Final Draft Water Resources Management Plan 2024

Annex 20: Resilience options and options reappraisal

May 2025

from Southern Water

Contents

List of Tables

Glossary

Acronym	Term	Definition
AMP	Asset Management Period	The AMP periods are 5-year cycles used by the Water Services Regulation Authority (Ofwat) to set the allowable price increase for consumers. AMP periods are five years in duration and begin on 1 April in years ending in 0 or 5; the current period is AMP7 (2020-2025)
ASR	Aquifer Storage and Recovery	A protocol for storing water in aquifers
BH	borehole	A deep, narrow shaft made in the ground for the purpose of extracting groundwater.
Cefas	Centre for Environment, Fisheries and Aquaculture Science	A centre of marine and freshwater expertise for the UK.
CIT	Cost Intelligence Team	Southern Water internal cost team
CO2e	carbon dioxide equivalent	A measure that allows the comparison of the effect of different greenhouse gases on the climate.
CSMG	Common Standards Monitoring Guidance	A programme to develop such guidance across the range of species, habitat and Earth science features which occur on UK protected sites.
DO	Deployable Output	The output of a source or bulk supply as per the licence (if applicable); pumping plant and/or well/aquifer properties; raw water mains and/or aqueducts; transfer and/or output main; treatment; water quality
DWI	Drinking Water Inspectorate	The Government's drinking water quality regulator
dWRMP	Draft Water Resource Management Plan	Our draft WRMP as consulted on during November 2022-February 2023.
DWSP	Drinking Water Safety Plan	Part of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer.
EA	Environment Agency	Government body responsible for flood management, waste management, regulating land and water pollution, and conservation.
eNGO	environmental Non-Governmental Organisation	Non-Governmental Organisation focussing on environment
fdWRMP	Final Draft Water Resource Management Plan	This current version of the WRMP that we are publishing in May 2025
HoF	Hands-off flow	A term that can be used within abstraction licences to specify a flow below which the abstraction should stop.
HRA	Habitat Regulations Assessment	Assessment to consider the potential effects of alternative options and strategies on designated European sites
HSE	Hampshire Southampton East	A water resource zone in Hampshire. Note that annex 1 of our rdWRMP24 describes how we define our WRZs.
HSW	Hampshire Southampton West	A water resource zone in Hampshire. Note that annex 1 of our rdWRMP24 describes how we define our WRZs.
HWTWRP	Hampshire Water Transfer and Water Recycling Project	An SRO with two component parts including a water recycling plant that makes use of the storage in Portsmouth Water's (PWC) consented Havant Thicket reservoir and a transfer pipeline from the reservoir to Itchen surface water WSW, being progressed as a collaboration between Southern Water (SW) and PWC
ICA	Instrumentation Control and Automation	A control system using smart devices to communicate data on performance and enable automation of processes
INNS	Invasive Non-Native Species	Organisms introduced to Britain from all over the world by people that can threaten indigenous species.

Acronym	Term	Definition
IOW	Isle of Wight	Isle of Wight water resources zone
LGS	Lower Greensand	Lower Greensand aquifer block
Ml/d	Mega or million litres per day	Millions of litres per day. Unit of measurement for flow in a river or pipeline. 1 Megalitre = 1,000,000 litres.
MMO	Marine management organisation	Organisation responsible for management of operations in marine environments
MRF	Minimum Required Flow	The minimum flow rate needed within a river or stream to maintain ecological health and support the Water Framework Directive (WFD).
NE	Natural England	Government advisor for the natural environment.
PWC	Portsmouth Water	Portsmouth Water company
RAPID	Regulatory Alliance for Progressing Infrastructure Development	The collaborative regulatory group of Office for Water Services, Environment Agency and Drinking Water Inspectorate formed to accelerate development of new water infrastructure and design future regulatory frameworks
rdWRMP	Revised Draft Water Resource Management Plan	Our revised draft WRMP consulted on in 2024.
RO	Reverse osmosis	Water purification using a semi-permeable membrane
SAC	Special Area of Conservation	Site designated under the Habitats directive
SBZ	Sussex Brighton	Sussex Brighton water resources zone
SoR	Statement of Response	Statutory document produced by water companies as part of the water supply planning process
SEA	Strategic Environmental Assessment	Statutory assessment to identify and assess any significant environmental effects of the WRMP
SES	SES Water	SES water company
SESRO	South East Strategic Reservoir Option	A reservoir to be built in the upper Thames catchment.
SNZ	Sussex North	Sussex North water resources zone
SRO	Strategic Regional Option	Water supply measures operating at regional or national scale (e.g. large reservoirs)
SSSI	Site of Special Scientific Interest (Protected Areas)	Land notified as an SSSI under the Wildlife and Countryside Act (1981).
SWZ	Sussex Worthing	Sussex Worthing water resources zone
UV	ultra-violet	Refers to light. Used in water treatment.
WFD	Water Framework Directive	The obligations to achieve good quality and good quantitative status of all water bodies under The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
WfLH	Water for Life Hampshire	see https://www.southernwater.co.uk/about-us/our-plans/water-for-life-hampshire/
WINEP	Water Industry National Environment Programme	A list of environment improvement schemes that ensure water companies meet European and national targets related to water
WRPG	Water Resources Planning Guidelines	Guidelines issued by UK government
WRMP	Water Resources Management Plan	Statutory plan produced by water companies every five years to plan to meet supplies over a minimum 25 year period.
WRSE	Water Resources South East - regional water resource group	Collaboration of water companies and regulators in South East England working together to make best use of available water resources

Acronym	Term	Definition
WRZ	Water Resources Zone	The largest possible zone in which all resources, including external transfers, can be shared and hence the zones in which all customers experience the same risk of supply failure from a resource shortfall
WSW	Water Supply Works	Water treatment station before water is transferred into the supply network

1 Introduction

Options appraisal is a key part of developing a Water Resources Management Plan (WRMP). It is important to have a suitably large and diverse set of options to choose from when coming up with solutions to meet future water needs. This process is typically carried out every 5 years with each WRMP cycle. We have however carried out additional options appraisal exercises since publication of our WRMP 2019 (WRMP19) for our Western area as part of the Regulators' Alliance for Progressing Infrastructure Development (RAPID) gated process through our Water for Life Hampshire (WfLH) programme.

HWTWRP was not select as an option atWRMP19 and the preferred strategy was a desalination option at West Southampton Coast. However our regulators required us to consider alternative schemes following the final determination for Price Review 2019 (PR19) and the creation of the RAPID gated process. The extended options appraisal process in the Western area has been driven by the RAPID gated process where at Gate 2, HWTWRP was identified as the highest-ranking option and is now our selected option. This is set out in further detail in section 3.1.1 of our fdWRMP24.

The extended options appraisal process has also been driven by the agreement we signed with the Environment Agency in 2018 under Section 20 of Water Industry Act 1991 (Section 20 Agreement) in order to protect the iconic chalk stream in the Western area, namely the River Test and River Itchen. As part of the agreement, we agreed to a reduction in our abstraction licences on the rivers Test and Itchen and to use 'all best endeavours' to end our reliance of water from the rivers. Similarly, while we carried out options appraisal exercise for Water Resources South East (WRSE) Regional Plan and our WRMP 2024 (WRMP24), we carried out a targeted review of our options following the publication of our draft WRMP24 (dWRMP24) to inform our revised draft WRMP24 (rdWRMP24) with a further refinement for our final draft WRMP24 (fdWRMP24) (see **Error! Reference source not found.**).

Table 1: Options appraisal processes for water resource schemes in Hampshire since 2019.

Options appraisal process	Publication date
Water Resource Management Plan (WRMP19)	2019
Water for Life Hampshire (WfLH) Gate 1	2020
Water for Life Hampshire (WfLH) Gate 2	2022
Water for Life Hampshire (WfLH) Gate 3	2024
Draft 2024 Water Resource Management Plan 2024 (dWRMP24)	2022
Water Resources South East (WRSE) revised draft regional plan	2023
Revised draft Water Resource Management Plan (rdWRMP24) – targeted review of resilience options	2024
Final draft Water Resource Management Plan (fdWRMP24)	2025

The additional options appraisal exercises as part of WfLH programme has been undertaken to identify the long-term solution for eliminating the reliance of drought options in Hampshire (Western area), namely Lower Itchen, Candover and River Test from 2030 onward. This annex provides an overview of the options appraisal exercises conducted following the publication of WRMP19, as summarised in **Error! Reference source not found.**.

1.1 WRMP19 preferred plan

WRMP19 identified the following main water supply solutions in the Western area for 2025-30 period (see https://www.southernwater.co.uk/media/nfrellg1/our-wrmp-for-2020-70.pdf and https://www.southernwater.co.uk/media/kuhle5o5/wrmp-2019-technical-overview.pdf).

1. A bulk import of up to 21Ml/d from Portsmouth Water to Southern Water's Hampshire Southampton East (HSE) water resource zone (WRZ) following the development of Havant Thicket Reservoir.
2. An additional bulk import of 9Ml/d from Portsmouth Water to HSE.
3. A 20Ml/d bulk import from South West Water into Hampshire Southampton West (HSW) WRZ.
4. A 75Ml/d desalination plant on the West Southampton Coast.
5. A water recycling plat at Sandown on the Isle of Wight (IOW) to provide up to 8.5Ml/d.

1.2 Water for Life Hampshire assessments

As part of our submission to RAPID Gate 1, WfLH programme reassessed the option of a 75Ml/d plant on the West Southampton Coast along with a number of alternatives. In total nine options were considered including three desalination options, five water recycling options and one water transfer option. We submitted our assessment in September 2020 (Southern-Water-accelerated-Gate-1-submission-summary.pdf). Further assessment post Gate 1 submission removed one desalination option and the Gate 2 submission dated in December 2021 identified two options for further development. (Gate-2-submission-summary_redacted.pdf).

The preferred option was a direct raw water transfer from Havant Thicket Reservoir to Itchen Water Supply Works (WSW) supplemented by the recycled water from a water recycling plant. This option is now known as the Hampshire Water Transfer and Water Recycling Project (HWTWRP).

A Back Up option was also identified. This involved transfer of recycled water from a water recycling plant to Itchen WSW via an environmental buffer. Desalination options were removed from further consideration at this stage. The outcome of the options appraisal process was supported by RAPID at Gate 2.

Although both HWTWRP and the Back Up option were able to meet requirements of supplying 75Ml/d in the Western Area (as required by WRMP19), and were able to meet the identified future need of up to 90Ml/d, HWTWRP presented significantly better value for customers and was better able to meet long-term regional supply requirements due to improved adaptability. Therefore, the focus was on progressing HWTWRP as the selected option.

Prior to the RAPID Gate 3 submission, in May 2023, it was confirmed to RAPID in the Interim Update for Gate 3 (rapid-gate-three-annex-8c-gate-three-interim-update.pdf) that further work developing the Back Up option would not be undertaken and work on this option would be paused to focus on delivery of HWTWRP.

In its recent Gate 3 decision for HWTWRP of February 2025, RAPID has approved continued funding for the development of this option (Gate three final decision letter to Southern Water - Ofwat).

All documents we have submitted as part of RAPID Gate 1, 2 and 3 submissions can be found here: Water For Life – Hampshire Technical Documents

A number of public consultations were held throughout this process as part of the Development Consent Order process for HWTWRP.

- A public consultation was held from 8 February until 16 April 2021. The purpose of the consultation was to consult on the proposed desalination plant on the West Southampton Coast as the strategic solution for the programme and on alternative water transfer and water recycling options should the desalination plant prove undeliverable, at this location and at this time. It was also used as an awareness and education opportunity to provide the public and key stakeholders with technical information on the solution and what it means for them.

- A second public consultation was held from July to August 2022 which covered the change of options from desalination to the preferred option of HWTWRP and included the site selection for the main site and pipeline corridor routes.
- In summer (May to July) 2024 we consulted on a number of aspects related to HWTWRP
  - The Project overall
  - The proposed pipeline routes
  - The proposed water recycling plant and associated pumping stations
  - The proposed sites for the above ground plant along the pipeline route
  - The process we have undertaken to develop the Project up to this consultation
  - The preliminary environmental and other impacts of the Project and initial proposals for mitigation.
- Our most recent consultation ran from March to April 2025 whereby we sought views on updated environmental water quality information and proposed project design refinements.

1.3 WRMP24 options appraisal

The process we adopted for appraising options for WRMP24 and WRSE Regional Plan remained unchanged from WRMP19. It reassessed options previously rejected as part of WRMP19 in addition to considering new options. Over 1,000 options were assessed in total and a list of options along with the screening results was shared with the Environment Agency in 2021. This process is described in Section 6 of the fdWRMP24 that has been published alongside the Statement of Response (SoR) to the consultation on rdWRMP24.

The following options that formed part of the WRMP19 preferred plan in the Western area have been excluded from WRMP24.

1. The 20Ml/d bulk import from South West Water into HSW was excluded as a feasible option as South West Water can no longer guarantee supply.
2. The additional 9Ml/d from Portsmouth Water to HSE was excluded as a feasible option as the boreholes drilled by Portsmouth Water for this supply did not provide the expected yield.
3. The 75Ml/d desalination option on the West Southampton Coast was excluded as a feasible option following the assessments carried out as part of the RAPID gated process.

The schemes that were excluded from the WRMP19 preferred plan in the Central area were:

1. A 4Ml/d Aquifer Storage and Recovery (ASR) option in Sussex Worthing (SWZ) which could not be progressed at access to the identified site could not be secured.
2. A 20Ml/d desalination on the Sussex Coast (SBZ) as our preferred location was no longer available and an alternative site could not be identified.

2 Targeted reappraisal for WRMP24

2.1 The need for targeted reappraisal

We consulted on our dWRMP24 between 14 November 2022 and 20 February 2023. We had over 500 responses and issued our Statement of Response (SoR) in August 2023 which addressed them. Following consultation we revised the delivery dates for some of our options. The key changes were as follows:

1. The delivery date for the Havant Thicket Reservoir was revised from 2028-29 to 2030-31 so that it first provides benefit from 2031-32. This impacts the 21Ml/d transfer from Portsmouth Water to HSE that is dependent on the reservoir.
2. The delivery date for HWTWRP was revised from 2029-30 to 2033-34 such that the scheme first provides benefit from 2034-35.
3. The delivery date of Littlehampton water recycling scheme in SNZ was revised from 2027-28 to 2029-30 such that it first provides benefit from 2030-31.

The changes to the delivery dates of these key schemes represented a material change in the dWRMP24 that had been consulted upon. We therefore decided to reconsult on our rdWRMP24 that incorporated these changes.

2.1.1 Impact in the Western area

The effect of the revised dates for Havant Thicket Reservoir and the HWTWRP is that we will have to continue to rely on the use of Candover Drought Order in HSE and the River Test Drought Permit/Order in Hampshire Southampton West WRZ (HSW) in the event of a drought until 2033-34. This reliance is longer than we previously planned for in our WRMP19, but we are significantly restricted by a lack of alternative options that can be developed in time to provide the required volumes of water. Without the continued use of drought options, we cannot achieve our projected supply-demand balance in the Western area in drought scenarios. In every scenario and every adaptive pathway considered throughout the development of our plan, drought options are selected as the best value option overall.

The changes in the use of drought permits and orders from the dWRMP24 are as follows:

- In dWRMP24, the Lower Itchen Drought Order in HSE was available up to 2026-27 under all drought conditions. This was in-line with our previous aim in WRMP19 of reducing reliance, ideally by 2027. However, this aim was always dependant on having the longer-term infrastructure in place. For rdWRMP24, its use was extended to 2029-30 under all drought conditions. After 2030, and by the time of expiry of our current Section 20 Agreement in March 2030, the use of the Lower Itchen Drought Order will cease. It should be noted that although our Western area resilience relied on this option in WRMP19, a Lower Itchen Drought Order has not to date been needed (and not applied for). This remains the case for fdWRMP24.
- In dWRMP24, the Candover Drought Order in HSE was available up to 2026-27 under 1-in-200 year drought conditions and up to 2028-29 under 1-in-500 year drought conditions. For rdWRMP24, this option was made available until 2033-34 under all drought conditions. This remains the case for fdWRMP24. As is the case with the Lower Itchen Drought Order, we have not needed to apply for the Candover Drought Order to date.
- In dWRMP24, the Test Drought Permit/Order in HSW was available up to 2029-30 under 1-in-200 year drought conditions and up to 2040-41 under 1-in-500 year drought conditions. We aim to achieve resilience to droughts of up to 1-in-500 year severity by 2040-41. For our rdWRMP24, this option was made available until 2033-34 under 1-in-200 year drought conditions. It is also used under 1-in-500 drought conditions until 2040-41 after which our plan requires no further use of supply-side drought permits and orders. This remains the case for fdWRMP24.

The process agreed by the Environment Agency and Southern Water by which the company will apply for drought permits and orders in Hampshire is set out in the Section 20 Agreement. The agreement was signed

in 2018 and is due to expire in 2030. We need to discuss any implications of our extended timelines with regard to the Section 20 Agreement with our regulators and these discussions are underway.

2.1.2 Impact in the Central area

The Environment Agency has indicated that it is not supportive of the continued use of the Pulborough surface water Drought Permit/Order in Sussex North WRZ (SNZ) beyond 2029-30. We were not aware of this position when we developed our dWRMP24.

The revised date for the Littlehampton recycling option has no impact on the need for the Pulborough surface water Drought Permit/Order beyond 2029-30 as it is planned for delivery by 2029-30. We nevertheless introduced measures in our rdWRMP24 that mean that the Pulborough surface water Drought Permit/Order is not needed beyond 2029-30 in droughts that are less severe than 1-in-500 year severity. The Pulborough surface water Drought Permit/Order is not needed beyond 2040-41 in droughts of up to 1-500-year severity (see Section 7 in our fdWRMP24 Technical Report).

2.2 Targeted reappraisal for rdWRMP24

The continued reliance on drought permits and orders presents an ongoing concern for our customers and stakeholders. The Environment Agency expressed its concern on this matter through a letter dated 24 August 2023. Without the use of drought options in the Western area, we cannot achieve our projected supply-demand balance and they therefore remain a necessary interim measure until the longer-term infrastructure (including HWTWRP) is developed and operational. We understand that the continued use of drought options present concern but their inclusion is still aligned with the Water Resources Planning Guideline (WRPG)[1], and, in terms of the best value planning requirements, represent the best value optional overall.

We have nevertheless been looking to minimise the level of reliance on those drought permits and orders during the interim period until our long-term infrastructure is developed. In developing our rdWRMP24, we held discussions with and arranged workshops with the Environment Agency and Natural England to identify potential options to mitigate the reliance on drought options in practice. As described later, we identified four interim options that could be introduced or accelerated and three of these are in the Western area and three of these options were included in our fdWRMP24. We refer to these in this annex as our ‘resilience options’.

2.2.1 Identifying resilience options

In order to identify potential resilience options, we carried out a targeted re-appraisal exercise for rdWRMP24 following the consultation on dWRMP. To carry out this re-appraisal exercise we appointed external technical consultants with experience in appraising options for WRMPs. The scope of the exercise was initially focused on the three main options highlighted in the Environment Agency’s letter of 24 August 2023. These were:

- Temporary desalination on the West Southampton Coast or the IOW
- Bulk import of water from Norway via sea tankers
- Supply of non-potable to a large industrial user in HSW

[1] Environment Agency, Natural Resources Wales and Ofwat, 2023. Water Resources Planning Guideline. Version 12.

Appendix A shows the list of options considered as part of the targeted re-appraisal following the letter from the Environment Agency. The purpose of this exercise was to identify any options that could be brought online by 2030 and would have a lower environmental impact than the continued use of drought options. This exercise was not a comprehensive re-appraisal of all the options assessed for WRMP24. Having already undertaken extensive work and considering hundreds of options (see Annex 12 to fdWRMP24 Technical Report), a full re-appraisal exercise was not considered time or cost beneficial given that the outputs were expected to largely remain consistent with the work already undertaken. As mentioned in Section 1, a detailed options appraisal exercise had been conducted to assess options in the Western area both as part WfLH programme, outside of WRMP planning cycles, as part of RAPID gated process.

Instead, a high-level qualitative re-appraisal identified and considered a select number of options that could potentially meet the much narrower objective of reducing the reliance on drought options following the expiry of the Section 20 Agreement in 2030 and before the larger strategic options are available

The key criterion for the resilience options was that they had to be operational by 2030-31. This ruled out large infrastructure options with significant lead time and led to a targeted reappraisal of options. The combined Deployable Output (DO) benefit of Candover and River Test drought options is over 100Ml/d. It was therefore clear from the start that we would not be able to identify options that would eliminate the need for these drought options altogether. The aim was to offset the volume available from these drought options by as much as possible by identifying options that could be available from 2030-31. We have an ambitious demand management programme. While we would look to accelerate the delivery of demand management activities, there is limited scope to achieve significantly greater savings in the 2025-30 period. We therefore focussed on supply-side options. These fell into three broad categories:

- **Accelerated delivery of options:** We reviewed options that were selected in our dWRMP24 post 2034-35 to assess and identify whether any could feasibly and realistically be delivered earlier to provide benefit from 2030-31.
- **Reconsidered dWRMP24 options:** We reviewed a selection of options that were either available for WRMP24 but were not selected or options that were not part of the dWRMP24 constrained list.
- **New options:** These were options that were not assessed as part of WRMP24 but were suggested to us during ongoing engagement.

2.2.2 Option selection

An internal workshop was held on 6 July 2023 with operational colleagues with local technical knowledge of our production and distribution networks to identify a list of potential options.

Options were positively selected, in that sites and areas were considered against the potential contribution to the expected deficit. While many of the schemes were the same as those that had been considered in the past, that list was not used as a starting point, as the intention was not to repeat the work that had been done previously.

To compile this list, we used the categories above and identified a limited number of options that could hypothetically be:

- delivered by 2029-30 (or sooner) in order to provide benefit from 2030-31,
- developed as a temporary measure (e.g. for a period of five years in order to specifically reduce the reliance on drought permit/order options in the interim period until the larger strategic options (e.g. HWTWRP) are available,
- implemented without the risk of causing further delay to the progress of HWTWRP.

Following the letter from the Environment Agency on 24 August 2023, the options proposed therein were also added to the list of options to be considered. The list of options to be reassessed included 33 options for the Western area and 19 for the Central area. All but a few of these options were shared with the Environment Agency and Natural England in October 2023 as part of the engagement described above. The conclusion was that, as per our original assessment, most remained unfeasible (see Appendix A).

Each of these schemes was worked up to an outline design so that a high-level costing and carbon assessment could be undertaken. The cost models were the same as had been used in the initial WRMP24 assessment. As stated above, the main criteria to assess which schemes to develop further were based around the expected timeframe for delivery and the impact that the new scheme may have on the HWTWRP. The rejection log for these schemes is included as Appendix A.

2.2.3 Internal and external engagement

Internal engagement

We held a workshop with internal staff, with knowledge of our sites and assets, on 6 July 2023 to see if there were any options that could be developed quickly through asset enhancement, site rehabilitation or bringing redundant sources back into service. We also looked at options that were previously considered but not taken forward to see if some of the constraints could be removed to make these options feasible.

As a result of this exercise, we selected 31 options in the Western area and 19 options in the Central area for reappraisal.

External engagement

Following the letter from the Environment Agency dated 24 August 2024, we held a workshop with the Environment Agency and Natural England on 28 September 2023 to discuss the scope of the work we were planning to carry out. We held another workshop with the Environment Agency on 2 November 2023 to discuss the progress on the resilience options. Ahead of the workshop, we shared the list of potential options that were reappraised and the outcome of our assessment. The list is included as Appendix A.

A third workshop with the Environment Agency and Natural England was held on 22 March 2024 to go through the final list of resilience options that were ultimately included in our rdWRMP24.

In addition to these workshops, we held weekly meetings with the Environment Agency and Natural England. The Environment Agency and Natural England are not the only external stakeholders that we have engaged with. As discussed later in section 2.3.1, we also engaged with the Drinking Water Inspectorate (DWI) to discuss the option of bulk import of water from Norway via sea tankers.

We also engaged with a variety of environmental Non-Governmental Organisations (eNGOs) for example at a site visit and presentation session held in our Western area in May 2024. Our Chief Executive Officer (CEO) also attended a national river summit in May 2024, the only water company CEO to do so.

To help explain some of the topics that can be technical and complex we developed a frequently asked questions (FAQ) section on our website to accompany consultation on our rdWRMP24.

2.3 Outcome of the targeted option appraisal exercise

The options identified as having potential to help reduce our reliance on the drought permits and orders in the Western and Central areas are described below. They do not however remove the need to rely on the drought permits and orders altogether. Extended reliance on these drought options therefore remains in our core plan and our preferred pathway. No single solution or combination of solutions was identified that could completely remove that need altogether before 2033-34. As part of our ongoing regional engagement with WRSE, no regional solution or scheme of any other south-east company could assist us in reducing the reliance on drought options in this timeframe.

2.3.1 Western area

Accelerated delivery of already selected options

Our dWRMP24 included the following groundwater options in the Western area.

- Groundwater (HRZ): New boreholes at Romsey (4.8Ml/d); first selected in 2031-32 in dWRMP24 and in 2035-36 in the interim rdWRMP24
- Groundwater (IOW): New boreholes at Eastern Yar3 (1.5Ml/d); first selected in 2039-40 in the dWRMP24 and in 2036-37 in interim rdWRMP24
- Groundwater (IOW): New boreholes at Newchurch (Lower Greensand) (1.9Ml/d); selected in 2034-35 in dWRMP24 and in 2036-37 in the interim rdWRMP24
- Groundwater (HSW): Test MAR (5.5Ml/d); first selected in 2040-41 in dWRMP24 and in 2035-36 in the interim rdWRMP24

The Romsey groundwater option in Hampshire Rural (HRZ) WRZ requires additional infrastructure development to be able to transfer more water from HRZ to HSW. The required infrastructure enhancements is already included as a constrained option for WRMP24 and accelerated delivery of this option is therefore considered feasible.

The groundwater option on the Isle of Wight (IOW) WRZ at Eastern Yar3 has zero DO under drought conditions. Accelerated delivery of this option therefore provides no additional benefit under drought conditions.

We tested a scenario whereby we pre-selected the Newchurch (LGS) groundwater option on the IOW from 2030-31. Pre-selection of this option simply reduces the utilisation of Sandown recycling option on the IOW. As water cannot currently be moved from the IOW to the mainland, maximising the utilisation of both the Newchurch groundwater option and the Sandown recycling option creates additional headroom on the IOW but does not reduce reliance on the Hampshire drought options.

The Test MAR option in HSW is a managed aquifer recharge scheme that requires further investigations and assessments to determine its feasibility. It would not be possible to complete the investigations and deliver the option by 2029-30. Earliest delivery by 2034-35 and benefit from 2035-36 is a more realistic timeframe. This option was therefore not considered for accelerated delivery.

Reconsidered WRMP24 options

A reappraisal of options considered for WRMP24 but not taken forward identified two options that could potentially be taken forward for rdWRMP24 after removal of infrastructure constraints. These were:

- Groundwater (HRZ): Remove constraints at Kings Sombourne (2.5Ml/d)
- Groundwater (HAZ): Recommission Chilbolton (0.5Ml/d)

We tested a scenario where both these options were pre-selected in rdWRMP24 to provide benefit from 2030-31.

The Chilbolton option in Hampshire Andover WRZ (HAZ) only provides a small benefit (0.5Ml/d) but even this benefit is confined to HAZ. In the absence of an option to transfer water from HAZ to HSW or HSE, pre-selecting this option only creates additional surplus in HAZ without reducing the volume required from either the Candover Drought Order or the River Test Drought Permit/Order.

The volume from the Kings Sombourne option can be moved from Hampshire Rural WRZ (HRZ) to HSW through the same infrastructure enhancements needed for the Romsey groundwater option mentioned above. This option was therefore included in rdWRMP24 and pre-selected to provide benefit from 2030-31. This is discussed further in Section 3.

The temporary desalination option proposed by the Environment Agency in its letter dated 24 August 2023 had previously been looked at as part of our WfLH programme. We re-appraised them for rdWRMP24 but our conclusions remain unchanged from our original appraisal (see Appendix A).

Regarding the change to our supply to a large industrial user in HSW, the current agreement with the industrial user expires in late 2026 and includes an obligation to negotiate a renewal of the industrial user's supply agreement. We do not consider amendments to the current supply arrangement before the existing

contract expires to be feasible. Not offering a future agreement or ceasing supply during a drought are not considered viable options given the importance of the industrial use to the local area. Negotiation of a replacement contract will include consideration of a range of options, including the option of alternative non-potable supply proposed by the Environment Agency in its letter dated 24 August 2023. However, these options are not yet fully determined and negotiations are at an early stage so we are unable to provide the certainty required for the purposes of inclusion in WRMP24 (see further details above and in Appendix A).

Bulk import of water from Norway or Iceland via sea tankers was considered for the WRSE regional plan and our dWRMP24 but not taken forward due to water quality concerns, excessive and disproportionate costs and the number of ships needed to provide the required DO. A scheme of this type has not been undertaken in the UK before. There are therefore no current industry examples to reference or follow. In addition to the projected excessive and disproportionate costs and logistical challenges, there are also substantial environmental risks, including the introduction of Invasive Non-Native Species (INNS) for which there are currently no established mitigation pathway in the UK context. This added further complexity and uncertainty to the feasibility of this option in the current planning period.

We had received a proposal from a commercial supplier to import water from Norway via sea tankers after we published our dWRMP24 for consultation. Following the conclusion of public consultation on our dWRMP24 in February 2023, we held a meeting with the commercial supplier in May 2023 to discuss their proposal. This was before the letter from the Environment Agency in August 2023. The meeting with the commercial supplier and subsequent internal review highlighted a number of key constraints that need to be resolved.

- A suitable berthing location for the tankers.
- A location for storing and treating the water to ensure compliance with DWI regulations.
- The infrastructure to transfer the water from the berthing location to the storage site.
- Agreement with regulatory bodies (e.g. DWI) on the water quality standard and ability to accept the water.
- Further environmental assessment of source water to minimise any potential water quality and Invasive Non Native Species (INNS) risk e.g. Salmon Fluke.
- Further discussions with the Environment Agency and Natural England regarding the potential impacts to designated sites, the conclusions of the Habitats Regulations Assessment (HRA) and whether any mitigation or compensation would be needed.

We held further discussions with the commercial supplier to further refine and develop their proposal and also carried out additional work in-house to address the key issues mentioned above. As a result, we produced a high level outline design for a solution that could potentially be in place from 2030-31 and included this as constrained option in our rdWRMP24. This is discussed further in Section 3.

New options

We have not identified any new options in the Western area for inclusion in rdWRMP24.

2.3.2 Central area

Accelerated delivery of already selected options

Our dWRMP24 included a groundwater option near Petworth in Sussex North (SNZ) (Groundwater (SNZ): New borehole at Petworth (4Ml/d)) that was first selected from 2043-44. In the interim rdWRMP24, the first need for this option was brought forward to 2040-41. In our view, it is potentially possible to deliver this option early to provide benefit from 2030-31. Its delivery has therefore been brought forward in rdWRMP24. See Section 3 for details.

Reconsidered WRMP24 options

Our targeted reappraisal of options in the Central area did not identify any options that could be considered feasible for rdWRMP24. We considered the proposal from the commercial supplier to see if sea tankering could be an option in the Central area as well. However, the lack of a suitable storage site in the vicinity of a potential berthing location prevented this option from being taken forward in the Central area. As described, we now know of many other reasons why sea tankering from Norway to our supply area is not a viable or environmentally acceptable option.

New options

We have not identified any new options in the Central area for inclusion in rdWRMP24.

2.3.3 Description of the options

Accelerated delivery

As an effort to reduce drought option reliance, we proposed to accelerate the delivery of two of the options that were already selected in our dWRMP24.

Groundwater (HRZ): New boreholes at Romsey (increase of 4.8Ml/d)

Romsey WSW is an operational groundwater site. The existing boreholes and well/adits at the site are either out of service or operating below their full capacity. This option involves drilling three replacement boreholes to increase Deployable Output (DO) on site. We expect the scheme to increase DO by 4.8 Ml/d to 13.7Ml/d. Replacement borehole locations are distant from existing borehole locations and so require new pipelines to connect to the treatment works. This option was previously selected to provide benefit from 2035-36. As part of our rdWRMP24, delivery was brought forward so that benefit can be achieved from 2030-31.

Environmental assessments for this option was included in annexes 17-19 to the rdWRMP24 Technical Report.

Groundwater (SNZ): Petworth groundwater source (4Ml/d)

This scheme aims to return our groundwater source at Petworth WSW to service by drilling a new borehole ca. 700m south of the existing WSW. The present boreholes are out of service due to raw water quality risks associated with their shallow depth and proximity to the River Rother. The new borehole is expected to be a minimum of around 300mm in diameter, and approximately 80m deep.

This scheme was previously selected in our dWRMP24 to be delivered in 2043-44 but rdWRMP24 included the delivery of this option in 2029-30 so that it provides benefits in 2030-31.

Reconsidered dWRMP24 options

We reviewed the list of options that were included in the WRMP24 unconstrained list of options but were not progressed to the constrained list. Both previously rejected options and reconsidered options still carry a significant level of risk, which is the reason they were originally rejected. These options are intended to be developed further during AMP8 (2025-30) with the aim of potentially reducing the level of risk in order to support reducing drought option reliance beyond 2030. As already stated, none of these options, even if all risk is capable of being reduced, remove the need for drought options altogether.

Groundwater (HRZ): Remove constraints at Kings Sombourne (2.5Ml/d)

This option involves recovering DO through the development of a new borehole at the site and additional pump capacity to increase the yield from the current 1.5Ml/d to the licenced capacity of 4Ml/d providing a net benefit of 2.5Ml/d.

This scheme was not previously included in our feasible options list for WRMP24 owing to potential Water Framework Directive (WFD) deterioration risks and the relatively small gain in DO compared to the degree of asset and network enhancement required. HRZ has also traditionally been in supply-demand balance surplus as the available DO from Romsey and Kings Sombourne sources exceeds the typical demand in

HRZ. However, by increasing the capacity of the Romsey Town and Broadlands link between HRZ and HSW, the surplus water from Romsey and Kings Sombourne sources can be transferred to HSW.

Bulk import (HSW): Sea tankering from Norway (45Ml/d)

This option would have involved a bulk import of water from Norway via sea tankers. An initial discussion took place with the DWI in April 2024. The meeting reinforced the need for additional work to assess and mitigate water quality risks to ensure that the imported water meets strict acceptability criteria. This additional work would involve the production of a Drinking Water Safety Plan (DWSP).

Some of the key issues we identified were as follows:

- The suitability of our identified berthing location for the anticipated size of tankers
- The further testing required to determine source water quality and hence treatment requirements and risk assessment updates at Test surface water WSW
- The time taken to offload a 45Ml tanker
- The need for additional space on the docks for installing pumps to pump water from the tankers and pipe it to Test surface water WSW
- The potential triggers for mobilisation
- The potential outline nature of commercial arrangements that will need to be in place with both the supplier and Southampton port operator to facilitate this option, including instances where the import may need to be aborted after initial mobilisation, for example, due to improving water resource situation.

This option was included in our rdWRMP24 but is no longer part of our WRMP24. We set out the reasons for removing it from our plan in section 2.4.

2.3.4 High level design and cost

Groundwater options

The Romsey groundwater option had already been designed at a high level as part of dWRMP24 development. The costs for the Romsey option were adjusted to 2020-21 cost base as was done for all options in rdWRMP24. There were no changes to high level for this option.

For potential groundwater options identified as part of this exercise, the following approach was used to come up with a high-level design.

- Pumps were sized against the flow and pumping head, assuming a pump efficiency of 80%. Where only the borehole depth was known in terms of required head, additional head was included to allow the water to pass through the required treatment and to join the network.
- Filtration was assumed to be by Amazon cartridge filtration unless the requirement for pressure or sand filtration was already included in the scope. Where media-based filtration was required, the size of filter was based on a conservative estimate of a normal sand filter.
- An upgrade in disinfection was normally assumed to be achieved by installing the correct size of Ultra-Violet (UV) reactor, followed by gas chlorination. In cases where super-chlorination was already used, an assessment was made on the size of the contact tank and the need to extend this. Generally, the water quality in the region contains nitrogen in the form of nitrate. Ammonia, which would affect the network chlorine residual is therefore not present and does not need to be removed by super-chlorination. This means that UV would be the preferred method of disinfection.
- Sand filters were sized in line with normal design practice seen at similar sites within the industry.
- Disinfection was assumed to be by UV treatment, unless adequate contact time for super-chlorination already exists.

The high-level outline designs were shared with our Cost Intelligence Team (CIT) to produce indicative costs for the defined option assets. The CIT maintains cost curves for the identified treatment processes. In the

case of Kings Sombourne, where the site is to be upgraded from an existing works, it was assumed that little additional infrastructure would be required beyond that which is already there.

Sea tankering

The sea tankering option would have had two main components:

1. **Procuring and transporting water from Norway to Southampton port**
2. **Transfer of water from Southampton port to Test surface water WSW.**

2.4 Changes to options for fdWRMP24

2.4.1 Changes to the resilience options identified for rdWRMP24

A number of respondents to our rdWRMP24, including the Environment Agency and Centre for Environment, Fisheries and Aquaculture Science (Cefas), highlighted a number of issues around the feasibility of importing water from Norway via sea tankers. These are included in annexes 3 and 4 to our Statement of Response (SoR) to the rdWRMP24 consultation.

A key concern raised by Cefas was the potential impact of this initiative on the UK's fish farming industry, wild salmon populations and local marine life, due to the threat of Gyrodactylus salaris. Gyrodactylus salaris is classified as Non-Native Invasive Species and its introduction could have potential devastating ecological consequences

Currently, there are no proven methodologies to guarantee that water imported from Norway via sea tankers would be free of Gyrodactylus salaris. Recognising the potential severity of impact arising from the introduction of this Non-Native Invasive Species, we accept that this poses an unacceptable risk to the environment.

Furthermore, the logistical challenges associated with this proposal are significant as were highlighted in our assessment of this option for rdWRMP24. These include the procurement of services and obtaining planning permission for pipeline construction through environmentally sensitive areas which could potentially lead to considerable disruption. Given these challenges and the extended timelines required to address them, we believe it is prudent to consider more sustainable and feasible alternatives. We have therefore excluded this option from fdWRMP24.

However, we recognise the potential of bulk import of water via sea tankers as an emergency drought measure, we are committed to conducting further feasibility studies to mitigate risks associated with water transfer through sea tankers, including sourcing the water from within the UK. These studies will help to inform Water Resources Management Plan 2029.

No other changes to option selection have been made for the fdWRMP24.

A number of respondents to our rdWRMP24 consultation, particularly in the Western area, suggested building more reservoirs and Aquifer Storage and Recover (ASR) schemes and relocating our abstraction on the River Itchen further downstream. We have now included additional information on these scheme types as well as desalination as follows:

- Appendix B: Rejection register for these schemes
- Appendix C: ASR and Managed Aquifer Recharge (MAR) schemes we have considered over multiple planning cycles
- Appendix D: Relocation of abstraction on the River Itchen further downstream.

2.4.2 Further review of options for fdWRMP24

In its feedback on the rdWRMP24, the Environment Agency as part of its recommendation R3.1.1 asked us to 'undertake a rapid appraisal of options with WRSE partners over the next 3 months, re-examining options where we have raised there being insufficient justification for rejection and any well-developed options from within WRSE' (see Annex 4 to our SoR document). In order to address the comment about insufficient justification for rejecting options, we have provided additional text in Appendix A of this document.

We have also commissioned a review of the options through WRSE. The review is looking at the options appraisal exercises we have carried out in the past for WRMP 2014 (WRMP14), WRMP19, WfLH and its consistency with the process carried out for WRMP24. This review will, once again, see if there are any short-term solutions that could be developed instead of and alongside using drought orders and permits in Hampshire. We anticipate this work to be completed in summer 2025. We will discuss the outcomes with our regulators and incorporate as appropriate into the WRMP24 annual review process.

We do not consider it practical to include additional options from within the WRSE, given that any options that could be developed by another WRSE company over AMP8 would have needed funding in Price Review 2024 (PR24). It is also impractical for a WRSE company to develop a scheme for Southern Water's benefit only in the event of a drought between 2030-31 and 2033-34, unless the scheme would be needed by the company for its out supply-demand balance post 2033-34.

Our in-house Innovation Team working with external consultants is also looking at a number of supply and demand options in the Western area to see if any of these can be delivered by 2029-30. These include alternative supply to the large industrial user in HSW as well as other large non-household users in Hampshire.

The review will assess if non-traditional approaches to water resource provision are feasible and realistic from a conceptual and geographic perspective. These reviews will help Southern Water understand if there are opportunities outside of typical water efficiency approaches, particularly when it comes to non-household and large water users. This is because their water requirements differ not only from domestic customers, but also from each other. Feasibility assessment into small scale or temporary desalination presents the opportunity to consider 'de-centralised' approaches to providing 'manufactured' water that has the potential to avoid some of the significant challenges presented by single-site, large desalination.

The specialist consultancy will assist us in assessing the several Western area options to increase supply resilience and reduce the need for drought options. This work includes a study to assess the feasibility of taking large non-household users off-grid, considering options for small scale desalination and other options for providing an alternative supply to the large industrial customer, and domestic regulation technology. When we say "off-grid" we are investigating whether these commercial and industrial customers can be supplied by different means than usual so that the water used to supply them is not abstracted from the Rivers Test or Itchen.

As mentioned above, the current agreement with the industrial user expires in late 2026 and includes an obligation to negotiate a renewal of the industrial user's supply agreement. Ceasing the current supply before the existing contract expires is not feasible, meanwhile consideration of options to either not offer a future agreement or not provide a supply is not considered a viable option given the importance of the industrial user to the local area. Negotiation of a replacement contract will include consideration of a range of options. However, these options are not yet fully determined, and negotiations are at an early stage so we are unable to provide the certainty required for the purposes of inclusion in WRMP24.

In preparation for the contract renewal, we are reviewing all options with the headline objective being the feasibility of agreeing and/or providing alternative water sources in order to reduce the demand in the Hampshire Southampton West Water Resource Zone (HSW WRZ). This includes considering the type of water provided (potable vs 'industrial' vs raw), reviewing the site requirements, and conducting a scoping exercise to understand non-traditional water resource options such as water reuse (including the reuse of grey water and final effluent). A range of metrics will be used so that the options can be compared which will include viability (technical and logistical), sustainability and cost. This optioneering exercise is underway and is

expected to complete in September 2025 and we are liaising with the large industrial user in order that negotiations can conclude in readiness for the supply contract renewal.

In preparation for the contract renewal with the large industrial user in HSW, we are reviewing all options with the objective of agreeing a way forward that reduces the demand on our supplies in HSW, particularly during a drought. This optioneering exercise is underway and is expected to be completed in September 2025. We are liaising with the large industrial user in order that negotiations on an alternative option(s) can be concluded in time for the supply contract renewal.

We should mention that none of the options being considered are seen as alternatives to HWTWRP, nor are they seen as full replacement for the drought options in Hampshire. They are primarily being assessed to see if they can provide benefit from 2030-31 (or sooner) and reduce the reliance on the Candover and River Test drought options until HWTWRP is delivered in 2033-34. The options are not of a similar scale and nature that can be a genuine alternative to our HWTWRP which will provide a permanent supply and protect the chalk streams.

3 Conclusion

The effect of revised dates for the Havant Thicket Reservoir and the HWTWRP means that we will have to continue to rely on the use of Candover and River Test drought options in Hampshire (Western area) until those schemes are fully operational. Without these drought options, we cannot maintain supply-demand balance in Hampshire during droughts and they remain a necessary interim measure until the Havant Thicket Reservoir and HWTWRP are operational. Through stakeholder and customer engagement, we understand that the continued reliance on drought options present ongoing concern and we are committed to working with our regulators and looking for ways to minimise the level of reliance on the drought options during this interim period and work is already underway in this respect.

The Environment Agency asked us to consider options to mitigate the reliance on drought permits and orders, including options that were previously considered but not considered feasible. We undertook a targeted reappraisal of options for our rdWRMP24 to identify options which could potentially reduce our dependency on drought options in the Western and Central areas in the interim period until our large infrastructure schemes could be delivered.

As a result of that process, our plan now includes three options comprising one new groundwater option at Kings Sombourne in the Western area and two accelerated groundwater options (Romsey in the Western area and Petworth in the central area). Our rdWRMP24 also included a bulk import of water from Norway via sea tankers in the Western area for utilisation in the event of a drought between 2031-31 and 2033-34.

After careful consideration of the risk and following feedback on rdWRMP24 consultation, we have withdrawn this proposal from the fdWRMP24. This decision reflects our commitment to the communities we serve and the environment. During consultation, significant concerns were raised about the option. These included the potential impact on the UK's fish farming industry, wild salmon population and local marine life due to the threat from the introduction of INNS. Other concerns included the proximity of the pipeline from Southampton docks to our River Test WSW to environmentally sensitive and protected areas and the logistical challenges. The proposal was therefore not deemed sufficiently feasible to include in our fdWRMP24. However, recognising the potential of bulk imports via sea tankers as an emergency drought water supply option, we are committed to conducting further feasibility studies to mitigate risks which will help inform WRMP29.

We have commissioned additional work following the consultation on rdWRMP24 to continue exploring options in the Western area in order to find ways to reduce reliance on the Candover and River Test drought options. These studies are scheduled to be completed by the end of summer 2025. We will discuss the outcomes with the regulators to see if any of the options are deliverable over AMP8.

The inclusion of Kings Sombourne groundwater option and accelerated delivery of the Romsey groundwater option does not remove the need to rely on drought options altogether, nor does it materially alter the frequency of application for drought permits or drought orders in the Western area.

4 Future Water and the transition into WRMP29

In view of the challenges we face across our supply area, we have recently started a project which involves a different way of thinking about water resources in our region.

The traditional approach to water resources management planning has historically been dependent on abstraction from surface and ground water sources of water. However, as we move forward the impacts of climate change are likely to have an ever-increasing impact on the way our customers use water. We acknowledge, that as a progressive water company, we need to be agile in our approach to water resource management and adapt our thought processes to consider and develop different options that may currently, or in the past, have been ruled out. This includes a review of innovation and ways of working which may have changed the feasibility of options that previously were not feasible. As we move forward with our 'Future Water' resource planning we will be considering emerging technologies and evolving approaches to water resource management, including addressing some of the challenges associated with desalination and water recycling. Taking desalination as an example, there are challenges to overcome which includes energy intensity, disposal of hyper saline brine, and compliance with the DWI Regulation 31 for components such as reverse osmosis membranes. The areas identified as current challenges will be reviewed to consider how alternative technologies or relationships could be used to address them. For example, could the waste brine become a by-product with commercial value and eliminate disposal to the environment? Such considerations are typical of the challenges which will need to be addressed as we progressively develop our thinking about future water needs, seeking opportunities to maximise the water available in water-stressed areas. We will continue to explore all avenues available to us to provide the resilience we need in the South East.

We are currently developing and adopting our Future Water approach which will feed into the annual updates of our WRMP24 and also inform the process as we begin to develop our WRMP29.

As with any form of change, we will continue to be open to new ideas and approaches. We will strengthen our engagement with all concerned stakeholders to involve them in shaping Future Water so they are involved in water resources management developing effective plans in partnership with us. As we move forward with our thinking, we will develop shared learning opportunities to ensure our mutual understanding of our catchments and strategic options develop in tandem so we can capture and develop ideas from outside of our business and influence and inform the organisations and communities around us too. Internally we will empower people to think differently about water resources strategies to inform future WRMP's to ensure we not only meet the needs of our customers and the environment but work together to provide water for people and the environment for life.

Outside of this WRMP24 process, and in preparation for WRMP29, we have started to explore our Future Water approach to thinking about water resources and we are excited to share a first look at some potential future options for our Pulborough site in our Central area and our Test surface water WSW in our Western area. In summary we have undertaken pre-feasibility reviews of the following options:

1) Recirculation of water on the River Rother, River Arun and also on the River Test. This option is not currently considered to be viable and would require extensive environmental investigations to ascertain potential for environmental impact.
2) Desalination of water to create potable drinking water. At the current time this option is not being progressed in the early stages of our rdWRMP24 due to significant environmental constraints in the locations where desalination has been considered (set out in the rejection register) regarding the disposal of hyper saline material, and energy intensity. We will investigate potential innovative techniques to assess whether desalination can become more attractive as an option by undertaking research in potential uses for the hyper saline solution and whether energy consumption could be reduced.
3) Abstraction of increased volumes of water on the transitional waters of the River Arun. We currently believe this option is worth investigating further and we will be pursuing more work on

this option which we are keen to work on collaboratively with the relevant stakeholders. We are aware of the environmental considerations required in the Pulborough area which can be complex in nature hence a joined up and collaborative approach will be essential to exploring this option further. We intend to provide updates on the development of this option during our annual review updates and potential for inclusion for consideration in our WRMP29.

We will develop Future Water thinking further as we move into the development of WRMP29 but should any option prove to be feasible at an earlier stage we will bring it forward if appropriate and update stakeholders via the WRMP annual review process.

Appendix A: Re-appraisal rejection register

Table 2: Western area options (appraised before 28 September 2023).

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
HSW	Test surface water WSW process loss recovery	Re-considered option - The existing works at Test surface water WSW currently discharges 3.4Ml/d to the river. Recycling this process loss to the head of the works could deliver a DO benefit of up to 3.0 Ml/d. An additional DO benefit of 0.35Ml/d could also be realised by further treating this wastewater to create a solid waste which would need to be taken for land spreading or landfill. This is already programmed for delivery end of AMP8 but is not included in WRMP24 baseline. Recycling of waste is a well-established process enabling water companies to maximise their licenced output from an abstraction which needs to be treated. The return of this water is regulated to ensure that it has no detrimental effect on the quality of water being produced. As such it would be treated such that no more than 10% of the works flow is recycled to the head of the works, with a return turbidity of less than 10 NTU, ideally around the same quality as the incoming water.	3.35	There are issues with the current treatment process on site which would need to be resolved before this scheme can be implemented. There would need a much larger upgrade to the site as opposed to only the wastewater handing system. The enhancement of the site could still be considered for WRMP29 but would not be able to respond as a resilience option.
HSE	Itchen surface water works process loss recovery	Re-considered option - The existing works at Itchen surface water WSW currently discharges 2.0 Ml/d to sewer. Recycling of this to the head of the works could deliver a DO benefit of up to 1.7 Ml/d. An additional DO benefit of 0.27Ml/d could be realised by further treating this waste water to create a solid waste which would need to be taken for land spreading or landfill. Recycling of waste is a well-established process enabling water companies to maximise their licenced output from an abstraction which needs to be treated. The return of this water is regulated to ensure that it has no detrimental effect on the quality of water being produced. As such it would be treated such that no more than 10% of the works flow is recycled to the head of the works, with a return turbidity of less than 10 NTU, ideally around the same quality as the incoming water.	1.97	There are issues with the current treatment process on site which would need to be resolved before this scheme can be implemented. This would need a much larger upgrade to the site as opposed to only the wastewater handing system. The enhancement of the site could still be considered for WRMP29 but would not be able to respond as a resilience option.
HSW	Test surface water – Little Lake	Re-considered option – Dredging of lake to increase storage. Enabling option to support DO to be delivered by other options	NA	No DO benefit because additional volume from dredging is negligible and these options are linked to other schemes. For

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
				example, these lakes could form an environmental buffer for wastewater recycling or sea tankering options.
HSW	Test surface water lakes	Re-considered option – Dredging of lake to increase storage. Enabling option to support DO to be delivered by other options	NA	No DO benefit because additional volume from dredging is negligible and these options are linked to other schemes. For example, these lakes could form an environmental buffer for wastewater recycling or sea tankering options.
HRZ	Near Andover 2	New option – Rehabilitation of existing source. Installation of nitrate treatment plan to overcome water quality issues. Modification of existing catchment management scheme. Provides limited benefit	0.5	Rejected because the option's maximum potential DO was low (c. 0.5 Ml/d) and it was not directly supplying the HSE or HSW zones. IVM results have shown that introducing this option has no material impact on the transfer to Winchester zone. As such, this option does not provide a DO benefit where it is needed.
HAZ	Andover	Re-considered option – Andover WSW is a mothballed site due to the high nitrate concentration in the raw water. When the site was mothballed, the abstraction licence was rescinded and a new licence would be required to run the works. This scheme involves recommissioning the site, with the inclusion of nitrate removal plant, as well as disinfection. The generated waste stream will require removal by tanker or discharge to sewer. Bringing this groundwater fed site into operation, with new borehole pumps, could provide a DO benefit of 0.8 Ml/d.	0.8	Although the site was decommissioned due to water quality issues rather than environmental concerns, it has not been run in 20-30 years and is highly likely to impact on nearby rivers, such as the Test and the Avon. The environmental impact will need to be carefully understood; increasing groundwater abstraction is not without its local impacts. The time that would be required for the environmental surveys as well as ensuring that it did not impact on other sources in the area means that this scheme is impractical under the timeframe required.
HRZ or HAZ	Overton	Re-considered option This involves the addition of a filtration process to address turbidity issues at higher flows from the groundwater fed Overton WSW. This could provide a DO benefit of 0.09Ml/d, taking the site to its licence flow.	0.1	The site already operates very close to its maximum output, with turbidity issues only noticeable at the higher flows. This scheme has very low potential benefit with a risk that other water quality issues may also present themselves at the higher flow, with this risk being most prevalent during the low ground water levels seen during drought periods. It is thus unlikely to be a benefit during drought conditions.
HAZ	River Way, Andover	Re-considered option – The site is subject to a licence reduction to protect the local environment. The aim of this scheme is to delay the reduction in abstraction to provide resilience. There is no additional work to be done on the site to enable this.	5.0	The licence reduction was undertaken on the basis of the environmental assessment of the local area. Maintaining the flow at the site would delay a change designed to improve environmental sustainability. In addition, Natural England raised concerns about the environmental impact of this option. Because it would mean increasing abstraction in part of the Test catchment (River Way is tributary of the Test) it is not a suitable

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
				option for reducing the abstraction pressure in the Test catchment.
HWZ	Twyford	Re-considered option – Twyford is currently running at an output of 18Ml/d, which is below the site licence of 36Ml/d. There are water quality issues with nitrate and turbidity on the site, particularly during the startup of Borehole 2. However, the main reason for the lower than licence flow is due to the level of water in the well, which cannot sustain a flow of higher than 18Ml/d.	5.0	Although the site is licenced for 36Ml/d, the maximum it can achieve is the current DO of 18Ml/d, due to the level of the water in the well. The well level will drop further under times of water stress, so this option will not be available during droughts. There are also likely to be environmental concerns around the increased abstraction during drought conditions. Surveys would be required to understand the impact on the nearby River Itchen. There is a high degree of uncertainty about completing these surveys to conclusively demonstrate that there would be no detriment to the environment. This would increase the timeframe to deliver the option so much that it would not be deliverable in the timescale required.
HRZ	Romsey 2	Re-considered option – Romsey 2 is based on taking advantage of available land on the existing Romsey WSW site and combining raw water flows from the Near Andover 2 and Near Salisbury groundwater sources through an expanded network for treatment in a single ion exchange nitrate removal plant. The generated waste stream will require removal by tanker or discharge to sewer. This could provide a DO benefit of 3.7Ml/d. The abstraction licences have been rescinded at Near Salisbury and would require new applications. An earlier iteration of this scheme also included the site of Broughton, which has also been mothballed with the licence rescinded. This scheme would require a raw water pipeline to be built between the three sources, delivering the water to Romsey. This scheme has no impact on the Romsey1 project, other than to have the treated water in the same place.	3.7	There are environmental concerns around the boreholes at Broughton and Near Salisbury. Neither site has been run for around 20 years, so there is great uncertainty over yield and the environmental impact on the surrounding areas. There would also be an environmental impact in building an extensive raw water pipeline to bring the water to the Romsey site. Time would also be an issue for building this scheme within the timeframe required, particularly the raw water pipeline, which would pass through rural and urban areas.
IOW	Rookley	Re-considered option – Development of a new raw water storage reservoir within the footprint of the existing Rookley WSW, with associated new process given existing sources are groundwater. This would require pumped transfer of raw water from Sandown and therefore a new abstraction licence. There are currently 2 boreholes on site. The nearest surface water is Sandown, so there is no surface water connection on	2.1	There would need to be a raw water transfer from Sandown, the development of a new raw water reservoir and the construction of a full surface water treatment works. This is not technically feasible within the timeframe required for these schemes. The scheme would also require a new abstraction licence at Sandown, which would be subject to environmental studies, again extending the timeframe for the project.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
		site. There is no existing structure at Rookley, so this would need to be constructed, nor is there a current source pathway. As well as a new reservoir and raw water main from Sandown to Rookley, the scheme would require the building of a full surface water treatment works.		
IOW	Caul Bourne	Re-considered option – By reducing the MRF on the River Caul Bourne, more water can be abstracted in addition to the current output, providing a potential benefit of 0.7Ml/d. The disinfection process on the existing treatment process would need to be uprated, otherwise, there are no site changes required.	0.7	This is not practical as a resilience option as it is unlikely that the additional water would be available under drought conditions without causing further environmental damage to the local environment. Water will not be available to maintain river flow and support the local habitats. Further increasing the abstraction at this time will only increase this.
IOW	Ventnor3	Re-considered option – Reintroduction of previously abandoned borehole. The site would need to be re-licenced and the treatment process reinstated.	0.6	There are environmental concerns over re-licensing a new borehole. The reintroduction of an abstraction licence for the site will require lengthy testing and may show environmental issues. So, this option was rejected on environmental grounds.
IOW	Ventnor2	Re-considered option - Reintroduction of previously abandoned borehole. The site would need to be re-licenced and the treatment process reinstated. There are also know water quality issues at Ventnor2, and an organic chemical removal process will need to be installed to ensure the water quality is not compromised.	0.5	There are environmental concerns over re-licensing a new borehole. The reintroduction of an abstraction licence for the site will require lengthy testing and may show environmental issues. So, this option was rejected on environmental grounds.
IOW	Shalcombe	Re-considered option - Reintroduction of previously abandoned borehole. The site would need to be re-licenced and the treatment process reinstated.	0.6	There are environmental concerns over re-licensing a new borehole. The reintroduction of an abstraction licence for the site will require lengthy testing and may show environmental issues. So, this option was rejected on environmental grounds.
IOW	Lukely Brook	Re-considered option - Reducing the linked Minimum River Flow (MRF) associated with the existing groundwater abstraction licence could provide a combined DO benefit of 1.5 Ml/d. The existing treatment on the site is able to treat 18Ml/d, which is significantly above the anticipated 3Ml/d at which the site would need to run.	1.5	The licence has been capped at current output to maintain the flow in the local watercourse. This scheme would impact this flow. Additionally, in times of drought, it is very unlikely that there would be sufficient flow available to increase the output from the site. Therefore, while the treatment is adequate, it is unlikely that the water would be available and would cause an environmental impact if was available.
IOW	Newport	Re-considered option - Newport WSW takes water from a mixture of underground drainage water and groundwater. The aim of the scheme was to take additional groundwater by drilling a new borehole producing an extra 2Ml/d.	2.0	There is also no certainty that drilling a new borehole would result in additional yield, particularly under drought conditions. The water levels are sufficiently low enough to cause turbidity issues when increasing the flow from the current boreholes. As

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
				the groundwater level would drop further under drought conditions, It is likely that turbidity would become worse, reducing the water available from the site. The scheme would require a number of pump tests and environmental surveys to ensure there was sufficient water of adequate quality as well as no environmental impact from the additional abstraction. There would also need to be an assessment of the impact on the existing boreholes, in terms of yield and quality. The time required to carry out these surveys and the substantial risk to the existing supply and the environment for potentially little to no benefit means that this scheme should be rejected.
IOW	Newchurch	Re-considered option - There are currently 2 greensand boreholes running at 2Ml/d plus a chalk well at 6Ml/d. The greensand cannot run without chalk due to water quality concerns, although there is aeration and filtration treatment in place for this. The aim of this scheme is provision of a new borehole and pump to increase yield from the greensand groundwater source. The existing treatment process would need enhancement with sand filters to accommodate this additional water and provide a DO benefit of 2Ml/d.	2.0	There are environmental concerns over drilling a new borehole due to the impact of removing more water from the environment. There is also a risk that a new borehole would impact the existing abstractions in terms of both quality and quantity. Surveying work would be required, which would cause a delay to the implementation of the scheme. Additionally, increasing the greensand proportion of the water has a known quality risk due to the amount of dissolved metals. A major treatment improvement would be required to enhance the removal of these substances, to ensure the water continued to meet the high standards required by the regulations.
HSW	Recycling of final effluent from Test Estuary WTW	Re-considered option – Final effluent (FE) from this works would be recycled using reverse osmosis (RO) technology to ensure that it is of sufficient quality to be used as a raw water elsewhere. This would result in a waste stream to be combined with the remaining FE. The recycled water produced would have to be carefully controlled to ensure that it does not interfere with the local ecology in these water courses.	Desalination with 10 Ml/d capacity considered here	This project is not yet suitably mature to achieve the deadlines for these resilience options. It remains in its very early development stage, and while it is likely to be an option in the future, it cannot be considered as a resilience option for these purposes within the required timeframe. There would also be a requirement for catchment sampling to ensure that there was no detrimental effect on the alternative discharge location.
HSW	Recycling of waste from New Forest,	Re-considered option - Final effluent (FE) from the wastewater would be recycled, using reverse osmosis technology, to Test surface water WSW via a new pipe across the New Forest. This would also result in a waste stream to be combined with the remaining FE from New Forest WTW.	9.0	This project is not yet suitably mature to achieve the deadlines for these resilience options. It remains in its very early development stage, and is unlikely to be an option in the future due to the transfer across the New Forest and the estuaries along this coast.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
HSE	Recycling of waste from Woolston.	Re-considered option - Wastewater would be recycled into Test surface water Little Lake (or the River Itchen was previously rejected and not re-considered)	5	There are two key issues making this option unfeasible: 1) the space for a water recycling plant at Woolston and then 2) the transfer under Southampton Water and dock yard. The area around Woolston is heavily developed and the transfer from this site under the water complicated, due to the length.
HSE or HSW	Desalination on the Solent	Re-considered option - Taking water directly out of the Solent to treat through removing the salt from the water. This water would then be sent as raw water to one of the larger treatment works (for example Test surface water via the lakes) with the concentrate being discharged back into the Solent. We have considered temporary and permanent variations of this option.	10.0	There are strong environmental concerns about the hypersaline waste stream that would be produced by this process (for either permanent or temporary desalination) and would be discharged into the Solent and Dorset Coast SPA and/or South Wight Maritime SAC. It is unlikely that a suitable location could be found for this option at this time as the exercise has already been conducted as part of the RAPID process. At the workshop we held in November 2023, our environmental regulators expressed concern about desalination in this location. For example, Natural England (NE) provided the following comment about this desalination option “Due to the environmental risks and expected impacts, constrained nature of the Solent and likely compensation that would be needed NE’s view is this should not be taken forward in this location.” The investigations into desalination at West Southampton Coast, an option from our WRMP19 plan, also showed the Solent not to be a suitable location for a desalination plant at this time. Should there be new technology to embrace and lessons to learn from other water companies installing (temporary) desalination in less environmentally sensitive areas then we will incorporate these in WRMP29. As we set out in our interim Gate 1 submission that discounted desalination options, prior to our RAPID Gate 2 submission, the Options Appraisal Process (OAP) carried out concluded that: • The options that enhance the daily volume of water that can be extracted from the Havant Thicket Reservoir (HTR) are the highest ranking • Water recycling options that deliver the raw water to a new environmental buffer at one of our treatment works on the River Itchen are middle ranking

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
				• The desalination options are the lowest ranking in our assessment, and the site at West Southampton Coast presents difficulties such that we consider these options are not likely to be consentable at this location at this time. We came to the view in the RAPID process that it is appropriate to no longer progress with any further work on the desalination options as there is now clear evidence to show that these are the least preferable options at this location and time. All the RAPID submitted documents for Gate 1, 2 and 3 along with the query responses are here: Water For Life – Hampshire Technical Documents
IOW	Desalination on the Isle of Wight	Re-considered option - Water would be taken directly from the English Channel and sent as raw water to a treatment works on the Isle of Wight, enabling water to either be exported from the Island, or removing the need to import water from the mainland. Due to the constraints on discharging desalination waste into the Solent, this would need to take place at the south of the island, so that the waste would be discharged into the English Channel, which would have a lower environmental impact.	10.0	Power would be a major constraint for this option. Desalination is a power intensive process and there is no spare power capacity on the island to enable the process to work. Temporary diesel generation could be used to cover the power shortfall but this would have environmental impacts from greenhouse gas emissions. Building on the south of the island would also require a lengthy pipeline to be constructed across the island. The timeframe required for this would take the project outside of the requirements of this process. In addition, there are potentially unacceptable negative impacts on the South Wight Maritime SAC and, as referred to above (desalination on the Solent), it is unlikely that NE would support this option in this location, due to the environmentally sensitive habitats in the vicinity and due to the environmental impacts being similar to options situated elsewhere in the Solent. Should there be new technology to embrace and lessons to learn from companies installing (temporary) desalination in less environmentally sensitive areas then we will incorporate these in WRMP29. This is part of the Future Water work described earlier in this annex. Also, as described above in relation to desalination on the Solent, there are preferable supply side options for our Western area to desalination on the Isle of Wight.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
HSE	Accelerate the option to take more water from Portsmouth Water	Accelerated delivery option - Accelerate the option to increase to existing bulk import or new bulk supply.	Variable	Discussion held with PWC; currently no surplus available, however this may change depending on the outcome of PWC's WINEP investigations. Therefore, we will explore this for WRMP29 but cannot adopt it in the required timescales so that it is operational by 2030.
All	Licence Trading	Re-considered option - If there are any holders of abstraction licences with material volumes of unused abstraction licences they might be willing to trade these with Southern Water on a permanent or temporary basis.	Variable	We have considered trades with neighbouring companies as part of WRSE and that is covered in our rdWRMP24. For WRMP19 we published a bid assessment framework to support the market to deliver WRMP options to help meet our supply duty. This did not lead to any viable options. As set out in section 4 of annex 12 for our rdWRMP24 we explored options with two large industrial companies, but we rejected both options. Also, in annex 12 we say why we rejected the option of "explore licence trading with large abstraction licence holders." When we consulted on our dWRMP24, any third party with a supply/ demand option could have presented it but we received no viable, sustainable options. It is logical that there are very few sustainable options of this sort because other abstractions in our region are likely to be subject to similar concerns and any increases in abstraction would need to demonstrate no deterioration.
HSW	Recycling New Forest WTW direct to supply the bulk export to a large industrial user in Hampshire Southampton West WRZ.	Re-considered option - Transfer direct to large industrial customer at Southampton West WRZ via existing infrastructure as an industrial use. Process capacity increase and enhancement. This option is similar to the recycling options described above except that this option exports that water to the large industrial customer.	9	The same reasons for rejection described above for the New Forest wastewater recycling option apply here but with the added complexity, as this option proposes a transfer via the existing infrastructure, 1) we would be mixing drinking water and raw water – not acceptable for customer safety - 2) Limit capacity in the old pipe to increase flow / pressure for the additional 9 Ml/d, over the existing SWW transfer, and 3) it reduces the resilience of the supply to the large industrial user, thereby increasing the risk of a "crash shutdown" of the industrial process due to any failures of the pipe. In addition, the current agreement with the industrial user expires in late 2026 and includes an obligation to negotiation a renewal of the industrial user's inclusion in Southern Water's licence supply area. Ceasing current supply pre-expiry of existing contract and/or imposing a future no-contract or no-

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
				supply scenario is not considered a viable option given the nature of the industrial use. Negotiation of a replacement contract for post-2026 supply will include consideration of various options for renewal including reducing maximum supply volume; flexing maximum supply volume in normal and drought periods; exploring alternative supply provision by Southern Water, by another water undertaker, or by self-supply; etc. However, these considerations are not determined and negotiations are not sufficiently progressed to provide the certainty required for the purposes of inclusion in WRMP24. When we appraise options as part of the WRMP29 preparation we will look at this option again in the context of the latest contract negotiations with this industrial customer.
IOW	Isle of Wight Cliff dewatering - Ventnor	Re-considered option - Cliff dewatering on Greensand to prevent cliff slumping. Scheme viability subject to NE and EA approval that this scheme is suitable for this location and the environment, and that the water is available. Tests and assessments into this scheme are at an early stage, so subject to outcomes of these investigations. But if this is deemed a viable option, this would be a source of water that would otherwise be discharged to sea.	0.5	Reason for rejection is that the time required for the environmental, hydro-geological and engineering studies needed would not allow it to be delivered by 2030.
HSW	Large industrial user at Hampshire Southampton West WRZ - recycling	Re-considered option - Water recycling but large industrial user building their own recycling plant at their site to enable reduce consumption of water at the site.	TBC	The same reasons for rejection described above for the wastewater recycling options apply here but with the added complexity that this option would involve the re-negotiation of an existing supply agreement (see above). When we appraise options as part of the WRMP29 preparation we will look at this option again in the context of the latest contract negotiations with this industrial customer.

The table above lists 28 of the 31 western area options shared with the EA and NE following the 28 September 2023 workshop referred to in section 2.4 of this annex. The three options not listed in this table are the selected options (bulk-import via sea tankering, Kings Sombourne and Romsey).

We have also considered a number of other options that have been suggested as part of the internal and external engagement but weren't on the list of 31 schemes circulated with the EA and NE in October 2023. These options are included in the following table:

Table 3: Western area options (appraised after 28 September 2023)

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
IOW	Groundwater (IOW) New borehole at Eastern Yar3	Re-considered option - This option was added after we shared the list of options to the EA/ NE in October 2023. It involves drilling a new replacement borehole, ca. 100m deep, for Eastern Yar3 augmentation well on the Isle of Wight (IOW). The existing borehole has ca. 90% loss in performance, and previous well rehabilitation and cleaning has not provided a notable improvement. A replacement well is required to regain resilience.	1.5	Following more detailed investigations we have established that the DO of this augmentation is already included as part of the baseline DO for Sandown. Therefore, this scheme does not provide a direct DO benefit so we have rejected it.
HSE or HSW	Recycling Test Estuary WTW to bulk export to large industrial user at Hampshire Southampton West WRZ	Re-considered option - As per WRMP19 option description – transfer of recycled water to large industrial user at Hampshire Southampton West WRZ to offset water supplied currently for industrial use from Test surface water. Process capacity increase and enhancement.	TBC	The same reasons for rejection described in the table above for the Test Estuary WTW water recycling option apply here but with the added complexity that this option would involve a new pipeline touching on the New Forest. In addition, the current agreement with the large industrial user expires in late 2026 and includes an obligation to negotiation a renewal of the industrial user's inclusion in Southern Water's licence supply area. Ceasing current supply pre-expiry of existing contract and/or imposing a future no-contract or no-supply scenario is not considered a viable option given the nature of the industrial use. Negotiation of a replacement contract for post-2026 supply will include consideration of various options for renewal including reducing maximum supply volume; flexing maximum supply volume in normal and drought periods; exploring alternative supply provision by Southern Water, by another water undertaker, or by self-supply; etc. However, these considerations are not determined and negotiations are not sufficiently progressed to provide the certainty required for the purposes of inclusion in WRMP24. When we appraise options as part of the WRMP29 preparation we will look at this option again in the context of the latest contract negotiations with this industrial customer. The Gate 2 RAPID document referred to below sets out reasons for rejecting option D.1 which involves using desalination to supply the large industrial user. Although this option considers using recycled water rather than desalinated water, some of the same rationale applies.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
HSE or HSW	Bi-directional link from IoW	Re-considered option - At the 22 March 2024 workshop with EA/ NE it was suggested that the link main from Hampshire to the Isle of Wight could be used in a different direction to use any future 'spare' capacity from Sandown. This option to take water from the IoW to the mainland was part of the dWRMP24 options appraisal.	TBC	We confirmed at the workshop that this option has a lead in time of 10 years so it does not satisfy the criteria set out in section 3.1
HSE or HSW	Bulk import via sea tanker from different location than Norway	Re-considered option - There are variations on the sea tankering option that we have selected. For example, options include sourcing the raw water from Wessex Water, France or other countries. In addition, there are sub options relating to where the sea tanker delivers the raw water to e.g. to Portsmouth, the Isle of Wight or the bulk export to large industrial user at Hampshire Southampton West WRZ.	TBC	These other sources of water for sea tankers are less certain and less well developed than the Norway option. However, for WRMP29, we will continue to pursue alternatives. The largest ships that have contain 45 Ml/d and Southampton container port is the only location suitable for ships of this size. We note that sourcing the water from Norway does not place additional pressure on a UK source. It is likely that any 'surplus' water in the Wessex Water area would be subject to WFD no deterioration assessments. In addition, another reason for progressing the bulk import from Norway as opposed to from any other country is that there is more known about the Norway option than imports from any other location. As a result, any sea tankering option from another source location would take longer to develop and have greater uncertainty associated with it than the Norway option.
Geology dependent	ASR/ MAR	Re-considered option - Aquifer Storage and Recharge/ Managed Aquifer Recharge. There are several options of this sort included in the WRSE investment modelling.	5.5	The uncertainties over yield, environmental impacts and engineering deliverability prevent options of this sort being ready by 2030. Whilst this means the lead in times are too long for this process, the Test surface water MAR scheme has been selected in 2036 in our updated WRMP24. It is also worth noting that these schemes are unlikely to provide as large a volume as the 45 Ml/d sea tankering option.
HSE or HSW	Variations on the large bulk export to the large industrial user at Hampshire Southampton West WRZ/ desalination options	Re-considered option and variations of this- There are variations and sub options relating to the bulk export from Southern Water to a large industrial user. For example, the bulk supply could be sourced from water from new recycling or desalination schemes or directly supplied by sea tankering.	TBC	The reasons for rejection for the bulk export to the large industrial user at Hampshire Southampton West WRZ and desalination options in the table above apply to these sub options too. In summary that there are unique, contractual and legal complications that mean the bulk export to a large industrial user cannot be altered in the required timescales. The delivery times and uncertainty associated with new desalination/ recycling schemes prevent sub options of those being delivered in the required timescales.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for re-appraisal rejection
				A desalination plant in this location would also have the same environmental impacts as our rejected WRMP19 desalination at this location, so would likely be unviable for this reason also. Further information on the reasons for rejecting the use of desalination to supply a large (up to 40 Ml/d) industrial user in conjunction with South West Water are included in the following Gate 2 report WFlH_7_Gate-2_conceptual-and-detailed-feasibility_desalination-redacted.pdf. In this and other RAPID documents this option is named option D.1.

Table 4: Central area options

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
SWZ	ASR Worthing (Sussex Coast Lower Greensand)	Re-considered option - Reinstatement of ASR scheme previously removed due to land availability issues.	TBC	Due to technical, hydro geological uncertainties as well as land availability concerns, this option could not reliably be investigated and delivered in the timescales required.
SBZ	Housedean WSW	Re-considered option - The site is constrained by pump capacity, UV performance and the size of the filtration plant. Increasing both would increase the amount of water available from the site.	1Ml/d	This work is part of the Falmer/ Brighton East project. This source will become a remote borehole and water will be transferred to Falmer for treatment. Option rejected because it would not provide any additional DO.
SWZ?	Sompting WSW	Re-considered option - This option involves recommissioning of borehole 2. This work has been completed during AMP7.	n/a	This work is complete borehole 2 has been re-commissioned however whilst this improves site resilience by creating duty-assist arrangement output is still restricted by capacity of the nitrate treatment plant. So, we rejected this option because it would not provide any additional DO.
SWZ	Littlehampton WSW	Re-considered option - The output of the site can be increased from 3Ml/d to 4Ml/d by increasing the size of the pumps. These should be capable of achieving 4Ml/d (each of the two boreholes has a pump nominally capable of achieving 2Ml/d). However, this has not been achieved for nearly 20 years. There are turbidity issues which are expected to increase as more water is abstracted from the ground. However, the filters on site were designed to treat 4Ml/d.	1.0	This scheme is already being taken forward by the Southern Water operations team. However, it is believed that the pump size is not the flow constraint for this site; it is the lack of water in the borehole which is preventing the site from reaching its output. This is likely to be worse during drought conditions, so the scheme should not be taken forward on the basis of this scenario.
SWZ	North Worthing WSW	Re-considered option - This is currently running at 7.2Ml/d, which is an increase over the historic output of 6Ml/d. The	4.2	There are a large number of uncertainties with increasing the flow at this site, in terms of water quality and network capacity.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
		increase in flow was due to valving restrictions being rectified. The site has a licence of 11.4Ml/d, so an additional 4.2Ml/d is theoretically feasible. It is not known whether the increased flow would result in water quality issues. There is turbidity treatment on site, but other contaminants may become prevalent. Increasing the flow to the licence would require a full refurbishment as 8.9Ml/d is the maximum possible flow through the existing disinfection process. The pumps and drives would also need upgrading to achieve higher than 8.9Ml/d, while the capacity of the sand filter will need to be checked, although it is believed to be adequate for the design flow. It is also not known whether the network would be able to cope with the additional water and any modifications that would need to be made		Continuing the current programme of incremental enhancements would be required before decisions can be made about further increase of the site output, and that would mean it is outside of the timeframe of these measures. Additionally, a third abstraction BH would likely be required, so as to ensure higher WSW outputs under drought scenarios. As the current combined BH1 and BH2 drought yields of c. 6 Ml/d look to also be constrained by the physically achievable maximum well/bore yields under low groundwater conditions. Options should be re-reviewed in WRMP29, and following better review of other site enhancements.
SWZ	East Worthing WSW	Re-considered option - The site is currently running at 6Ml/d and has a licence of 7Ml/d. It is believed that the lower flow from Northbrook is due to a throttled valve as any increase in flow above 6Ml/d leads to an increase in turbidity which cannot be treated with the processes that are currently on site. It will therefore need bespoke turbidity removal treatment for the full 7Ml/d. The design capacity of the UV unit is 7.7Ml/d, so this will be adequate for an increase in flow from 6Ml/d to 7Ml/d. There may be demand constraints on the site, which will need to be resolved.	1.0	The water quality issues that may come from increasing the flow at the site means that there is a great deal of uncertainty as to the potential benefit from the site. Turbidity is known to be an issue as the flow increases. However, given the presence of industrial pollution within the raw water, it is likely that increasing the flow would also lead to a deterioration of the water quality with respect to hydrocarbon contamination.
SWZ	Durrington WSW	Re-considered option - The current flowrate is 3.36Ml/d, whereas the licence is 7Ml/d. The site runs off a single well, with the pump designed to supply 7.24Ml/d. This will need to be replaced or refurbished should the site need to meet the increased flow as it cannot achieve additional flow. The disinfection is sized for 9.2Ml/d, so will be able to treat a higher flow. The reason for the lower flow is demand constraint. A higher flow is achievable from the site providing that it can be moved off site. The site pumps to a reservoir, which maintains its demand with the flow received from the site.	3.6	The changes required to the network will make this scheme unfeasible within the timeframe required for these schemes.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
		There are some turbidity issues during recharge of the aquifer during the autumn and winter periods. There is no treatment on site to deal with this as the water is not generally needed during these periods and the lost volume can be made up from elsewhere.		
SNZ	Pulborough	Re-considered option - The site runs at 75Ml/d with a potential additional 10Ml/d available from the tidal River Arun abstraction. The treatment on site is adequate for treating the current and additional flow. However, 2.5Ml/d lost as washwater is returned to the river rather than to the head of the works. The reason for the loss of the water is due to poorly functioning filter presses and the acrylamide content of the concentrate. Once the out of service filter presses are repaired, this will allow water to be returned to the head of the works along with the settled supernatant rather than being discharged to the river. Repairing or replacing these presses would enable the sludge to be thickened to a much higher concentration, allowing the filtrate to be returned to the process.	2.5	Under the drought scenarios covered by WRMP24, it is unlikely that this WSW would be running. Therefore, this scheme would not provide additional water in a drought.
SWZ	Steyning	Re-considered option - The current flow through the works is 1.8Ml/d, with the licence being 2.5Ml/d. The disinfection is sized for 5.9Ml/d. There are two boreholes with one pump in each, capable of producing 1.4Ml/d and 1.8Ml/d. These act as duty/standby, so new pumps would be required for an increase in flow. There are concerns over the nitrate levels at Steyning, although catchment management is currently considered a viable option. The main issue with this site is the demand constraint and a network solution is required to move the additional water.	0.7	The changes required to the network will make this scheme unfeasible within the timeframe required for these schemes.
SWZ	South Arundel	Re-considered option - South Arundel, despite being groundwater fed, suffers from high turbidity in the spring, possibly due to tidal affects in the river Arun. Conductivity, saline ingress, turbidity and Cryptosporidium are all an issue on the site. There is a filtration system on site which is capable of treating the full flow, which will address turbidity and Cryptosporidium, but not the salinity or conductivity issues. The licence is 25Ml/d and the site runs at around 12Ml/d.	5.0	Desalination produces a hypersaline waste stream that cannot be discharged to the environment without causing damage. The use of desalination technology within the treatment process is currently not feasible under current DWI regulations. This would also require a major change to the way that the treatment works operates, so that the water remains both safe to drink and non-corrosive to the distribution system.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
		To increase the flow to a reliable 25Ml/d, desalination technology would be required to deal with the saline ingress that is seen on the site. However, the additional water would then lead to a demand constraint as the network is not capable of accepting that quantity of water, so network modifications would be required.		The extent of the upgrade to the treatment works and the work within the network mean that this scheme is unfeasible within the timeframe required.
SWZ	Long Furlong B	Re-considered option - Long Furlong B is demand limited at its current output of 3.4Ml/d. The site licence is 4.9Ml/d, and disinfection is sized to 6.2Ml/d, so no increase in the UV capacity would be required. The site has nitrate and is blended with water from Pennyhill. This would need to be considered if the output is increased, but it is not thought to be problematic as there is adequate water. There are 2 pumps on site, capable of treating 4.3Ml/d. These can run duty/ duty, but currently run duty/standby due to the demand constraints.	1.5	There is no spare capacity within the network to increase the output from the works. The changes required to the network will make this scheme unfeasible within the timeframe required for these measures. Deployable Output from Long Furlong B is groundwater level constrained during drought, so this scheme will only lead to a resilience benefit to output at the site under normal year conditions.
SWZ	Long Furlong A	Re-considered option - The licence for the site is 4.5Ml/d but the site currently runs at 2.7Ml/d. There is one pump which can do a maximum of 3.3Ml/d and turbidity is an issue when the site output exceeds 2.7Ml/d, particularly within the winter period, when water quality is impacted by recharge. Filtration would be required to deal with the additional turbidity. However, there is a further concern with the capacity of the network. The site is unable to push more water into the local network, so changes to the distribution system would be required.	1.8	The turbidity issues at a flow higher than the current operating flow indicate that it is likely that the maximum yield of the borehole has been reached. The extent of the upgrade to the treatment works is feasible within the timeframe. However, improvements to the network cannot be made by the required time.
SBZ	Hove B	Re-considered option - The site has a licence of 17.5Ml/d but is currently providing 9.2Ml/d. The disinfection process is sized for 18.2Ml/d so would be adequate for any uplift in flow. There are three boreholes, each of which could supply 6Ml/d. All have variable speed drives so would be able to change their flows to a required amount so that it is possible to increase the flow to what is required. The site has a filtration stage which will accommodate the required flow. The water from the site is blended with water from Hove as part of the nitrate control measures. This would need to be assessed along with the ability of the network to receive the additional	8.0	The main issue with this scheme is the capacity of the network to accept the additional water as well as the increased blend flow that would be required from Hove to maintain the required water quality in terms of nitrate. The increased water would need to be sent to a storage facility so that the blending with Hove water is controlled and understood. The time and complexity required for the construction of a new storage facility along with the need to expand the capacity of the network to allow additional water from Hove B as well as the blend water means that it is unlikely to be achievable within the timeframe required for these schemes.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
		water. It may be that once the flow increases, there is insufficient blending volume available, so a nitrate removal plant would be required.		
SBZ	Shoreham	Re-considered option - There are three pumps on site, running at 6.6Ml/d, 4.1Ml/d and 2.25Ml/d so they can provide the 10Ml/d licence capacity. The highest the site has run was 7.2Ml/d during the summer of 2018. The disinfection process is also sized for the site licence. The water quality at a higher output is poor, with turbidity increasing significantly when the flow increases above the current operating flow. It is likely that this is due to the availability of water in the borehole. Therefore, for any additional output, a filtration system would be required. It is likely that the losses due to a filtration system would offset any increased output from the works.	2.8	The cause of the turbidity at higher flows is not known, but likely to be due to the drawdown of the water level caused by the flow increase. This makes the scheme unworkable as a drought scheme as water levels will be significantly lower during these times. It is also highly likely that the losses caused by a filtration system would significantly reduce any benefit from increasing the flow from the works. Deployable Output from Shoreham is groundwater level constrained during drought, so this scheme will only lead to a resilience benefit to output at the site under normal year conditions.
SBZ	North Shoreham	Re-considered option - The site has a licence of 4.5Ml/d and currently operates at 3Ml/d. The borehole pump is sized to 6.5Ml/d but has only achieved a maximum of 4.2Ml/d in the past, so it is likely that a new borehole pump would be required to achieve the licence flow. It is also likely that turbidity and nitrate removal would be needed to treat the water with this increased flow. Ion exchange is already planned for the site in the next AMP; a filtration system will also be required. The disinfection process would also need to be upgraded as it is currently sized to 3.6Ml/d.	1.5	This work has already been planned into the next AMP. Deployable Output from North Shoreham is groundwater level constrained during drought, so this scheme will only lead to a resilience benefit to output at the site under normal year conditions. We rejected this option because it would give no benefit in a drought.
SBZ or SWZ	Temporary desalination - Sussex	Re-considered option - Temporary desalination at Coastal Sites: Sussex Coast. Located at Shoreham or Littlehampton.	TBC	Temporary desalination cannot be delivered in a shorter timescale than the options selected in our WRMP for the central area. As described in relation to desalination options in the western area, there are a number of environmental concerns relating to desalination options. This, coupled with the planning and engineering uncertainties, mean that it will be faster to deliver schemes that are already selected in our WRMP than these less mature schemes. This is because they are more developed and have more feasibility studies carried out. Despite that, we continue to follow the progress South West water is making on the desalination plant it plans to deliver in AMP7.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
				Should there be new technology to embrace and lessons to learn from companies installing (temporary) desalination in less environmentally sensitive areas then we will incorporate these in WRMP29. In addition, some of the reasons given for not selecting temporary desalination in Hampshire or the Isle of Wight also apply in Sussex.
SBZ or SWZ	Tankering (Norway/ France / Welsh Water / Wessex Water)	Re-considered option - Similar option to that being pursued in the western area but using a port in the central area.	TBC	As described earlier in this annex, we have included a bulk import via sea tankers from Norway in our updated WRMP. This option is available for our western area because Southampton Docks is large enough for the tankers. There are no other suitable ports in our region. We have previously considered other supply sources than Norway, inclusive of Wessex Water (no longer available to us) and other countries. As noted above, it is likely that any 'surplus' water in the Wessex Water area would be subject to WFD no deterioration assessments. We will continue to pursue alternatives for WRMP29, however tankering is not a viable option to supply the central area (and Sussex North specifically. For WRMP29, we will continue to monitor new technologies and methods which could enable further release of rejected options, or acceleration of existing options
Any zone	Licence trading	Re-considered option - To trade abstraction licences or abstracted water we engage with other abstractors in the region. This engagement occurs through regional groups such as WRSE and can result in receiving water from neighbouring water companies as new bulk supplies. It can also involve potential permanent or temporary trading of abstraction licences. The following website is one tool for pursuing options of this sort: Trade water abstraction rights - GOV.UK (www.gov.uk)	TBC	Our updated WRMP includes future bulk supplies from SES Water (see below), South East Water, Portsmouth Water and Thames Water. There are no additional options for the following reasons: - For WRMP19 we published a bid assessment framework to support the market to deliver WRMP options to help meet our supply duty. This did not lead to any viable options. - As set out in section 4 of annex 12 for our rdWRMP24 we explored options with two abstraction licence holders but rejected both options. Also, in annex 12 we say why we rejected the option of "explore licence trading with large abstraction licence holders."

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
				- When we consulted on our dWRMP24, any third party with a supply/ demand option could have presented it but we received no viable, sustainable options. - It is logical that there are very few sustainable options of this sort because other abstractions in our region are likely to be subject to similar concerns and any increases in abstraction would need to demonstrate no deterioration.
SNZ	Additional bulk supply from Sutton & East Surrey Water	Re-considered option - This is a sub option of licence trading that was specifically suggested by the EA during ongoing WRMP engagement.	TBC	As above, we have considered trades with neighbouring companies as part of WRSE and that is covered in our rdWRMP24. Our updated WRMP includes a supply from SES of 10 Ml/d to become available before 2035 and smaller volumes prior to that. There are no additional supplies available from SES within the WRSE modelling.

Appendix B: Rejection register - selected Western area options

Additional information provided following 2024 public consultation

A large number of responses to our rdWRMP24 consultation suggested that building several small reservoirs could replace the need for the HWTWRP scheme. Many other consultation responses mentioned options relating to Managed Aquifer Recharge (MAR) or Aquifer storage Recharge (ASR) and moving river abstraction points downstream.

- Regarding storage, reservoirs require a unique set of geological, geomorphological and hydrological settings to be viable. Our plan includes building two reservoirs (Havant Thicket Reservoir and SESRO) with the possibility of building a third (River Adur Offline Storage). We have considered a number of storage options in the past and will reassess them for WRMP29 in addition to considering locations for new reservoirs. We have also provided some information about specific small reservoir options that we considered in the table below.
- Regarding MAR and ASR options, we have provided some summarised information in the table below and given more detail in Appendix C of this document.
- Regarding options involving moving river abstraction points downstream we have provided high level information in the table below and provided more details in Appendix D of this document.

Table 5: Reasons for rejection of selected options

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
All	Building several small reservoirs	A large number of responses to our rdWRMP24 consultation suggested that building several small reservoirs could replace the need for the HWTWRP scheme.	unknown	Appendix D of this annex describes the work we have done on reservoirs. Reservoirs require a unique set of geological, geomorphological and hydrological settings to be viable. Our plan includes building two reservoirs (Havant Thicket Reservoir and SESRO) with the possibility of building a third (River Adur Offline Storage). We have considered a number of storage options in the past and will reassess them for Water Resources Management Plan 2029 (WRMP29) in addition to considering locations for new reservoirs. We discuss some specific reservoir schemes that are not selected in our WRMP24 below.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
HSE	New surface water storage at Colden Common	Storage: small reservoir option considered in HSE zone	2	Very significant environmental impacts due to the destruction and disruption to various designated sites including an AONB and SNCIs, with disproportionate costs and limited DO.
HSW	River Test WSW lakes	Storage: River Test WSW Lakes (conjunctive use with local WTW	28	This option has been superseded by the SRO process. There were also considerations of local designated sites SSSI /SAC / RAMSAR.
HRU	North of Romsey	Potential site for new reservoir with capacity of between 1,600Ml and 3,900Ml	unknown	Site constrained in terms of size by being situated between River Test and railway.
HSW	Rownhams - Tanner Brook	Potential site for new reservoir with capacity of 6,400Ml	unknown	Each side of M27 - complex delivery constraints, due to proximity to the M27.
HSE	East Bank of Itchen	Potential site for new reservoir with capacity of 2,300 Ml - 3,400 Ml	unknown	Within Airport bird strike risk zone meaning new reservoir development would be unsuitable.
HSE	Woodland near , Wickham	Potential site for new reservoir with capacity of 3,400Ml	unknown	Site situated in ancient woodland and in South Downs National Park.
All	Managed Aquifer Recharge (MAR) or Aquifer storage Recharge (ASR)	In both options, the key idea is to pump excess water available in winter months into the groundwater aquifer so that it can be used in subsequent summers or dry periods including droughts. The key difference between these two types of water supply option is the way in which the aquifer is used.	Varies with scheme	Appendix C of this annex describes the work we have done on both MAR and ASR. Aquifer recharge was considered and rejected as part of the Gated SRO process described in section 1 of this report. For example, option B2 assessed within the WfLH Gated options appraisal considered MAR options within the overarching B2 option. We provided further details and links to online WfLH documents in **Error! Reference source not found.** of this annex. Conceptually, pumping water into the underground aquifer might be possible in Hampshire but not at the scale required. We are developing a small-scale pilot project to explore this option but, if feasible, it could only produce a small amount of the 90 million litres of water a day that is needed until the completion of the HWTWRP.

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
HSW	Western Area Test MAR/ASR scheme.	As described in Annex 5 of our 2025 SoR this option that would involve either MAR or ASR in the vicinity of the Lower River Test. The key principle of this scheme would be to take excess winter water from our existing surface water abstraction from the River Test and inject it into the confined chalk aquifer nearby to be stored until needed in dry years or summer periods when the river abstraction becomes limited.	5.5	NA - this has not been rejected. However, the forecast 5.5 Ml/d is a fraction of the c. 90Ml/d required. As we describe in Appendix C, the potential for scaling up of ASR schemes as large water supply options is relatively limited, constrained to very specific areas, with yields likely to be relatively small compared to alternative new sources of water. Whilst they have broader appeal, the more limited yields from ASR schemes compared to, for example, water recycling or desalination, restrict their usefulness in solving the large supply-demand balance challenges that we face. For instance, in the long term to ensure that the conventional groundwater sources can be sufficiently reduced in the future to leave more water available for the environment, to protect the unique chalk stream habitats we have within our water supply area. Appendix C also states that the groundwater flow system is very well developed and hydrogeologically connected such that any additional artificial or augmented recharge is likely to be lost back to the River Test or the River Itchen via the natural groundwater discharge / baseflow. So, it is unlikely to provide a source of water that would persist when it was required in drought years. Appendix C provides more detail on the risks associated with this scheme.
HSE and HSW	Moving abstraction points downstream	Several responses to our rdWRMP24 consultation suggested moving abstraction points downstream, for example on the River Itchen.	unknown	Appendix D of this Annex describes the work we have done on this option in further detail. Some options of this sort were also described in annex 12. We have considered moving our abstractions on the River Itchen further downstream. As part of our 2009 and 2019 plans (WRMP09 and WRMP19), we considered its relocation to a point nearly 11km downstream just upstream of the tidal limit of the River Itchen. This was not considered viable because of the potential impacts on Portsmouth Water's abstractions in the area and on migratory fish. We also considered moving the abstraction point downstream, close to the tidal limit and pumping the water to Portsmouth

WRZ	Option Name	Option Description	Estimated DO (Ml/d)	Reason for rejection
				Water's water supply works on the River Itchen. This would have required a significant increase in the treatment capacity of at Portsmouth Water's water supply works. This option was not taken forward due the potential impacts of a large abstraction on the River Itchen's downstream ecosystems.
HSW	Bulk import from Cheddar reservoir	Bulk import: Cheddar Reservoir to River Test WSW	65	This was considered as an SRO as part of the RAPID Gated process. However, options for transferring water from Cheddar to Southampton were considered not to be technically feasible or sustainable and delivery timescales were considered to be prolonged, when compared with other available options. Therefore they were not processed further.
HSW	Bulk import from Mendip quarry	Bulk import (HSW): Mendip quarry to River Test WSW	Up to 87	The quarry will not be decommissioned until the 2040s and so the scheme could not meet all the project objectives of being technically feasible and sustainable and delivery timescales were considered to be prolonged when compared with other available options so this option was not progressed further.

Appendix C: Aquifer Storage and Recovery and Managed Aquifer Recharge

The latest UK climate projections suggest that, as climate change progresses, we will experience hotter drier summers and milder, wetter winters. In addition, the frequency and intensity of extreme weather events such as heat waves, flooding, and droughts is likely to increase. Developing increased water storage capacity to capture water under wetter conditions to use when it is drier will be an essential part of building a resilient water supply system for the future. Our WRMP24 and WRSE Regional Plan considered several new storage reservoir options.

Alongside conventional surface reservoirs, another option to capture and store water is to use the natural aquifers, which hold vast amounts of water underground, much like a surface reservoir, but within the pore spaces or fissures in the soil or rock. We already utilise these aquifers as part of our existing water supply base, abstracting groundwater in particular from the Chalk and Lower Greensand aquifers, which make up a large proportion of the drinking water that we provide to our customers.

Our dWRMP24 sets out the future challenges we face in needing to reduce the amount of water we can abstract from these aquifers and rivers, in order to ensure the right balance of water is available for the environment as well as for drinking water. We therefore need to investigate alternative ways to use the natural storage these aquifers provide but also minimise impacts upon the environment and sensitive groundwater-dependant habitats.

Two potential options to generate additional water supply using groundwater aquifers differently from conventional groundwater abstraction are Aquifer Storage and Recovery (ASR) and Managed Aquifer Recharge (MAR). In both options, the key idea is to pump excess water available in winter months into the groundwater aquifer so that it can be used in subsequent summers or dry periods including droughts. The key difference between these two types of water supply option is the way in which the aquifer is used. In MAR, the aim is to more simply enhance and/or manage the natural groundwater recharge process of the aquifer. In ASR, surplus water is injected into the aquifer via boreholes for direct storage and is then pumped back out for use at a later date. Water is generally stored in aquifers where existing groundwater is not suitable for conventional abstraction. In ASR, a ‘bubble’ of potable good quality water is created around the borehole, displacing the native groundwater in the aquifer. The ‘bubble’ of good quality water then remains in place until it is re-abstracted later for water supply. ASR therefore needs a well bounded, confined aquifer, that will prevent the movement and subsequent loss of the ‘bubble’ of stored water. It therefore requires specific combinations of geologic and hydrogeologic conditions for ASR to work effectively. In contrast, MAR can be carried out more widely, without needing such specific conditions, but it also means that there can be less control and retention of groundwater used to recharge the aquifer, as it will tend to flow naturally with the ambient groundwater.

There are many factors that need to be considered when developing ASR and MAR. Aquifer conditions and geology are critical to their success, with the need for sufficient transmissivity (ability for groundwater to move relatively freely through the aquifer), a need for careful management of the groundwater storage to allow (for ASR in particular) a reserve of groundwater to be built up, and for the injected water to be preserved and not to be lost via natural discharge. The hydro-geochemical conditions also need to be well understood as the introduction of new water, especially to confined aquifers, may lead to mineralisation which could clog up pore spaces and prevent re-abstraction of the water rendering the scheme useless. There may also be a potential for mineral dissolution to occur within the aquifer, which may adversely affect the injected water quality, making it more difficult to treat and use as drinking water. These factors are particularly important for ASR, to successfully create a ‘bubble’ of potable water. But these factors can also apply to MAR schemes

An additional consideration is having sufficient excess water available for ASR or MAR, and not simply intercepting water that would be naturally recharging the aquifer anyway. Recycled water for example could be a good example of excess water available for both options; Australia, for instance, has relatively mature MAR schemes utilising recycled water.

ASR and MAR schemes do offer several advantages compared to conventional surface water storage reservoirs. The surface footprint is much smaller and hence the environmental impact and planning process is likely to be easier and faster. Our previous studies have concluded that ASR is only potentially viable if the scheme involves limited infrastructure. Long transfer mains, pump-to-waste pipelines or complicated water treatment are likely to make the scheme un-economic and would face significant planning challenges.

Our History of Investigation into ASR Schemes:

Neither ASR nor MAR is new to water resource planning at Southern Water. We have investigated potential ASR and MAR schemes in both Kent and Sussex as far back as the 1970s. We have historically undertaken extensive reviews[2][3][4][5][6][7] of the potential across South East England for ASR and developed associated options. The results of this review are summarised in Table 6. Early studies considered the following issues over the whole of the Southern Water area including:

- The suitability of the geology and hydrogeology for ASR
- The suitability of the water distribution network for ASR
- The environmental impact of ASR

The review considered the ASR potential of all aquifer units within 500m of the ground surface in terms of their aquifer properties, depth to groundwater and type/degree of confinement. We also undertook a wide-ranging literature review and discussion with other water companies, including Thames Water and South East Water on the success and challenges in developing their own ASR schemes. This study concluded that the Lower Greensand within the Sussex North, Sussex Brighton, and Sussex Worthing Water Resource Zones (WRZs) was the only potentially viable target aquifer for a successful ASR scheme within the Southern Water supply area.

Further work then led to a scheme in our Sussex North WRZ being dismissed because the pumping boreholes would have been close to the geological outcrop of the aquifer, and there may have been undesirable environmental impacts. The Sussex Brighton WRZ scheme was also dismissed because of the length of transformation required to supply water into the Sussex Brighton WRZ from the River Rother at Pulborough[8].

[2] Southern Science Limited, 1996, Aquifer Storage and Recovery (ASR) Preliminary Feasibility Study Report No 96/7/1417, Southern Water Services Ltd.
[3] Southern Water Technology Group, 1998, Aquifer Storage and Recovery Feasibility Investigation Report - Report No. 70881TR60.98 - ASR opportunities for Southern Water Services within the context of contemporary demand/resource balance issues and existing licenced headroom
[4] Southern Science Limited, 2006, Hardham Basin Artificial Recharge Review, Report No. 96/7/1621, Southern Water Services Ltd.
[5] Atkins, 2007 Southern Water Regional Review – Phase 2 Review of ASR Potential for Sussex
[6] Atkins, 2013 SWS AMP5 ASR, Assessment of ASR Feasibility at Findon WSW. Ref: 5100295/70/DG/022 v1.0 (Draft only)
[7] Atkins, 2016 AMP5 Aquifer Storage and Recovery Feasibility and Literature Review Final Report Southern Water Services Limited
[8] Atkins, 2007 Southern Water Regional Review – Phase 2 Review of ASR Potential for Sussex

Table 6: Summary of regional ASR potential from our AMP4 options appraisal[9]

Region	Aquifer	Comments	ASR Potential
Hampshire	Bagshot Beds	Semi-confined. Poorly consolidated fine sands which are likely to result in severe well construction / clogging problems	Very Low
	Chalk	Largely unconfined. Where confined, permeabilities are too low	Very Low
	Greensand	At too great a depth in the south (> 600 m). Potentially suitable in the Winchester area, but information is limited.	Low
Isle of Wight	Bembridge Marls and Limestones	Low hydraulic conductivity.	Very Low
	Bagshot Beds	Too close to outcrop, otherwise likely hydraulically connected to the sea.	Very Low
	Chalk	Too close to outcrop. Too steeply dipping.	Very Low
	Upper Greensand	In continuity with the Chalk. Too close to outcrop. Too steeply dipping.	Very Low
Sussex North	Tunbridge Wells Sands	Low permeabilities except the Ardingly Sandstone, which is heterogeneous. Significantly faulted. Abstraction boreholes have siltation problems	Very Low
	Ashdown Beds	High permeabilities are limited in extent, limited thickness especially where well confined. Significantly faulted.	Very Low
	Greensands	Generally unconfined or close to outcrop within this WRZ, with the possible exception of the Hythe Beds, which may be sufficiently confined within the Hardham Basin to provide some potential for ASR.	Medium
	Portland Sandstone	Clogging may be a problem. Heterogeneous and limited information available.	Low
Sussex Brighton and Sussex Worthing	Chalk	Limited confined area	Very Low
	Upper Greensand	Hydraulically connected to the Chalk	Very Low
	Lower Greensand	Important aquifer. Artesian, and at depth, which will both have cost implications	High
	Tunbridge Wells Sands	No information available	Low
	Ashdown Beds	No information available	Low
East Sussex	Tunbridge Wells Sands	Low permeabilities except the Ardingly Sandstone, which is heterogeneous. Significantly faulted. Abstraction boreholes have siltation problems	Very Low
	Ashdown Beds	High permeabilities are limited in extent, limited thickness especially where well confined. Significantly faulted.	Very Low

[9] Atkins, 2016 AMP5 Aquifer Storage and Recovery Feasibility and Literature Review Final Report Southern Water Services Limited

Region	Aquifer	Comments	ASR Potential
	Portland Sandstone	Clogging may be a problem. Heterogeneous and limited information available.	Low
Kent Medway	Thanet Sands	In connectivity with the Chalk. Limited extent of confined formation	Very Low
	Chalk	In connectivity with the Thanet Sands. Where confined, transmissivities are low.	Very Low
	Greensands	Located at depth in the north. Limited thickness away from unconfined areas.	Low - Medium
Kent Thanet	Thanet Sands	In connectivity with the Chalk. Limited extent of confined formation.	Very Low
	Chalk	In connectivity with the Thanet Sands. Limited extent of confined formation.	Very Low
	Lower Greensand	Thin and of limited extent	Low
	Jurassic Limestone	Thin	Low
	Upper Coal Measures Sandstone	Likely to have been impacted by mining, resulting in impacts from saline and acidic groundwater as well as impacted flow regime	Low

Our Sussex Worthing WRZ ASR Scheme

We undertook further options appraisal and development work on the Lower Greensand aquifer in Sussex Worthing WRZ between 2010 and 2015 (AMP5), in the form of a pilot study to investigate the feasibility of ASR as part of our 2014 Water Resource Management Plan (WRMP14). It was re-selected in our 2019 Water Resources Management Plan (WRMP19).

This was further progressed between 2015 and 2020 (AMP6), into detailed design. Our design process was aided by investigations undertaken by the British Geological Survey, which allowed us to characterise the geometry and geochemistry of the Lower Greensand aquifer in the Worthing area. We estimated this scheme to be able to produce between 2-4Ml/d[10]. However, despite extensive negotiations with landowners and a further review of alternative sites, we were unable to secure a suitable location for the ASR pilot borehole and the scheme was eventually paused and is not currently considered possible to develop further.

Our Proposed Western Area Test MAR/ASR Scheme

Following changes to our abstraction licences from the River Test, and River Itchen in 2019, we are faced with large deficits in water supply in our Western area, with the requirement of leaving more water in the rivers to benefit the environment. This led to the development of our Strategic Regional Options (SROs) alongside the need to find more water from a combination of, water efficiency measures, leakage reduction, and development of other water supply sources.

In southern Hampshire the Chalk aquifer is confined, overlain by younger Palaeogene era strata, silty clay deposits of the London Clay Formation, that provides a low permeability confining layer. The geological setting here (Hampshire geological basin) is similar to the London geological basin, where MAR schemes to

[10] Ml/d = mega or million litres per day

the confined chalk have been in operation for a few decades. Wessex Water have undertaken some historical drilling into the confined chalk of south west Hampshire to investigate the potential for ASR and these investigations suggested limited environmental impacts and aquifer properties that might support development of limited ASR schemes. However, these investigations also identified issues with poor raw water quality that would require blending or significant treatment to be useful. Our earlier reviews had considered the confined Hampshire Chalk as having 'very low' potential for ASR on the basis that the confined chalk was unlikely to be sufficiently well fractured or developed due to the depth of burial and lack of past sub aerial exposure that would allow a natural flow system to develop. We had considered the Lower Greensand to have slightly greater potential than the Chalk in the Winchester area but was buried too deeply further south. Presently, extremely limited information on the properties and geometry of the Hampshire Lower Greensand aquifer exists due to the lack of outcrop and prior investigation. During the early options appraisal process for 2024 Water Resources Management Plan (WRMP24) we decided to look again at the potential for either MAR or ASR schemes in Hampshire. Consequently, we developed a new option that would involve either MAR or ASR in the vicinity of the Lower River Test. The key principle of this scheme would be to take excess winter water from our existing surface water abstraction from the River Test and inject it into the confined Chalk aquifer nearby to be stored until needed in dry years or summer periods when the river abstraction becomes limited. However, both we and the Environment Agency consider there to be several risks with the scheme given our current level of understanding. These include:

Our earlier reviews had considered the confined Hampshire Chalk as having 'very low' potential for ASR on the basis that the confined chalk was unlikely to be sufficiently well fractured or developed due to the depth of burial and lack of past sub aerial exposure that would allow a natural flow system to develop. We had considered the Lower Greensand to have slightly greater potential than the Chalk in the Winchester area but was buried too deeply further south. Presently, extremely limited information on factors that constrain the aquifer properties of the confined Chalk aquifer and whether it has sufficient flow or permeability to support an ASR scheme. The potential for poor hydrogeochemical effects of injecting surface water into a dual porosity aquifer like the chalk, and the development of the aquifer 'bubble'.

- Concerns around the potential unproven changes to groundwater levels and movement in the Chalk aquifer, and consequently potential environmental impacts where the Chalk is at outcrop.
  - At present, given our current understanding of expected aquifer properties, the local geology and distance from the unconfined Chalk, we expect limited environmental impact on surface water. If abstraction and reinjection is proven possible, we anticipate that managed recharge will be required to retain scheme viability as natural recharge is likely to be limited. Environmental impacts will be fully investigated as the project progresses.
- The need to undertake pilot drilling testing and a programme of recharge and discharge cycles to examine the evolution of the aquifer and hydrochemistry the outcomes and timelines for which are uncertain.
- The Water Framework Directive (WFD) imposes a principle of 'No Deterioration' such that any actions taken on a waterbody must not deteriorate the status of either quality or quantity of that water body. There are implications for ASR schemes:
  - The potential unproven changes to groundwater levels and movement in the Chalk will need to be considered to make sure there is no implications for the aquifer itself and cause a deterioration in water quality to the groundwater body.
- Future application of Natural England's Common Standards Monitoring Guidelines (CSMG) might set flow targets that would restrict abstraction from the River Test even when river flows are high during the winter, as flow targets are defined by an allowable departure from 'natural' flows. This could mean that excess water would not be available for the ASR scheme.

The MAR/ASR water supply scheme was selected in our fdWRMP24 to start providing water from 2041. Although it may be technically possible to develop the River Test MAR/ASR scheme sooner (prior to 2040), we consider the risk and uncertainty surrounding the scheme to be sufficiently high to defer implementation until the 2040s to give us sufficient time to investigate and undertake full feasibility studies. This also means

that it could not be relied upon as part of any short to medium term solutions to our supply demand deficits, as it would present an unacceptable risk of failure to supply if the scheme is eventually found, through further investigations and testing, not to be viable.

Environment Agency Representations on our draft WRMP24

We consulted the Environment Agency during the pre-consultation phase of our draft WRMP24 on the River Test MAR/ASR scheme. In its feedback, the Environment Agency noted that such a scheme had never been explored in this area and that there is limited knowledge about the aquifer properties of the confined Chalk in Hampshire. It also expressed concerns over the potential yield of such scheme and that significant work would be required to determine if such a scheme is viable. The Environment Agency further noted that it is critical that the scheme is demonstrated to not having any impact on the designated rivers and must be compliant with the Habitats Directive.

In its representation to our draft WRMP24, the Environment Agency reiterated its previous concerns over the feasibility of this option in particular relating to the aquifer properties (limited storage and tight, poorly fractured chalk). It also restated concerns over flood risk for the potential site and the potential for environmental impacts on the designated rivers.

In recognition of these concerns, we had already deferred the earliest start date for the scheme from 2030 to 2036 in the development of our draft WRMP24 to provide us more time to undertake these feasibility studies. This work is likely to take a phased approach, involving:

- Test drilling to establish the aquifer properties of the confined Chalk, at the same time determining geochemistry and hydrochemistry of the aquifer. A programme of groundwater modelling to understand the potential hydraulics and any environmental impacts of the scheme.
- A programme of pilot cycle testing would follow if secondary porosity is sufficiently development in the confined Chalk to allow adequate yield, to understand the geochemical characteristics and development of the ‘bubble’ within the aquifer, and its potential efficiency
- Further scaling up considerations of the surface works required, if the scheme is deemed viable hydrogeologically, including arrangement of water mains, sewers and other supporting infrastructure

Natural England Representations on our draft WRMP24

Natural England echoed the Environment Agency’s concerns around the potential impact on the River Test Site of Specific Scientific Interest (SSSI) and Habitat Directive sites downstream and that further work was needed to ensure that there would not be significant impacts. It also raised concerns over the suitability of the geology of the proposed site.

WRMP Sensitivity Testing

We share the concerns that the Environment Agency and Natural England have over the hydrogeological viability of this scheme.

For the revised dWRMP24, we have introduced a longer 10 year’ lead time for this option to allow sufficient time for further investigations. We have also tested a scenario which excludes this option to understand the impact on our strategy if it is not prove to be viable. This testing is described in Section 7.3 of our revised draft plan.

This option is first selected in 2036 in both our least cost and best value plans. The exclusion of this option under the sensitivity testing results in a deficit in the bulk supply to a large industrial user in Hampshire in 2037 (up to 4.4Ml/d) in situations 1-6 under 1:100 DYAA scenario.

Other Stakeholder and Customer Feedback

Wider use of ASR or MAR schemes received strong support from both customers and stakeholders during the consultation on our draft WRMP24. This is consistent with feedback received on WRMP19 where groundwater schemes such as this were amongst the most highly favoured by customers and stakeholders.

Some concerns were raised that we were not adequately considering ASR and MAR more widely for WRMP24. This stems from the fact that we have already undertaken extensive review and feasibility studies leading up to WRMP24. As mentioned, our feasibility work in AMP5 has shown that much of the South East is not viable for widespread ASR. Where potential has been found (Lower Greensand in Sussex Worthing WRZ) we had developed the feasibility to detailed design, but unfortunately other factors such as planning and land availability has so far rendered the schemes unviable.

It must be noted, the potential for scaling up of ASR schemes as large water supply options is relatively limited, constrained to very specific areas, with yields likely to be relatively small compared to alternative new sources of water. Whilst they have broader appeal, the more limited yields from ASR schemes compared to, for example water recycling or desalination, restrict their usefulness in solving the large supply-demand balance challenges that we face in the long term to ensure that the conventional groundwater sources can be sufficiently reduced in the future to leave more water available for the environment, to protect the unique chalk stream habitats we have within our water supply area.

Potential for other Managed Aquifer Schemes in Hampshire

We have considered the potential for MAR in the unconfined and exposed Chalk aquifer in the central and northern parts of Hampshire. Winter Rainfall already naturally recharges this aquifer where it is meets the ground surface. However, the groundwater flow system is very well developed such that any additional artificial or augmented recharge is likely to be lost back to the River Test or the River Itchen via the natural groundwater discharge / baseflow, and is unlikely to provide a source of water that would persist when it was required in drought years.

In addition, we do already have a de-facto MAR scheme in Hampshire south of Winchester where treated wastewater is discharged to ground and infiltrates into the chalk aquifer, and this likely provides a degree of limited groundwater recharge to the River Itchen catchment.

A further consideration is that our strategic groundwater sources for Hampshire are presently constrained by flow conditions in the rivers which restrict the opportunity to take additional groundwater during drought periods or even under normal conditions should further environmental licence constraints be introduced. This may render any MAR unusable.

During the development of our proposed and preferred SROs, the Havant Thicket Reservoir and Havant Thicket Water Transfer and Water Recycling Project, we did consider the potential for a MAR scheme that would use recycled water discharging to the Hampshire Chalk as an environmental buffer which could then be re abstracted at our existing groundwater or surface water works in the vicinity of the Lower Itchen. However, we concluded that due to the volume of water required and the future application of Natural England's CSMG set flow targets on the designated River Itchen Special Area of Conservation (SAC) it would likely be deemed unacceptable by regulators, and so the option was not developed further.

We will though continue to review opportunities for both ASR and MAR for future Water Resource Management Plans.

Appendix D: Moving the River Itchen abstraction point downstream

Below sets out the work we have done in terms of reviewing the possibility of relocating the River Itchen surface water abstraction close to the tidal limit. If possible, the benefits of this would be that the abstraction affected a shorter reach of this ecologically important chalk river.

This option did not progress to the feasibility stage. However, our reasoning was previously published as part of WRMP14 and our regulators did not suggest that this had been prematurely ruled out.

In the SoR, we have confirmed that we will continue to consider whether future opportunities arise which would warrant fresh investigations into the location of abstraction points. We will look at all available options, these included, when we start work on the WRMP29 options appraisal.

A summary of our WRMP14 assessment of this option is as follows. We considered multiple options for relocating our existing abstraction further downstream close to the tidal limit.

1. A 56Ml/d abstraction at a downstream location to be pumped to Portsmouth Water's treatment works. This would require the treatment capacity at PWC Source A to be increased to 90Ml/d. 45Ml/d would be used by Southern Water.
2. A 56Ml/d abstraction at a downstream location to be pumped to PWC Source A treatment works. 11Ml/d would be treated at PWC Source A whereas the remaining 45Ml/d would be pumped up to Itchen WSW for treatment.
3. An 85Ml/d abstraction at a downstream location to be pumped to PWC Source A treatment works. It would cover the entire sustainability reduction at Itchen WSW (surface water and groundwater). This would require the treatment capacity at PWC Source A to be increased to 119Ml/d.
4. An 85Ml/d abstraction at a downstream location to be pumped to PWC Source A treatment works. It would cover the entire sustainability reduction at Itchen WSW (surface water and groundwater). 74Ml/d would be transferred to Itchen WSW for treatment.

None of the these options was taken forward due to the following reasons:

5. The Itchen SAC Stage 4 Review of consents concluded the proposed changes to Portsmouth Water abstraction licences would provide sufficient protection for salmon migration from tidal waters into the lowest non-tidal reach of the Itchen.
6. Relocating abstraction at the current licence limit to a downstream location would not provide the protection required.
7. This option would allow full benefit of increased residual flows along the length of the Itchen which is designated as an SAC and SSSI, the impact of fully licensed abstraction on flows into tidal waters would be the same as under the existing permissions.
8. There are also environmental and planning issues associated with a new intake and pumping station, and locating a new pipeline away from environmentally sensitive sites and historic landfill.
9. The option would also require a new pipeline along the Itchen valley upstream to our Itchen WSW through environmentally sensitive sites.
10. The 85Ml/d abstraction at a downstream location can potentially have significant adverse impact on the Lower Itchen ecosystem.