308.87	317.30			
SWA	WRMP19 Forecast	170.52	170.43	170.34	170.25	163.38
	Actual	161.50	159.79			
Kennet Valley	WRMP19 Forecast	138.68	138.36	138.05	137.73	137.42
	Actual	139.53	140.44			
Guildford	WRMP19 Forecast	62.07	62.06	62.04	62.03	62.02
	Actual	63.79	63.16			
Henley	WRMP19 Forecast	25.29	25.29	25.29	25.29	25.29
	Actual	18.50	20.75			

Table 13: DYCP WAFU compared to WRMP19 forecast

WAFU (Ml/d) - DYCP		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast					
	Actual					
SWOX	WRMP19 Forecast	354.54	354.25	353.94	353.63	353.31
	Actual	358.71	361.66			
SWA	WRMP19 Forecast	189.83	189.77	189.71	189.65	182.69
	Actual	187.81	186.79			
Kennet Valley	WRMP19 Forecast	150.82	150.58	150.35	150.11	149.88
	Actual	144.19	143.81			
Guildford	WRMP19 Forecast	67.95	67.94	67.92	67.91	72.50
	Actual	70.50	69.77			
Henley	WRMP19 Forecast	25.54	25.54	25.54	25.54	25.54
	Actual	23.32	23.31			

175. 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.
176. The variance in Critical Period WAFU in Thames Valley compared to WRMP19 forecast is also not seen as material to the WRMP19 forecast. There have been movements in

DO following annual source review and reductions in outage following the introduction of a new methodology, consistent with neighbouring companies in the South East.

177. Further details on changes to components of WAFU are provided in Appendix F.

C.2.2 Growth

Population

178. 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.

179. Table 14 presents the total population in our supply area broken down by WRZ, compared with the WRMP19 forecast.

Table 14: Population compared with WRMP19 forecast

Total Population (000s)		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast	7,977.100	8,049.740	8,110.772	8,163.623	8,213.322
	Actual	8,045.127	8,104.579			
SWOX	WRMP19 Forecast	1,135.968	1,151.527	1,165.446	1,178.508	1,190.732
	Actual	1,089.714	1,090.338			
SWA	WRMP19 Forecast	581.564	586.513	590.207	593.817	597.559
	Actual	550.239	549.827			
Kennet Valley	WRMP19 Forecast	431.287	435.818	439.933	443.550	446.670
	Actual	416.931	419.115			
Guildford	WRMP19 Forecast	174.506	176.229	177.888	180.030	182.316
	Actual	168.430	169.920			
Henley	WRMP19 Forecast	53.912	54.265	54.577	54.830	55.028
	Actual	50.115	50.605			
Total	**WRMP19 Forecast**	**10,354.337**	**10,454.092**	**10,538.822**	**10,614.359**	**10,685.626**
	Actual	**10,320.556**	**10,384.384**			

180. Total population is marginally lower but not materially different compared with the WRMP19 forecast. At WRZ-level the population is higher in London and lower in Thames Valley.

Properties

181. Table 15 and Table 16 present the number of billed household properties and billed non-household properties, respectively, by WRZ, compared with WRMP19 forecasts.

Table 15: Billed Household Properties compared with WRMP19 forecast

Billed HH Properties (000s)		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast	2,907.192	2,950.577	2,989.769	3,026.022	3,061.809
	Actual	2,870.965	2,908.261			
SWOX	WRMP19 Forecast	469.028	478.979	485.445	491.696	497.702
	Actual	416.250	423.962			
SWA	WRMP19 Forecast	234.397	239.274	242.886	246.413	250.063
	Actual	205.051	206.995			
Kennet Valley	WRMP19 Forecast	166.296	168.375	169.898	171.071	172.147
	Actual	156.868	159.881			
Guildford	WRMP19 Forecast	66.408	67.717	68.400	69.269	70.229
	Actual	60.844	61.680			
Henley	WRMP19 Forecast	22.004	22.051	22.114	22.208	22.305
	Actual	20,241	20.630			
Total	**WRMP19 Forecast**	**3,865.324**	**3,926.973**	**3,978.511**	**4,026.679**	**4,074.255**
	Actual	**3,730.219**	**3,781.409**			

Table 16: Billed Non-Household Properties compared with WRMP19 forecast

Billed NHH Properties (000s)		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast	156.044	157.468	158.892	160.316	161.740
	Actual	138.903	141.396			
SWOX	WRMP19 Forecast	25.474	25.706	25.938	26.170	26.402
	Actual	22.970	19.214			
SWA	WRMP19 Forecast	10.920	11.032	11.145	11.257	11.370
	Actual	8.058	9.422			
Kennet Valley	WRMP19 Forecast	7.969	8.052	8.135	8.219	8.302
	Actual	6.791	6.235			
Guildford	WRMP19 Forecast	3.869	3.906	3.942	3.978	4.015
	Actual	2.794	3.078			
Henley	WRMP19 Forecast	1.158	1.170	1.182	1.194	1.206
	Actual	0.763	0.780			
Total	**WRMP19 Forecast**	**205.435**	**207.335**	**209.235**	**211.135**	**213.035**
	Actual	**180.279**	**180.125**			

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

183. 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 and now COVID-19 lockdown. The market has not yet recovered and thus house building remains lower than planned by the Local Authorities.

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

Per Capita Consumption (PCC)

185. 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.

186. Table 17 shows the average per capita consumption by WRZ compared with WRMP19 forecasts. Both the actual and WRMP19 forecast reflect "dry year" demand.

Table 17: Per Capita Consumption (Average) compared with WRMP19 forecasts

Average PCC (l/hd/d)		20/21	21/22	22/23	23/24	24/25
London	WRMP19 Forecast	141.23	140.03	138.69	137.38	136.18
	Actual	150.96	145.97			
SWOX	WRMP19 Forecast	134.62	132.77	130.82	129.00	127.24
	Actual	155.23	146.78			
SWA	WRMP19 Forecast	137.61	137.24	136.90	136.58	136.27
	Actual	154.35	150.15			
Kennet Valley	WRMP19 Forecast	132.12	131.74	131.29	130.84	130.45
	Actual	149.25	142.96			
Guildford	WRMP19 Forecast	144.86	143.36	141.66	139.97	138.40
	Actual	157.94	148.30			
Henley	WRMP19 Forecast	140.08	139.50	139.02	138.71	138.47
	Actual	160.20	155.49			

187. AR22 average PCC (uplifted to dry year conditions) is lower than reported at AR21, but remains higher than that forecast in the WRMP19 in all WRZs.

188. This is likely to be due to customers spending more time at home due to COVID-19 restrictions. It is also noted that we experienced hot dry weather during the early months of 2020/21.

C.2.3 AMP7 Demand Management

Leakage

189. Table 18 presents out-turn year leakage (from B2.7) uplifted to dry year for comparison with the WRMP19 forecast, by WRZ.

Table 18: AMP7 Leakage tracker (vs WRMP19)

Total Leakage (Ml/d) (uplifted to Dry Year)		AR21	AR22	AR23	AR24	AR25
London	Actual	460.23	439.34			
	Forecast	483.56	465.80	445.03	424.27	408.20
	Variance	-23.33	-26.46			
SWOX	Actual	63.64	70.44			
	Forecast	59.74	58.19	56.64	55.08	53.56
	Variance	3.9	12.25			
SWA	Actual	39.73	44.72			
	Forecast	37.4	37.40	37.40	37.40	37.40
	Variance	2.33	7.32			
Kennet Valley	Actual	23.78	28.02			

Total Leakage (Ml/d) (uplifted to Dry Year)		AR21	AR22	AR23	AR24	AR25
	Forecast	26.2	26.20	26.20	26.20	26.20
	Variance	-2.42	1.82			
Guildford	Actual	16.11	18.73			
	Forecast	12.63	12.30	11.98	11.65	11.32
	Variance	3.48	6.43			
Henley	Actual	3.76	4.61			
	Forecast	3.58	3.58	3.58	3.58	3.58
	Variance	0.18	1.03			
Company	Actual	607.23	605.86			
	Forecast	623.11	603.47	580.83	558.18	540.26
	Variance	-15.88	2.39			

190. At company-level leakage is above the WRMP19 forecast position by 2 Ml/d.

191. Leakage remains below forecast in London WRZ. We have been able to keep leakage levels below forecast in London in 2021/22 as a result of our continued focus on leakage detection and repair productivity. London also continues to benefit from the rollout of smart meters.

192. Regretfully, leakage remains above forecast in the Thames Valley WRZs. In these zones 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 rural areas where customer demands fluctuate significantly in the summer. The Thames Valley region was most impacted by the resource and performance challenges faced during 2021/22, with repair performance in Thames Valley falling 26% short of our enhanced leakage plan. As part of our insourcing plan over the coming year, the repair teams in Thames Valley are planned to transition across first (during August 2022) to drive an improvement in performance as early as possible. These areas will need further focus in the coming year to restore leakage levels to those required.

193. Overall, we look ahead to AR23 with leakage in a positive position. We will continue to actively monitor and report on our leakage performance throughout the year.

Metering

194. In Part B2.8 we set out progress with the metering programme in 2021/22. In this section we will track the total number of progressive and optant meters to be installed during AMP7 and how this compares with the WRMP19 forecast (Table 19).

195. In the WRMP19 we included for progressive meter installation in London, SWOX and Guildford WRZs. We have focussed initially on installation in London, helping to target leakage reduction. The programme will be rolled out into the Thames Valley WRZs over the AMP7 period and has been reprofiled and expanded, through the Green Economic Recovery (GER) programme, which we highlighted as a potential 'opportunity' in AR21.

196. The GER programme will be a continuation of the Progressive Metering Programme, converting unmeasured households to metered account customers.

197. Our GER programme will install 200,000 smart water meters in our Thames Valley WRZs, by the end of AMP7.

198. There has been no delivery of the GER programme in 2021/22. We are forecasting to undertake the majority of GER delivery in 2023/24 and 2024/25. GER will require procurement, recruitment, stakeholder engagement and dig/installation scheduling in 2022/23.

Table 19: AMP7 Metering tracker

Metering (No.)		AR21	AR22	AR23	AR24	AR25
Progressive	Actual	44,137	94,454			
	WRMP19 Forecast	64,741	88,974	89,006	89,048	88,973
	Re-forecast incl. GER			133,705	153,999	143,784
	Variance	-20,604	+5,480			
Optant	Actual	12,353	21,006			
	Forecast	17,280	17,280	17,280	17,280	17,280
	Variance	-4,927	+3,726			
Total	Actual	56,490	115,460			
	WRMP19 Forecast	82,021	106,794	106,286	106,328	106,253
	Re-forecast incl. GER			150,985	171,279	161,064
	Variance	-25,531	+9,672			

199. Table 20 splits the progressive metering programme to WRZ level.

Table 20: AMP7 Progressive metering tracker (by WRZ)

Progressive Metering (No.)		AR21	AR22	AR23	AR24	AR25
London	Actual	44,120	94,067			
	WRMP19 Forecast	56,253	77,159	77,202	77,228	77,165
	Re-forecast			109,705	85,940	11,843
	Variance	-12,133	+16,908			
SWOX	Actual	0	0			
	WRMP19 Forecast	7,077	9,853	9,840	9,855	9,851
	Re-forecast incl. GER			14,957	28,905	56,036
	Variance	-7,077	-9,853			
SWA	Actual	0	0			
	WRMP19 Forecast	0	0	0	0	0
	Re-forecast incl. GER			0	15,673	30,384
	Variance	0	0			
Kennet Valley	Actual	0	0			
	WRMP19 Forecast	0	0	0	0	0
	Re-forecast incl. GER			0	16,777	32,524
	Variance	0	0			
Guildford	Actual	17	387			
	WRMP19 Forecast	1,411	1,962	1,964	1,965	1,957
	Re-forecast incl. GER			9,043	5,034	9,759
	Variance	-1,394	-1,575			
Henley	Actual	0	0			
	WRMP19 Forecast	0	0	0	0	0
	Re-forecast incl. GER			0	1,670	3,238
	Variance	0	0			

200. The water efficiency element of GER will run in parallel with the smart meter installation programme and will primarily involve the delivery of Smarter Home Visits (SHV) on newly smart metered household customers. These SHVs will target households with higher than average water use and/or continuous flows (e.g. internal wastage, leaky-loos), aiming to maximise the water savings benefit per visit and resolve high use and wastage, and enable these customers to convert to metered bills.

201. Overall, we expect the GER programme to deliver an additional c.18 Ml/d of demand reduction (leakage and usage) to the Thames Valley WRZs.

Water efficiency

202. There are no water efficiency activity-based performance commitments in AMP7. They have been replaced with a more general commitment to reduce demand as measured by PCC. See section C2.2 for the tracking of PCC against WRMP19 forecasts. Further information on water efficiency is provided in Appendix I.

C.2.4 AMP7 Supply enhancement

203. Our supply enhancement programme for AMP7 comprises five schemes in two WRZs and is summarised in Table 21.

Table 21: AMP7 Supply enhancement schedule

Scheme	WRZ	Resource Type	WRMP19 Target (Ml/d)	AMP7 Forecast (Ml/d)	AMP7 Delivery				
					20/21	21/22	22/23	23/24	24/25
RWE Didcot	LON	Licence Trade	18	24	24				
New River Head	LON	Groundwater	3	0	X				
ASR Horton Kirby	LON	Aquifer Recharge	5	0					X
Southfleet & Greenhithe	LON	Groundwater	8	0					X
Ladymead WTW	GUI	Groundwater / Constraint release	4.6	4.6					4.6
AMP7 Totals			38.6	28.6					
Cumulative AMP7 Delivery Profile					24	24	24	24	28.6

204. The new temporary licence trade agreement with RWE Npower at Didcot was signed and came into force from 1st April 2020 as planned. The increase in output from the trade is based on a reassessment of the benefits, rather than reflective of a material change to the agreement itself.

205. With the supply demand balance in the London WRZ remaining in surplus, the delivery of the New River Head scheme continues to be deferred and similarly, the delivery of the ASR Horton Kirby and Southfleet & Greenhithe Groundwater schemes are also now deferred beyond the end of AMP7. Despite delivery being deferred, development work has progressed on all three of these schemes in case they are required.

206. In Guildford WRZ, the groundwater enhancement/constraint release work at Ladymead WTW is on track, as is its optimised delivery with a new interconnector, the Shalford to Netley internal transfer main. This main will improve our ability to transfer water across Guildford WRZ, improving resilience in supporting our Albury/Netley WTW as well as providing additional supply to address growth in East Guildford.

207. Having progressed through the initial stages of investment governance and budget release, both projects are now defined, with delivery in Year 5 of AMP7.

C.2.5a Option Studies

208. 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 C.2.5.b).

Effluent Reuse – Deephams

209. The Deephams STW Reuse option was included as a preferred option in the adaptive pathway of our adopted WRMP19, subject to further investigations. It has a potential benefit to the supply demand balance of 46.5 Ml/d and was scheduled to deliver by 2030/31 in order to provide 1 in 200-year drought resilience for the London WRZ.

210. Treated effluent from the Deephams STW would be pumped to a discharge location on the River Lee Diversion and subsequently abstracted to supplement the raw water supply in the Lee Valley reservoirs.

211. The Environment Agency's representation on our revised draft plan included the recommendation to "Ensure that the Deephams option is feasible and does not pose a risk to the environment", due to concerns over environmental impacts on downstream habitats from reduced flows from Deephams STW; and in the estuarine Thames Tideway.

212. In response, we set out a programme of further research to ensure the option is compliant with the Water Framework Directive (WFD) Regulations before being progressed.

213. This further research has been carried out with extensive collaborative working with the Environment Agency throughout, including 10 meetings with Hertfordshire and North London Area Environment Agency staff. This has led to the adoption of a Methodology Report for the assessment which included scope development, assessment criteria and assessment methods.

214. Following completion of our further studies and review of the findings with the Environment Agency a statement of common understanding is being agreed regarding the potential environmental effects of the option. It will establish that Deephams STW Reuse option does have potential environmental risks.

215. At times of operation, it is considered that a Deephams STW Reuse option would reduce flow in reaches of the River Lee downstream of Deephams STW. For the stretch of the Lower Lee impacted by the scheme, the WFD classification for hydrological regime is 'Does not support Good'. In the Water Resources National Framework, the Environment Agency utilised a bespoke spreadsheet tool (Waterbody Abstraction Tool) to estimate

water balance deficits in 2050; and some of the reaches downstream of a Deephams STW Reuse option have been identified to have a water balance deficit. For the Lower Lee, the calculated deficit is substantial and ranges between 425-521 Ml/d under a range of scenarios for the reach impacted by this scheme. The WRSE Regional Group is working with water companies and the Environment Agency to develop the most appropriate environmental ambition scenarios for the South East to redress these deficits.

216. The flow reduction associated with a Deephams STW Reuse Option is therefore contrary to the environmental ambition for these waterbodies as laid out by the Environment Agency Waterbody Assessment Tool (2021) and adopted by WRSE, if the scheme were implemented before 2060, after which schemes such as Beckton Reuse will be able to provide compensatory flows. No further work on the environmental risks of a Deephams STW Reuse option before this point, or work to identify bespoke mitigation of the risks, will satisfactorily resolve the risk in the absence of a compensatory scheme.

217. As such, after detailed discussion of the findings, we have withdrawn the option as the preferred WRMP19 option and also as a feasible option from future WRMPs in the medium-term period to 2060.

218. Our WRMP19 proposed alternatives to the Deephams option, should it not be available. These are currently being progressed as part of the Strategic Regional Options Studies (see below).

219. We continue to work with WRSE to establish which alternative should be developed and when, ahead of a key decision point for the delivery of any scheme in 2022/23.

C.2.5b Strategic Regional Option Studies

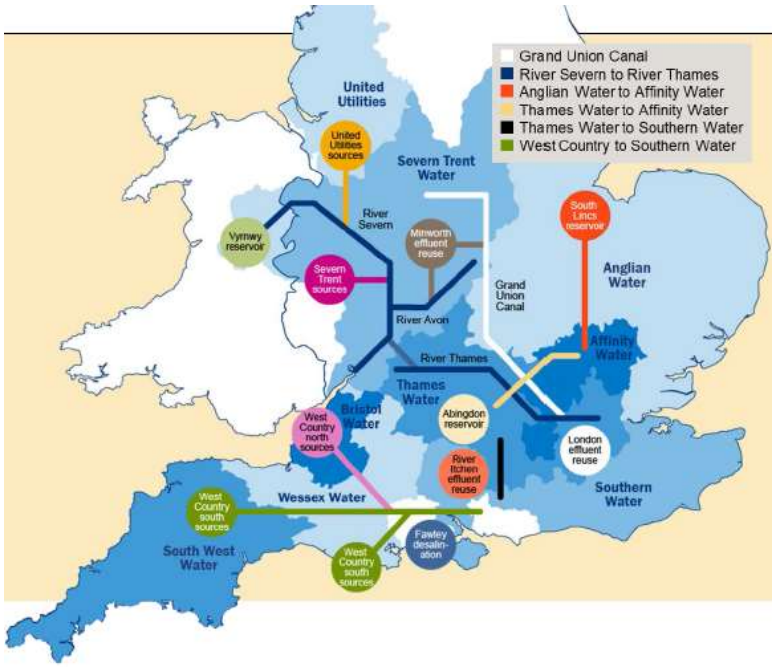
220. In August 2018, Defra, Ofwat, the Environment Agency (EA) and the Drinking Water Inspectorate (DWI) wrote to water companies setting out their expectation for increased ambition in water resources planning to transcend boundaries, enhance resilience and increase efficiency. A number of water companies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

221. To facilitate this work Ofwat proposed development funding[14] 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.

222. The development work involves nine water companies and 17 potential solutions (see Figure 5 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 (eg. WRSE).

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

Figure 5: Strategic water resources solutions map



223. A new organisation, called the Water Regulators' Alliance for Progressing Infrastructure Development, or RAPID[15], has been established to oversee progress of the strategic resource solutions. RAPID was formed post-WRMP19 to provide a regulatory interface to support the industry in promoting the development of national water resources infrastructure in the interests of water users and the environment.

224. 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.

225. 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 should be progressed to the next stage of activity with confirmation of further funding, or not viable and the work should be concluded.

Table 22: Strategic regional options – development gates

Gate	Date	Activities include
1	5 July 2021	Initial concept design and decision making
2	November 2022 (Draft WRMP24)	Detailed feasibility, conceptual design and multi-solution decision making
3	Summer 2023 (Final WRMP24)	Developed design, finalised feasibility, pre-planning investigations and planning applications
4	Summer 2024	Planning applications, procurement and land purchase

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

Gate	Date	Activities include
5	2025-2030	Land purchase and finalising development consent orders

226. Dates for Gate 3 onwards are to be agreed with RAPID and are expected to vary between the different SROs, dependent on programme requirements of the individual SROs and the timing of the options in the regional plan / WRMP24.

227. During AMP7 we are undertaking joint technical studies into five potentially regionally significant 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.

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

- The following summary comments apply to all:
- Independent project managers have been appointed
- Third party assurance is in place
- An All Company Working Group (ACWG) is in place to provide consistent methods, which are reviewed by RAPID.
- The Environment Agency and Natural England have established a National Appraisal Unit that 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 and there is regular engagement on the technical and engagement work to inform the development of the schemes.
- The Gate 1 assessment was satisfactory for Severn-Thames Transfer and good for the other four schemes. All expenditure was considered appropriate and efficient.
- Option cost and benefits data has been provided to the WRSE to facilitate development of the regional best value plan.
- All SROs are on target to meet the requirements of Gate 2. The reports will be publicly available in November 2022, so only summary progress information is provided here for each SRO.
- It is anticipated that all of the five SROs will go forward to Gate 3.

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	Maximum of 271 Ml/d (150 Mm^3 option)
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	There are 6 scheme variants under consideration (size and phasing)
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

229. This option is on track to meet Gate 2. The scheme development has proceeded to plan with all key milestones met, including regional data submissions to WRSE in February 2022.

230. Given a substantial amount is already known about the SESRO options, the design of the major components of SESRO has not significantly changed since WRMP19. Six variants of reservoir size and phased development are being considered.

231. Work carried out for Gate 2 has focused on studies to reduce uncertainty related to three main aspects – flood risk review, rail access and visitor movement strategy – and has also undertaken extensive work on the embankment design to reflect stakeholder concerns, the alignment of the intake tunnel to avoid new developments and the design of the auxiliary drawdown channel.

232. Further environmental assessment has been undertaken in accordance with the methodology in the ACWG and WRMP environmental assessment guidance. Further analysis has been completed to confirm expected compliance under the Water Framework Directive. Adverse environmental impacts, especially during construction are noted and have been explored further for Gate 2 via a series of technical 'desk-based' assessments to confirm initial plans for mitigation. Major benefits are possible through biodiversity gain and recreational / amenity use. A new landscape Master Plan for the 150 Mm^3 scheme has been developed for Gate 2 to guide environmental assessment and stakeholder engagement.

233. Measures have been put forward to control all identified water quality risks. There are potential risks of algal growth within the reservoir, but these can be mitigated through mixing. Modelling confirms that the discharge, in general, is likely to result in slightly better water quality in the River Thames.

234. Our stakeholder engagement plan has two parts: firstly, activity to inform the development of the South East regional plan to ensure stakeholders understand how SESRO, and other SROs, fit within the strategic planning framework; and secondly, SESRO specific discussions.

235. To guide SESRO specific discussions to Gate 2, the focus has been on exploring areas of specific impact, concern or stakeholder feedback to ensure that final optioneering and selection of an initial preferred scheme can occur before Gate 3 as the scheme develops towards a DCO submission in 2026. Close collaboration with the WRSE regional modelling has taken place, to investigate the sensitivity in the choice and timing of SESRO relative to competing alternatives and the relative benefits and risks with alternative strategies.

Status

236. Six options (different storage volumes and phased development) have been considered for SESRO (the same as WRMP19). Gate 2 is expected to recommend that the largest SESRO option proceed to Gate 3, but with all other schemes retained as feasible alternatives. This recommendation will be guided by the WRSE regional plan and WRMP24 strategies.

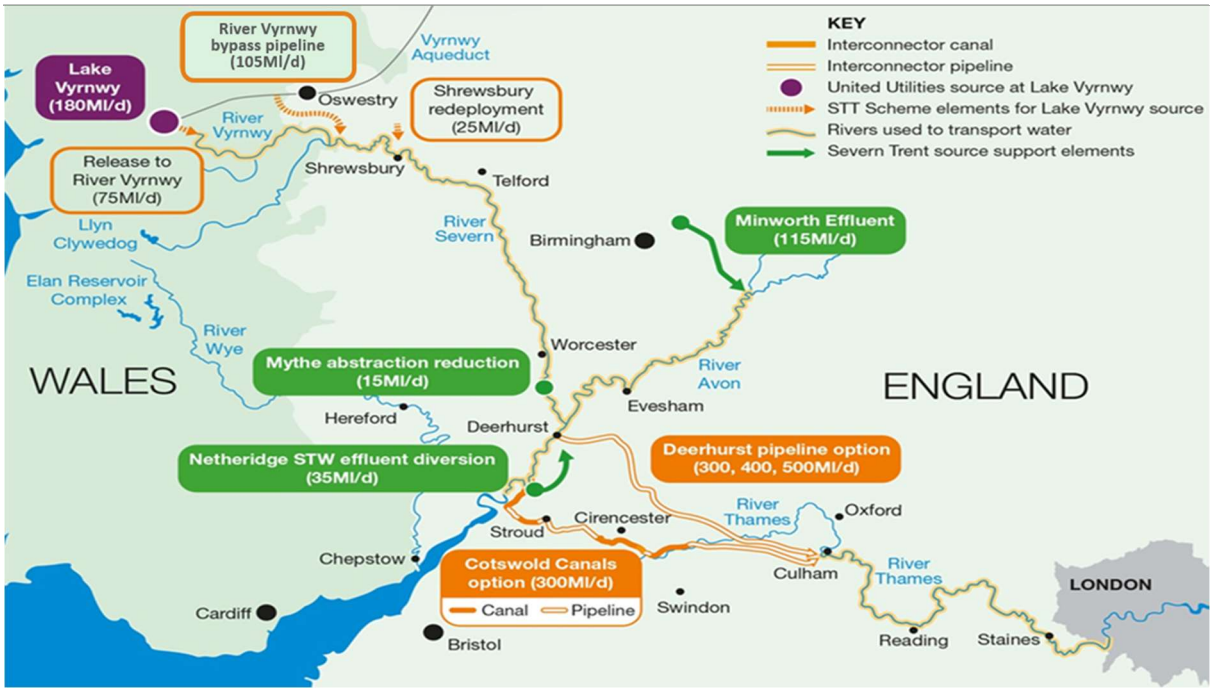
237. The solution proposed by both partners in their Final WRMP19, a 150 Mm3 storage reservoir shared between TW's London WRZ and AFW's Central Region, remains the preferred solution. None of the investigations undertaken for Gate 1 or Gate 2 change this conclusion although extensive further investigations are required to fully understand both impacts and benefits.

238. The alternative options at the site have been put forward to the regional WRSE modelling, to test this previous preference and ensure the best value option is selected.

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 River Severn to River Thames Transfer (STT) would convey raw water from the River Severn into the River Thames via an interconnector. The preferred 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. The source of the water would be from excess flows occurring within the River Severn and from additional support sources which would provide additional flows into the River Severn for transfer purposes. These support sources include: Lake Vyrnwy; the diversion of enhanced treated effluent from Minworth STW to the River Severn via the River Avon; the diversion of the current Netheridge STW effluent discharge further upstream on the River Severn; other sources from Severn Trent and United Utilities such as releasing current licensed water treatment abstraction capacity at Mythe and Shelton WTW; as well as the opportunity to supplement this in the future from other sources. To mitigate any adverse environmental effects of Lake Vyrnwy discharges into the River Vyrnwy a bypass pipeline is required from the Vyrnwy Aqueduct at Oswestry WTW into the river system further downstream from the head of River Vyrnwy.
Scheme yield	Current interconnector capacity sized from 300Ml/d up to 500Ml/d providing a DO benefit of 250-400 Ml/d
Lead time	10 years
Location	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. The bypass pipeline runs from Oswestry with options to discharge into the River Vyrnwy at Llanymynech or River Severn upstream of Shelton.
Sub-options	As an alternative to a pipeline only interconnector, a solution utilising pipelines plus existing and currently disused sections of the Cotswold Canal has been assessed. This option, with a

	maximum capacity of 300 Ml/d, abstracts water from the River Severn near Gloucester Docks into the Gloucester and Sharpness Canal. Water would then be pumped up to the Sapperton Tunnel, with options including restoration of the tunnel. The canal to the east of Sapperton 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.
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: North West transfer (United Utilities); Vyrnwy Aqueduct; Minworth Effluent Reuse (Severn Trent) and; other Severn Trent sources. Not all support options may be required, depending on the capacity of the STT that is selected.
Illustration of the scheme	



Progress

239. The SRO is on track for Gate 2. Updated data were provided to WRSE in February 2022 for development of the best value plan for WRSE regional plan and WRMP24.

240. This is an ambitious, strategic project to provide additional capacity of raw water to the South East of England during drought events. At the project's heart is the Interconnector which enables the transfer of raw water from the River Severn to the River Thames.

241. Due to the risk of concurrent droughts in both river catchments, additional sources of water, apart from those naturally occurring in the River Severn, have been identified to augment the baseline flows. These multiple diverse sources of additional water provide resilience in the provision of raw water flows to the River Thames.

242. The scheme capacity of 300 to 500Ml/d equates to a Dry Year Annual Average Deployable Output benefit of 250 to 400Ml/d to the South East. The regional planning process will determine the need for the scheme and the volume, timing, and utilisation of water to be transferred as part of an adaptive, best value solution.

243. The diversity of sources means they can be developed in a phased manner to meet the ultimate demand profile as determined by the regional planning.

244. The interconnector includes a treatment plant to mitigate potential impacts on water quality or from invasive species on the River Thames.

245. To ensure that the required volume of water can always be transferred, a 'put and take' arrangement has been agreed in principle with the Environment Agency (EA) and Natural Resources Wales (NRW).

246. This agreement will need to be formalised through a review of the river regulation of the River Severn. The agreement in principle means that if additional source water is 'put' into the river then the Interconnector can 'take' that volume, less River Severn catchment losses, regardless of the baseline flows in the River Severn itself.

247. A permitting strategy is being developed to enable the operation of the scheme. The work to date shows there is no need to amend the Act controlling regulation of the River Severn. The various abstraction, transfer and discharge licenses and permits and associated operating agreements that will need to be revised and or added has also been established.

248. River losses have been estimated based on physical trial water releases into the River Severn system, River Avon modelling and other statistical analysis. The losses now proposed represent a moderate reduction when compared to the WRMP19 position.

249. We have examined the available evidence and data to determine the potential environmental effects of implementing and operating the STT scheme, consistent with the All Company Working Group (ACWG) methodologies. Where the assessments identified the potential for adverse effects, we have proposed mitigation measures.

250. We applied the ACWG cost methodology and have estimated the capital costs for the bypass and Interconnector options.

251. Our review of the planning and procurement requirements on the project have highlighted that the Interconnector can be advanced through a DCO planning route and is suitable for procurement through a DPC model, or similar.

252. A commercial operating model for the STT system has been developed setting out possible roles and commercial arrangements between the suppliers and users of the water. This will be tested and developed further with the regulator and other parties as the scheme progresses.

253. Our customer and stakeholder engagement to date has concluded that there is support in principle for transferring water to the South East in times of drought. Customer

research studies undertaken by WRW and WRSE confirm that customers see a role for water transfer schemes and favour them over other supply options such as desalination. Feedback from the WRSE and WRW emerging Regional Resilience Plan consultations saw strong support for the transfer of water between regions.

254. Our engagement approach as we complete Gate 2 is to undertake targeted engagement with key stakeholders identified in our updated stakeholder plan. This is focused on engaging with stakeholders interested in the interconnector and River Vyrnwy; the two key elements that underpin the SRO.

255. If the STT scheme is selected as an option in the WRSE Regional Plan and company WRMP24 plans, then the project will commence detailed engagement with stakeholders and the public. This will include non-statutory consultation regarding the preferred and alternative routing options for the Interconnector.

256. Continued engagement is important as it will help to shape and challenge each stage of the scheme development. It will also ensure a scheme is developed that is both feasible and supported by the customers and stakeholders it affects.

Status

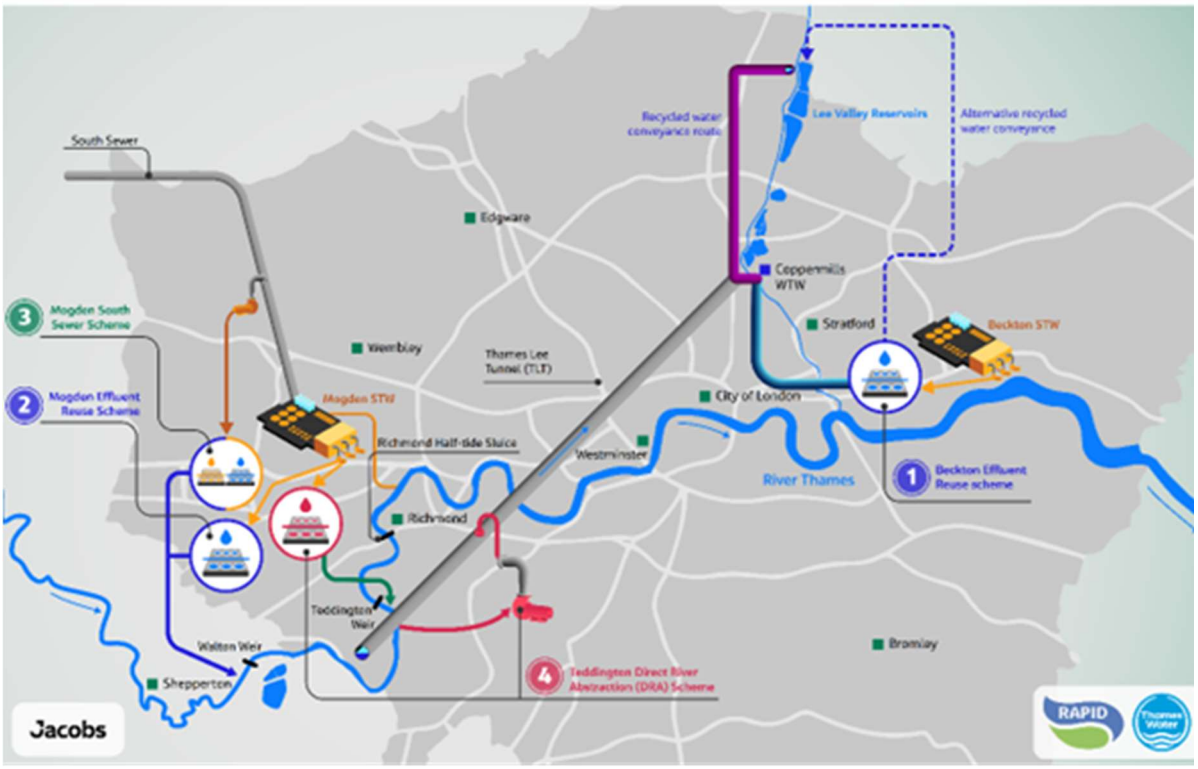
257. No 'showstoppers' have been identified during the Gate 2 process, however the conceptual design has been developed to take account of new information.

258. Recommendations on options to progress to Gate 3 will be based on outputs of the Gate 2 assessments and the draft regional plans.

Effluent Reuse

Scheme name	London Effluent Reuse
Collaborators	Thames Water
Description	The London Effluent Reuse SRO comprises 4 potential schemes: **Teddington DRA**: Mogden STW effluent would be subject to tertiary treatment at a new plant on the STW site. The treated effluent would be transferred to a discharge location upstream of Teddington Weir. The tertiary treated effluent discharge would directly compensate flows taken from a new abstraction on the River Thames, upstream. The abstracted water would be pumped into the nearby Thames Lee Tunnel (TLT) for transfer to the Lee Valley reservoirs in East London. **Mogden Effluent Reuse:** Final effluent from Mogden STW will be pumped to a new Advanced Water Recycling Plant (AWRP) location, south west of Kempton WTW. The recycled water would be discharged into the River Thames upstream of the existing Thames Water Walton intake. **Mogden South Sewer:** Sewage would be abstracted from the South Sewer which supplies Mogden STW and pumped to a new sewage treatment and AWRP near Kempton WTW for treatment. Recycled water would be discharged into the River Thames upstream of the existing Walton intake.

	Beckton Effluent Reuse: Final effluent from the Beckton STW would be treated at an AWRP within the STW boundary. The recycled 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	There are a range of sizes under consideration for each scheme with 46-252 Ml/d DO benefit. Combinations of options are feasible.
Lead time	8-10 years depending on scheme size and combination.
Location	**Teddington DRA:** The discharge and abstraction points are located upstream of Mogden STW in Isleworth, West London. **Mogden Effluent Reuse & Mogden South Sewer:** The proposed new site is located at near Kempton WTW, Hampton, West London. Recycled water is discharged to the River Thames upstream of the Walton weir. **Beckton Effluent Reuse:** The effluent is treated at a new AWRP adjacent to the Beckton STW site in the London Borough of Newham, East London. The discharge location is upstream of the the King George V Raw Water Reservoir in Enfield, North London.
Sub-options	The west London options could potentially provide a resource to Affinity Water by discharging further upstream on the River Thames, this is being considered as part of the TW to Affinity Transfer SRO. Similarly, the Beckton Effluent Reuse option could provide a resource in the River Lee for Affinity Water to abstract as part of the TW to Affinity Transfer SRO (T2AT).
Illustration of the schemes	



Recipients of the water	Thames Water (Potential for supply to Affinity Water from Mogden, Teddington and Beckton options.
Inter-relationship with other schemes	Could provide a resource for Thames to Affinity Transfer either in East or West London
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. The reduction in freshwater inputs to the Tideway should be limited to mitigate potential impacts on sensitive ecological receptors and therefore there is a limit to the total yield of water reuse, desalination and DRA schemes in east London.

Progress

259. The scheme is on-track to meet Gate 2 and no ‘showstoppers’ have been identified.

260. Maximum capacities of each option will be reviewed for Gate 2 to reflect the outcomes of the environmental assessments.

261. Updated data were provided to WRSE in February 2022 for development of the best value plan for WRSE regional plan and WRMP24.

262. Each conceptual design has been developed to an equal level which has enabled technical and environmental appraisal and water quality assessments.

263. The WRSE draft Regional Plan outcomes will be used to determine what combinations, sizes and phasing is required to deliver the need and best value to the customer at Gate 2. Water reuse has a degree of scalability, which is offered via phased DO configurations for the effluent reuse schemes.

264. ACWG costing methodology has been applied in our Gate 2 submission demonstrating that the costs at Gate 2 have been refined but remain comparable with those presented at Gate 1 and WRMP19.

265. Environmental and drinking water regulatory assessments are on track to be completed for Gate 2. The environmental assessment has been undertaken in accordance with the methodology set out in the ACWG to ensure consistency. We have extensively engaged with multiple stakeholders to develop an agreed evidence base and shape environmental assessments for Gate 2.

266. A research programme coordinated by WRSE to examine customers' views on resilience planning, supply and demand options, sharing resources and the SRO has confirmed that customers are prepared to accept the promotion of effluent reuse subject to compliance with water quality, environmental and navigation requirements.

267. For some customers it is difficult to get past the "yuck factor" associated with reuse of wastewater. There is some evidence that the more informed customers become, the more they recognise the benefits. The challenge is therefore to improve communication about water reuse to lessen the perceived concerns of customers.

Status

268. Based on the delivery and construction programmes developed for Gate 2, the SRO would meet the RAPID requirement to be "construction ready" in Asset Management Plan 8 (AMP8).

269. The Gate 2 submission is likely to confirm that all schemes presented are feasible and can be delivered within the timeframes set out by RAPID and if required as early as 2030 as set out in WRMP19, but with delivery risks due to timing of decisions to progress through WRMP24 and planning stages etc.

270. Recommendations on options to progress beyond Gate 2 will be based on outputs of the Gate 2 assessments and the WRSE Regional Best Value Plan.

Thames to Affinity transfers

Scheme name	Thames to Affinity Transfer (T2AT)
Collaborators	Affinity Water, Thames Water
Description	A transfer of raw water from Thames Water's London WRZ to Affinity Water's Central Region. The potential sources of water are: • South East Strategic Reservoir Option (SESRO) • Supported Severn Thames Transfer (STT) • London reuse (Mogden, Beckton, Teddington DRA) 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.
Scheme yield	50-100Ml/d
Lead time	Dependent on the supporting scheme
Location	Raw water from the West of the Region could be taken from a new or from existing AFW abstraction points on the River Thames or directly from an existing TW reservoir. Raw water from the East of the Region would come from the River Lee, supported by a reuse scheme.
Sub-options	There are 8 shortlisted variants to the scheme.
Illustration of the scheme	
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

271. WRMP19 identified the need to investigate and shortlist combinations of transfer routes with either reservoir storage, effluent reuse or trading resources. The WRMP19 options have been robustly reviewed and challenged, resulting in an unconstrained list of 33 possible alternatives. The transfer could be derived from various new sources of water, either from the Thames upstream of Teddington Lock or from existing treated effluent in the Thames Tideway (sharing of resources from the London Reuse SROs).

272. Options screening has enabled eight newly short-listed options to be configured, costed and submitted into the regional modelling process. The WRSE modelling and further options appraisal has identified two leading options, one in west London and one in east London.

273. The emerging draft WRSE regional plan (January 2022) selected two T2AT schemes, one supported by SESRO and one supported by the Beckton effluent reuse scheme. These two leading solutions for the transfer scheme have both been developed and refined for Gate 2 to identify and assess a preferred working solution for each.

274. Any additional natural streamflows, which may be delivered through future reductions in chalk groundwater abstraction by Affinity Water (AFW), may be used by these options as extra resource for London or else potentially to augment flows upstream of any new raw water abstraction. Such streamflow benefits are built into the deployable output modelling as part of the representation of reductions to Affinity Water's existing groundwater abstractions, driven by their Environmental Destination commitments.

275. Although the primary driver for T2AT is dry year peak conditions, the scheme also is expected to be needed during average operating conditions if there are future sustainability reductions at existing groundwater sources. Therefore, scheme design enables day-to-day operation at low utilisation (at c.25% capacity) but then relatively rapid increase to peak operating capacity. Utilisation of about 80% is expected during most summers, with 100% utilisation during more extreme droughts.

276. The environmental impacts of the construction of each option would be similar across all options, with some negative but largely temporary impacts expected. There are opportunities for habitat creation and enhancement at WTW sites.

277. Proposals to share water between regions are treated positively by customers, but transfers tend to be less favoured than demand options and supply options such as reservoirs.

Status

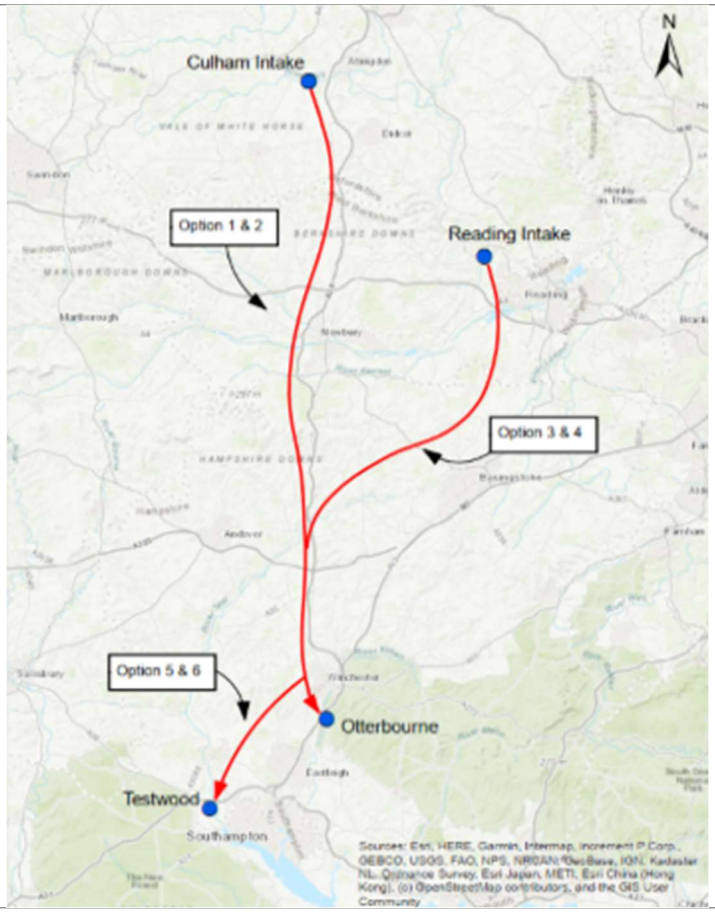
278. The T2AT is a viable solution for a transfer of raw water from Thames Water's London WRZ to Affinity Water's Central Region. The T2AT partners have worked collaboratively to review this proposal and can confirm that no 'showstoppers' have been identified.

279. Gate 1 assessment expanded the possible source water alternatives for the T2AT, to include other raw water sources into the Thames Basin and possible sharing of effluent reuse schemes in London. All feasible options have been submitted to the WRSE regional planning process, to help develop an adaptive, best value water resource strategy choice for the South East.

280. The Gate 2 submission will confirm which of the options should be progressed to Gate 3 based on Gate 2 and the WRSE Best Value regional plan.

Thames to Southern transfers

Scheme name	Thames Water to Southern Water Transfer (T2ST)
Collaborators	Thames Water, Southern Water
Description	This option involves a bulk transfer from Thames Water to Southern Water's Hampshire zones.
Scheme yield	50 to 120 Ml/d.
Lead time	9 years, but dependent on the development of SESRO and/or a Severn Thames Transfer to provide the resource.
Location	The transfer would start at Culham and water would be delivered to service reservoirs close to Otterbourne WTW, with the potential for spur mains delivering water to other locations en route.
Sub-options	Two alternative routes between Culham and Hampshire are being considered.
Recipients of the water	Southern Water
Inter-relationship with other schemes	The proposed options all require a new raw source of water from Thames Water's area. The source of water will be either SESRO and/or the supported STT. There are also other potential solutions to the long-term water supply needs of the Hampshire supply area which will directly affect the needs case for the scheme.
Exclusivity or dependency with other schemes	The options are dependent on the delivery of the SESRO and/or supported STT.
Illustration of the scheme	



Progress

281. The SRO is on-track to meet Gate 2 and no 'showstoppers' have been identified.

282. The scheme development has proceeded to plan with all key milestones met, including regional data submissions to WRSE in February 2022

283. The six feasible options identified at Gate 1 have been subject to a further detailed option appraisal in Gate 2. As a result of this assessment, carried out in consultation with the National Assessment Unit (NAU), the four raw water transfer options have been rejected on cost and environmental grounds.

284. The configuration of the remaining two potable transfer options, including preliminary pipe route alignments, and outline locations of water supply works, pumping stations and storage tanks have been developed and assessed for inclusion in WRSE regional modelling.

285. Through discussion and agreement with the WRSE regional planning team, 50Ml/d, 80Ml/d and 120Ml/d scheme capacities have been considered. A 200 Ml/d option was also provided to WRSE to ensure that the upper limit of the transfer was not unduly constrained, however this capacity has not been selected in the modelling and has not been developed further.

286. Further route and site selection assessment during concept design concluded that the potable transfer from Culham should be taken forward as the preferred option to Gate

2, with two alternative pipe route sub options. The potable transfer from Reading is not preferred due to high planning risk and water resource planning considerations.

287. Utilisation of the T2ST is dependent on the outcome of the WRSE regional modelling and will be determined as part of the Gate 2 investigations. At this stage it is expected that the transfer would only be required in periods of extreme drought but increased utilisation of the transfer may be required to meet the longer-term supply-demand balance of the Hampshire region depending on the implementation and timing of other schemes and future environmental destination targets. The utilisation of the transfer will also be dependent upon the required sweetening flow for the preferred option. A minimum flow rate of 15% maximum design capacity has been adopted for Gate 2 to minimise operational costs and the volume of water transferred to the SRN network during normal year operation.

288. An environmental assessment has been undertaken on the two potable transfer sub-options from Culham which has included a Habitats Regulations Assessment (HRA); a Water Framework Directive (WFD) Assessment; and a Strategic Environmental Assessment (SEA) level options assessment. In addition, the risk of spreading invasive non-native species associated with the options has been investigated; Biodiversity Net Gain and Natural Capital assessments have been undertaken; the wider benefits of the scheme have been reviewed; and opportunities to contribute to net zero carbon emission objectives were investigated.

289. The combination of these environmental assessments and studies shows that positive benefits will likely result from operation of the T2ST scheme through the scheme improving water transfer, water resource management and resilience of water supply and the scheme providing protection against future drought scenarios. Construction of the scheme will likely result in some negative effects, mostly temporary, even with the application of mitigation measures. The potential for permanent or long-term effects on high value habitats and landscape features and cultural heritage assets will be further assessed at Gate 2.

290. The T2ST was not included in Southern Water's or Thames Water's WRMP19 as a preferred option and therefore there was no specific stakeholder engagement on this scheme for WRMP19. In principle there is support for sharing water resources subject to sufficient resources, compliance with water quality and environmental requirements, and responsiveness to local issues and concerns. Our work programme and engagement plan to Gate 2 was developed with this in mind.

Status

291. The T2ST is a viable solution for a transfer of raw water from Thames Water's supply area to Southern Water's WRZs. The T2ST partners have worked collaboratively to review this proposal and can confirm that no 'showstoppers' have been identified.

292. The Gate 2 submission will recommend which options should be progressed to Gate 3, based on the Gate 2 assessments and draft regional plan. It is expected that the SRO will continue with further focussed assessment to identify a single preferred route and size at Gate 3.

293. Upon receipt of the outcomes from the draft regional plan, the overall need, timing and capacity of the scheme will be confirmed and a decision on whether the scheme should continue beyond Gate 2 can be made.

C.2.6 Regional Need – WRSE

Regional Planning

294. 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.

295. The Environment Agency's National Framework for Water Resources[16] (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.

296. 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.

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

298. 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.

299. The 2022/23 date aligns 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.

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

WRSE Progress

301. WRSE has developed 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.

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

302. 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.

303. As well as the assessment of deployable output, the close collaboration between WRSE companies has resulted in methodological consistency for other key components of the supply-demand balance. For example, WRSE companies have aligned approaches to demand forecasting, outage allowance calculation, weather datasets, and climate change impact calculation.

304. WRSE has developed a model which can conduct multi-objective optimisation, using adaptive planning methods. The outputs from this model will be used to derive the TW best value plan. The use of a single investment modelling platform has required the development of consistent input datasets.

305. Through the Regional Planning process, WRSE companies have reviewed one another's option lists in order to ascertain whether options deemed unnecessary/unsuitable for one company may be useful for another.

306. WRSE has developed options involving transfers between WRSE companies which had not previously been considered.

307. Environmental assessments are being undertaken through WRSE, which will drive alignment.

308. This work is being undertaken in parallel to the Strategic Regional Options development work (see C.2.5b). This ongoing programme of studies will inform the selection of strategic options as part of the best value WRSE regional investment programme.

309. In January 2022, WRSE published its emerging Water Resources Regional Plan for a period of public consultation. The emerging plan gave early sight of the big issues and emerging solutions to gain initial feedback from stakeholders. The consultation was a step in an ongoing process of plan development, and not yet a formal preferred plan.

310. The consultation took place over an 8-week period between January and March 2022 and over 1,150 responses were received.

311. The outcomes of the consultation will provide useful insight and guidance as the final steps of the best value planning process are completed, and a preferred, adaptive plan is selected.

312. The draft Regional Plan will be published and consulted on alongside company WRMP's in autumn 2022.

C.2.7 Environmental Need – WINEP

AMP7 Environment Programme

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

314. 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.

315. The WRMP19 includes two sustainability reductions by the end of 2024/25. One at Hawridge in SWA WRZ, the other at North Orpington in London WRZ.

316. 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). Options appraisal is complete, and the scheme is undergoing design phases. Outline design and detailed design is being progressed and any EIA needs being identified. Delivery is planned to follow design and resolution of environmental issues related to the pipeline route and there is a risk that delivery may be completed after the target date of March 2025.

317. The reduction on the Cray followed investigation at Bexley and the options appraisal identified a reduction further upstream at North Orpington as the preferred option. The reduction at North Orpington replaces the original solution of reduction at Bexley as it provides benefit to a greater length of the River Cray. The reduction would be from the current licence of 9.07 Ml/d to zero, a loss of 9 Ml/d of DO.

318. The North Orpington scheme is also undergoing design development. Outline design and detailed design is being progressed. Delivery is planned to follow design. The design review phase and strategic considerations for the optimum solution have resulted in changes from the originally identified solution and this means there is a risk that delivery may be completed after the target date of March 2025.

Likelihood and magnitude of further sustainability reductions in the future

319. Our WRMP19 included scenarios looking at the potential impact of further sustainability reductions to ensure 'no deterioration' under the Water Framework Directive and also address the potential impact of abstraction on vulnerable chalk streams.

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

321. We have been working with the WRSE and the Environment Agency to identify the likely requirements for sustainability reductions to meet the Environmental Ambition in relation to chalk streams and other sensitive rivers in the region.

322. We have reviewed the initial scenarios from the WRSE work on Environmental Ambition and have worked with the Environment Agency to agree scenarios to be used for the regional modelling.

323. We have developed scenarios to reflect what we think are plausible future programmes for sustainability reductions and these have been used in the regional modelling to provide an indication of the potential affordability of sustainability reductions that can be implemented in the medium and longer term. The scenarios we proposed were termed 'Company Central' and 'Company Alternative', and were in addition to the 'Business as Usual' (BAU) and 'Enhanced' scenarios that had already been put forward by the Environment Agency to be evaluated as part of the WRSE WRMP24 investment modelling.

324. Following the development of the BAU, Enhanced and Company-defined scenarios, we have conducted further development of these scenarios in collaboration with the EA, and have provided Low, Medium and High (High being based on the Enhanced

scenario) scenarios for the WRSE modelling to show the impact of differing levels of environmental ambition.

325. The volumes of DO reduction by 2060 for each of the scenarios are Low – 109Ml/d, Medium - 228Ml/d, High - 536 Ml/d.

326. The Environment Agency has also recently issued guidance covering the requirement for licence capping to recent levels of abstraction to protect water bodies from potential risk of deterioration, based on an interpretation of the Water Framework Directive. This guidance has only recently been received (finalised data was received near the end of May) and so the potential reductions in DO are still being considered. A key issue for the outcome of this consideration will be whether licences should be capped at recent actual average level of abstraction or can be capped at recent actual peak annual abstraction. Initial analysis suggests that there could potentially be a significant impact on the DO for London due the capping of the Northern New River Wells at RA and for sources in SE London. There may also be licence caps required in the SWOX WRZ that would present significant challenges for supply/demand balance solutions in the next AMP due to the strategic nature of any solution required for even a small amount of DO.

West Berkshire Groundwater Scheme (WBGWS)

327. The WBGWS is an important augmentation scheme which is managed by the Environment Agency. 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.

328. This analysis 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.

329. The Environment Agency is making significant investment in the WBGWS abstraction assets with a programme of work continuing during AMP7. This investment should extend the assumed asset life of the scheme well beyond 2031, reducing the likelihood of future losses in benefit in the future.

330. We have continued to discuss testing the WBGWS with the Environment Agency and planned testing in 2022 has been deferred. This is largely as a result of the ongoing refurbishment and upgrade work being undertaken by the Environment Agency. We are working towards joint testing of some elements of the scheme after these works are completed, aiming to assess more rigorously the WBGWS drought yield and benefits. The timing of the testing will, in part, be dependent on weather and resourcing, but it is likely to continue into AMP8.

C.2.8 Resilience Need

331. Our WRMP19 included an allowance for increased drought resilience from 1 in 100-year to 1 in 200-year in 2030/31. We also included scenarios to explore what additional investment would be needed to deliver 1 in 500-year drought resilience.

332. Since publication, there has been clear guidance from government, as incorporated into the WRPG for WRMP24, that greater drought resilience is necessary and that all future planning should demonstrate resilience to extreme 1:500 drought.

333. The increased level of public water supply drought resilience translates into an annual chance of no more than 0.2% that Emergency Drought Orders would need to be imposed.

334. This planning assumption is in line with the recommendation from the National Infrastructure Commission.

335. The National Framework states that this level of drought resilience 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.

336. 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.

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

C.3 WRMP19 Validity Statement

338. On the basis of the updates described above we consider the status of our WRMP19 is as follows:

Table 23: WRMP19 Validity Statement

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

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

Table 24: WRZ-level status

WRZ	Status	AMP7 Programme
London		Due to the favourable position in the supply demand balance, we have deferred three groundwater options in London.
SWOX		As reported at AR21, the peak supply demand balance in SWOX is tighter than anticipated in the WRMP19. We have taken steps to bring forward demand management in this zone (and across the Thames Valley WRZs) to ensure we remain in surplus. We are confident that we can maintain a secure water supply.
SWA		No changes
Kennet Valley		No changes
Guildford		No changes
Henley		No changes

Part D – Forward Look

D.1 Challenges, risks, and opportunities

340. 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 – Maintaining and Improving Performance on Leakage and Consumption Reduction

341. Our WRMP19 includes measures to deliver significant reductions in per capita consumption (PCC) and leakage over the planning period, including ambitious targets for AMP7. It is important that we deliver measures that we set out in WRMP19 to ensure current security of supply, and to set us on the path to delivering 50% leakage reduction by 2050. Our customers see measures to reduce leakage and measures to enable consumption reduction as good options.

342. Our leakage performance in the AR22 reporting year has been positive, with leakage in London having been reduced by around 22Ml/d since AR21 and being significantly below the WRMP19 Final Plan forecast. Leakage at the company level is 1Ml/d above the WRMP19 Final Plan forecast, due to challenges in several Thames Valley zones.

343. In years 3-5 of AMP7 we will need to maintain our focus in the London WRZ to continue to see leakage reduction in the zone, and will need to do more across Thames Valley. Issues seen in some Thames Valley WRZs which resulted in increased leakage are believed to be temporary issues, and so recovery should be feasible.

344. The most effective way of reducing leakage is asset replacement. While in the short term this method is an expensive option compared to alternatives such as 'find and fix' and household metering (identifying customer-side leakage), '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.

345. 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 its leakage reduction targets.

346. PCC has fallen in each of our WRZs from AR21 to AR22, but is still above the WRMP19 Final Plan forecast for PCC by 5-15l/h/d. The gap between forecast and current PCC is largest in the SWOX and SWA WRZs, and we believe that a significant proportion of this gap is due to shifts in working and living habits due to the pandemic. Contributing further reductions in PCC through continued metering and water efficiency programmes is a key activity for us in AMP7.

347. It is notable that our Measured PCC has fallen significantly between AR21 and AR22, but that our Unmeasured PCC has not fallen between AR21 and AR22. Our Green Economic Recovery (GER) programme, which will include installation of 200,000 meters

across Thames Valley, should give us insight into reasons for this, and will give us an opportunity to reduce customer usage.

348. Water companies are not in direct control of how customers use water, as demonstrated by the significant swings in PCC in recent years, but we are important enablers, providing 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 through building regulations, water using appliances labelling requirements and driving efficient practices.

349. 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.

350. A key challenge for our future planning in WRMP24 is how to incorporate risk associated with the potential for under-delivery of demand reduction. Our current plan is heavily reliant on demand reduction, through leakage and consumption reduction, to ensure supply-demand balance. Should measures introduced not be as effective as is anticipated, we may be in a position of need for new supply sources. Our adaptive approach and constant monitoring of the effectiveness of new measures will help us manage this risk.

Challenge 2 – Environmental Ambition

351. Our WRMP19 included sustainability reductions which were deemed necessary to meet WFD requirements, as well as future sustainability reductions (focussed on chalk stream catchments) considered likely.

352. The Environment Agency has brought in significant new guidance for WRMP24, outlining the need to consider 'Environmental Destination' within water resource planning. This guidance sets out the need to consider long-term profiles of licence reductions at existing sources.

353. We have, in collaboration with regulators, developed scenarios of potential future sustainability reductions which may be required up to 2050. The largest scenario of reductions aligns with the EA's 'Enhanced' scenario, which results in around 500 Ml/d of Deployable Output reduction; the smallest scenario of reductions results in around 100 Ml/d of Deployable Output reduction.

354. Reductions in supply capability set out in our environmental destination scenarios represent the largest future impact to our supply-demand balance within our WRMP24, and the largest uncertainty that must be considered in the medium to long term.

355. Incorporating Environmental Destination scenarios into our WRMP24 involves an extensive application of adaptive planning techniques, due to the scale of uncertainty present.

356. Determining our future profile of abstraction reductions will also involve significant challenges. Firstly, there is a need to determine the appropriate pace and scale of reductions, balancing potential ecological benefit with robustness of evidence; this will involve detailed investigations throughout AMP8 and AMP9 as we must be sure that sustainability reductions will deliver ecological benefit before committing to reductions, given the scale of investment required to offset reductions in supply capability (up several billion pounds). Secondly, there will be a need to better understand the supply system resilience impacts that reductions will bring (i.e., beyond drought periods) in order to determine the cost associated with more local infrastructure requirements to ensure that customers supplies remain resilient. With such potentially large scenarios of future abstraction reduction, the risks posed to customers' supplies are significant, and different magnitudes of licence reduction will result in very different infrastructure solutions (e.g., removal of a single source may be mitigated by a local infrastructure solution, while removal of the bulk of the supply to a portion of a WRZ may need a wholesale redesign of that WRZ's network).

357. The challenge of planning for future sustainability reductions has been extended by the late-stage introduction of a new policy of capping abstraction licences to quantities that have been used in the recent past. This guidance, confirmed in April 2022, sets out licence reductions that would be implemented on a significantly shorter timescale (2025-30) than those set out in Environmental Destination profiles (2050).

Risk 1 – Resilience to drought

358. Supply systems in the UK are not designed to be resilient to all potential droughts as the cost to do so would be prohibitive. 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.

359. WRMPs are developed to meet levels of service for supply restrictions that are agreed with customers and stakeholders. WRMP19 sets out that until 2030/31 our system is resilient (i.e. avoidance of the most serious supply restrictions) to the worst historic drought on record (~1 in 100-year return period).

360. We are delivering a programme of investment to increase resilience to a severe drought (1 in 200-year return period). A key component of our WRMP19 plan was to deliver an effluent reuse scheme at Deephams. Following further investigation, in agreement with the EA, we have withdrawn this option from our WRMP19 and have ruled it out for selection in our dWRMP24 until 2060 due to environmental risk to downstream habitats.

361. We are currently considering alternative solutions to enable our 1 in 200-year resilience and will set out our plan for achieving this in our dWRMP24 and the WRSE Regional Plan.

362. In forthcoming plans, we are now required to plan to be resilient to extreme drought (1 in 500-year return period), so it is essential that projects can progress in a timely manner and that environmental risks are established as early as feasible.

Risk 2 – Timetable for WRMP24 and Multiple Concurrent Consultations

363. For WRMP24, water company plans will be developed from the new regional-level plans and within a new national-level framework. The timetable for delivery of Regional Plans and WRMP24 is very tight indeed, with these plans being consulted on in autumn 2022.

364. There will be multiple public consultations running simultaneously, with the WRSE regional plan (along with other regional plans) and our dWRMP24 (along with all other companies' WRMPs) being consulted on from November 2022 to February 2023.

365. In addition to the Regional Plan and dWRMP submissions, there will also be submissions made associated with the multiple Strategic Resource Option projects, as well as WINEP and PR24 submissions.

366. The volume of consultations and submissions being made around the same time poses a risk of confusing and overwhelming stakeholders, and so there will be a need to clearly signpost customers and stakeholders to avenues through which they can respond to consultations.

Opportunity 1 – WRSE Regional Plan

367. We are, in collaboration with five other companies, developing a fully adaptive, Best Value Plan for the water resources in the South East of England. The development of this plan gives an opportunity for us to deliver a plan which is efficient across a range of potential future supply-demand balance scenarios, and which delivers value to customers across the South East, rather than giving siloed views of the 'best' plan for each company's customer base.

368. This will also be the first time that our WRMP uses an 'adaptive-first' approach. Our WRMP19 incorporated adaptive planning methods, but relied on non-adaptive methods in some key steps. The bulk of our investment modelling for WRMP24 will apply adaptive planning methods, and this will result in a plan which is robust across uncertain futures.

Opportunity 2 – Understanding Future Patterns of Demand

369. The coronavirus pandemic had a marked impact on our customers' demand for water, and the distribution of demand across our supply area. We saw a fall in overall demand for water in London, and an increase in demand in other parts of our supply area. We also saw a significant shift towards more household consumption and less non-household consumption.

370. Determining the isolated impact that coronavirus restrictions had on demand has, however, not been possible to date. Given the uncertainty over future working patterns, we have also not been able to confidently assess the future patterns of demand that we may see across our supply area.

371. As we transition out of lockdown, it may be possible to better determine the influence that coronavirus restrictions had on demand for water. We may also be able to gain insight into how working and living arrangements will evolve in the future, in order to analyse how this may impact future demand for water. It is unlikely that we will be able

to incorporate insight into our WRMP24, given the tight timescales, but we are nonetheless posed with an opportunity for improved understanding.

372. Our adaptive planning approach means that our future plans should be robust against a range of future demand patterns, despite not explicitly accounting for coronavirus impacts.

D.2 Stakeholder engagement

Introduction

373. There is wide 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.

374. We engaged with stakeholders throughout the development of WRMP19 sharing information in a timely, open and transparent manner and providing opportunity for challenge and input to inform the plan. Overall the approach was positively received by regulators and stakeholders.

375. In WRMP19 we committed to undertake monitoring and reporting to give regulators and stakeholders visibility of our progress delivering the programme of studies for WRMP24 and facilitate stakeholder input and engagement to the overall work programme. This included a six-monthly progress update to government and regulators. We provided a report in Autumn 2021, which covered the period to the end of September 2021, and this report, the Environment Agency's June Annual Review of the water resources programme, covers the full year to April 2022.

376. Our engagement programme comprises three main components:

    i. To share information and seek input to inform the development of the South East regional plan, and in turn our draft WRMP24.

    ii. To share information and seek input to the work to examine the Strategic Resource Options we are involved with.

    iii. To engage with all stakeholders as we progress work to deliver the commitments made in WRMP19 including the delivery of the demand management activities and development of new resource schemes.

    In addition, there is on-going stakeholder engagement as part of work to progress the environmental investigations, catchment-based schemes and the Smarter Water Catchment initiative, and the Drought Plan.

377. We continue to host stakeholder meetings, both in conjunction with WRSE and also the Water Resources Forum jointly with Affinity Water, reflecting our close working alliance and common stakeholders. The meetings continue to be well attended with a diverse stakeholder audience.

378. In addition, it is important that we engage with customers to seek, and take account of, their views and preferences as we continue work to develop our long-term water resources plan. This year we have completed collaborative research through WRSE to inform the strategic planning process, to understand preferences for solutions and the reasons for customers' preferences and also the best value criteria and metrics. The findings have been used in the work to develop the best value plan. A further phase of customer research is planned as part of the consultation on the draft regional plan in Autumn 2022 which will focus on the trade-off decisions as part of the determination of

the best value plan. This work continues to be guided and challenged by a regional Customer Challenge Group and the Consumer Council for Water.

Our engagement programme to support the development of the South East regional plan

379. Water Resources South East (WRSE) is working closely with the six water companies in the South East region, and the other water using sectors, to develop a multi-sector resilience plan for the region. The regional plan will be reflected in the South East companies' WRMP24s which in turn will set out the "need" for new strategic infrastructure development.

380. WRSE has established stakeholder groups to ensure there is representation of all water users across the region to help guide the development of the plan. The groups are the stakeholder advisory board, environmental advisory group, and the multi-sector stakeholder group. WRSE has continued to engage on a regular basis with these groups to share information at key points in the process and seek their input and contributions. This will continue throughout the development of the best value plan.

381. Working closely with WRSE, we have continued to work collaboratively and provide opportunities for the wider stakeholder community to get involved and to help shape the regional plan such as water retailers, developers, and local authorities. The activity comprises both WRSE-led and company-led activity, and has been delivered through forums and meetings, and we have also continued to use an interactive web-based platform for all the engagement activity.

382. In January 2022 WRSE published its emerging Water Resources Regional Plan for a period of public consultation. The emerging plan gave early sight of the big issues and emerging solutions to gain initial feedback from stakeholders. The consultation was a step in an ongoing process of plan development, and not yet a formal preferred plan.

383. The consultation took place over an 8-week period between January and March 2022. WRSE and the water companies undertook direct and indirect publicity and awareness raising ahead of the consultation, including direct emails to stakeholder organisations, media briefings and print and social media activity. Additional notifications were issued through various media channels on the day the consultation started and were repeated during the consultation period and ahead of the close of the consultation.

384. WRSE used a dedicated consultation website which hosted information about the regional plan including the documents, short videos and other information, and an online survey where responses to a series of consultation questions could be submitted.

385. WRSE also hosted five virtual webinars as well as an online interactive Q & A session through the consultation period. These were attended by over 590 attendees in total.

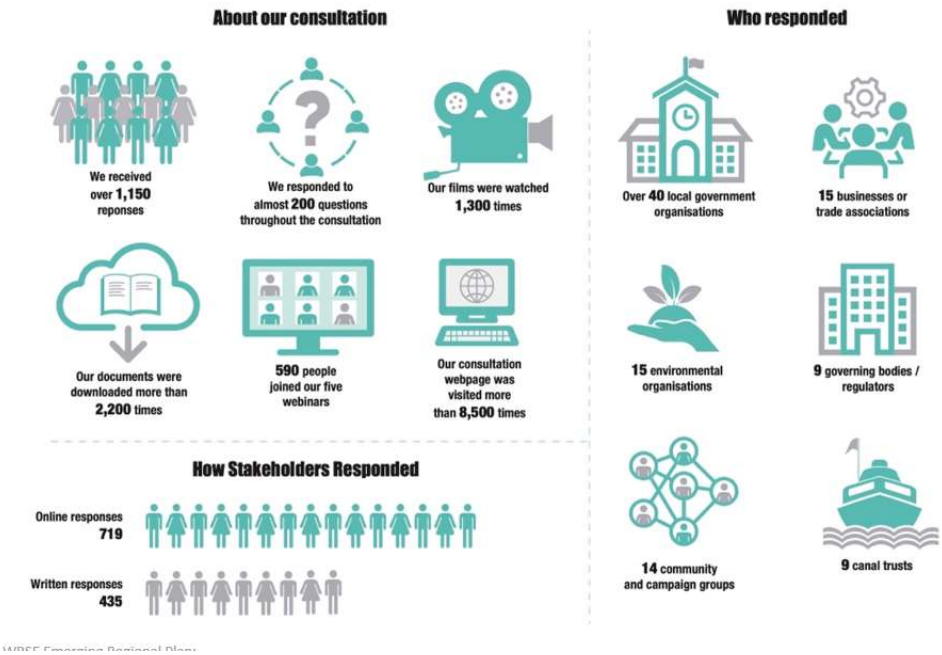
386. Thames Water also held briefings for the Vale of White Horse District Council, Oxfordshire Country Council, and a community drop-in session in Oxfordshire during the consultation period recognising the interest in the plan in Oxfordshire.

387. A summary of the consultation activity is shown in Figure 6.

388. WRSE received over 1,150 responses to the consultation.

389. WRSE published a response to the consultation in May 2022. This provided a summary of the consultation responses, highlighting themes and issues raised in the responses received and providing WRSE's position in response to them.

Figure 6: Overview of the consultation on the WRSE emerging plan



390. There is ongoing work to transition from the emerging (least cost) plan to the best value plan and there will be a further consultation held on the draft regional plan in Autumn 2022.

391. The regional plan will be reflected in our WRMP24, and we have used the regional technical methods and assessments to inform our WRMP24 thereby ensuring alignment between the regional plan and our WRMP24, and across the South East more widely. There will also be a consultation on the draft WRMP24 in Autumn 2022.

392. For the WRMP24 we have continued pre-consultation engagement with regulators comprising monthly meetings with the Environment Agency to share information, build understanding and identify issues of concern to try and ensure "no surprises" in the draft plan. We have also held meetings with Ofwat and Natural England. In addition, we are continuing to proactively engage with a wide community of stakeholders who have an interest in, or could potentially be affected by, the WRMP24. This will continue ahead of the formal public consultation in Autumn 2022.

393.

Our engagement programme to support the work on the Strategic Resource Options

394. We are involved in five Strategic Resource Options (SROs)[17], these options are considered in the South East regional plan alongside other options. The SROs are following a parallel gated regulatory process defined by Ofwat and overseen by the Regulators' Alliance for Progressing Infrastructure Development (RAPID). Engagement is an important part of the development of these options, and a requirement set out by Ofwat.

395. The SRO activity since Gate 1 (July 2021) through Gate 2 has involved more detailed feasibility studies and accordingly the main focus of engagement has been with regulators and strategic stakeholders, and as the detail of the scheme became more defined the engagement has expanded and included discussions with local planning authorities and specific stakeholders who have an interest or relationship with the potential schemes. Engagement plans are in place for each SRO, and we have provided quarterly progress reports to RAPID relating to the work programme, using the prescribed template. Full detail will be reported in the SRO Gate 2 submissions to be published in November 2022.

396. Two collaborative research studies have also been undertaken, as a "club" of SRO projects, to explore two key topics with customers namely a potential change in their source of water and how to explain and communicate this and to seek customer preferences on opportunities for wider social and environmental value that could be afforded by these schemes.

Our engagement programme to shape, and take forward, commitments set out in WRMP19

397. We included a monitoring and reporting programme as part of WRMP19 to give regulators and stakeholders visibility of our progress delivering the commitments made in WRMP19 and the programme of studies for WRMP24 to enable a decision to be made by 2022/23 on the strategic resource options that need to be progressed. Progress against each of the outputs is presented in a 6-monthly report. This report details the progress for the full year from April 2021 to end March 2022.

398. We have targeted engagement on specific deliverables in our plan. For example, we have continued close working with the Environment Agency on technical studies to ascertain the feasibility of the Deephams reuse option; and have an established engagement programme with catchment partnerships as we deliver our Smarter Water catchments work.

[17] London Reuse, Severn to Thames Transfer, South East Strategic Reservoir option, Thames to Affinity Transfer, Thames to Southern Transfer

Appendices

Appendix A: Out-turn Tables – Annual Average

See accompanying file.

Appendix B: Out-turn Tables – Critical Period

See accompanying file.

Appendix C: Deployable Output

399. An update of Deployable Output (DO) for AR22 has been calculated by the Water Resources Modelling Team, which reflects the latest information from a variety of sources across the Company, with this report providing a summary of the changes and new DOs calculated.

400. Source Deployable Outputs (SDOs) have been subject to an annual internal review. This includes groundwater sources as well as the run-of-river surface water sources that do not pump into raw water reservoirs. To continually improve the SDO assessments, the regulatory, hydrogeological/hydrological and infrastructure constraints on water source outputs, water treatment works (WTW) 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.

401. The conjunctive use DOs for the London and SWOX Water Resource Zones (WRZ) are calculated using WARMS. Updates to DOs in both London and the Thames Valley, adjustments to information contained within WARMS, as well as updates to water treatment works capability of the Large Process Plant (LPPs) and process loss assumptions are contained within this update. Additional updates include implementation of new assumptions on demand savings for London that align with those being used in current regional water resource management planning, i.e. Water Resources South East (WRSE) planning for WRMP24. In addition, the update of DO for AR22 includes the improvements from updating the WARMS model software from Aquator 4.2 to Aquator XV.

London WRZ

402. The review and updating of London WRZ DO, as shown in the table below, starts with the AR21 DO of 2291 Ml/d. 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 several factors eg. the level of demand, the balance of treatment capability and process losses, where the losses are returned to the environment, assumptions within the Lower Thames Operating Agreement and trigger levels for demand savings and strategic schemes within the associated Lower Thames Control Diagram (LTCD).

Table 25: London DO - Changes from AR21 to AR22

Steps		DYAA DO (Ml/d)
1	AR21	2291
2	Upgrade to Aquator XV	2296
3	Revised demand savings (Temporary Use Bands being implemented at 'Level 2' to align with other WRSE companies, as set out in our Drought Plan)	2314
4	AR22 source reviews	2311

403. Implementing the new Aquator XV software has resulted in the London WRZ DO increasing from 2291 Ml/d to 2296 Ml/d.

404. As set out in our revised 2022 Drought Plan, we have made a change in the timing of when demand saving measures would be introduced during dry weather and drought. Previously, a sprinkler ban would have been implemented at Level 2 on the Lower Thames Control Diagram (LTCD) with a Temporary Use Ban (TUB; referred to previously as a hosepipe ban) being introduced at LTCD Level 3. We have now changed the timing of their implementation such that both a sprinkler ban and TUBs would be introduced at LTCD Level 2. These changes are also being implemented in future water resource management plans, i.e. the regionally based WRMP24. The consequence of combined implementation of these demand saving measures at LTCD Level 2, and specifically the earlier implementation of TUBs, reduces demand on London's reservoir storage. This resulted in an increase in the London WRZ DO from 2296 Ml/d to 2314 Ml/d, an increase of 18 Ml/d.

405. In the subsequent year end update, groundwater SDOs, water treatment works capabilities and process losses have been reviewed and updated. Only a small (1 Ml/d) increase in groundwater SDO resulted from the year-end review. There was also a small decrease of around 5 Ml/d in the London LPP treatment capability as well as an associated decrease in their treatment process losses of around 9 Ml/d. These changes resulted in a decrease in the London WRZ DO from 2314 Ml/d to 2311 Ml/d, a decrease of 3 Ml/d.

406. Overall, therefore, the combined impact of the above changes is that London's WRZ DO of 2311 Ml/d for AR22 is 20 Ml/d higher than the AR21 DO of 2291 Ml/d.

Thames Valley WRZs

407. The SWOX WRZ DO is calculated using the WARMS model of the Upper Thames part of the WRZ combined with the sum of the groundwater SDOs in the South Oxfordshire part of the WRZ. For the AR22 update, the WARMS model update from Aquator 4.2 to Aquator XV has also been included as well as review and update of groundwater SDOs, water treatment works capabilities and process losses. The impact of changes on the whole SWOX WRZ DO can be seen in the table below, together with the changes in the Upper Thames DO. The impact of changes on the SWOX WRZ DO can be seen in the table below.

Table 26: SWOX DO - Changes from AR21 to AR22

Steps		DYAA DO (Ml/d)	DYCP DO (Ml/d)
1	AR21	316.76	362.82
2	Impact of model changes from Aquator 4.2 to Aquator XV and reassessment of WRZ DO, including updated groundwater SDOs, treatment capability and process losses.	325.67	365.46

408. Groundwater SDOs, water treatment works capabilities and process losses have also been reviewed and updated for the remaining four Thames Valley WRZs, Kennet Valley,

Henley, SWA and Guildford. The most significant change in these four WRZs is an increase in the average WRZ DO for Henley. This results from an increase in the availability of groundwater abstraction at the Sheeplands WTW, following activity reported at AR21 which reduced DO.

Summary for all WRZs

409. A comparison at WRZ level of DYAA and DYCP DO from AR20-22 are presented in the tables below, with variance calculated between AR21 and AR22.

Table 27: Comparison of DYAA DO – All WRZs

DYAA DO (Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
AR20	2302	318.55	183.56	144.05	65.30	25.65
AR21	2291	316.76	182.49	142.93	67.69	19.39
AR22	2311	325.67	182.68	143.99	66.98	21.55
Variance	+20	+8.91	+0.19	+1.06	-0.71	+2.16

Table 28: Comparison of DYCP DO – All WRZs

DYCP DO (Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
AR20	N/A	372.71	201.58	150.57	71.33	25.90
AR21	N/A	362.82	199.11	149.45	73.14	21.70
AR22	N/A	365.46	199.18	149.67	72.42	21.70
Variance	N/A	+2.64	+0.07	+0.22	-0.72	0

Table 29: Groundwater SDO Review – London WRZ - May 2022

Resource Zone	Site	Average (Ml/d)			Peak (Ml/d)			Comments
		AR21 SDO	AR22 SDO Update	Difference	AR21 SDO	AR22 SDO Update	Difference	
London								
Thames Valley	Brixton	5.84	8.54	2.70	6.80	8.54	1.74	Successful recommissioing of the site in 2021
	Battersea	6.82	6.89	0.07	6.82	6.89	0.07	Reassessment of process losses from GAC using MB model
	Waddon	7.56	7.56	0.00	13.60	14.40	0.80	Max treatment capability increased in MB model as per SOM
	Addington	5.35	5.51	0.16	5.54	5.70	0.16	Reassessment of process losses using MB model
			Total	2.93		Total	2.77	
Lee Valley	Barrow Hill	1.72	0.00	-1.72	1.99	0.00	-1.99	Discharge pipe has been cut and no permanent power to site. Currently no active plan to reinstate
			Total	-1.72		Total	-1.99	
New River	No SDO Changes	No SDO Changes			No SDO Changes			N/A
			Total	0.00		Total	0.00	
South East	Westerham	0.88	0.87	-0.01	1.34	1.34	0.00	Reassessment of treatment capabilty and proess losses using MB model
	Wilmington	19	18.60	-0.40	19.60	19.10	-0.50	Reassessment of treatment capabilty and proess losses using MB model
	Bean Wellfield	18.1	18.10	0.00	23.60	23.50	-0.10	Reassessment of treatment capabilty and proess losses using MB model
	Green St Green	4.46	4.47	0.01	5.05	5.03	-0.02	Reassessment of treatment capabilty and proess losses using MB model
	North Orpington	8.75	8.94	0.19	8.77	8.96	0.19	Reassessment of treatment capabilty and proess losses using MB model
			Total	-0.21		Total	-0.43	
Total London				1.00			0.35	

Table 30: Groundwater SDO Review – Thames Valley WRZs - May 2022

Total London				1.00			0.35		
Thames Valley									
North Oxon	Farmoor & Swinford	138.28	146.79	8.51	173.80	174.00	0.20	Reasons David Process losses and capabiality	
			Total	+8.51		Total	+0.20		
Swindon	Ashdown Park	2.73	2.72	-0.01	3.01	3.01	0.00	Reassessment of process losses using MB model	
	Latton	16.50	17.00	0.50	16.50	19.50	3.00	Reassessment of data has led to a revised drought curve, which has resulted in an increase in DO. Process losses are negligible	
			Total	+0.49		Total	+3.00		
South Oxon	Manor Road	3.09	3.00	-0.09	3.56	3.00	-0.56	Reassessment of treatment capabilty and proess losses using MB model	
			Total	-0.09		Total	-0.56		
Total SWOX				8.91			2.64		
Kennet Valley	East Woodhay	6.70	6.70	0.00	9.00	8.50	-0.50	Reassessment of borehole pump performance	
	Playhatch	7.23	7.23	0.00	8.12	7.78	-0.34	Reassessment of process losses using MB model, and update to booster pump capability	
	Speen	7.30	7.36	+0.06	8.56	8.62	+0.06	Reassessment of treatment capabilty and proess losses using MB model	
	Fobney	62.70	63.70	+1.00	62.70	63.70	+1.00	Process loss reduction due to SSF modelling revision in MB model	
			Total	1.06		Total	0.22		
Henley	Sheeplands	9.04	11.20	+2.16	11.20	11.20	0.00	Increased availability of Sheeplands ABH3, and reassessment of process losses from IEX plant	
			Total	2.16		Total	0.00		
Slough, Wycombe & Aylesbury	Hawridge	6.78	6.91	+0.13	6.90	6.91	+0.01	Pump capacity	
	Eton	8.56	8.62	+0.06	8.56	8.62	+0.06	Reassessment of process losses using MB model	
			Total	0.19		Total	0.07		
Guildford	Dapdune	7.98	7.99	0.01	10.30	10.30	0.00	Reassessment of process losses using MB model	
	Millmead	3.38	3.46	0.08	4.42	4.50	0.08	Reassessment of treatment capabilty and proess losses using MB model	
	Shalford	28.6	27.80	-0.80	28.60	27.80	-0.80	Abstraction inflow updated to reflect operational practice and process losses reassessed using MB model	
			Total	-0.71		Total	-0.72		
Total Thames Valley				11.61			2.21		

Appendix D: Environment Programme Investigations and Options Appraisals

Investigations

410. We are undertaking 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 under WFD; these are shown in the table below.

Table 31: AMP7 Environmental Investigations

Investigation name	Waterbody	WRZ	EA Area	Completion Date
Thames at Reading ND	Thames	KV	Thames	complete
Colne ND	Colne and Chess	SWA	HNL	complete
Upper Kennet	River Kennet	KV	Thames	31/03/2023
Hogsmill	River Hogsmill	London	KSL	31/05/2023
Ampney Brook and Lower Churn ND	Ampney Brook and Lower Churn	SWOX	Thames	30/09/2023
River Coln and Dikler ND	Coln and Dikler	SWOX	Thames	30/09/2023
Tillingbourne ND	Tillingbourne	Guildford	Thames	30/09/2023
Chiltern Chalk scarp ND	Scarp streams	SWOX	Thames	30/09/2023
Pang ND	Pang	KV	Thames	30/09/2023
Upper Lee U Bedford Ouse Chalk INV and ND	River Lee	London	HNL	31/03/25

411. The Thames at Reading ND investigation into the impact of increase of Pangbourne abstraction up to full licence was concluded at the end of Phase 1. It was concluded that an increase in abstraction up to full licence at Pangbourne did not pose a risk of deterioration to the River Thames at Reading.

412. We have also agreed with the Environment Agency that the Colne ND investigation (in conjunction with Affinity Water) does not require any further investigation by us. This is because our only source under investigation is Hawridge and we already plan to close the source.

413. The other investigations were 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.

414. We have agreed extensions to these investigation with the Environment Agency so that we can deliver a comprehensive investigation in each case. The revised dates are shown in the table below. In each case the investigations will be used to provide an interim view in March 2022 of the potential sustainability reductions that may be required for WRMP24.

Options Appraisals

415. No options appraisals were carried forward from AMP6. However, some of the AMP7 investigations listed above are likely to progress into options appraisals. So far, we have identified the need for options appraisals for the Upper Kennet, Hogsmill and Upper Lee investigations. We are also considering bringing forward options appraisals on the Pang and Tillingbourne as a part of our PR24 WINEP development.

Beyond 2025

416. The investigations and options appraisals in AMP7 will provide evidence to inform the requirement for chalk streams abstraction reduction in some cases but further work will be required to address the WRSE environmental ambition scenarios.

417. As such, we are also developing plans for further investigations in AMP8 to inform the need to make further sustainability reductions to address the impact of abstraction on chalk streams and to inform future planning to confirm whether the Low, Medium or High scenario should be followed.

Appendix E: Outage

418. 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.

419. The outage analysis and calculation for each Water Resources Zone (WRZ) has been carried out in AR22 using the same outage model and methods used in AR21. This model was developed for the Water Resources South East (WRSE) companies to enable improved consistency between the companies.

- This Appendix is structured as follows:
- Actual outage 2021-22
- Outage allowance 2021-22
- Outage summary

Actual Outage 2021-22

London

420. The outage data collated for London over the 12-month period to the end of March 2021 are summarised in the table below. The total London actual outage figure for AR22 is 170.8 Ml/d, which is 24.4 Ml/d higher than for the AR21 reporting year actual outage of 146.4 Ml/d.

421. This is because we have been able to undertake significant outages enabled by the low risk to the water resources situation due to favourable weather conditions and also due to lower customer demand in London owing to continued impacts from COVID-19.

Table 32: Actual Outage - London WRZ

WRZ	Site	Cause	Outage (Ml/d)
London	Gateway	Planned refurbishment of treatment components	91.5
	LPPs	Multiple, including process issues, site trip and power failures.	41.0
	QE2 reservoir	Planned outage for inspection and maintenance.	19.1
	Brixton	Multiple system trips.	5.9
	Other	Various	13.3
		Total	170.8

422. The planned refurbishment of Gateway WTW during 2021/22 resulted in an output of 100 Ml/d being demonstrated in June 2021, with further refurbishment continued to enhance asset resilience.

423. The LPP outages included outages at Hampton, Ashford, Hornsey and Walton WTW, which were a combination of planned and unplanned outages. The impact of these outages was limited as a result of low customer demand in London.

424. Of particular note is the Queen Elizabeth II (QEII) reservoir outage for inspection and refurbishment of the inlet and outlet tunnels, which is estimated to have had an outage impact of approximately 20 Ml/d. Working closely with the Environment Agency Area team in assessing operational and water resources risks, this major QEII outage was delivered successfully and ahead of programme. Such a major reservoir outage could not be undertaken during dry weather/drought years without significant risk to water resources and customer water supply.

425. Asset maintenance and refurbishment works carried out this year will make a positive contribution to outage reduction in AR23.

Thames Valley

426. The outage data collated for Thames Valley over the 12-month period to the end of March 2022 are summarised below. The peak actual outage has been calculated as the product of outage magnitude and outage duration in the July-August peak period, averaged over the duration of July-August peak period.

Table 33: Actual Outage - Thames Valley WRZs

WRZ	Site	Cause	Average Outage (Ml/d)	Peak Outage (Ml/d)
SWOX	Cleeve	Planned outage (leakage)	1.31	0
	Chinnor	Power and water quality	0.86	0.70
	Watlington	Water quality	0.62	0.38
	Other	Various	1.55	0.43
		Total	**4.34**	**1.51**
SWA	Hampden	Planned site refurbishment	2.00	0
	Eton	Minor system trips	1.52	1.69
	Pann Mill	Minor system trips	1.37	1.12
	Other	Various	1.21	0
		Total	**6.10**	**2.81**
Kennet Valley	Pangbourne	Communications	1.21	3.29
	Fobney	Water quality	1.02	0
	Other	Various	0.19	0.13
		Total	**2.42**	**3.42**
Guildford	Sturt Road	Pumps	0.22	0
	Other	Various	0.16	0
		Total	**0.38**	**0**
Henley	Sheeplands	Process and water quality	0.70	0
	Harpsden	Communications	0.09	0.33
		Total	**0.79**	**0.33**

427. Actual outage has reduced in Thames Valley and comprises ongoing planned site maintenance work and generally minor system trips for a variety of reasons.

428. Filter process upgrades were installed at Watlington and on-site leakage reduction was carried out at Cleeve. At Hampden, planned work on process control was carried out and a new run-to-waste system installed.

Outage allowance 2021-22

429. Outage allowance is based on an outage risk assessment looking at the actual outage that has occurred since 2007-08.

430. It is the outage allowance that this used for water resources planning and can be compared to WRMP19.

431. The total Outage Allowance for the Thames Water area for the reporting year 2021-22 has increased slightly at 134.3 Ml/d (AR21 = 131.0 Ml/d).

Outage summary

432. Outage values reported over recent previous submissions are shown in the tables below (noting the peak outage method change for AR21). The accompanying graph shows the difference between Actual Outage and Outage Allowance for the London WRZ over recent returns.

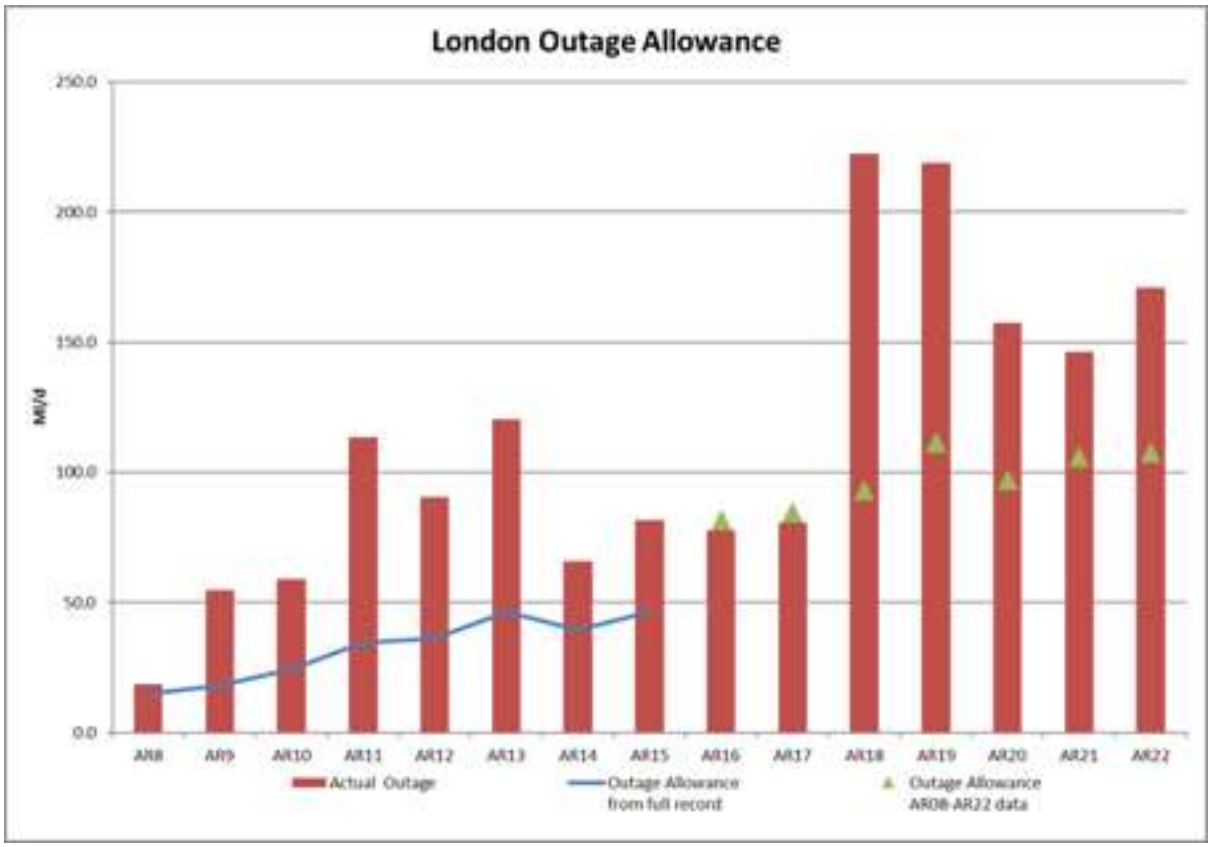
Table 34: Annual Average Outage Allowance and Actual Outage by WRZ

Report	London	SWOX	SWA	Kennet Valley	Guildford	Henley
AA 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
AR21	105.8	6.52	13.80	1.93	1.63	1.24
AR22	107.4	6.69	15.49	1.95	1.55	1.15
Variance	+1.8	+0.17	+1.69	+0.02	-0.08	-0.09
WRMP19	99.76	17.23	9.46	2.49	1.40	0.36
Variance	+7.64	-10.54	+6.06	-0.54	+0.15	+0.79
AA 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
AR21	146.4	5.61	10.22	2.31	0.22	2.60
AR22	170.8	4.34	6.10	2.42	0.38	0.79
Variance	+24.4	-1.27	-4.12	+0.11	+0.16	-1.81

Table 35: Peak Outage Allowance and Actual Outage by WRZ

Report	London	SWOX	SWA	Kennet Valley	Guildford	Henley
CP OUTAGE ALLOWANCE (Ml/d)						
AR20		17.14	14.45	2.69	1.54	0.80
AR21		3.60	3.04	0.72	0.37	0.16
AR22		3.06	3.26	0.99	0.38	0.17
Variance		-0.54	+0.22	+0.17	+0.01	+0.01
WRMP19		17.23	9.46	2.49	1.4	0.36
Variance		-14.17	-6.20	-1.5	-1.02	-0.21
CP ACTUAL OUTAGE (Ml/d)						
AR20		13.82	14.91	3.11	0.97	6.42
AR21		2.53	16.08	2.41	0.44	0.13
AR22		1.51	2.81	3.42	0	0.33
Variance		-1.02	-13.27	+1.01	-0.44	+0.2

Figure 7: London annual average outage allowance



Appendix F: WAFU

433. This appendix summarises the components of water available for use (WAFU) by WRZ compared to forecast values from WRMP19.

WAFU = Deployable Output (DO)

- Changes to DO (New resources, Climate change, Constraints)
- Outage Allowance

[+/- Transfers (Imports and Exports)]

Table 36: DO to WAFU AR22 vs WRMP19

DO to WAFU (Ml/d)	DYAA	DYCP				
	London	SWOX	SWA	Kennet Valley	Guildford	Henley
AR22						
Deployable output	2311.00	365.46	199.18	149.67	72.42	21.70
New resource development	0.00	0.00	0.00	0.00	0.00	0.00
Sustainability Reductions	In DO	In DO	In DO	0.00	0.00	0.00
Climate Change Impacts	44.50	2.87	0.28	2.74	0.00	0.00
Network Constraints	0.00	0.17	2.00	0.00	0.00	0.00
Outage Allowance	107.44	3.06	3.26	0.99	0.38	0.17
Other reductions	In DO	0.00	0.00	0.00	0.00	0.00
WAFU (own sources)	2159.06	359.36	193.64	145.94	72.04	21.53
Total Exports	19.66	2.67	6.85	2.13	2.27	0.00
Total Imports	In DO	4.98	0.00	0.00	0.00	1.78
Total WAFU	**2139.40**	**361.67**	**186.79**	**143.81**	**69.77**	**23.31**
WRMP19						
Deployable output	2302.00	385.38	214.40	155.40	71.70	25.90
New resource development	3.00	0.00	0.00	0.00	0.00	0.00
Sustainability Reductions	4.00	14.43	7.30	0.00	0.00	0.00
Climate Change Impacts	44.33	2.88	0.55	2.13	0.09	0.00
Network Constraints	0.00	0.41	2.00	0.00	0.00	0.00
Outage Allowance	99.76	17.23	9.46	2.49	1.40	0.36
Other reductions	21.00	0.00	0.00	0.00	0.00	0.00
WAFU (own sources)	2143.91	350.43	195.09	150.78	70.21	25.54
Total Exports	17.11	1.18	5.32	0.20	2.27	0.00
Total Imports	18.00	5.00	0.00	0.00	0.00	0.00

Total WAFU	2144.81	354.25	189.77	150.58	67.94	25.54
Variance						
Deployable output	+9.00	-19.92	-15.22	-5.73	+0.72	-4.20
New resource development	-3.00	0.00	0.00	0.00	0.00	0.00
Sustainability Reductions				0.00	0.00	0.00
Climate Change Impacts	+0.17	-0.01	-0.27	+0.61	-0.09	0.00
Network Constraints	0.00	-0.24	0.00	0.00	0.00	0.00
Outage Allowance	+7.68	-14.17	-6.20	-1.50	-1.02	-0.19
Other reductions		0.00	0.00	0.00	0.00	0.00
WAFU (own sources)	+15.15	+8.93	-1.45	-4.84	+1.83	-4.01
Total Exports	+2.55	+1.49	+1.53	+1.93	0.00	0.00
Total Imports		-0.02	0.00	0.00	0.00	+1.78
Total WAFU	**-5.41**	**+7.42**	**-2.98**	**-6.77**	**+1.83**	**-2.23**

London DYAA

434. Total WAFU is 5 Ml/d (0.25%) lower than the WRMP19 forecast for the AR22 reporting year. This is due to an increase in outage allowance and exports, balanced partly with an increase in DO. Although the delivery of the proposed new resource development at New River Head has been deferred, the Didcot import agreement incorporated in the London WRZ DO, which was renewed in AMP7, delivers an increased benefit.

SWOX DYCP

435. Total WAFU has increased by 7.4 Ml/d (2.1%) compared with the WRMP19 forecast. This is the result of changes in a number of the WAFU components.

436. DO has reduced by 15 Ml/d (5.2%), primarily because of sustainability reductions at Axford, Ogbourne and Childrey Warren. These previously forecast reductions are now part of our 'current' DO and combine with other reductions at Woods Farm, Leckhampstead and Farmoor/Swinford that were not forecast in the WRMP19. These reductions in total WRZ DO are balanced in part by an increase in the Latton groundwater source DO.

437. Increases in exports have also reduced total WAFU, but this and the reduction in DO are counterbalance by a significant reduction in peak outage allowance. This reduction occurred in AR21 following the adoption of a new outage methodology by the companies in the South-East, which enabled calculation of a specific DYCP outage allowance. This change continues to be reflected in the decrease in AR22 outage compared with the WRMP19 forecast.

SWA DYCP

438. Total WAFU is around 3 Ml/d (1.6%) lower than forecast in the WRMP19.

439. DO reductions of around 15 Ml/d (7.1%) make up the largest component of this change. A sustainability reduction at Pann Mill was completed in AMP6 as forecast in WRMP19 and is now included in our 'current' DO. In addition, several sources, most notably Taplow but also Dancers End, Datchet and Hampden, have had source DO reductions to reflect performance capabilities at these sites.

440. The reduction in DO is balanced by a significant reduction in peak outage allowance. This reduction occurred in AR21 following the adoption of a new outage methodology by the companies in the South-East. This change continues to be reflected in the decrease in AR22 outage compared with the WRMP19 forecast.

Kennet Valley DYCP

441. Total WAFU is 7 Ml/d (4.5%) lower than forecast in the WRMP19 for the AR22 reporting year.

442. The most notable change to WAFU in Kennet Valley is the 5.7 Ml/d (3.7%) reduction in DO. This is largely associated with a DO reduction at Bishops Green reflecting a DO reduction taken at AR20 to as a result of raw groundwater turbidity issues. Other smaller DO reductions have also occurred at the Playhatch and Bradfield groundwater sources.

443. The reduction in DO is balanced in part by the peak outage allowance decrease in AR21 following the adoption of a new outage methodology across the companies in the South-East. This change continues to reflect the decrease in AR22 outage compared to the WRMP19 forecast. However, an increase in exports from Kennet Valley WRZ in AR21 has continued for AR22 reporting as a result of the inclusion of a treated water transfer to Henley WRZ. This was not forecast in WRMP19 and contributes to the reduction in WAFU.

Guildford DYCP

444. Total WAFU is almost 2 Ml/d (2.7%) higher than forecast in the WRMP19 for the AR22 reporting year. This reflects a small increase in DO (0.72 Ml/d), as a result of an increase in source DO at Shalford, with other small movements at other groundwater sources, together with a small reduction (1.02 Ml/d) in outage allowance.

Henley DYCP

445. Total WAFU is 2 Ml/d lower than forecast in the WRMP19 for this reporting year. This is due to a reduction in DO at Sheeplands, which account for asset constraints not forecast in WRMP19, but partially counterbalanced by an increase in treated water imports from Kennet Valley WRZ.

Appendix G: Estimation of Dry Year Demand

Method

446. As in previous years, dry year demand (both annual average (DYAA) and peak week (DYCP)) has been derived using analysis of the impact on demand of a range of weather scenarios using a long time-series of weather data. This analysis is coupled with models of how demand varies as a function of weather, with the models explaining the weather dependent variability of both usage and leakage.

447. Consistent with previous estimation of dry year demand, the models have been "levelled", producing a de-seasonalised base DI that is matched to the measured distribution input (DI) for the reporting year from 01/04/2021 to 31/03/2022. Using this "levelled" DI, the models have then been used to estimate the amount of demand attributable to the prevailing weather conditions in 2021/22. Using a reference year, in which DI represents the sum of 1in5 usage and 1in5 leakage, the difference between the 2021/22 modelled demand and that of the reference year is reported as the annual average dry-year uplift. Similarly, the uplift factors for the peak demand are calculated using the maximum 7 day rolling average demands for July and August.

448. The methodology of using the relative severity of the annual reporting year to estimate dry year demand again remains unaltered in AR22 for annual averages. For AR21, owing to the impact of Covid-19 lockdown on demand, with the strength of lockdown impact on weather-related demand varying significantly across summer 2020, the methodology for estimating peak dry weather demand was adapted. This involved uplifting the observed peak DI in July and August 2020, so embedding the actual impact of lockdown. For AR22, the effect of Covid-19 restrictions on demand appears to be less significant although there remains a broad spatial shift in demand, with reduced customer demand in London and increased demand in the Thames Valley WRZ.

449. As a result, for AR22 we have reverted to approaches used prior to AR21 for estimating peak dry weather demand; the Dry Year Critical Period (DYCP) demand figures are estimated by uplifting observed annual averages using an uplift calculated from the weather dependent models, implementing a consistent approach across the Thames Valley WRZs. To provide further context, the following points are of note:

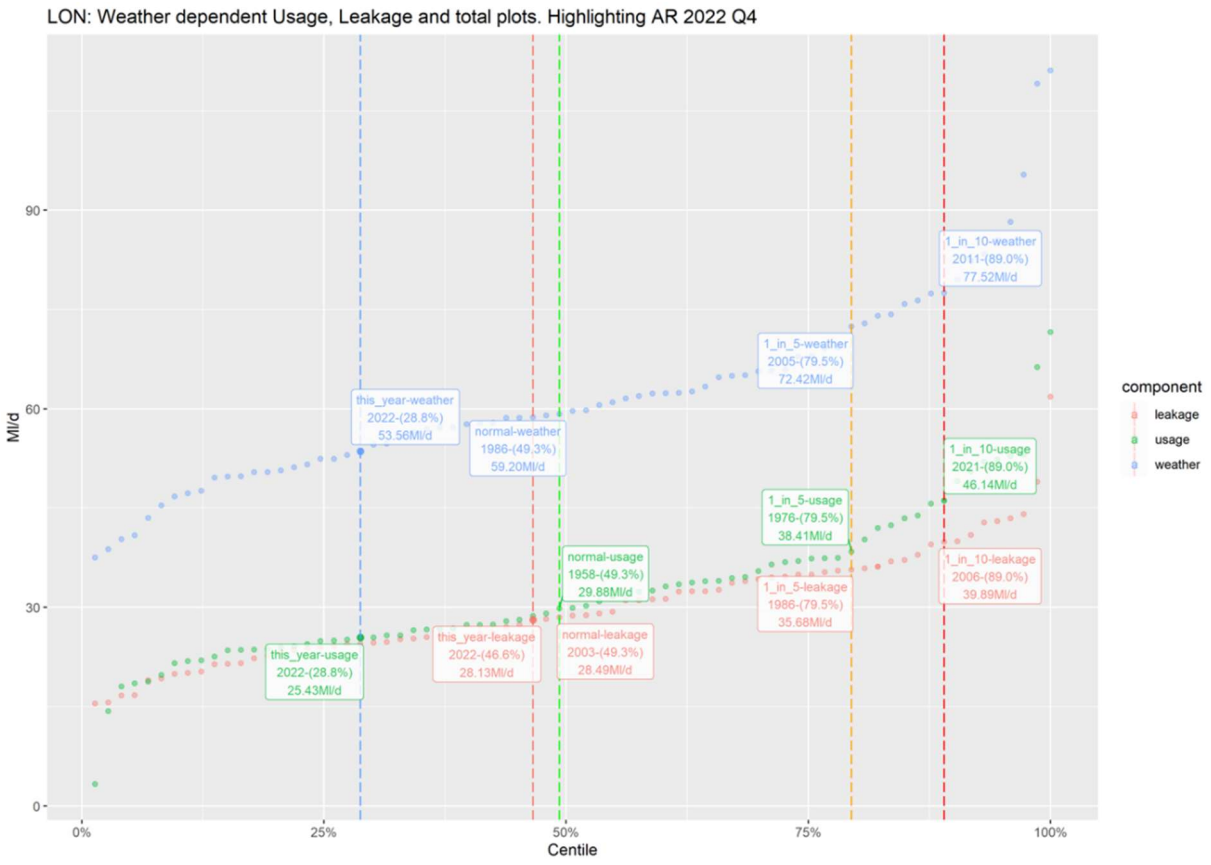
    - Modelling AR22 weather-influenced demand using the approach adopted in AR21 produces a poorer match to the actual demand.
    - Assessing the impact of Covid-19 on customer demand requires a return to previous, pre-pandemic patterns to enable clear step changes to be identified. At AR22, there has not yet been a return to pre-pandemic levels and patterns.
    - Demand since mid-March 2020 has shown evidence that it has become more sensitive to weather, particularly peak demand in warmer, drier weather. This means that the relationship between demand and weather for the AR21 and AR22 reporting years is different from that developed and used in our demand-weather modelling.

- With only two years, AR21 and AR22, showing potentially different demand-weather relationships there is currently insufficient data to develop a new relationship.
- It is possible that the pattern of demand and its sensitivity to weather may continue with the shift to increased home-working and, as a result, may require several additional years of demand and weather data to confirm the correlations and responses that are appropriate to use.

Risk Curves

450. Figure 8 shows the annual average risk curve for London. The overall weather impact on demand over the whole reporting year has been lower than normal, consistent with the milder weather conditions experienced this year. The modelled weather impact on leakage is near normal, at around the 47th centile, but this year's modelled usage is at the 29th centile, so significantly below normal.

Figure 8: London annual average risk curve for weather dependent demand



451. The equivalent annual average risk curve for the whole of the Thames Valley water supply area is shown in Figure 9, with the breakdown for each WRZ in Table 37. As for London, the weather impact on demand over the whole reporting year for Thames Valley has also been lower than normal, although at around the 45th centile of the 54 available years it is closer to normal compared with London. The Thames Valley annual average

for this reporting year shows that the modelled leakage is significantly lower than normal as a result of this year's weather, being at the 16th centile reflecting a mild winter. Considering usage, the modelled outcome for Thames Valley is slightly above normal this year at the 56th centile.

Figure 9: Thames Valley annual average risk curve for weather dependent demand

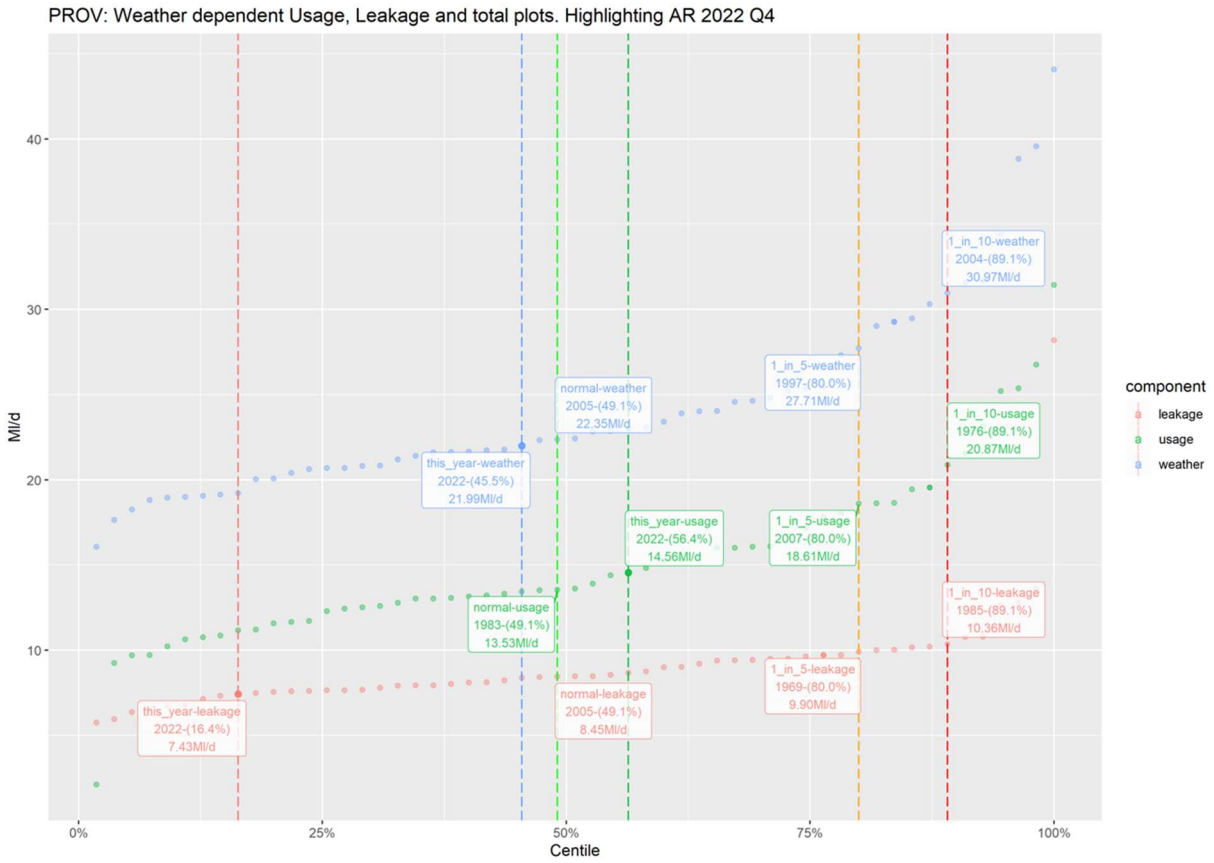


Table 37: London and Thames Valley modelled demand components for annual average and critical period

		London	SWOX	SWA	Kennet Valley	Guildford	Henley	Thames Valley
DYAA	Weather	29%	31%	58%	51%	44%	62%	45%
	Leakage	47%	13%	33%	36%	36%	80%	16%
	Usage	29%	55%	60%	58%	55%	55%	56%
DYCP	Demand		70%	80%	74%	70%	70%	70%
		Normal = 50%		1 in 5 = 80%		1 in 10 = 90%		

452. The relative position on the risk curves enables us to calculate what uplift factors (or reductions) are required in order to estimate a normal year, dry year annual average and dry year critical period condition, for water resources planning purposes.

Peaking factors

453. Below is a tabulated summary of the peaking factors applied in AR22 used to turn pre-MLE out-turn DI into dry year and peak week equivalents.

454. The DI is exclusive of usage by inset appointments. These are removed, uplifted separately then counted as a Bulk Exports in the supply demand balance.

Table 38: AR22 Uplifts by WRZ

2021/22 Uplifts (Ml/d)		Normal Year	Dry Year
London	AA	4.80	20.53
	CP		
SWOX	AA	0.47	3.62
	CP	30.64	60.27
SWA	AA	-0.23	0.89
	CP	15.76	28.69
Kennet Valley	AA	-0.07	0.86
	CP	8.99	18.06
Guildford	AA	-0.05	0.61
	CP	7.66	14.69
Henley	AA	-0.10	0.17
	CP	3.38	5.91

455. Critical Period is not calculated for the London WRZ.

Appendix H: Target Headroom

456. 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.

457. We reassess and rebase our Target Headroom in each annual review of our WRMP. This tends to reduce headroom compared to WRMP19 forecasts as many of the key components are now known and reported as actuals, as opposed to a forecast made several years before.

458. As such, comparing Target Headroom reported in each annual return is more useful than comparison with WRMP forecasts, to understand the underlying uncertainty.

- The components of uncertainty are:
- Accuracy of supply side data
- Climate change
- Demand uncertainty

459. We routinely review and update our supply and demand-side assumptions in light of data gathered in the reporting year.

460. The DYAA and DYCP Target Headroom allowances are presented below.

Table 39: AR22 Target Headroom: DYAA output

DYAA (Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
AR22	73.28	5.02	2.84	4.14	1.15	0.32
AR21	65.73	6.40	3.17	3.95	1.18	0.33
Variance	7.55	-1.38	-0.33	0.19	-0.03	-0.01

Table 40: AR22 Target Headroom: DYCP output

DYCP (Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
AR22		15.16	8.65	6.89	3.82	1.14
AR21		14.86	8.87	6.63	3.77	0.99
Variance		0.30	-0.22	0.26	0.05	0.15

461. There are no material changes in the overall Headroom outputs this year.

Appendix I: Water Efficiency

462. During 2021/22 we've focussed on optimising our delivery methods to continue delivering reductions in water demand whilst also maximising cost and water savings efficiency. . We continued to deliver household and non-household visits to install devices and fix internal leaks and continued data and insight sharing with industry groups.

463. This has saved 15.76 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

464. 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.

465. During 2021/22 3,667 virtual SHVs were carried out and 20,993 face to face SHVs were carried out resulting in estimated measured savings of 1.56 Ml/d. Following the easing of government restrictions, we were able to enter customer homes again to repair internal leaks, and we repaired 2,328 internal leaks ('wastage') following an SHV, saving an additional 1.16 Ml/d.

466. SHVs have been offered to all customers who had a smart meter fitted and are observed to use more than 500 litres per day per household. 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.

467. In addition to this, we offer help to customers in vulnerable circumstances and added 3,682 SHV customers 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. Customers can save an average of £2,700 per year in unclaimed benefits due back to them because of this service.

468. 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. However, since the optimisation of our SHV delivery to high use customers, this partnership has been halted, any future visits to Housing Association or Local Authority housing will be through the SHV programme.

469. Smarter Business Visits (SBVs) is our innovative and water industry-leading programme that has helped 3,688 businesses across the region save water in 2021/22. 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 12.11 Ml/d (based on calculated savings from installed products and fixes).

Long term behaviour change

470. Since the start of the Covid pandemic in 2020 we have observed household consumption increase due to a combination of warm weather, COVID-19 lockdown and an increase in home working. Our household and non-household consumption data has contributed to the Artesia Impact of COVID-19 on water consumption report (Feb 2021). While there was some decrease in consumption as more people returned to work, consumption remained higher than pre-pandemic levels. We will review the scale of our water efficiency ambition in response to this increase in household consumption and will be contributing to the upcoming Ofwat consultation on Per Capita Consumption (PCC).

471. 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.

472. During Summer 2021 we undertook a series of customer engagement email campaigns in key water resource zone areas as a mitigation response to peak demand patterns. These initiatives both raised awareness of current local water resource issues and advocated water efficiency behaviours to reduce short-term household water demand. We will undertake similar customer engagement activities in 2022 and quantify the consumption savings through smart meter analytics.

473. Water and energy calculator – Our free online calculator has continued to help thousands of households work out how much water they're using (Figure 10). 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 PCC metrics.

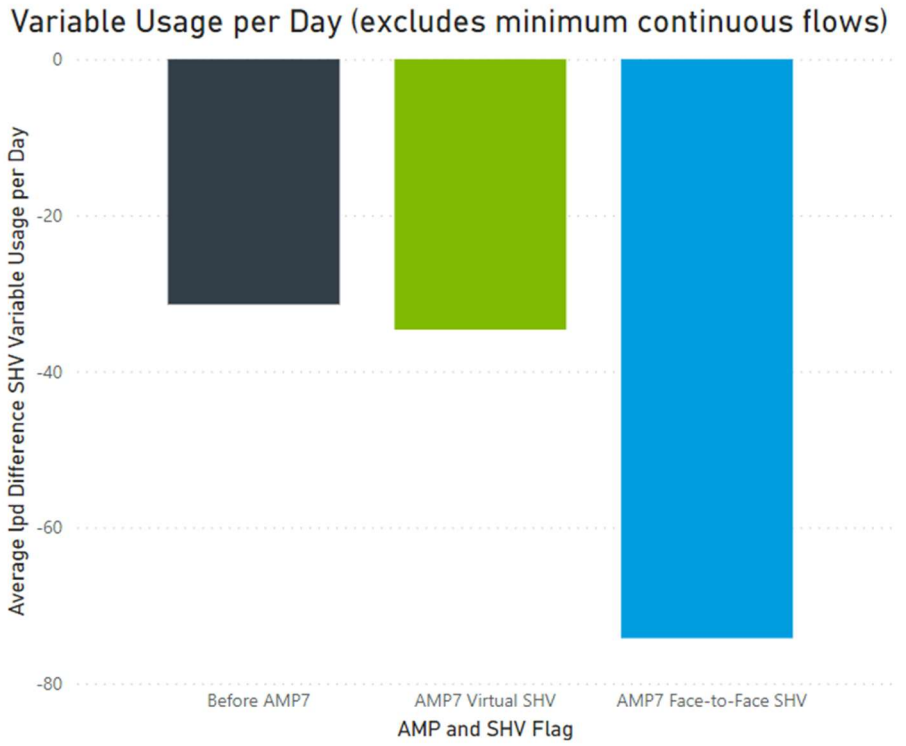
Figure 10: Water efficiency: Water and Energy Calculator

474. **Free water saving devices** – For 2021/22 we optimised our free device offering by incorporating our water and energy calculator into the order process so that customers receive bespoke behaviour change advice to help them save water, and to help them select the most appropriate devices for their home. This resulted in 19,415 completions of the calculator journey, and 17,950 products being ordered.

Innovation

475. **Targeting of SHV** – During 2019-20 we analysed our AMP6 Smarter Home Visits and found the measured water savings were significantly higher when delivered to household using above 500 litres per day. We used this analysis to shape our delivery for AMP7, targeting both our virtual and face to face Smarter Home Visits to high users. This change doubled our average water saving per visit from around 35 litres to over 70 litres per day per household. This method of delivery was continued in 2021/22, and our analysis has showed these savings levels have been sustained. Our Smarter Home Visits continue to be available to all customers seeking assistance high bills.

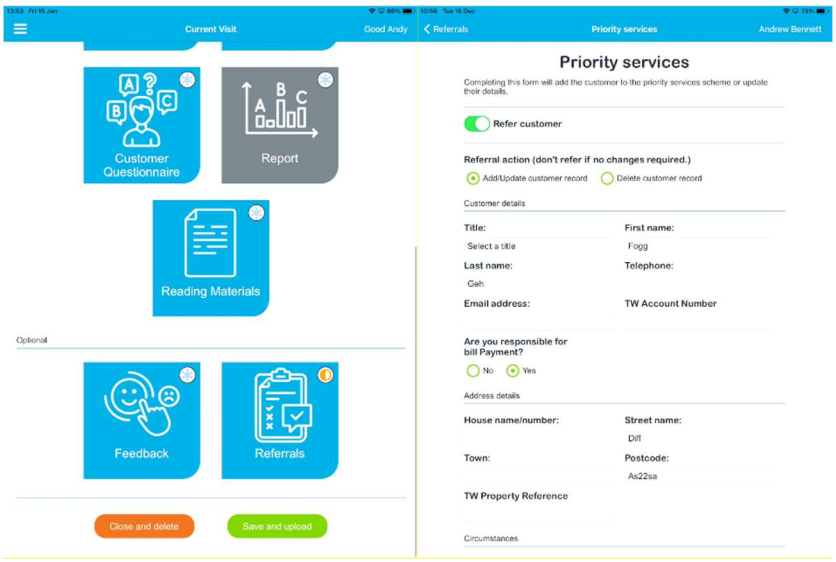
Figure 11: Water efficiency: live dashboard showing SHV measured savings



476. Virtual Smarter Home Visits – To continue delivering household water savings safely during COVID-19 we implemented the industry's first virtual home water efficiency visit in June 2020. visits are delivered over the phone or by video call and are followed with a bespoke water saving report, water efficient devices identified as suitable for the household and a follow up call to help the customer with device installation. We continued to offer virtual visits in 2021/22, and as with our face to face visits, the virtual visits have been targeted at high using household. We have monitored the savings delivered by these visits using our smart meters and live dashboards (as above). We think the difference in savings between virtual and face to face targeted visits is due to not being unable to convert toilets from single to dual flush virtually and propensity of customers not to self-install devices in comparison to installation by advisors.

477. Water efficiency engagement app – In September 2020 we rolled out a new mobile application for use during out Smarter Home Visits which incorporates our water and energy calculator and embedded sign up to our priority services register, affordability assistance and to our household incentive scheme. In its second year of use we have found it continues to deliver a significantly enhanced service and user experience, and it will continue to be the basis of our in-home delivery throughout AMP7.

Figure 12: Water efficiency: New water efficiency engagement app



478. **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. In 2021/22 we embedded the option to sign-up to the scheme in our in-home engagement app. This dramatically increased our membership base and therefore the size of audience we could engage on a weekly basis. In 2021/22 our incentive scheme membership over doubled in size from approx. 8,000 to over 17,000 customers. The households involved continue to achieve water savings of approximately 1 to 5% against their baseline depending on household size.

Figure 13: Water efficiency: Incentive schemes

479. **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

480. 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 are a long-term active member of the UK Water Efficiency Strategy Steering Group and Water Efficiency Network steering group. We have played key roles in the working groups on water neutrality and water reuse, resulting in guidance publications to advance both agendas.

481. We are also an active member of the Retailer-Wholesaler Water Efficiency sub-group which has developed the action plan in response to the Ofwat-Environment Agency letter seeking insight and action to increase the levels of demand reduction within the non-household market.

482. 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 J: Supply Demand Balance

483. This appendix summarises the main components of the SDB by planning scenario (DYAA and DYCP) and by WRZ, and compares them with the WRMP19 forecasts.

484. The SDB is calculated as SDB = WAFU – (DI + Target Headroom).

Table 41: Comparison of SDB Components – AR22 vs WRMP19 Forecast (DYAA)

DYAA (All figures in Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
Annual Return 2022						
WAFU	2139.40	317.30	159.79	140.44	63.16	20.75
Distribution Input	1975.50	289.12	144.20	101.87	49.40	14.04
Target Headroom	73.28	5.02	2.84	4.14	1.15	0.32
SDB	**90.62**	**23.16**	**12.75**	**34.43**	**12.61**	**6.39**
WRMP19 Forecast						
WAFU	2144.81	297.61	170.43	138.36	62.06	25.29
Distribution Input	1998.77	264.44	138.11	102.84	45.28	12.93
Target Headroom	132.39	14.24	5.44	5.45	2.28	0.67
SDB	**13.65**	**18.93**	**26.88**	**30.07**	**14.5**	**11.69**
Variance						
WAFU	-5.41	19.69	-10.64	2.08	1.1	-4.54
Distribution Input	-23.27	24.68	6.09	-0.97	4.12	1.11
Target Headroom	-59.11	-9.22	-2.6	-1.31	-1.13	-0.35
SDB	**76.97**	**4.23**	**-14.13**	**4.36**	**-1.89**	**-5.3**

Table 42: Comparison of SDB Components – AR22 vs WRMP19 Forecast (DYCP)

DYCP (All figures in Ml/d)	London	SWOX	SWA	Kennet Valley	Guildford	Henley
Annual Return 2022						
WAFU		361.67	186.79	143.81	69.77	23.31
Distribution Input		345.33	171.70	119.02	63.48	19.78
Target Headroom		15.16	8.65	6.89	3.82	1.14
SDB		**1.18**	**6.44**	**17.90**	**2.47**	**2.39**
WRMP19 Forecast						
WAFU		354.25	189.77	150.58	67.94	25.54
Distribution Input		323.97	170.85	123.68	61.83	19.29
Target Headroom		19.57	8.04	6.51	2.99	0.9
SDB		**10.71**	**10.88**	**20.39**	**3.12**	**5.35**
Variance						
WAFU		7.41	-2.98	-6.77	1.83	-2.23
Distribution Input		21.36	0.85	-4.66	1.65	0.49
Target Headroom		-4.41	0.61	0.38	0.83	0.24
SDB		**-9.53**	**-4.44**	**-2.49**	**-0.65**	**-2.96**


Thames
Water