Water Resources Management Plan 2024

Affinity Water

Contents

1. Introduction

1.0. This is Affinity Water's Water Resources Management Plan 2024 (WRMP24). The WRMP24 is a technical document following principles set out in the Water Resources Planning Guideline (WRPG)[1].

Water companies have a statutory obligation to prepare and maintain a Water Resources Management Plan (WRMP), setting out how they will ensure that they have sufficient water resources to meet the current and future demands of their customers, over a minimum 25-year period, while looking forwards 50 years into the future. WRMPs are published every five years.

Our WRMP24 outlines plans to provide a reliable, resilient, efficient and affordable water supply to our customers between 2025 and 2075. It also sets out how we intend to maintain the balance between water supply and demand. The draft WRMP24 (dWRMP24) was published for consultation in November 2022. This WRMP24 reflects the changes made in response to that consultation, with further updates based on new information and updated model outputs.

We have produced a separate non-technical summary document[2] (NTS). The NTS provides a simpler overview of our WRMP24 and explains at a high level what we heard during the dWRMP24 consultation. We have published our Statement of Response (SoR) to the consultation and all updated materials on our online engagement site. This ensures transparency regarding plan updates and includes direct responses to everyone who contributed to the consultation. **Table 1.1** sets out the content of the WRMP24.

Who are Affinity Water?

1.1. We are the largest water-only supply company in the UK, owning and managing the water assets and network in an area of approximately 4,500km² across three supply regions in the southeast of England. We sub-divide our supply regions into eight different communities[3], see **Figure 1.1** below, based on our existing water resource zones (WRZs). Each WRZ is named after a local river. This allows us to tailor services to customers at a local level (our water resource zone integrity report is available as **Appendix 1.1**). We operate in a water scarce region which is vulnerable to climate change and has a fast-growing population. It also has precious, environmentally vulnerable Chalk streams.

We abstract approximately 65% of water from groundwater sources and the rest is from surface water, principally from the River Thames. We also receive water from, and provide water to, neighbouring water companies, known as

[1] https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline
[2] https://affinitywater.uk.engagementhq.com/4398/widgets/28286/documents/33645
[3] Central region is split into six communities – Wey (WRZ6), Pinn (WRZ4), Colne (WRZ2), Misbourne (WRZ1), Lee (WRZ3) and Stort (WRZ5). Our Southeast region is the Dour community (WRZ7) and our East region is called the Brett community (WRZ8).

'bulk supplies'. In our East region, we obtain water from Ardleigh reservoir that we jointly own with Anglian Water.

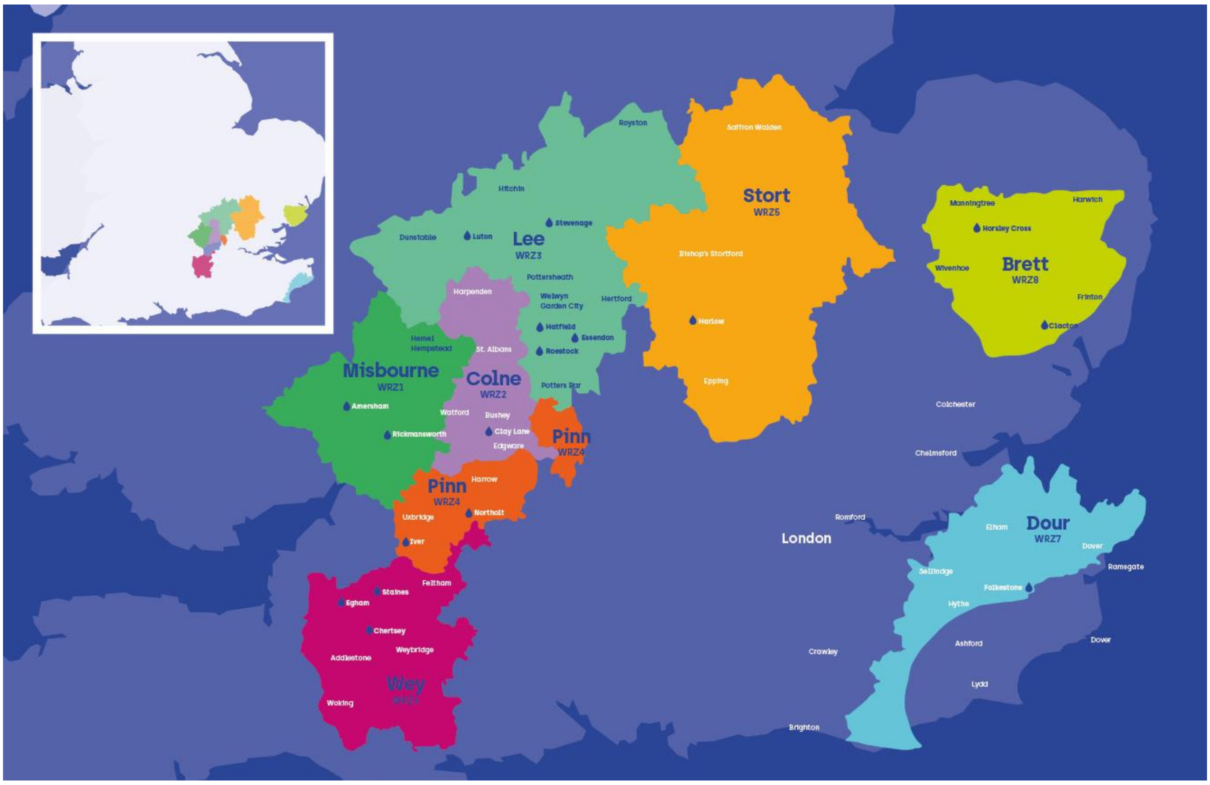

Figure 1.1: The Affinity Water Area

Regional planning

1.2. We face significant and complex challenges in the southeast of England which affect all six water companies in this region. These water companies are grouped together as Water Resources South East (WRSE)[4]. Our Brett community sits outside the WRSE region and instead forms part of Water Resources East (WRE)[5] which is one of the other regional groups[6] formed across the UK.

In line with the WRPG, we have ensured our WRMP24 continues to reflect the WRSE and WRE best value regional plans and focuses on what those regional plans indicate are the most appropriate measures for us to take (see **Chapter 2** for more details).

Both the regional plans[7] and our WRMP24 are required to present a best value plan, both in the short and long term. As well as ensuring a secure supply of wholesome drinking water for our customers, we have

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[4] WRSE consists of Affinity Water, Portsmouth Water, SES Water, South East Water, Southern Water and Thames Water

[5] WRE has over 200 members and includes Affinity Water, Anglian Water, Cambridge Water, Essex & Suffolk Water and Severn Trent Water

[6] Regional groups across the UK are Water Resources South East (WRSE), Water Resources East (WRE), Water Resources North (WRN), Water Resources West (WRW) and West Country Water Resources (WCWRG)

[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872222/Appendix_2_Regional_planning.pdf

considered factors alongside economic cost and sought to achieve an outcome that increases the benefit to customers, the wider environment and society. One key element of this is to secure the supply of water from alternative sources to protect our Chalk streams. We call this need to reduce abstraction our 'environmental destination' – where our long-term targets are to reduce abstraction from our Chalk groundwater sources to restore sustainable river flows in the affected catchment area. Providing for the delivery of our environmental destination forms a key part of how we created our WRMP24.

In parallel with our dWRMP24 consultation, the regional groups also consulted on the best value regional plans.[8] This followed the emerging regional plan consultation in Spring 2022.

Customers and stakeholders have also been able to give feedback on the significant water resource schemes that feature in the regional and company plans, via the Regulators' Alliance for Progressing Infrastructure Development (RAPID).

What drives the challenges we face?

1.3. Our geography and customer base means we have several challenges to address in developing our WRMP24. We explore these challenges in more detail in **Chapters 4** and **5**. However, in summary, the key areas that have driven the size and shape of our plan are:

- A continued forecast of substantial population and housing growth, which will increase the demand for water within our region by around 10% by 2050
- We need to tackle water leakage from our network so that we can make better use of the resources that we have
- We have 10% of globally rare Chalk streams in our area, which we need to protect to continue to provide a unique habitat for flora and fauna
- A groundwater-dominated supply and abstraction can have a damaging impact on ecologically sensitive areas (such as chalk streams) so it is important to minimise how much groundwater water we take
- We have limited raw water storage of surface water in reservoirs - this means our supplies are vulnerable when there is high demand for water during summer months
- We need to pace the scale of abstraction reductions to balance affordability for our customers with our environmental destination
- We need to stop relying on exceptional drought permits and orders to take water from our rivers when they are at their most vulnerable
- We are reliant on the weather, with one of the lowest total annual average rainfall per person in the UK in our region. In addition, climate

[8] WRSE regional consultation

change has increased our chances of having prolonged periods higher demand for water.
- Our communities are not as connected by pipelines as we would like. Historically, there has not been a need for a connection between areas, because each one had been fed by its own water source
- We need to plan for uncertainties in demand and account for the currently untested impacts of some government-led water reduction strategies

Our starting position for our WRMP24

1.4. We have delivered our WRMP19, providing the starting point for this WRMP24. The below points provide a summary of progress we have made to achieve the deliverables set out in the WRMP19 corresponding with our Asset Management Period 7(AMP7) 9 (full details are explained in **Chapter 8**):

- **Delivering leakage targets**
  - In 2015, leakage was around 20% (183.5 Ml/d) of the water we put into supply. We set out to reduce this to 15% by 2025. We were disappointed to have only achieved a reduction of 1.7% in the 3-year annual average leakage in the first year of the AMP. This left us 1% short of our target of 2.7% in 2020/21
  - In response to this, we developed a recovery plan including more efficient working, increasing our detection activity, reducing the length of time leaks run and focusing on activities that will generate the greatest benefit for the effort employed. These efforts have allowed us to achieve over 17 Ml/d reduction in leakage between 2020/21 and 2021/22. This resulted in a total reduction in the 3-year annual average leakage 10.5% since the start of the AMP
  - Whilst we fell slightly short of achieving our three-year rolling average performance commitment in 2021/22, this performance puts us ahead of the WRMP19 forecast
  - In 2022/23, we achieved a further leakage reduction of 3.64 Ml/d, primarily due to leak repairs on our distribution system. This put us 0.85 Ml/d below the WRMP19 leakage target at a company level and puts us ahead of our overall plans for the period 2020-25
  - This year, we exceeded our leakage performance commitment with a 3- year rolling average reduction of 18.3% against a target of 17%. On an annual basis, this meant a slight increase in leakage by 1.9% (2.84Ml/d) from 2022/23. This put us 7.99Ml/d above the WRMP19 leakage target at a company level. The reason for this change and the implications for our end of AMP7 position have been detailed in **Chapter 9**.

[9] AMP - asset management plan period is a five-year time period used in the English and Welsh water industries. It is used by the financial water regulator Ofwat to set allowable price increases for water companies and for the assessment of many key performance indicators

- **Per capita consumption (PCC[10]) reductions through metering and the implementation of our 'concerted action on water efficiency' programme.** In response to poor delivery of PCC reductions in the first year of the AMP, we developed an action plan[11] to increase our efforts and enable us to drive down PCC further this reporting year. We have successfully delivered a multi-faceted approach to achieving this reduction including the following key elements:
    - We undertook major campaigns, such as 'Save 10 a Day' during the pandemic and, in April 2021, we launched our 'Save our Streams' campaign. This successful campaign had over 225,000 sign ups with over 106,176 water saving devices ordered and distributed to our customers
    - We have driven innovation in other areas, such as the new education platform encouraging water efficiency. We developed it using the Minecraft platform which is now built and ready for customer deployment following children-focused Steering Group testing and feedback
    - To mitigate peak demand risks and provide a pilot study in preparation for AMP8, we have also worked with non-household customers in the Clacton region. Our 'Water Smart Holiday Parks' project worked across five sites, reducing their water consumption by 42% during peak demand in summer 2021
    - A new partnership with Whitbread group is currently underway across our geography, targeting hotel chains to expand on the joint working concept. This provides a template for further interventions

- **These interventions, alongside some reduction in usage by the gradual return to pre-pandemic behaviours, have seen our average PCC reduce from 171.6 l/h/d in 2020/21 to154.0 l/h/d in 2023/24**
    - In 2023/24, this included a significantly higher volume of Home Water Efficiency Checks (HWECs) with 21,446 face-to-face visits delivered. This is double the visits we undertook in 2021/22 and is due to our new provider partnership to ensure the service delivers both the greatest saving, and the best experience, for our customers
    - We have also continued to invest in our Save our Streams campaign. Whilst this still leaves us above our target for the year, we are pleased to see that our efforts have led to a significant reduction in PCC for the 2023/24 reporting year

- **Investigation of major infrastructure schemes and strategic options that could provide new water supplies for the future through the RAPID programme[12].**
    - We have been joint promoters on RAPID's assessment of six strategic resource options (SROs): (Minworth; Grand Union Canal (GUC); South East Strategic Reservoir Option (SESRO); Thames to

[10] PCC - per capita consumption is defined as the sum of measured household consumption and unmeasured household consumption divided by the total household population. It is reported as the annual arithmetic mean per capita consumption expressed in litres per person per day (l/p/d)

[11] https://www.affinitywater.co.uk/docs/reports/Affinity-Water-Annual-Report-2022-final.pdf (section 4.5 details monitoring plan)

[12] The RAPID gated process and the proposed water resource solutions - Ofwat

Affinity Transfer (T2AT); South Lincolnshire Reservoir (SLR); and Anglian to Affinity Transfer (A2AT). (**Chapter 7** covers more details regarding these schemes and the SRO process).
  - All six options successfully progressed without issue through the initial regulatory assessment (called Gate 1)
  - At Gate 2 both the SLR and A2AT schemes were not progressed as options for Affinity Water. We are currently on track to meet the Gate 3 milestone set out by the regulator for the remaining four schemes. We have not identified any other significant strategic options as part of our WRMP24 work.

1.5. We introduced a monitoring programme tracking and sharing our progress, including quarterly water resource forums, bi-annual demand management forums and liaising regularly with regulators and river groups about the scale, strategy, and pace of our environmental destination. We set out more details on our current performance in our Annual Review 2022/23[13]. This is the starting point from which we have built our WRMP24.

Navigating our WRMP24

1.6. We have sought customers and stakeholder views throughout the development of our WRMP24 to ensure it is an informed, customer-centric plan. This is addressed in more detail in **Chapter 3**.

1.7. The main WRMP24 plan is supported by a suite of WRMP documents including the technical appendices , which explain our methodologies and provide the detailed findings of our analysis, Water Resources Planning (WRP) tables and commentary, and other key assessment and supporting documents.

1.8. A non-technical summary (NTS) of the main plan is being used as part of our engagement with customers and stakeholders. The full list of WRMP24 documents is summarised in **Figure 1.2.**

[13] Affinity water Annual Review 2023

Figure 1.2: Description of WRMP documents on Affinity Water Engagement HQ platform

1.9. All our WRMP documents are available on our online engagement site[14]. In addition, we have included the results of the following statutory environmental assessments:

- Strategic Environmental Assessment: Environmental Report (SEA) in **Appendix 7.2.1** (WRMP 2024)[15]
- Habitats Regulation Assessment Report (HRA) in **Appendix 7.2.2** (WRMP 2024)
- Water Framework Directive (WFD) in **Appendix 7.2.3**

We have also considered and addressed Biodiversity Net Gain in the SEA **Appendix 7.2.5** This will be an important matter to be considered in delivery of SROs.
We have undertaken rigorous security checks to ensure that our plan does not include any information that would be contrary to the interests of national security or is commercially confidential.

[14] https://affinitywater.uk.engagementhq.com/wrmp
[15] SEA WRMP24 including Appendices 7.2.1(SEA), 7.2.2(HRA), 7.2.3 (WFD), 7.2.4 (INNS) and 7.2.5 (Natural Capital and BNG)

Structure of this document

1.10. The following chapters set out how we have developed our WRMP24, the challenges we face and the strategies and options we have adopted. To aid navigation, **Table1.1** below sets out what each chapter contains.

Chapter	*Title*	*What it covers*
1	Introduction	A high-level introduction including how to navigate the plan and supporting documents
2	Basis of planning	Sets out what is included in our plan and how it interacts with other plans
3	Customers and stakeholders; shaping our plans	The engagement activities and the results to ensure the WRMP delivers for both customers and stakeholders
4	The demand for water	How we measure and forecast demand for both household and non-household customers now and in the future
5	Water supply	Our water supply forecast outlining how much water we can reliably supply to our customers today and in the future
6	Our baseline supply demand balance	The balance between water availability (supply) and water need (demand)
7	Our options	How we have developed and assessed our options to manage supply and demand for water in the future
8	The decision-making process	How we 'get it right' for customers, stakeholders and the environment is key to creating a WRMP. We explain how we find an appropriate balance between environmental, social, and economic needs, while accounting for a deeply uncertain future
9	Our 'best value' plan	Our WRMP plan – the options and strategies selected to deliver for customers, stakeholders, and the environment, and how we will monitor our progress against delivery
10	Board assurance and governance	Our engagement with the Affinity Water Board and the assurance process we have followed to produce a robust, high-quality plan

Table 1.1: Navigating our WRMP24

2. The basis of planning

Taking a regional planning approach

2.1. As previously highlighted, a key feature of our WRMP24 is that it sits alongside, and reflects, the WRSE and WRE regional best value plans.

2.2. We aimed to ensure that the region's key strategic decisions were developed in the most effective and efficient way for our customers. In some cases, our work builds on work undertaken by the regional groups or individual member companies for previous WRMPs. However, in many cases, the regional groups have developed and implemented new techniques and developments as part of the regional plan. These include designing new investment modelling tools and exploring the best value metrics on the proposed plans. By providing both technical advice and challenging ideas, we have successfully integrated these regional plans into our WRMP24. We have also played a key role in ensuring a consistent approach to engagement with stakeholders and customers across the region.

2.3. The regional investment modelling tools and best value metrics that reflect the WRSE approach are set out and explained in greater detail in **Chapter 8**. Although we have worked collaboratively with WRSE, this WRMP remains our own statutory plan. As such, we have implemented an assurance framework that encompasses the below elements.

- Our own assurance of the WRSE model's inputs and outputs
- A peer review process, stress testing and sensitivity testing of the WRSE investment model.
- The WRSE assurance framework that covers its own modelling processes.
- Our own assurance of how we have translated and used the WRSE modelling to support our WRMP24

2.4. Using this framework we have been able to utilise the WRSE modelling and therefore reflect the regional plan when developing our WMP24. This assurance framework is described in **Chapter 10.**

2.5. As mentioned in Chapter 1, the Brett community sits within WRE, we have also worked with WRE on the Northern Catchments of our Central communities as there is an interest in them on the supply side for WRE. This also extends through our approaches to engagement with retailers, providing support on several technical areas and engagement activities. The Brett Community is the only Affinity Water geographical area that is located within the WRE region.

As such, we have worked with WRE to identify solutions for resilient joint operation of our resources and investment appraisal of the preferred plan for this community. This process is also described in **Chapter 8.** In a change from the dWRMP24, the WRMP24 reflects our recent engagement with WRE regarding their environmental ambition. By maximising the size of the GUC transfer we have increased flexibility in the 2030-2040 period, so we can take less water from Grafham reservoir. This water can then be used by the WRE region (see **Chapter 9**).

Regional reconciliation

2.6. Our WRMP24 reflects the high degree of regional collaboration. This is because of the existing and potential future inter-connections between regions, and the key role that sharing resources across regional boundaries plays in water resources planning. There has been close collaboration and shared work across all the regions via regional working groups, in particular for WRSE, with key regional interfaces with the East, West and West Country regions.

2.7. The expectation at the outset of the South East regional plan process was that regional imports had a key role in meeting some of the scale of the challenges that the South East and Affinity Water's supply area are facing. The regional reconciliation process (explained in **Chapter 8**) has enabled the regions to test this against consistent planning scenarios (ensuring all strategic transfers are considered equally). This includes testing against the effects of achieving higher levels of resilience (1:500), population growth and climate change. Crucially, it also assesses how different levels of environmental destinations will affect the future availability of water for transfer to other areas.

2.8. The outcomes of this work have shown that under the more challenging environmental and growth futures, all the regions outside of the South East would be facing a significant water resource deficits. As a result, they would not have plentiful supplies of water which could be transferred to the South East and therefore Affinity Water. Water Resources West (WRW) is the exception. WRW has identified a water recycling scheme (Minworth) that could provide water effectively downstream to WRSE. As explained in greater detail in Chapter 5 of the WRMP24, there is a need for additional water for supply in our region, meaning that new infrastructure is required but the majority of that will be from within the region.

Our approach for our WRMP24

2.9. The scale of abstraction reductions (our environmental destination) is one of the greatest uncertainties we face, and this is key in driving our draft plan. The pace of these reductions will be dependent on the balance between affordability, stakeholder desires and evidence that the benefits will deliver increased flows. In addition, there is uncertainty around the level of population growth which needs to be provide for[16]. In addition to fulfilling the key legislative and regulatory requirements (set out in **Chapter 1**), our WRMP24 also follows four key principles to help meet these long-term challenges. These include adaptive, best value, cost efficient and deliverable, all of which are outlined further below.

Adaptive. The WRPG recommends that our WRMP24 is adaptive[17]. We have integrated this approach as we acknowledged the many uncertainties in supply, demand, and environmental policy when it comes to forecasting future conditions. An adaptive plan accounts for these different futures.

Best value[18]. For the environment and society, the required outputs in our draft plan are based on a 'best value' approach which was informed by our customers. This means that solutions have been chosen, not only by lowest cost, but also on the basis of which consider areas such as net zero carbon and biodiversity net gain (BNG) to deliver the best value overall.

Cost efficient. Our water resources management planning seeks to be 'cost efficient'. The plan considers the cost of all solutions but reflects the delivery of wider benefits and looks to maximise those for the least cost.

Deliverable. A key area, especially for our demand management programme. We have evaluated our approach based on different strategic options. The strategies we have proposed carry different risks in this area and we explore the deliverability of those strategies in **Chapter 9**.

2.10. Based on these four key principles, we have created our WRMP24 using cost, risks, benefits, and impacts to evaluate the best value investments (demand management initiatives and supply-side schemes) to maintain the supply-demand balance. This enables us to adapt it in the face of those 'best' and 'worst' case future scenarios. Full details of the decision-making process are set out in **Chapter 8**.

How our WRMP24 links to other plans and policies

2.11. Our principal duty in relation to the preparation of this WRMP24 is set out in Section 37A of the Water Industry Act 1991, where the WRMP must address the following:

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[16] WRPG – section 6 (https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline#section-6--developing-your-demand-forecast) requires we base our forecast population and property figures on published local plans, but we also look at alternatives through the adaptive approach described in this chapter and **Chapter 8**

[17] **Chapter 8** explains the adaptive approach in further detail

[18] WRPG – section 9: Aspects to consider in compiling a best value plan

37A Water resources management plans: preparation and review
(1) It shall be the duty of each water undertaker to prepare, publish and maintain a water resources management plan.
(2) A water resources management plan is a plan for how the water undertaker will manage and develop water resources so as to be able, and continue to be able, to meet its obligations …
(3) A water resources management plan shall address in particular –
(a) the water undertaker's estimate of the quantities of water required to meet those obligations
(b) the measures which the water undertaker intends to take or continue for the purpose set out in subsection (2) above (also taking into account for that purpose the introduction of water into the undertaker's supply system by or on behalf of [water

Figure 2.1: Summary of key policies and plans signposted in the WRMP24

2.12. The WRMP24 has been produced to fulfil this statutory duty, which includes the other relevant sections of the WRMP directions. In England, the requirement for a Strategic Environmental Assessment (SEA) derives from the Environmental Assessment of Plans and Programmes Regulations 2004. Similarly, the requirement for a Habitat Regulation Assessment (HRA) is contained in the Conservation of Habitats and Species Regulations 2017 (HRA Regulations). Our WRMP24 is subject to an SEA, HRA and WFD assessment and can be found in the SEA Environmental Report Addendum and SEA Post Adoption Statement.

2.13. In addition to meeting the guidance set out in the WRPG and the statutory environmental requirements (SEA, HRA, WFD), our WRMP24 links to several other key policies and plans. We have also addressed those requirements throughout the WRMP24 document. This includes policies such as the Government's 25 Year Environmental Plan which sets out government goals for improving the environment within a generation and leaving it in a better state than found. **Table 2.1** sets out the plans and policies we have referenced, with signposts to the relevant chapters.

Plan / policy	Link with the WRMP	Where to find
Government's 25 Year Environmental Plan	Our WINEP[19] and long-term environmental destination	Chapter 5 – Water supply
	Natural capital and Biodiversity Net Gain in decision-making	Chapter 8 – The decision-making process Chapter 9 – Our 'best value' plan
	Our approach to catchment options	Chapter 7 – Our options
Ofwat Long Term Delivery Strategies	Decision-making and best value plan – we have incorporated the Ofwat scenarios in our adaptive planning branches	Chapter 8 – The decision-making process Chapter 9 – Our 'best value' plan
Drought Management Plan	Our explanation of our Levels of Service is aligned to our Drought Management Plan (DMP)	Chapter 2 – The asis of planning
River Basin Management Plans	Our WINEP ensures no deterioration from existing abstractions	Chapter 5 – Water supply
	SEA, HRA, WFD ensures that we prevent deterioration from future options and that we propose a secure sustainable set of options for the long-term security of supply	Chapter 7 – Our options

[19] WINEP – Water Industry National Environmental Programme is set by the Environment Agency and provides information to water companies on the actions they need to take to meet the environmental legislative requirements that apply to water companies in England.

	Our approach to catchment management options	Chapter 7 – Our options
Drainage and Wastewater Management Plans	Options to supply multiple needs for both water only and wastewater companies	Chapter 7 – Our options
Drinking Water Safety Plans (or Risk Assessments) (DWSPs)	All our SRO programmes have incorporated DWSPs, and every non-SRO supply option has assessed risks associated with drinking water quality	Chapter 7 – Our options
Local Authority Development Plans	Our growth forecasts incorporate local authority estimates of planned growth	Chapter 4 – The demand for water
Local Nature Recovery Strategies	Nature recovery strategies sit with upper-tier Local Authorities, County and Unitary Councils.	Ongoing engagement at early stages as the approach is under development
Drought Vulnerability Strategies	How our WRMP24 links with the Drought Management Plan Drought vulnerability to supply	Chapter 2 – The basis of planning Chapter 5 – Water supply

Table 2.1: Summary of key policies and plans signposted in the WRMP24

Drought levels of service

2.14. Our drought plan[20] sets out the actions we would take to manage the effects of drought on our water supplies. These include demand management actions, where we would ask our customers to use less water, either voluntarily or through temporary use restrictions, depending on the severity of the situation. In severe droughts, we can also apply for drought permits or drought orders to take more water from underground aquifers at some of our sources where necessary.

Our WRMP24 fully aligns with our drought plan. **Table 2.2** shows that the levels of service we present in our WRMP24 are consistent with the drought plan.

Drought Measure	Current frequency in our DMP (up to 2024), WRMP19 and WRMP24	Annual probability of implementation
Temporary Use Ban to restrict non-essential use	1 in 10 years on average	10%
Ordinary Drought Orders further restricting non-essential use	1 in 40 years on average	2.5%
Drought Permits/Drought Orders for temporary abstractions	1 in > 40 year on average Modelling suggests that drought permits not needed for a 1 in 200-year drought event post March 2024, in line with WRMP19, and the current update of the DMP	<2.5% <0.5% post March 2024 (without relying on drought permits)
	Will change to 1 in >500 in 2040 in WRMP24. The difference between a 1 in >200 and 1 in >500 is minimal in the supply-demand balance	<0.2% post 2040
Emergency drought orders	Deemed an unacceptable drought response	

Table 2.2: Our drought levels of service

2.15 The probabilities for Temporary Use Bans (TUBs) and Non-Essential Use Bans (NEUBs) shown in **Table 2.2** are based on the groundwater triggers identified in our Drought Plan. The process of determining these probabilities uses groundwater triggers based on data modelled from 1918 onwards. To calculate frequency, the total number of years in the record is divided by the number of times the modelled curves are breached. Post 2025, the use of

[20] https://www.affinitywater.co.uk/docs/Drought/2023/Drought-Management-Plan-2023.pdf

supply side Drought Permits will reduce to once in every 200 years. This has been calculated using the same models as for TUBs and NEUBs, but with stochastically generated input data to derive the 1 in 200-year curves. The same process was then used to generate the curves for the 1 in 500-year failure events post 2040. These trigger curves were used in the water resources system modelling described in **Chapter 5**, so all of the supply side drought supply capability described in this WRMP24 is fully aligned with the levels of service and probabilities of failure provided in **Table 2.2** above.

3. The public, customers and stakeholders - shaping our draft plan

3.1. We have relied upon several strands of engagement in preparing our WRMP24 (**Figure 3.1**). They have informed the way in which our plans have been developed and are explained in more detail in this chapter.

- **Regional engagement** – WRSE engaged with the public, customers and stakeholders across the South East water region in the preparation of its regional plan. Affinity Water has been able to utilise this regional engagement in the preparation of our draft plan because we operate in shared geographical areas. This collaborative and efficient programme of engagement allowed stakeholders to input during the critical development of the regional planning approach while also minimising respondent fatigue. In a similar way, WRE adopted an engagement programme with its stakeholders in its geographical areas, and this was taken into account in formulating our Affinity Water WRMP24.[21]
- **Strategic schemes engagement** – engagement and research has been undertaken during the promotion of the six Strategic Resource Options (SROs) by Affinity Water and other water companies who will share the infrastructure. Customers and stakeholders potentially impacted by these schemes were engaged with and their feedback has helped inform the development of the schemes.
- **WRMP pre-consultation engagement** – Regular pre-consultation meetings are held with the statutory consultees. We have executed a programme of regular forums (including one focused on water resources more broadly and the other focused on demand management) to supplement the other strands of engagement and enable our stakeholders to raise more local issues. This has enabled us to share and test our approaches in developing the WRMP24 with a more local audience.
- **WRMP statutory consultation** – from the 14 November 2022 to 20 February 2023 we shared our draft plan across a wide range of communication channels. This allowed us to test the draft plan with customers and stakeholders across our area - we received 223 responses.
- **PR24 engagement** – the WRMP24 forms a key part of the Price Review (PR) process and coordinates the wider company customer and stakeholder engagement programmes with the WRMP24 research and engagement to ensure consistency and alignment. This shared engagement across the two plans enables line of sight for both our customers and stakeholders.

3.2. The outputs of the engagement activities and how they have informed our work are set out in this chapter.

[21] WRE Triangulation report, 24 Aug 2022, Impact

Figure 3.1: Insight flow from customer and stakeholder engagement

Stakeholder and public engagement

3.3. Our approach to pre-consultation has been to maximise our engagement via the work carried out in the regional groups, particularly WRSE; this is because most of the Affinity Water supply region sits within this regional group's boundary. We have fully reflected the WRSE regional plan in our WRMP24 and, as a result, focusing our stakeholders on the development of the policies, technical methods, solutions and programme appraisal for the WRSE regional plan has been appropriate.

3.4. A continuous thread of engagement throughout the development of the WRSE regional plan has involved a wide range of stakeholders (regulators, NGOs, local river groups, action groups and local authorities, etc) to understand their priorities and preferences. Method statements, policies and forecasts have been published and consulted on[22], with inputs considered in decisions leading to the preparation of the best value regional plan.

WRSE also established links with other water resource regional groups to ensure the opportunities to share resources effectively were understood and fully investigated in order to provide a coordinated national water resources picture. This led to the regional reconciliation process which is set out in **Chapter 8.**

3.5. WRSE established stakeholder groups to help guide the development of the regional plan. The groups are the stakeholder advisory board[23], environmental stakeholder group[24] and the multi-sector stakeholder group[25].

[22] WRSE Library of documents
[23] Members of stakeholder advisory board: CCW, RWE, Kent County Council, Greater London Authority (GLA), Chalk Streams First, Blueprint for Water, South East Councils, and observers (EA, Natural England and RAPID)
[24] Members of environmental group: Herts and Middlesex Wildlife Trust, Blueprint for Water, South East Rivers Trust, Chalk Streams First, Environment Agency, Natural England
[25] Members of multi-sector group: Kent County Council (independent chair), NFU, West Sussex Growers, RWE Generation, Uniper Energy, Environmental Consultant, BIGGA/England Golf, DS Smith (paper manufacturer), Confederation of Paper Industries, Mineral Products Association, Canal & River Trust, Vitacress. Environment Agency

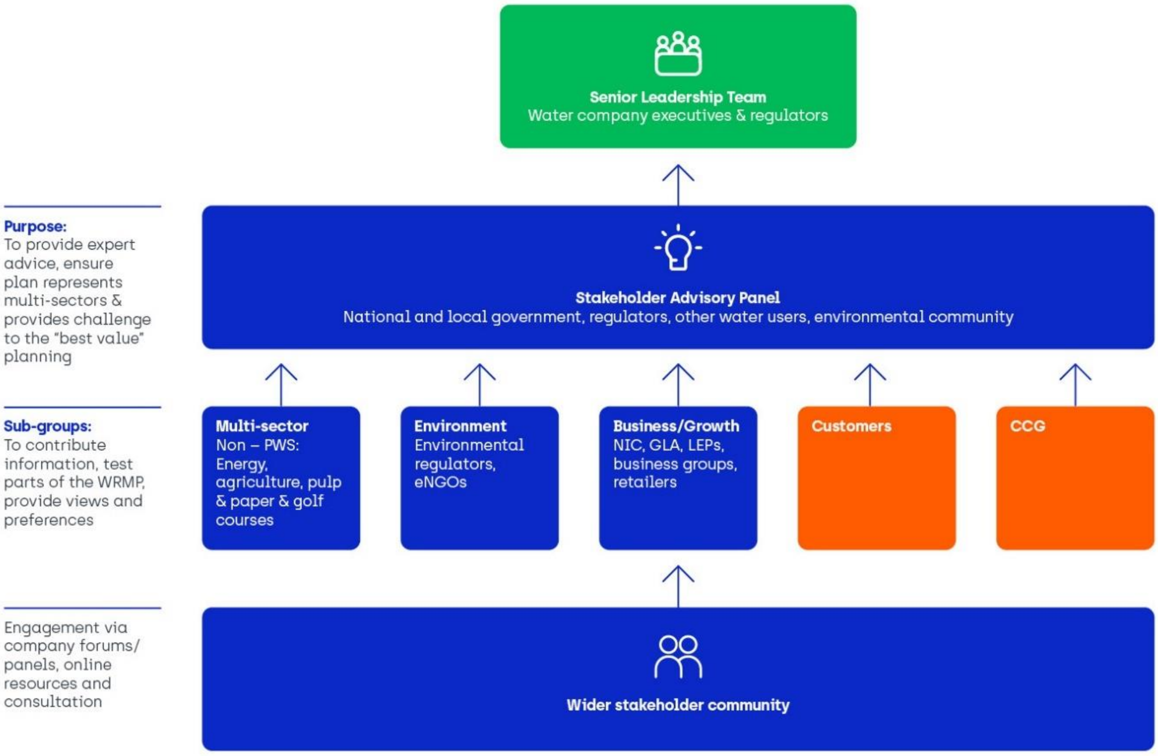


Figure 3.2– Stakeholder groups challenging the WRSE regional plan

3.6. WRSE and the member companies have worked openly and transparently to enable participation and ensure stakeholders have been clear about why they are being consulted. The efforts include sharing information in a timely way and across a range of channels and activities. They have also highlighted the scope of the many consultations and how those fit with the wider water resources planning landscape. The overall process is set out in **Figure 3.3**.

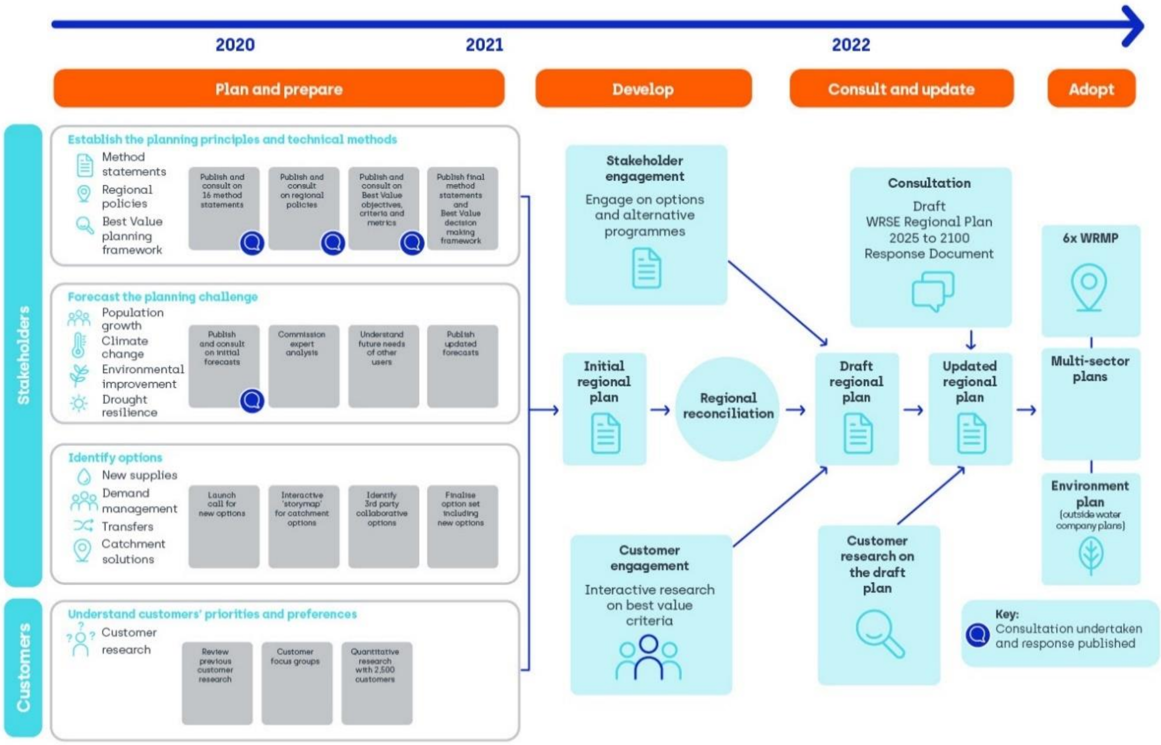


Figure 3.3 WRSE engagement process

3.7. The WRSE engagement and consultation programme had three main phases:

- **Plan and prepare** – up to 2020, the focus was on the building blocks of the regional plan. These were the technical methods, approaches and tools that would be applied in the development phase, the forecasts for future growth and demand for water, the environmental assessments and the regional policies and were all shared with stakeholders for comment. WRSE ran a programme of webinars and held topic-specific consultations to give stakeholders the opportunity to engage and input to the process.

- **Develop** – during 2021, the focus broadened and set out the planning challenge for the region, sharing information through webinars on feasible solutions including the SROs, and formulating the approach to determine the best value regional plan.

- **Consult and update** – during 2022 the focus moved to the plan itself. WRSE held an eight-week period of engagement and consultation on the 'emerging regional plan' in January 2022. The responses to this consultation were addressed in the published response document and have been taken into account in the development of the best value regional plan. In November 2022, a further round of consultation was undertaken on the best value plan, alongside the statutory consultation on the WRMP24. A final regional plan has now been produced.

3.8. WRSE has produced a Stakeholder Engagement Report which details the extensive engagement and consultation activity that has taken place to date. The report[26] has been published alongside the draft best value regional plan. It contains further details of the 40-plus engagements held to mid-2023, including sessions with local authorities, retailers, 'Blueprint for Water', National Infrastructure Commission, National Farmers Union (NFU) and the Horticultural Traders Association.

What have stakeholders already told us?

3.9. Over 1,150 written responses were received in the WRSE consultation on the emerging regional plan. **Figure 3.4** provides a summary of the consultation and the responses. Over half of the individual responses focused on specific water resources options identified for development, such as large new reservoirs, strategic water transfers and water recycling schemes. Approximately 500 of these expressed opposition to South East Strategic Resource Option (SESRO). The remainder came from stakeholders that represented wider areas of regional and national interest.

Figure 3.4: WRSE Emerging Regional Plan Consultation

[26] WRSE Stakeholder engagement Report, November 2022: [Library | WRSE - Water Resource South East]

WRSE published a response document in May 2022[27]. This document provided a summary of the consultation responses, highlighted the main themes and issues raised and provided WRSE's consideration of the points and consequential actions. We have reviewed the comments they received and taken account of all their conclusions with which we agree.

Many of the wider comments received from stakeholders focused on specific technical areas. In general, there was support for the adaptive planning approach undertaken and proposals for significant leakage and water efficiency measures. There was also support for greater protection of the environment through abstraction reductions.

A key concern from stakeholders was the logic of the timings of the branch points selected in the regional modelling, which also inform this WRMP24. **Chapter 8** describes how these challenges were addressed by bringing forward the timing of those branch points. Additional concerns were also raised, including challenges to population and environmental data (both in terms of assumptions made and lack of transparency) and assumptions underpinning the emerging regional plan. WRSE have addressed these in their best value regional plan[28] by ensuring a wide range of pathways are available within the adaptive models.

There were also scheme-specific issues raised, particularly regarding some of the larger strategic options such as large new reservoirs, strategic water transfers and water recycling schemes. The regional plan has considered these challenges in the development of the best value regional plan. **Chapter 9** sets out how the regional plan was sensitivity-tested to ensure these options provided best value for Affinity Water customers.

3.10. Over 900 responses were received by WRSE to their draft Regional Plan consultation (November 2022), **Figure 3.5** provides a summary of the responses received.

[27] WRSE emerging regional plan response document

[28] WRSE Best Value Regional Plan November 2022 - Water Resources South East (engagementhq.com)

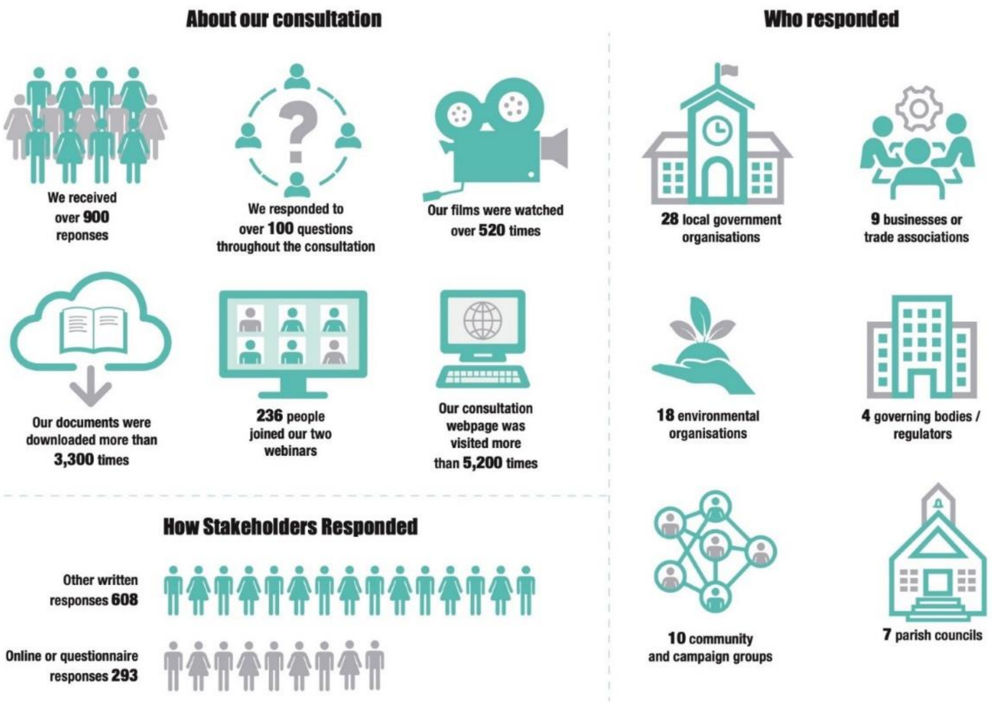


Figure 3.5: WRSE Draft Regional Plan Consultation

The comments received on the draft regional plan were positive. Many supported the adaptive planning approach that is being undertaken. There was also strong approval for preparing the plan based on achieving the best value, rather than on a least cost basis. Additionally, the proposals for significant leakage reduction and water efficiency measures were well-received. Commenters also expressed support for the plan's emphasis on greater environmental protection through reductions in water abstraction.

The responses highlighted some challenges towards population and environmental data, and assumptions underpinning the scale of water needed in the future. Significantly, over 80% of the responses focused on specific water resources options identified for development, such as large new reservoirs, strategic water transfers, and water recycling schemes. Concerns were expressed about the need for the schemes selected, the cost and timescales for delivery, and the environmental impacts associated with their development.

Customer engagement

3.11. Customer engagement has been embedded into our plan through the WRSE decision-making process. This has been undertaken by methods described below (summarised in **Figure 3.6**). The preferences customers expressed about different options to solve the supply-demand deficit have been directly used by the WRSE investment model, and the weights customers attributed to the 'best value' criteria informed the selection of a preferred regional plan. The WRMP24 reflects both these elements. WRSE also conducted qualitative research with a representative sample of customers across the region to assess their overall acceptance of the regional plan in terms of affordability and ambition. WRE also embedded customer research and insight into its plans. Although the remainder of this report will focus on specific engagement efforts by Affinity Water and WRSE, it's important to note that we also supplied evidence through some of the joint research. Additionally, we provided input for the triangulation report, which was used to inform the WRE regional plan.[29]

Approach

3.12. WRSE worked with Eftec, a leading market research agency who are registered with the Market Research Society (MRS)[30]. They used a breadth of techniques to elicit customer views on water resources. They engaged a wide range of customer segments including hard to reach, future and non-household customers and retailers. The methods and sample sizes used were deployed in accordance with good industry practice and were considered by us to be appropriate to inform the production of the WRMP24 in advance of formal consultation.

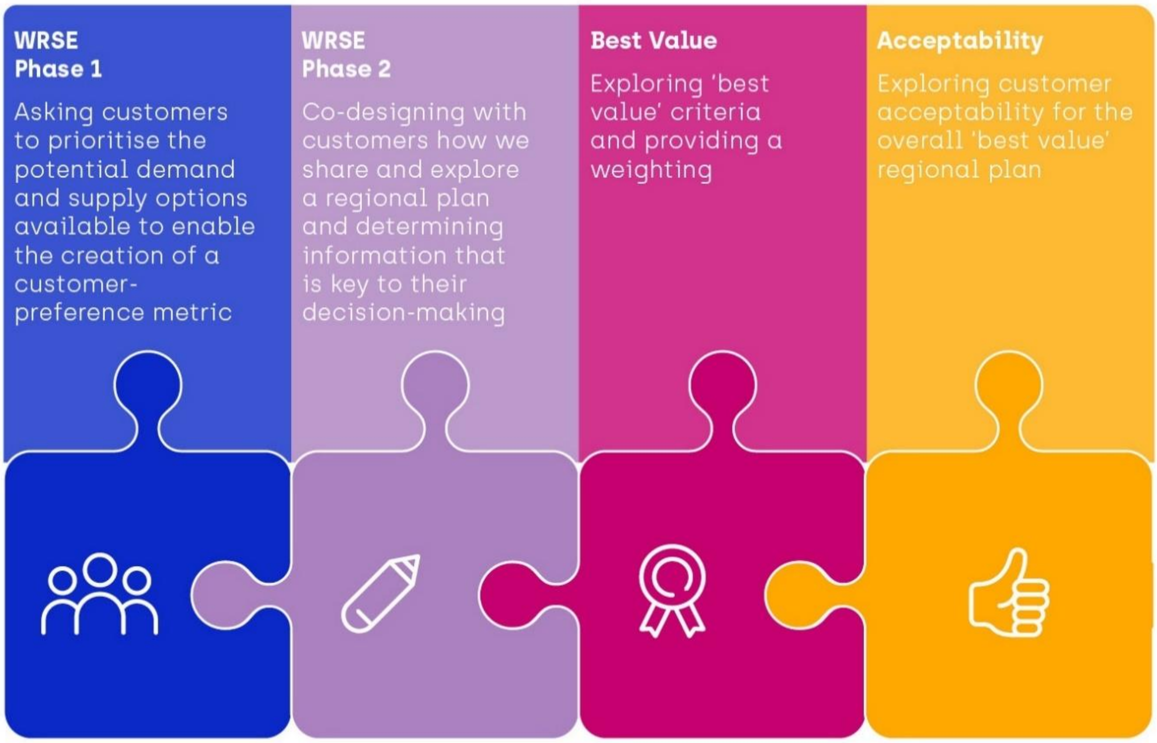


Figure 3.6: Summary of WRSE customer engagement

[29] https://wre.org.uk/wp-content/uploads/2022/11/WRE-draft-Regional-Plan-Triangulation-Report.pdf
[30] The Market Research Society is a professional body for market research. They promote the highest professional standards throughout the sector via the MRS Code of Conduct. MRS is the world's largest association serving those with professional equity in provision or use of market, social and opinion research, and in business intelligence, market analysis, customer insight and consultancy

3.13. The full reports for the research conducted can be found in **on the WRSE engagement platform**[31], which details the methods, materials and findings. We have included a short summary below.

Challenging the approach

3.14. The process of collaboratively delivering customer engagement activity at a regional level has been driven primarily through the WRSE Engagement and Communications Board. Company experts in the field of customer research have helped design and develop the engagement activities, ensuring both best practice and alignment to wider insight activities across the companies.

Engagement with the Independent Challenge Groups (ICGs) of all the companies within WRSE has been coordinated by a regional Customer Challenge Group (rCCG). This group brings together representatives from the Consumer Council for Water (CCW) and the independent challenge groups from each company. The purpose of the rCCG is to share and provide input on the approaches and materials used to engage customers effectively.

Phase 1 Prioritising options research

3.15. As part of WRSE Phase One, a major review was conducted of 120 documents demonstrating previous customer engagement across ten of the participating water companies. This review was undertaken to identify key themes to inform regional policy. Results for each water company were produced.

The review came to the following conclusions described below.

- Overall, there is limited insight in the previous research by companies on customers' views for resilience outcomes. Rather, the customer evidence is piecemeal and does not provide a coherent view on the range of factors that matter to customers in terms of support for resilience planning.
- In general, customers are supportive of demand management measures. Moreover, whilst there is support for efforts to save water and reduce usage customers feel that companies and other stakeholders have as much of a role to play as they do (including reducing leakage). It is also evident that research to date has focused on short-term solutions and not the longer-term need for more significant changes in customer behaviour and the use of water.
- There is broad evidence based on customers' views on supply-side solutions. It shows a consistent picture on customer preferences, where familiar 'tried and tested' solutions such as reservoirs are favoured over alternatives such as reuse and desalination.
- The previous evidence tends to indicate that customers are supportive of

[31] WRSE engagement platform – customer engagement

policy objectives to reduce leakage, reduce PCC and protect the environment. However, there is limited insight on the level of support for specific targets, particularly in relation to the cost of investments to reduce leakage and abstraction, or the impact on customers' lifestyles from significant reductions in water use.

3.16. These findings[32] gave support to WRSE and, in turn, the companies, in developing policy statements on demand management strategies. They also confirmed the need to develop a clearer resilience framework that could be further tested with stakeholders. The findings helped to frame the second part of the Phase One work where WRSE wanted to understand the preference of customers across the region for particular 'types' of solution.

3.17. To help inform the quantitative work, 84 customers participated in qualitative research with separate groups for each of the 10 water companies that participated. The groups featured a mix of discussion topics and exercises across two sessions. Each group also completed pre-read and between session 'homework' exercises to build the participants' knowledge before discussion in the sessions. The preparation and the online setting created high levels of engagement with a diverse mix of customers.

The key findings are described below.

- Overall, the deliberative research has shown the high level of priority that participants placed on environmental protection.

- There is also a high level of support for a collaborative approach to long-term planning for water resources and resilience to drought and unexpected events. Participants had a good baseline understanding, and increasing awareness, of climate and population pressures and are reassured that companies are planning for future risks.

- There is support amongst participants for reducing the risk of emergency drought restrictions. 81% of participants chose a reduction from current risk levels. The experiences of people through the COVID-19 pandemic has made the implications of restrictions on day-to-day activities less abstract. It provides a reference point for gauging impacts that are tolerable and those that are to be avoided.

- Participants also supported the sharing of resources, but more detail needs to be provided on the strategic context (availability of water by location). For example, what would happen without these resources as well as local level impacts to help customers decide whether specific strategic resource options are the right choice for them.

Determining whether a plan across multiple companies is acceptable may be challenging, given the expectations of customers that a good level of support will need to be evident for all companies (including 'supplier' and 'recipient' areas).

[32] WRSE Customer Preferences Part A - Evidence Review (Appendix 3.4)

Details of the findings and materials shared with the customers are available in the full report[33].

3.18. This was then followed by quantitative engagement (in the form of a paired comparison choice task[34]) with just over 2,300 household customers and 350 non-household customers across the region[35]. This survey was developed from two stages of qualitative testing: learnings and findings from the deliberative research; and iterative testing through 10 one-to-one cognitive interviews.

The survey material was piloted and then implemented via a soft launch[36] to test the choice task on customer preferences for demand and supply options. It was then implemented to provide results that were representative of all households in the southeast of England and non-households connected to the public water supply in the region.

The household survey results were representative of geographic, demographic and socio-economic characteristics of the southeast. In addition, socio-economic characteristics on household vulnerability and attitudinal characteristics were identified to provide additional insights on the preferences of household customers. The non-household survey results reflected a breadth of views across sectors and company areas. Views of non-household respondents tended not to differ substantially from household customers.

3.19. The research showed a clear priority order of supply and demand options from the customers perspective. It identified that a top priority was ensuring the efficiency of the current system . Practically, this means reducing leaks and removing constraints in the water supply network.

Secondly, efforts should be focused on increasing the efficiency of water that is currently supplied and helping customers use less water. Additionally, actions that deliver wider benefits and public value, such as catchment management initiatives should also be prioritised.

Customers saw the role for new resource schemes at the next level down and associated inter-/intra-regional transfer options. Beyond this are the least preferred options that have potentially significant negative environmental impacts, including increased abstraction and greater reliance on drought orders and drought permits as short-term measures. The full details of the materials shown to customers, sampling methodology and full results by company can be found in the full report[37]. **Figure 3.7** shows the results breakdown for Affinity Water customers – this was similar across the other companies.

[33] WRSE Customer Preferences Part B - Qualitative (Appendix 3.4)
[34] Paired comparison choice task – a statistical method of prioritisation
[35] Note: a sample size of 10% of the population sampled is considered statistically significant with a maximum of 1,000 across any population size. A sample of 2,650 has a 0.045% margin of error assuming a 19m population in the WRSE area
[36] Soft launch is a method of slowly releasing the survey to a small number of respondents to test usability, understanding and effectiveness of the survey
[37] WRSE Customer Preferences - Part C Quantitative (Appendix 3.4)

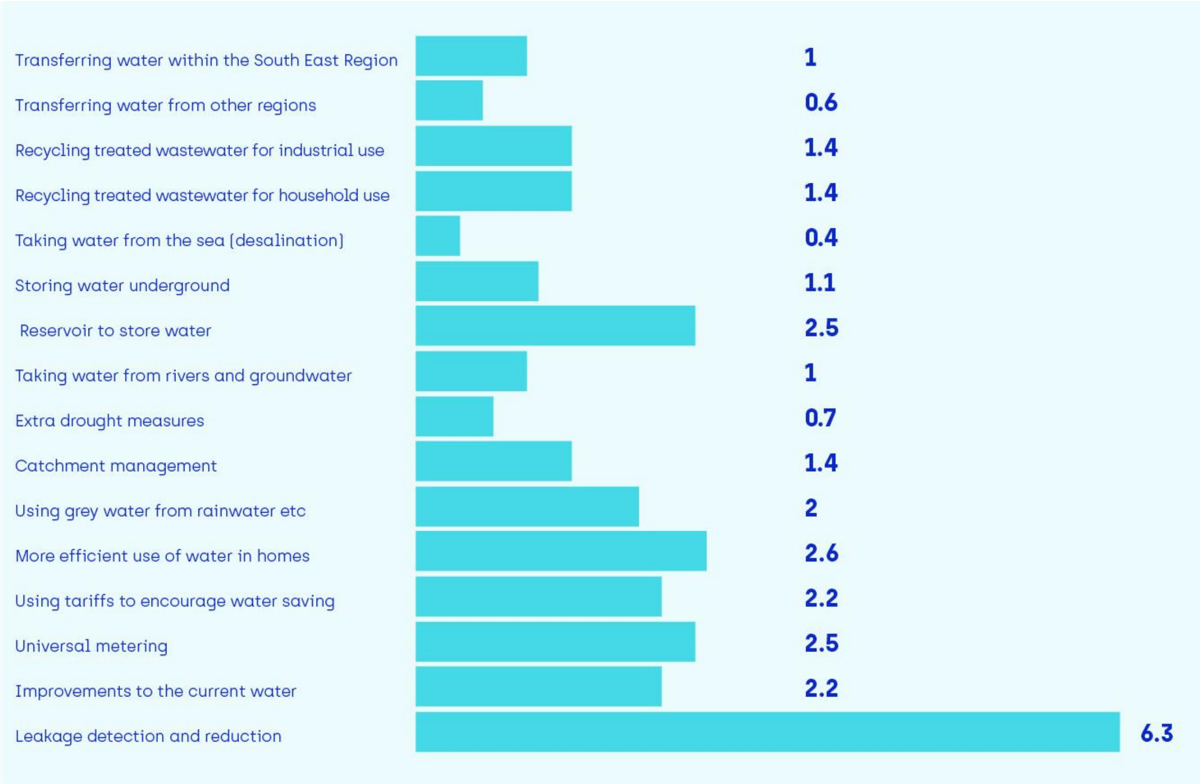


Figure 3.7: Option preference weights from customers for **Affinity Water** (sample size 363[38] customers)

3.20. The weights of these option preferences were used as an input into the WRSE investment model.[39] The research also provided useful information to guide future engagement. It highlighted the type of information customers wanted to see (cost, environmental impact, constructions) and the importance of framing the discussions in this context, as well as explaining the full scheme composition and how the scheme fits within a wider water resources plan.

Phase 2 - determining 'best value' research

3.21. To help WRSE prioritise the outputs of the investment modelling runs, it was important to understand the preferences customers had for the different best value metrics (WRSE had already consulted on whether these were the right mix of metrics with their stakeholders). This quantitative engagement explored preferences with just over 30040 household customers across the Southeast of England. Customers were also segmented by age, socio-economic group and gender. Details of the materials shared with customers and the full findings can be found in the full report.41

3.22. In general, customers placed more weight on the delivery of a secure supply of water, followed by cost or environmental improvements, with

[38] Note: a sample size of 10% of the population sampled is considered statistically significant with a maximum of 1,000 across any population size. A sample of 363 has a 0.1% margin of error assuming a 3.5m population for Affinity Water
[39] WRSE Method Statement – Best Value (Appendix 8.2)
[40] Note a sample size of 10% of the population sampled is considered statistically significant with a maximum of 1,000 across any population size. A sample of 300 has a 0.045% margin of error.
[41] WRSE Best Value research (Appendix 3.5)

resilience placed on the lower end of the scale. **Figure 3.8** shows a summary of the findings for the WRSE region. WRSE have used the criteria and the weights customers set out and have judged each of the modelled regional plans against them. This provided an indication of which of the modelled regional plans are meeting the customer expectations and which ones aren't.[42] Our WRMP24 inherently takes account of these preferences by reflecting the regional plan.

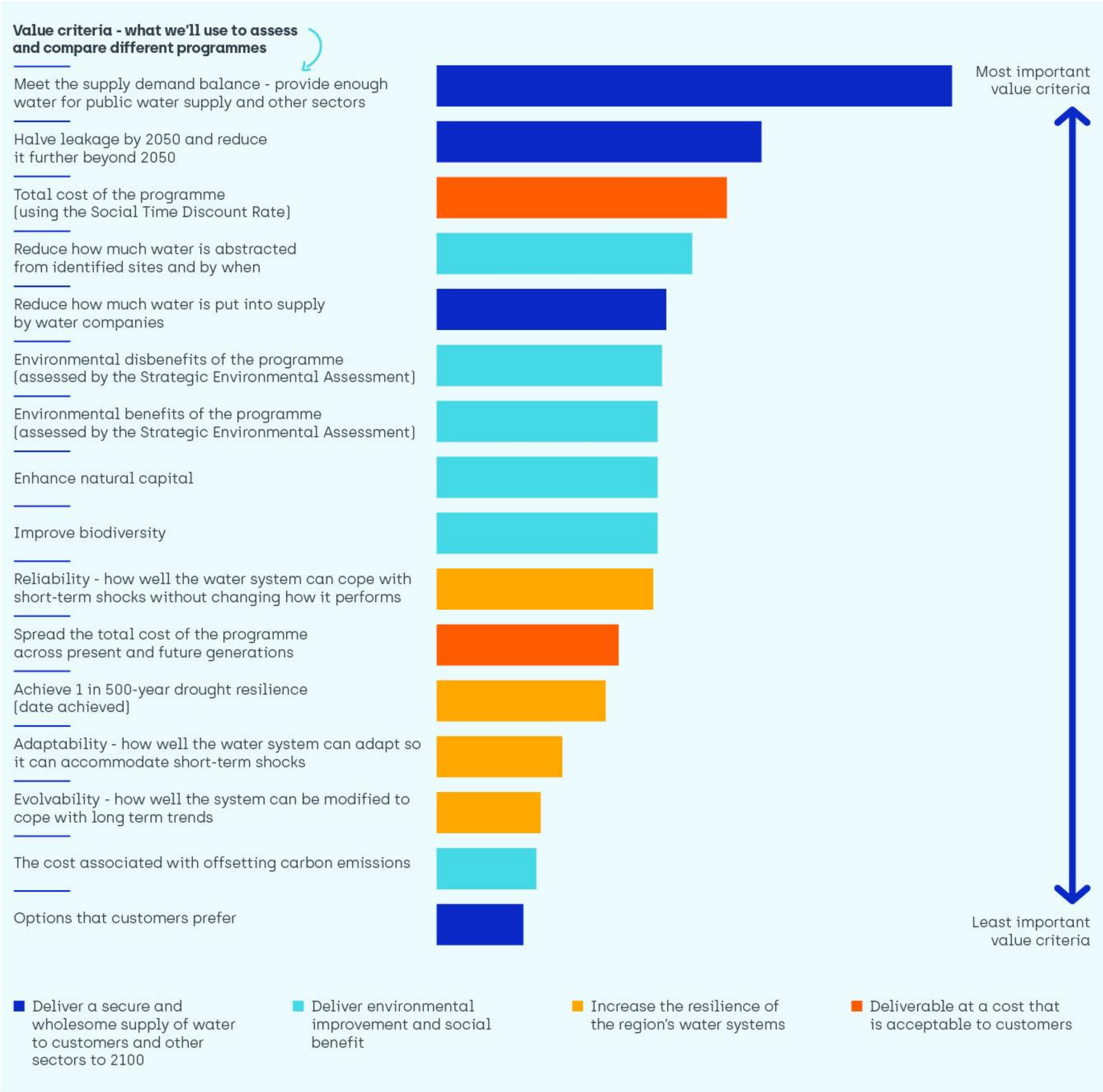


Figure 3.8: Views from customers on WRSE best value metrics

Acceptability of the regional plan

3.23. Approximately 1,700 household and non-household customers participated in an online survey that was carried out by WRSE in March – May 2023[43]. The respondent samples were representative of the Southeast of England and

[42] WRSE Method Statement – Best Value (Appendix 8.2)
[43] WRSE Regional Plan preferences - Appendix 3.6

provided coverage of the six WRSE water companies. The customer research study examined preferences for the balance of the regional long-term water resources plan in terms of reducing demand for water, developing new schemes, and bill impact. The results and findings from the research complement consultation feedback from regulators, stakeholders and other interested groups on the regional plan.

3.24. In the survey respondents were asked to pick their preferred profiles for the regional plan via a series of choice exercises. Two choice exercises were put forward to the respondents.

- Preference over alternative plans without bill impact. This provided an "unconstrained" view of customer preferences based on the profile of each plan (i.e. the mix of schemes and impacts).
- Preference over alternative plans with bill impact. This provided a "constrained" view on customer preferences reflecting trade-offs between higher/lower bill amounts and the profile of each plan.

3.25. The profiles of alternative plans shown to respondents were specified according to outputs from WRSE's extensive investment modelling over 2022. The alternative profiles characterise the high-level choices and trade-offs for the balance of the regional plan based around sources of water (supply schemes, inter-region transfers and demand management) and selected impacts.

The high-level findings are outlined below.

- Customers' overall preference is for a balanced regional plan.
- Customers value the added resilience offered by the Best Value plan.
- Customers recognise the need to reduce demand and see this as an integral part of the regional plan
- Customers' preferences did vary across the region but in line with the profile of the alternative plans
- Split views between the Least Cost and Best Value plans were in part attributable to customer socio-economic and demographic characteristics

3.26. Overall, no single plan stood out with a majority share of customer support. The balance of preference varied according to aspects including bill impact, location, and customer characteristics. Nevertheless, the research findings in relation to the patterns of customer preferences are conclusive and the following points can be drawn with respect to the choices that remain for finalisation of the regional plan.

- There was a greater level of customer support for a regional plan that incorporates large strategic schemes that can share water resources across multiple company areas. An alternative approach with more emphasis on "local" schemes and the exclusion of larger strategic schemes received relatively limited support and was clearly preferred less by most customers.

- There was also a greater weight of customer preference was for self-sufficiency within the WRSE region.
- Large-scale transfers from outside of the region were not viewed as the primary solution. A sizeable proportion of customers preferred demand reduction over reliance on large-scale transfers as the basis of "balanced" regional plan to secure water supplies.
- The regional plan must be supported by Government led measures to help bring down per capita consumption. However, customers tended to favour enhanced resilience over the very highest level of demand reduction, which does indicate there is a limit to the level of ambition – and risk - that should be targeted in the regional plan. For a sizeable proportion of the region's customers, the appropriate balance appears to be achieved by the Best Value plan with 50% achieved through demand management measures.

Our pre-consultation for WRMP24 – Strategic Resource Options engagement

Stakeholder engagement

3.27. Although the SROs are still in the early development phase, we have held several focused SRO workshops as part of the engagement programme. These have included:

- local authority workshops and briefings (including Historic England and National Highways);
- Grand Union Canal Scheme canal user workshops; and
- A face-to-face community event to support the engagement focused on the SESRO scheme.

3.28. Full details of these workshops are included in the Gate 2[44] reports for the specific schemes. These important collaborative workshops and events will continue to play a key role in our ongoing engagement for those significant schemes that are selected as part of the best value plan.

The aim of these sessions has been to update interested stakeholders on the technical studies being conducted to inform the schemes' validity and design. They also provide an opportunity to understand any key concerns from the stakeholders on scheme specifics. As a result, a visualisation tool is in development for SESRO to show bank height and impact on the landscape. Additionally, more detailed studies are being undertaken to look at wider benefits associated with the GUC SRO scheme, such as increased access and understanding the impact of velocity in the canal of the fish lifecycles.

[44] Gate 2 reports for Affinity SORs – https://affinitywater.uk.engagementhq.com/strategic-resource-options

Customer engagement

3.29 The early customer research that was conducted for WRSE highlighted the need for further customer engagement specifically around these strategic schemes. Customers had already highlighted some concerns regarding these regional transfers and the impact they would have both on the customers receiving potentially different sources of water and the impacts locally of these schemes to the communities in which they would be built.

3.30. Therefore, to help inform the further development of these schemes, we commissioned two research projects, jointly[45] across 11[46] of the strategic schemes:

- **Changing water sources research** - this looked at the impact a change in water source would have on those customers who received it, identify the concerns they would have and how we, as water companies, could concisely communicate the changes.

- **Public value research** - this looked at how a scheme of such significant scale could deliver wider public value, not only for the community in which the scheme was delivered but at a national level. We wanted to understand customers' support and willingness to pay for such benefits and whether this was dependent on scheme type and distance from the customers impacted.

3.31. To ensure our approach and materials shared with customers were scrutinised, the CCW and the Drinking Water Inspectorate (DWI) were directly engaged to review materials prior to the research, and findings were shared via two webinars. The public value research was also subject to independent technical review by an academic in environmental economics.

We look at both research projects in greater depth below.

Changing water sources research

3.32. This research was undertaken by BritainThinks[47], a leading UK, MRS registered, market research agency. It included a review of the wider evidence base on source changes, both nationally and internationally, and a qualitative review of customer views, including product testing and the co-design testing of a communications framework. 96 customers were engaged in the qualitative phase, spending a full day learning about and exploring the various options for water supply and transfer and discussing their views. They were then re-engaged online to help co-design a communications framework. This was tested with1,400 customers and 200 non-households, during a quantitative phase (**Figure 3.9**).

[45] The water companies involved were Affinity Water, Anglian Water, Cambridge, Thames Water, Severn Trent Water and Southern Water
[46] SROs involved were A2AT, SLR, Fens Reservoir, T2AT, SERSO, T2ST, London Water Recycling, Minworth, GUC, Southern recycling and STT
[47] Full report found in Appendix 3.2

Figure 3.9: Summary of the approach taken for the changing sources customer research

3.33. The key findings were as follows.

- Water is a low salience topic, with customers indicating a low level of awareness and understanding of issues relating to it. This, in part, is driven by general satisfaction with the customer experience of water, in terms of taste, smell and hardness.

- Customers also have low awareness of water scarcity. While all take steps not to 'waste' water, most are not actively trying to reduce their water consumption. Information on the topic is easily understood, however, this is not always enough to change long-standing perceptions that water is abundant in the UK. Customers believe that water companies should now be taking steps to respond to the issue of water scarcity and recognise that a mix of demand and supply-side solutions are required. However, there is a general desire to see water companies implement demand-side options first, including fixing leaks and educating customers.

- When prompted, customers assess water source options by balancing efficacy (including reliability) and the cost and time commitments associated with the change. There is also an expectation of water companies to evaluate options through this lens.

- Customers say they are unlikely to engage with communications on source change. Taste tests indicate that most are not able to detect differences at the level that might be expected in a source change. However, there is still a need to communicate to explain the rationale for the change, alleviate taste concerns and provide clear guidance on the impact.

- In terms of communication, overall, the 'human' frame (explaining the impacts of the change in terms of how it impacts the customers' daily use e.g., taste, limescale etc) combines the qualitative and quantitative findings together the most effectively. Quantitatively, environmental and human framings are slightly preferred to practical framings to communicate a water source change. However, in qualitative sessions, environmental framing is felt to lack impact, indicating that human framing works best overall.

- Most household customers want initial notification three to six months in advance of the change. Non-household customers are more likely to want an earlier notification of a change. Most respondents then want one further reminder of the change, at a point closer to the time.

- An email message and a letter, separate from the water bill, are the preferred forms of communication about source changes, consistent across sources. Most customers claim they would click through to look at additional information. Whilst this number may be lower, it is essential to provide comprehensive information to those who want it.

- Of those who are more inclined to visit a website for further detail on the change, there is an expectation that this would include a wealth of comprehensive information. This includes detail on bills, taste, the process, the reason behind the change, safety, environmental impact, and information from an independent source.

- While there is a need to communicate on any source change, water recycling and desalination need more engagement due to a higher level of spontaneous concerns. For water recycling, these concerns are centred around taste, hygiene and safety. Desalination also generated concerns which tended to be around taste and price.

3.34. One of the key outputs from this research was a communications framework. This framework brings together all the insights gained to create a practical tool for use when we do decide to change a water source. It guides us on the language, framing and timing of communications. The tool will be used as we begin to prepare to change the source water for our customers, as determined by this WRMP24.

Public value research

3.35. This research was conducted jointly by research agencies, Accent and PJM Economics, both MRS registered, and specialists recognised in the water industry for this type of economic-led engagement.

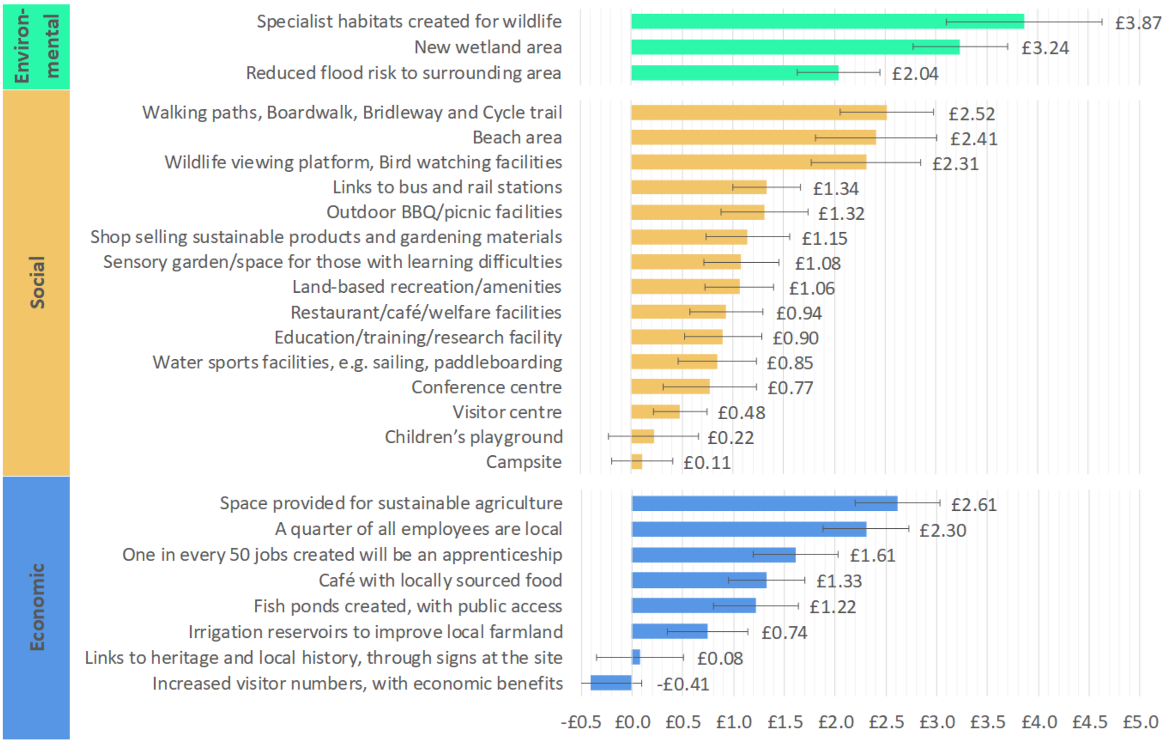
3.36. The qualitative phase involved a reconvened method to introduce and explore generic 'public value' and then test what is important for large infrastructure projects within the water industry; supported by preparatory and interim homework activities. In total, 24 online Zoom groups with household, non-household and future customers across six water companies (including Affinity Water) were used.

Figure 3.10: Summary of qualitative engagement activities for Public Value research

3.37. The quantitative phase engaged 5,902 household customers and 553 non-household customers using a stated preference design which utilised a pairwise choice exercise followed by a contingent valuation exercise[48]. The full report[49] shows the details of the materials shared with customers and detailed findings. **Figure 3.11** provides a summary of the Willingness to Pay (WTP) values for household customers.

[48] Pairwise choice exercises and contingent valuation exercises are recognised statistical methods for understanding customer preferences through a survey

[49] Full report found in Appendix 3.1



Base: 5,902 participants. Annual WTP in terms of a higher water bill for project additions at sites 5 miles from home (weighted estimates). The error bars show 95% confidence intervals calculated using the delta method.

Figure 3.11: A summary of Willingness to Pay values across all types of schemes for household customers

3.38. In both the qualitative and quantitative work, environmental project additions were valued highly and there was a high emotional resonance with them. The narrative of supporting wildlife/new wetlands/habitats was consistent across all the customers who participated.
The top three most highly valued project additions by households were:

- 'Specialist habitats created for wildlife' (£3.87 annually, on average);
- 'New wetland area' (£3.24 annually, on average); and
- 'Space provided for sustainable agriculture' (£2.61 annually, on average).

The biggest variation in the qualitative work was by project type. This was consistent with the quantitative work where valuations of project additions differ considerably across different types of sites and by distance, while the extent of variation across companies was small.

In the quantitative work, overall, project additions at water treatment works were valued most highly, followed by reservoirs, canals, and pipelines. This could be due to reservoirs/canals being naturally more positive/pleasant.

Qualitatively, people felt that the social project additions at water treatment works would be less valuable because they would be unlikely to want to visit, but environmental and economic benefits were supported.

The Willingness to Pay (WTP) for a 'package' of project additions was lower than the sum over individual project additions. This indicated that capping may be needed for individual project additions to ensure that total WTP is not exceeded.

These findings will help inform the further development of the design stages for the SROs (listed in **Chapter 7** of this WRMP24) to reflect the preferences of our customers.

Non-household research

3.39. This research was conducted with the Water resources East (WRE) companies and looked at how we promote water-efficiency amongst non-household customers and how wholesalers could motivate usage reduction (See **Appendix 3.3** for full report). The research was conducted by Blue Marble, a UK leading market research agency registered with the MRS.

3.40. The research engaged both wholesalers directly and the retailers through a series of depth interviews and roundtable discussions. These resulted in the following insights.

- Cost control is more acute than ever for NHH.
- Complacency about water saving is prevalent in all but largest users.
- Focused discussions and exposure to propositions suggests that NHH are open to nudges/new ideas.
- Propositions explored received mixed a response: short- and long-term approach is required.
- Future strategies should focus on communicating/educating regarding the wider need to tackle water security.

3.41. The outputs of this engagement have helped inform our demand management strategy as set out in **Chapter 9**.

Our pre-consultation for WRMP24 – WRMP specific engagement

Stakeholder engagement

3.42. To supplement the regional engagement, we held formal pre-consultation meetings with Ofwat, the Environment Agency (EA) and Natural England (NE). In these meetings, we received helpful feedback which we have fed into our WRMP24. The feedback relates to a wide breadth of areas including highlighting the need to reflect long term scenarios as part of the adaptive planning process (**Chapter 8** and **Chapter 9**) and expectations regarding significant demand management reductions (**Chapter 9**). We have reflected these in our WRMP24 and can be seen in the Statement of Response[50].

[50] SoR - https://affinitywater.uk.engagementhq.com/wrmp

3.43. We have established our quarterly Water Resources Forum (held jointly with Thames Water) which, on average, has an attendance of over 45 stakeholders. This open forum allows us to 'deep dive' on more company-specific materials as well as share the regional plan progress. The presentation materials from each forum are published on our online engagement site[51].

3.44. We have also established a Demand Management Forum, held bi-annually. This forum is designed to update key stakeholders who have a particular interest in demand management such as Waterwise. We present detailed updates on our progress within the current AMP and share some of the innovative approaches we have developed. We have also used this forum to update on our forward demand strategy for our WRMP24, again, using the sessions as a more open discursive forum to understand our stakeholders' thought processes and enable open collaboration.

3.45. For key geographical and technical areas of interest, we have supplemented the broader engagement with local, focused, one-to-one meetings. Examples of this include Essex County Council who are developing a wider environmental strategy for their region and Chalk Streams First who are leading an initiative aimed at wholesale cessation of abstraction across the breadth of the Chilterns chalk streams.

3.46. We have engaged the Affinity Water customer panel on our WRMP24 consultation – they not only responded directly to the consultation questions but also provided comment and feedback on the materials and communications shared as part of the consultation. The consultation responses and our feedback are set out fully in the Statement of Response document[52].

Our pre-consultation for WRMP24 – aligning with PR24 engagement

3.47. As well as being responsible for WRMP24, Affinity Water must engage with OFWAT, the water industry regulator in relation to the charges that it is able to levy in a period that is coterminous with the plan. This process, known as "Price Review 24" ("PR24") also involves public engagement.

3.48. In addition to our WRMP-focused engagement and research, we engage with our stakeholders and customers on a regular basis to inform our wider business planning and our day-to-day operations. As set out by Ofwat in their guidance[53] for good quality customer engagement, we are currently consolidating and triangulating our insights to form a synthesis report which will be published as part of our PR24 business plan. The triangulation process systematically assesses and scores sources of insight through a developed framework to weight their significance and the synthesis report pulls together this weighted insight in a digestible format. The findings from our WRMP24 engagement form a key source and are complemented by an additional PR24 programme of insight gathering.

[51] https://affinitywater.uk.engagementhq.com/wrmp
[52] SoR - https://affinitywater.uk.engagementhq.com/wrmp
[53] Appendix-Reflecting-customers-preferences.pdf (ofwat.gov.uk) – Chapter 4

Through the work we have done to date there are some key outputs that have confirmed the approach we are taking with our WRMP24. **Figure 3.12** summarises current insights in the PR24 'What customers and stakeholders want' report.

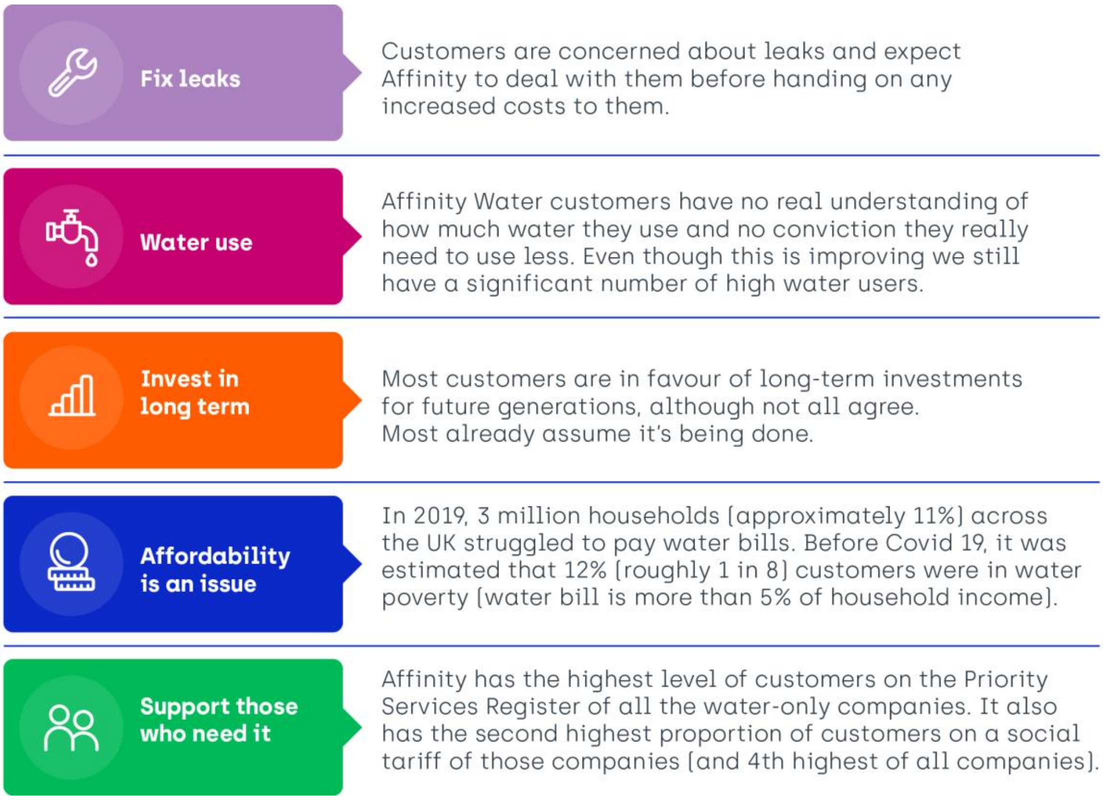


Figure 3.12: Key insights[54] reflecting customer views to inform the WRMP24

Engaging customers as part of the WRMP24 consultation process

3.49. We believe engagement and transparency are key to the development of our WRMP24 and our dWRMP24. We have aimed to share material and information with our stakeholders and customers when it has become available. We also appreciate that we have a wide range of stakeholders; some wish to see a great deal of technical detail while others deem a higher-level, less detailed overview more appropriate. To help facilitate this wide range of requirements we are using our online engagement site as a single point of information. This online platform houses all the detailed technical reports as well as providing easy-to-digest summaries and videos to enable universal and easy access to all interested parties.

Response to the dWRMP24 consultation

3.50. We received 223 responses during the public consultation in respect of the dWRMP24, from a wide range of customers and stakeholders. As part of our consultation, we held workshops for interested groups including councils, environmental organisations, and businesses. We also engaged our online

[54] Affinity Water - What customers and stakeholders want V6

customer community, produced social media advertising, videos and podcasts to explain and highlight the details in our draft WRMP, and emailed our customers and stakeholders directly to inform them about the consultation and encourage them to read it. The draft WRMP, together with all the supporting materials and the consultation survey, were published on our online engagement site to ensure accessibility to as many interested parties as possible.

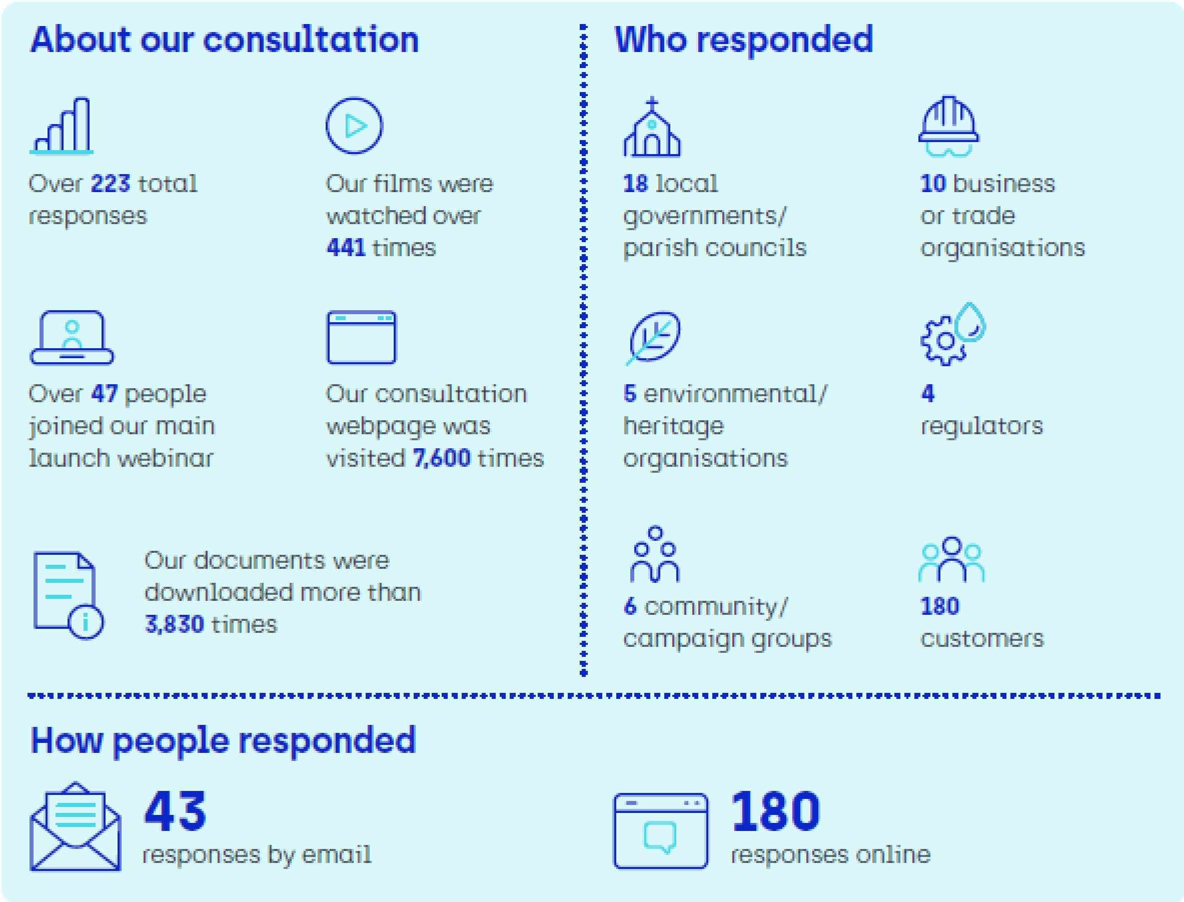


Figure 3.13: Response to the dWRMP24 consultation

What we heard

3.51. Full details of the response to the consultation can be found in our Statement of Response (SoR) summary document but at a high level 55% of respondents felt the draft plan represented the best value plan for our customers, communities and the environment.

Key areas raised included the extent and pace of the abstraction reductions of the Chalk streams with particular challenges and discussions regarding the Upper Lee and Colne catchments, the updating of both the company and regional population forecasts, the provision of clarity around our plans for non-household demand management (including smart metering), the challenge of reaching 110 l/h/d Per Capita Consumption(PCC) for a dry year, concerns raised from Natural England regarding some of the schemes towards the end of the planning horizon and concerns raised by the Environment Agency in using the Brent reservoir and a request to look at options to support water deficits in the WRE region.

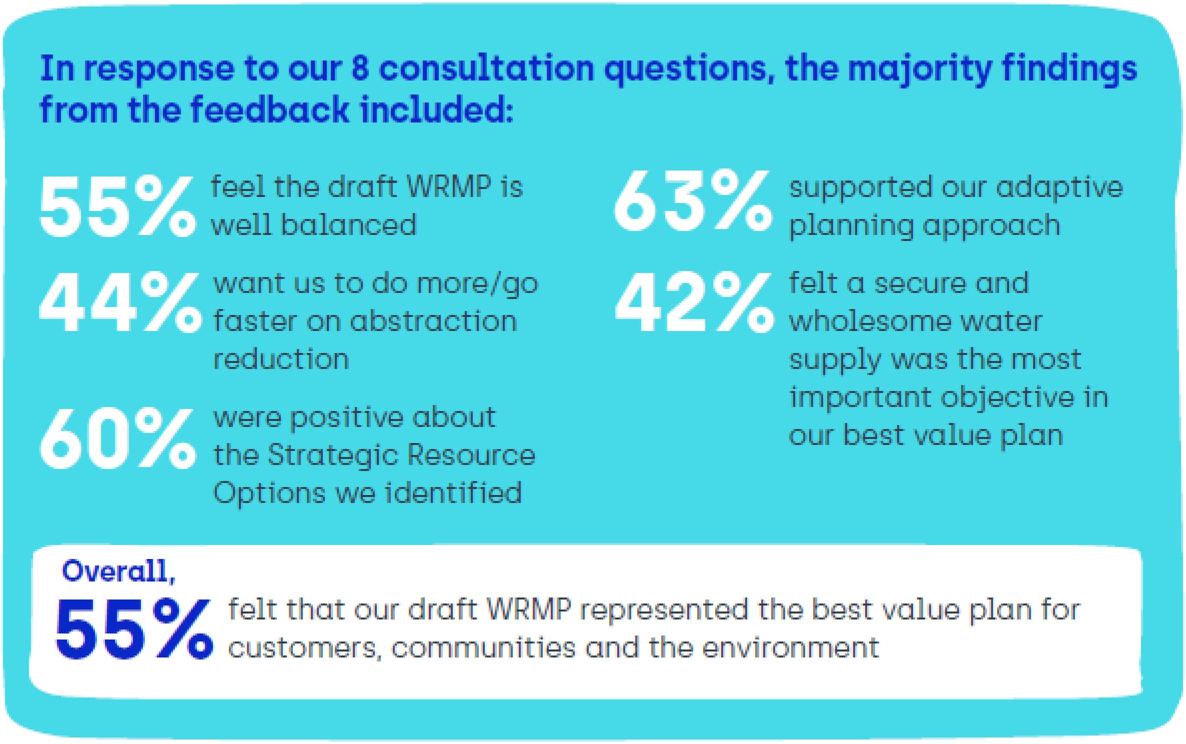


Figure 3.14: Summary of responses to our dWRMP24 consultation

The key areas informing our WRMP24

3.52. The feedback received from the consultation and engagement activities described in this chapter have been taken into account in the development of our WRMP24. This is alongside further technical analysis described in the following chapters.
The key changes we have made are as follows.

- Clarified the role of our 'Connect 2050' programme and maximised the size of the GUC transfer to allow us to pursue our abstraction reduction programme as quickly as possible within the Central region in those catchments that are of greatest concern. We have confirmed that additional transfer will be available from Thames Water, which, when combined with the 'Connect 2050' transfers, will allow us to make use of increases in flows that result in changes to our abstractions in the upper catchments. Maximising the size of the GUC transfer then offers us increased flexibility in the 2030-2040 period and allows us to support the Water Resources East area with their environmental ambition (by taking less water from Grafham reservoir). The feedback we received showed good support for the GUC transfer and we believe it is reasonable to utilise this option as much as we can to support abstraction reduction in the Colne, Lee, Ivel and Cam catchments.

- We have sought to reduce costs and improve affordability by working with the EA to defer licence changes that might not be best for the environment and would trigger potentially inefficient or problematic investment.

- We have increased our demand management ambition, but maintained our proposals for smart metering rollout as there are benefits to a staged approach that can generate the required savings whilst making the programme as affordable to customers as we can.

Informing our WRMP24

3.53. The feedback received from the public, customers, and stakeholders as a result of the consultation and engagement activities described in this chapter have been taken into account in the development of our WRMP24. This is also alongside the technical analysis described in the following chapters. **Chapter 7** and **Chapter 8** explain how customer insight regarding option preferences and views on best value metrics were used to help inform the WRMP24.

4. The demand for water

4.1. The demand for water includes both the supply of water to meet demand, and the measures employed to manage that demand.

This chapter describes the following elements.

- The change in demand in the last ten years. This includes our study to understand how different customers use water and our approach to metering, water efficiency and leakage.
- The impacts of the Covid-19 pandemic.
- Our base year assessment
- Our progress to achieve our AMP7 performance commitments.
- Our baseline forecast of future water demand to 2100
- Potential strategies for demand management to 2050.

4.2. 'Demand' is the term we use to describe the water required by the communities we supply. Demand includes all water that is supplied through our distribution network. This comprises the water consumed by households and businesses, the water lost through the distribution system as leakage, water taken illegally such as through illegal connections, and water taken legally but unbilled, such as water used for firefighting and maintaining the water network.

4.3. It is our core responsibility to provide high quality drinking water to more than 3.9 million customers and to take care of the environment for our communities now, and in the future.

Since 2013, our supply areas have been classified as under serious water stress by the Environment Agency[55]. Under the Water Industry (Prescribed Conditions) Regulations 1999, serious water stress is defined as where '*the current household demand for water is a high proportion of the current effective rainfall which is available to meet that demand; or the future household demand for water is likely to be a high proportion of the effective rainfall which is likely to be available to meet that demand*'[56].

4.4. We have been designated as 'water stressed' based on the water demand in our communities. To ensure we continue to meet our core responsibilities, we must accurately forecast and manage our future demand. To do this, we produce two future forecasts; our baseline demand forecast and our demand management forecast.

Our baseline demand forecast determines the volume of water required in the future due to population and property growth. This forecast includes the leakage reduction and PCC commitments we have made to the start of the new planning period in 2024/2025. Beyond this, it looks at the

[55] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf
[56] https://www.gov.uk/government/publications/water-stressed-areas-2021-classification

forecast for demand without any planned demand reduction interventions. Our baseline demand forecast is detailed further in this section and is used as the starting position for the future supply-demand balance (**Chapter 6**).

4.5. Our demand management forecast determines the future volume of water required considering reductions in demand from our demand management strategy. Demand management includes all activity that achieves a reduction in demand on our distribution network, such as compulsory metering, water efficiency and tariffs to reduce household and business consumption and active leakage control and mains replacement to reduce leakage. The details of the demand options included in our demand management strategy are provided in the 'potential strategies for demand management' subsection of this chapter.

4.6. We have developed our baseline demand forecast and demand management strategy forecasts consistently across our water supply areas. Our approach is also consistent with that used in the WRSE and WRE regional plans. Our forecasts for Central and South East regions have been supplied to WRSE and our forecasts for East region have been supplied to WRE for their modelling.

Our journey over the last 10 years

4.7. Our journey over the last 10 years informs both our baseline and demand management strategy forecasts.

Between 2012/13 and 2022/23, the population we serve has grown by just over 13%, from 3.48 million to 3.95 million. This means that, on average, population has increased by 46,500 people each year for the last ten years. This growth has had a corresponding impact on consumption with household consumption increasing by 20% over the same period.

4.8. A combination of this increase in demand and our commitment to reduce unsustainable abstraction from our Chalk aquifers, means we have moved from our 2009 WRMP position of forecasting surplus water compared to demand, to one where we are forecasting deficits.

This change in our water resources position has facilitated our focus on demand and the interventions we can employ to reduce demand. To do this, we have concentrated on understanding how our customers use and save water.

Understanding how our customers use water

4.9. People across the UK do not use water uniformly. There are many things that influence consumption, including weather, house size, garden size, affluence, environmental commitments and technology.

Historically, our average per capita consumption (PCC) tends to be 10 l/h/d higher than the UK average. This is attributed to the demographics of the customers we serve and the geographical location of our company boundaries, particularly within our Central region where there is less rainfall than other areas of the country, average earnings tend to be higher than the UK average and house sizes tend to be larger, all of which are known to influence water using behaviours.

4.10. If we are to commit to helping our customers reduce water use, we need to understand the key drivers for these differences; the greater our understanding of the nature of these differences from the UK average, the more we will be able to tailor our messaging and our activities to help individual customers reduce their consumption.

4.11. Using data collected as part of our Save Our Streams (SOS) campaign, we have been able to start to classify how water use practices and volumes differ between different segments of our customers. This research led us to develop five segmentation groups which range from *Super Low* users through to *Super High* users.

Figure 4.1 shows the split between different types of water users in our supply area.

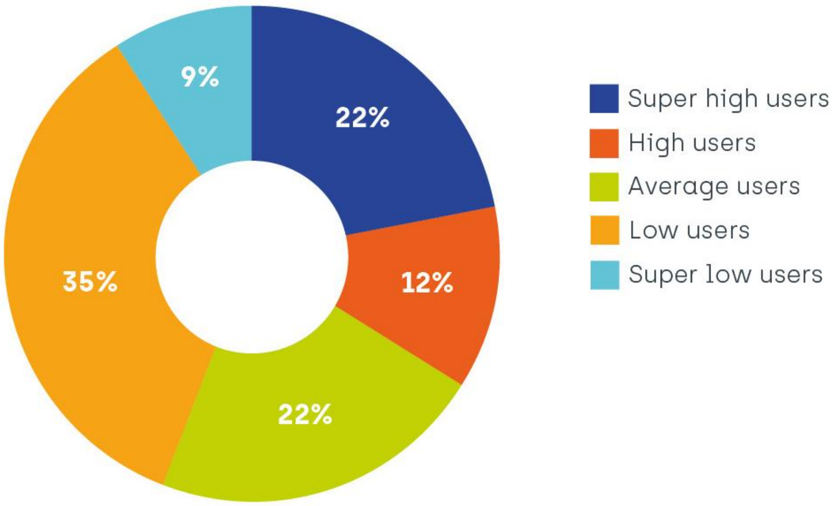


Figure 4.1: Differences in water use between different segments of our customer base

Figure 4.1 shows that 44% of our customers fall within either the *Super Low* or *Low* user categories. These customers use less than 150 litres per person per day. Although these customers may be able to reduce their demand further on their own, most of their usage is already efficient, particularly those we classify as *Super Low* users. To achieve further reductions in their usage, these customers would require targeted messaging. Non-targeted messaging about standard water saving practices would not help these customers to further reduce their consumption.

4.12. In contrast, 22% of customers are classified as *Super High Users*. These customers use double that of our low customers with usage of at least 300 litres per person per day. Like our low user customers, messaging about turning off the tap whilst brushing your teeth would not be effective for the

Super High Users group. There are more significant water using practices that need to be addressed by this group to achieve the substantial demand reduction required.

4.13. The different type of water users within our supply area have demonstrated that blanket messaging is not an effective approach to communication and targeting. Therefore, in AMP7, we have changed the way we work with our customers to provide a targeted approach to both metering and water efficiency initiatives.

4.14. In 2015, following the publication of our WRMP14, we commenced our Water Savings programme. This programme was a compulsory metering initiative that aimed to increase meter penetration in our Central region from 40% to 70% over 10 years. The programme was not extended to our Southeast (Dour community) and East region (Brett community), because meter penetration was already at least 70% in these areas.

4.15. Compulsory metering was included as a demand management measure in WRMP14 because on average, customers billed on a measured tariff use less water than those on an estimated unmeasured tariff. Our current evidence shows that customers paying for water on a measured tariff use, on average, 12% less water than customers who are not billed based on their usage[57].

The impact of compulsory metering can be seen in the change in consumption over the past 10 years.

Figure 4.2 shows the measured and unmeasured household consumption and meter penetration for our supply area for the past 10 years.

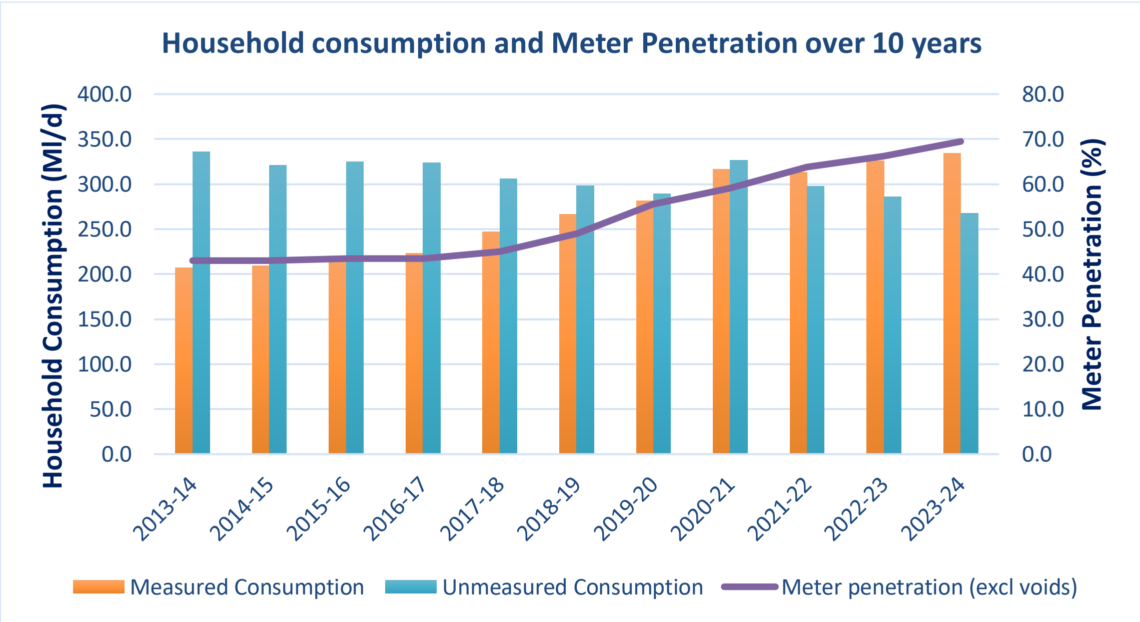


Figure 4.2: Total company measured and unmeasured household consumption and meter penetration over the last 10 years

[57] Atkins. 2020. Affinity Water PCC Data Insights and Analysis

Figure 4.2 shows that in the last 10 years meter penetration (excluding voids) has increased by over 10%, from 43% in 2013/14 to 69.5% in 2023/24. As meter penetration has increased, there has been a corresponding decrease in unmeasured consumption. Between 2013/14 and 2023/24, unmeasured consumption decreased by 20%. This reduction represents the volume of customers who moved from an unmeasured tariff to a measured tariff following the installation of a meter.

4.16. The increase in measured consumption between 2013/14 and 2023/24 includes both the unmeasured customers moving to a measured tariff following metering and the addition of newly constructed measured properties in our area. The construction of measured new build properties means that the increase in measured consumption is greater than the decrease in unmeasured consumption, concealing the savings made by customers when they move to a measured tariff.

4.17. It is worth noting that the consumption between 2020/21 and 2023/24 includes the impact of Covid-19. Specifically, there is a significant increase in both unmeasured and measured consumption in 2020/21 compared to 2019/20, reflecting the impact of pandemic lockdowns during this period. The impact of the pandemic continued throughout 2021/22 and some impact from 'working from home' continues in 2022/23 and 2023/24. This is discussed further in the sub-section 'impacts of the Covid-19 pandemic'.

4.18. In WRMP19, in addition to metering, we introduced our 'concerted action on water efficiency' options. These options were additional measures to assist our customers to use less water. In 2020, delivery of these options was interrupted by the global Covid-19 pandemic. Despite this, we have established and delivered our most comprehensive programme of water efficiency activities during this AMP period.

These activities include the ones outlined below.

- The introduction of virtual home water efficiency checks (HWECs) in addition to face-to-face visits. These checks are designed to help customers save water, energy, and money through the identification of internal leaks and by fitting water saving devices in customer homes. HWEC visits are completed across all WRZs and all customer types, however, we use a targeted approach to deliver the majority of the HWECs in the segmentation of the greatest water-saving benefits.

- In 2020/21 and 2021/22, we conducted virtual HWECs during Covid-19 restrictions and lockdown periods. In 2021/22, we completed 8,015 HWEC visits, with technicians installing devices and offering water-saving tips and advice to customers. In 2022/23, we returned to predominantly face-to-face visits and completed 20,894 visits. In 2023/24, we undertook 21,446 Home Water Efficiency Checks (HWECs), an increase of 552 visits compared to 2022/23 and two and a half times the visits conducted in 2021/22. We also installed 11,393 flow regulators into high consumption households and fixed 1,093 internal leaks identified during HWECs.

- The roll out of our award winning 'Save our Streams' (SOS) campaign. This is a new campaign for AMP7 which has featured in the industry publication, The Water Report[58], describing the campaign as 'perhaps the most quirky, engaging and successful water-efficiency campaign the industry has ever seen'. At the heart of our initiative was the drive to link personal water use with the impact on our local environment. Through national and regional media coverage, targeted social media, billboards, adverts and high-profile events, SOS has reached 38 million people. Nearly 75 per cent of people that came across the campaign, said it has caused them to take some form of action to cut their water-wasting habits and save money on their bills.

- Working with non-household customers to trial new projects and help all customers reduce their demand. For example, by working with non-household customers in Clacton, our Water Smart Holiday Parks project installed water efficiency devices at five holiday park sites during the summer of 2021. Overall, the sites included within the project reduced their water consumption by 42% during peak demand in summer 2021, compared with previous years. They also received far fewer complaints from holiday makers about low water pressure.

4.18. In WRMP19, we also committed to significantly reduce leakage.

Figure 4.3 shows the reduction in leakage between 2013/14 and 2023/24.

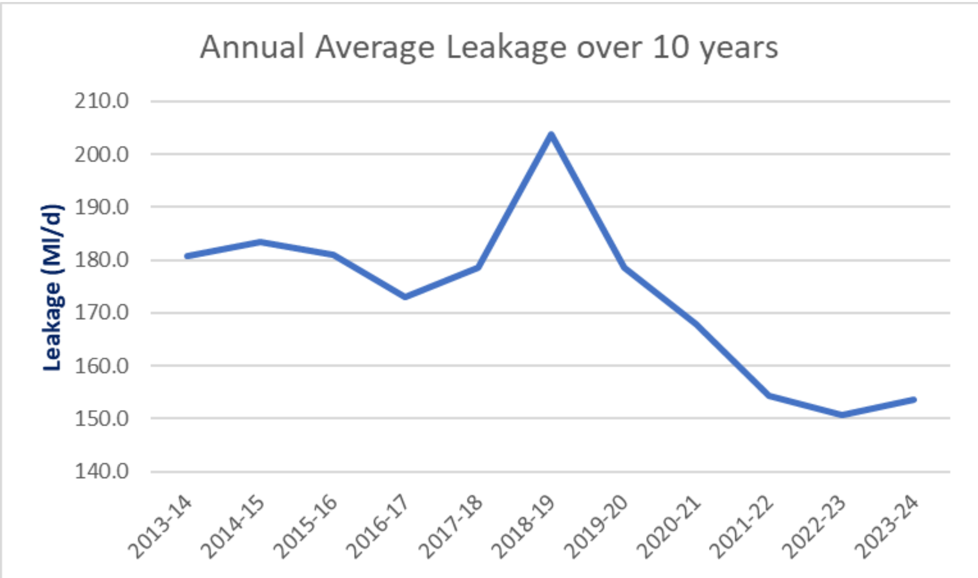


Figure 4.3: Total company leakage for the last 10 years

Figure 4.3 shows that we have reduced leakage by 15% in the last 10 years, from 180.7 Ml/d in 2013/14 to 153.5. Ml/d in 2023/24. We have also fully recovered from the increase seen in 2018/19 which was due to adverse weather conditions that year. We have achieved these reductions through a

[58] The Water Report (March 2022). 'Streaming ahead', page 24

combination of pressure reduction schemes, supply pipe leakage savings achieved through metering, and 'fast logging' of customer meters. We have also implemented a change in approach and policy to our Active Leakage Control (ALC) activities which has involved trialling more innovative approaches and improving the monitoring and modelling of our network.

Impacts of the Covid-19 pandemic

4.19. The Covid-19 pandemic saw people use water differently. This was due to both the behavioural changes made by customers and physical location of customers during the Government lockdowns.

During the pandemic we conducted customer research to understand the motivation for customer water use behaviour. This demonstrated that during lockdown periods, people connected with water on a more emotive level. Showers and baths were a way of 'escaping' when at home all day; maintaining gardens became a much higher priority and a source of both relaxation and enjoyment, and water play became a way to entertain children who weren't at school. Rather than being a functional resource to wash, cook and clean, water became much more important to the way our customers lived their lives. These changes in customer behaviour are reflected in the increase in both unmeasured and measured consumption seen in **Figure 4.2**.

4.20. Covid-19 also changed working practices for many of our customers. People who had previously worked in an office five days a week were suddenly asked to work from home. This not only resulted in usage moving from non-household consumption to household consumption, but because people were no longer at their place of work, it also changed the spatial distribution of consumption.

4.21. A collaborative study[59] carried out by Artesia showed that between January and October 2020, London's total demand decreased by an estimated 50 Ml/d, whereas all the surrounding areas saw an increase in total demand.

The study concluded that this was likely due to the reasons outlined below.

- Fewer people commuting into London for work. This would lead to a reduction in office water use and water use from the commercial premises which serve those offices. Those people would be spending their time in places of residence outside London, increasing the household water consumption in these water resource zones.
- Students moving back home to study remotely.
- Fewer tourists and day visitors to London.
- Potential migration of transient workers out of London back to their countries of origin.

[59] Artesia Consulting 2021, *The impact of COVID-19 on water consumption during February to October 2020 – Final report*

Figure 4.4 from the Artesia report shows the impact of the Covid-19 pandemic policies on our Central and Southeast regions. This shows the significant decrease in London consumption and associated increase in consumption in the surrounding home counties.

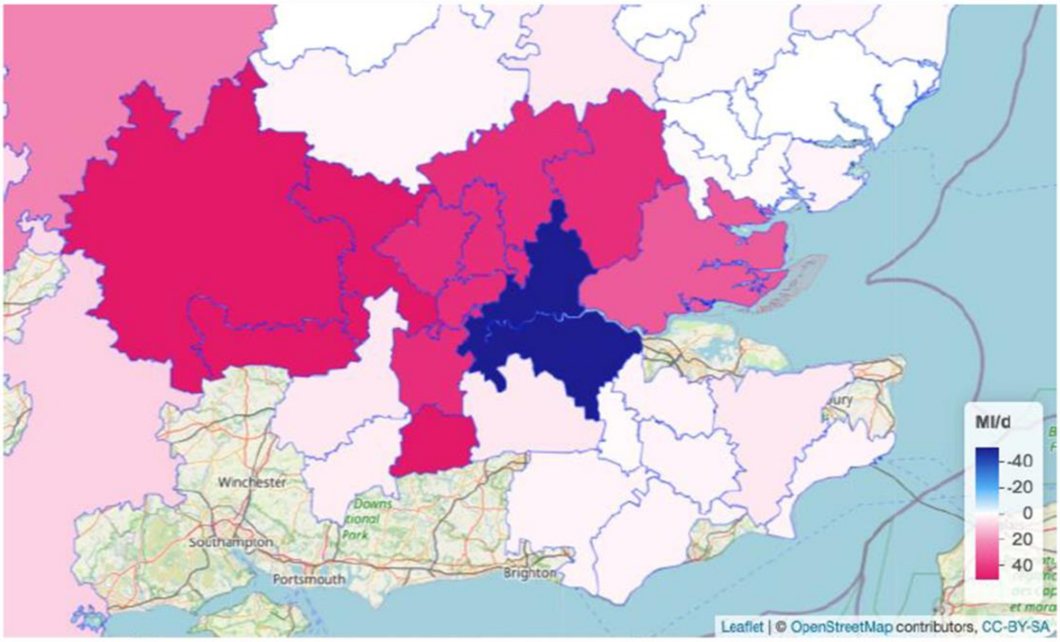


Figure 4.4: Change in total demand (Ml/d) from January to October 2020 due to Covid-19 policies

4.22. In the WRMP24, the change in behaviour due to the Covid-19 pandemic has been accounted for in our baseline household demand forecast. This is a change from the dWRMP24 where it was still too recent to predict the longevity and impact of these changes on our forecasts, so we accounted for them in Target Headroom. The detail included in our WRMP24 forecast, including the predicted longevity of the Covid-19 impacts on behaviour, are included below in the section 'Baseline forecast of future water demand'.

Base year assessment

4.23. As part of our WRMP24, a baseline demand forecast is required. This forecast calculates the demand for water in the chosen base year (2021/22) and forecasts it across the planning period, from 2025 to 2100. Our baseline demand forecasts are our calculation of demand without any planned interventions from demand management activity.

Our demand forecasting process has been undertaken in line with the latest Environment Agency (EA) WRPG and UK Water industry Research (UKWIR) technical guidance. These methods have been employed consistently by companies through their submissions to the WRSE and WRE regional plans. Details of the methods that have been used to determine our forecasting methodology, are provided in the following reports.

- Appendix 4.1 – Household consumption forecast
- Appendix 4.2 – Non-Household consumption forecast

4.24. There are three steps to forecast the baseline future water demand.

1. Determine the base year of assessment.
2. Assess progress against AMP7 commitments and determine the 2024/25 demand position.
3. Forecast baseline demand from 2024/25 to 2100.

The first step in developing the baseline demand forecast is to carry out the base year assessment. Each water company is responsible for selecting the most appropriate base year. To ensure consistency in the WRSE and WRE regional plans, companies have selected the same base year.

4.25. The base year is the first year of the baseline demand forecast. The information included in the base year is sourced from our company 'water balance'. Every year, as part of our annual reporting, we create our 'water balance' where we assess how closely the water we put into supply (our Distribution Input) matches the sum of household consumption, non-household consumption and the other components of demand. We seek to close the water balance to within a few percent and we report this as part of our Annual Return. The four main components of DI are illustrated in **Figure 4.5** and described further below.

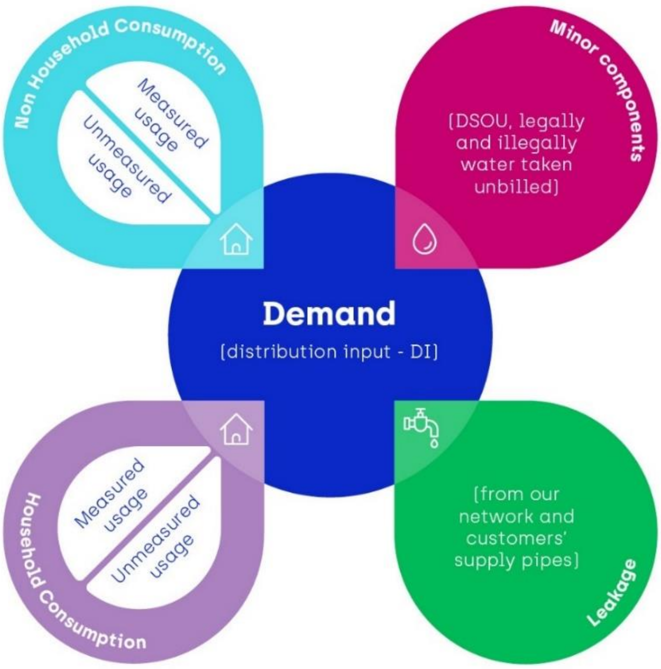


Figure 4.5: Components of Distribution Input

4.26. We measure the quantity of water supplied from all our treatment works using flow meters; this is known as our **Distribution Input** (DI). We measure flows within our pipe networks at the entry points to district meter areas (DMAs), which are local zones including urban areas, towns and villages, generally covering a few thousand homes. These flows are monitored continuously and enable us to constantly assess changes in demand at a detailed level and the need to vary our source outputs. DMAs are primarily used to monitor consumption to identify leaks on our network so we can arrange to repair them, but they also provide useful information on consumption.

4.27. Customer demand comprises water use by households and non-households (commercial and industrial). A further split is undertaken between measured (metered) properties and unmeasured (those without a meter); this distinction is relevant because we know the consumption of measured customers from meter readings. We also know from experience that metered households use, on average, less water than unmeasured; this is due to a greater awareness of minimising wastage, as well as having greater control over water and energy bills.

For household customers with meters, cumulative flows are taken from meter readings usually every six months, coinciding with our bi-annual billing cycle. For our household customers who do not have a meter, we determine unmeasured demand via our consumption monitor, which we summarise in our 'Base year assessment' below.

For larger commercial customers, meter readings are taken more frequently, and, in the case of our largest customers, flows are logged continuously. For other elements of demand, including unmeasured non-household customers, we estimate demand. As the vast majority of our non-household customers are metered, this unmeasured component is very small. Non-household demand is explained in more detail in our 'Non-household demand forecast' section below.

4.28. Other minor components of demand include elements such as builders' temporary supplies from standpipes, water for fire-fighting purposes, and operational use such as flushing of hydrants.

4.29. In our dWRMP24, we used 2019/20 as the base year and forecast all subsequent years for our demand forecasts. Due to the uncertainty caused by the Covid-19 pandemic, we could not use 2020/21 as this would reduce the accuracy of the long-term forecast. To address the uncertainty around recovery from the Covid-19 pandemic in our dWRMP24, we incorporated a risk allowance in our Target Headroom.

4.30. In our final WRMP24, we have updated our demand forecast to use 2021/22 as the base year. 2021/22 has been used by companies in both WRSE and WRE. This year was used because it was the most up to date dataset available and it included the impact of Covid recovery. Since our understanding of the impact of Covid has grown since the dWRMP24, we have included this in our baseline forecasts and removed it from Target Headroom. This is described further in the 'AMP7 Commitments' section and the 'Target Headroom' section.

Our base year data is sourced from 2021/22 outturn data from our company 'water balance' that is adjusted to dry year and normal year annual average

figures. Outturn data is the annual average value for each component of demand under 2021/22 weather conditions. For the demand forecast, we then adjust the outturn data to consider what the demand would be like under dry year, normal year and critical peak conditions.
The definition of and methodology to adjust outturn figures to dry year, normal year and critical peak figures, is described in the section 'Peaking factors/planning scenarios'. The impact of the change in base year on the end of AMP7 position is outlined in the next section - AMP7 Commitments.

Table 4.1 summarises the difference between the forecast 2021/22 position used in the dWRMP24 and outturn position used in the final WRMP24. The numbers included in this table reflect the dry year annual average position used in the demand forecast.

2021/22 DYAA Data	dWRMP24 Forecast	final WRMP24 Outturn	Difference
Household Consumption (Ml/d)	611.3	642.4	+31.1
Non-Household Consumption (Ml/d)	137.3	147.3	+10.0
Leakage	161.6	154.3	- 7.3
DSOU/Unbilled	10.4	14.9	+4.5
Distribution Input	**920.6**	**958.9**	**+38.3**

Table 4.1: Comparison of dWRMP24 and final WRMP24 2021/22 data

4.31. **Table 4.1** shows that our 2021/22 outturn (uplifted to DYAA) DI is 38 Ml/d greater than the DI forecast in the dWRMP24. This is predominantly due to the difference in household consumption between the value forecast in the dWRMP24 and the outturn of 2021/22. The household consumption value forecast in our dWRMP24 did not include the impact of Covid-19. Therefore, the outturn household consumption that has been included in our final WRMP24 is 31 Ml/d higher than the value forecast in our dWRMP24.

For the 2021/22 reporting year, we have records from our billing system of the number of customers supplied, the water delivered to metered customers, and the overall quantity of water supplied from all our sources.

4.32. We produce estimates of the quantity of water delivered to unmeasured customers using our water consumption monitor, Watcom. This is a long-standing monitor that has been in operation since 1995. We selected a wide range of property types (flats/apartments, terraced houses, semi-detached and detached properties) across the Central region to better understand how water use differs across properties. For example, we would expect to see garden watering to be lower for those living in flats than for those living in detached properties. As our East and Southeast regions have a higher metering penetration (above 70%), we use the Watcom sample to extrapolate the data to produce an estimate for unmeasured consumption in those areas.

4.33. We read the meters of our unmeasured consumption monitor four times each year. The key objective of our unmeasured consumption monitor is to produce auditable and consistent figures to estimate unmeasured per capita consumption (PCC), for our Annual Return regulatory submissions to Ofwat and the Environment Agency. The water balance methodology accounts for the uncertainty on this measure through the Most Likely Estimate (MLE) process.

4.34. We also calculated the volume of leakage within the base year as part of the water balance process. As the volume for the 2021/22 Annual Return was calculated using our AMP6 methodology, it has been adjusted based on OFWAT's convergency methodology[60] to ensure the forecast is consistent with future reporting requirements.

We also estimated other components of water use, such as flushing of mains or building water supplies from standpipes within the 2021/22 base year. The forecasting for these components maintains a flat forecast.

4.35. The population of our supply area is based on the Office of National Statistics (ONS) mid-year estimates. The ONS updates and publishes their population figures annually. The data included in our final WRMP24 uses projections from Edge Analytics which is a combination of measured and unmeasured customers. Using the split of measured and unmeasured population from our Annual Return 2021/22, we have then split the Edge Analytics projections into the two different property classifications.

4.36. As part of the base year assessment, we reviewed our assumptions around occupancy rates. National statistics provide a good estimate of household occupancy at the total household level, but when we produced the forecasts, we needed to do this at a great level of granularity. The property types we consider when producing the forecasts are as follows.

- Unmeasured.
- Measured (existing properties) – properties which have had a meter installed previously.
- Measured (new properties) – all new properties that are connected to our network have a meter installed.
- Measured (optants) - customers who have recently been fitted with a meter at their request and tend to have a lower-than-average occupancy.
- Measured (selective) – properties which have had a meter installed as part of our compulsory metering programme.

4.37. In previous WRMPs, we have relied on customer surveys from a sample of our customer base. Whilst these types of surveys are very useful and based on representative samples, they also have known weaknesses such as a smaller and self-selecting sample with the potential for low quality data. For our final WRMP24, we improved this process by purchasing CACI ACORN household-level occupancy data. ACORN is a consumer classification tool used to segment the population into 62 different

[60] Ofwat. Reporting guidance – leakage: https://www.ofwat.gov.uk/publication/reporting-guidance-leakage/

classification types and is widely used across the water industry. The addition of the household-level occupancy information meant that we could then link that to property types and metering classification and get a much more robust estimate of household occupancy for the different property types and how that varies across the different WRZs we supply.

4.38. The numbers of household and non-household properties for the base year of the forecast in each of the property classifications exclude empty properties, also referred to as ‘voids’, which have had no demand for water. The number of void properties is reported separately in the supporting WRP tables.

Peaking factors/planning scenarios

4.39. With the base year assessment in place, we then consider peaking factors. The base year assessment identifies the demand under the 2021/22 weather conditions, however, for the forecast we need to consider what demand would be like under set planning conditions as per the WRPG guidance. The conditions used for planning purposes are as follows.

- Normal Year Annual Average (NYAA) - the demand in a typical (normal) weather year.
- Dry Year Annual Average (DYAA) - the level of demand, which is just equal to the maximum annual average, which can be met at any time without introducing demand restrictions. This should be based on continuation of current demand management policies.
- Peak demand scenarios – the highest level of demand experienced in days or weeks typically during the summer, during hot dry weather conditions (often known as critical period or CP).

4.40. As we have a 1 in 10 years levels of service agreement for temporary use bans (see **Chapter 2** for further information on levels of service) to generate the peaking factors, historic demand is considered alongside the historic weather conditions. An assessment was done to identify how much higher (or lower in the case of the normal year) demand would have been under these conditions and an uplift factor generated.

4.41. In our modelling of the supply-demand balance, we assume that demand restrictions allowing the temporary restriction of certain non-essential uses of water (Temporary Use Bans (TUBs) and Non-Essential Use Bans (NEUBs)), would be in place at both DYAA and DYCP, given our adoption of a 1 in 200-year or 1 in 500-year design scenarios.

Our assessments have shown that there is little impact on other areas of demand, therefore peak uplifts are only applied to our household demand.

AMP7 commitments

The second step to develop our baseline forecast is to determine the 2024/25 demand position. To do this, we assess progress against our AMP7 commitments and project the volume for Distribution Input by the end of 2024/25.

The section below describes the development of our 2024/25 position for inclusion in our WRMP. The progress on delivery of our AMP7 commitments is detailed in Chapter 9 in subsection 'Progress on delivery of our AMP7 commitments'.

In our WRMP24, we have projected a **DI of 896.0 Ml/d by 2024/25** and allowed for **target headroom** to account for any uncertainty in achieving this forecast. This projection was developed based on the annual return values up to 2021/22 which were available at the time, and then adjusted to account for weather.
Table 4.2 summarises the annual return values used to predict our 2024/25 position. These numbers were reported up to 2021/22 based on the original AMP7 water balance methodology.

Annual Return (original water balance method) **Ml/d**	2017/18 Annual Return	2018/19 Annual Return	2019/20 Annual Return	2020/21 Annual Return	2021/22 Annual Return
Distribution Input	**920.2**	**947.4**	**931.3**	**966.0**	**936.4**
Leakage	181.2	204.1	181.1	171.4	154.3
Household Consumption	573.0	561.3	559.1	660.9	610.9
Non-household consumption	149.5	164.3	174.1	127.7	147.3
Minor components	16.5	17.7	17.0	6.0	23.8

Table 4.2: Annual Return Figures from 2017/18 to 2021/22

Table 4.3 then details the subsequent forecast, accounting for weather (uplifting household consumption for DYAA conditions) for 2022/23 – 2024/25.

Predicted and DYAA Ml/d	**2022/23 DYAA Prediction**	**2023/24 DYAA Prediction**	**2024/25 DYAA Prediction**
Distribution Input (DYAA)	**942.8**	**919.9**	**896.0**
Leakage	153.5	149.6	148.5
Household Consumption (DYAA)	621.2	601.5	577.0
Non-household consumption	153.2	153.8	155.6
Minor components	14.9	14.9	14.9

Table 4.3: Predicted DYAA profile to develop our 2024/25 position

For leakage, our 2024/25 position was based on achieving our PR19 leakage performance commitment to reduce our 3-year annual average leakage by 20% between 2019/20 to 2024/25.

In our draft WRMP, this was based on a 3-year annual average leakage of 188.8 Ml/d in 2019/20 (derived by taking the average of 2017/18 to 2019/20 leakage in **Table 4.2**)**.** This resulted in a 3-year annual average target of 151.0 Ml/d and 12-month target of 147.0 Ml/d in 2024/25.

In our revised draft and final WRMP we have upheld this commitment to reduce our 3-year annual average leakage by 20% in AMP7. However, due to augmentations to improve the accuracy of our water balance in July 2023, we have restated our annual return figures for 2017/18 to 2020/21. This has updated our 3-year annual average leakage in 2019/20 to 187.1 Ml/d and our 3-year annual average 2024/25 target to 149.7 Ml/d. To achieve our 3-year annual average target, we must achieve a **12-month leakage level of 148.5 Ml/d by 2024/25 (Table 2)**.

For per capita consumption, our 2024/25 position was based on our PR19 performance commitment to reduce 3-year annual average PCC by 12.5% from 2019/20 to 2024/25. The PR19 target was based on the normal year annual average profile with a 3-year annual average target of 135.7 l/h/d and 12-month target of 128.2 l/h/d by 2024/25 (Table 4.4). This was based on a 2019/20 3-year annual average PCC of 155.1 l/h/d.

PCC (l/h/d) 2024/25 Target	DYAA 12-month average	NYAA 12-month average	NYAA 3-year average
PR19	n/a	128.2	135.7
Draft WRMP	142.5	131.9	135.7
Revised Draft WRMP	145.0 (+2.5 l/h/d covid allowance)	134.4 (+2.5 l/h/d covid allowance)	*n/a*
Final WRMP	145.0	140.2 (+4.8 l/h/d 'new normal weather' uplift)	*n/a*

Table 4.4: 2024/25 PCC Target development

Our draft WRMP upheld this commitment to achieve the PR19 3-year annual average PCC of 135.7 l/h/d by 2024/25. However, due to an update in the glidepath for years 3-5 of AMP7, this equated 12-month targets of 131.9 l/h/d (NYAA) and 142.5 l/h/d (DYAA) (**Table 4.4**).

In our final WRMP, we have continued to uphold our commitment to achieve the annual average PCC targets included in our draft plan with an uplift applied to account for the impact of covid.

4.42. To understand the impact of covid on household consumption and to predict the degree and longevity of this impact, we developed a machine learning Covid model. Our model has shown that although the impacts from Covid have decreased significantly since the height of the pandemic, we expect customers to use 2.5 l/h/d more in 2024/25 than they otherwise would have used before the pandemic. This is due to ongoing changes such a remote working being much more common than pre pandemic. This continues to redistribute demand from both non-household consumption to household consumption and across different areas of our supply area, especially in some of our communities which are part of the commuter belt.

Consequently, in our revised draft WRMP24, we have forecast we will achieve a normal year PCC of 134.4 l/h/d and **dry year annual average PCC of 145.0 l/h/d by 2024/25** (**Table 4.4**). This represents a 2.5 l/h/d uplift applied to our draft WRMP24 PCC commitments to take account of the impact of Covid. This is a conservative assessment and we note that it is lower than the amount calculated by Ofwat in its appendix to the Draft Determination.

For our final WRMP, we have made one further additional change to our NYAA PCC target. This change does not impact our DYAA forecasts which have remained unchanged from the rdWRMP24.

'New Normal' Weather

Due to the Covid pandemic and its effects on demand in the first half of AMP7, our 'Normal Year' PCC is based on an assessment of the 2010-2020 period and our dry year uplift is based on the 2018/19 compared to the average.

We are confident in 2018 as being a representative 'dry year' because we have supporting evidence from the Met Office report into the event[61], which concludes that climate change has resulted in it being in the order of a 1 in 10-year return period. It also remains the largest summer demand event in the 2010-2024 period, once Covid impacts on 2020 have been normalised. The demand forecast for the DYAA is therefore robust and based on appropriately recent data.

Whilst the 'dry' year is based on the 2018 demand profile and hence presents a reliable, pre-Covid view of dry year demand, 'normal' year conditions have not been observed in the demand record since the early 2010s.

Even accounting for the pandemic lockdowns, it appears that we have had four out of the six years since 2017/18, that were much closer to 'dry' than they were to the 2010s average year. We therefore have significant concerns that climate change may have created a shift in summer events where our WRMP24 NYAA represents a figure towards the bottom end of the plausible range. Therefore, we have looked at a New NYAA target. This does not have any impact on the WRMP outside of Table 2a, as our need for new supply-side capacity is driven by the DYAA supply-demand balance.

Our New NYAA target has been developed by looking at the daily DI from 2011/12 to 2023/24. Each of these years has an average base demand that occurs irrespective of weather. Accounting for leakage, non-

[61] Hadley Centre Technical Note 106: Attribution of the 2018 summer heatwave in the UK

household consumption and the impact of Covid, we then assessed the household consumption uplift from the base demand that is caused by a summer event (April to September). For instance, in 2018/19 when the summer was extremely hot and dry, the household consumption uplift from the base consumption was much greater than the uplift that occurred in 2012/13, a more moderate, wet summer.

For 2023/24, we then compared the average summer uplift for this year against the average for 2019/20 to 2023/24. This showed that the summer of 2023/24 was below the average we had seen in the last six years. Therefore, we needed to increase the 2023/24 outturn PCC by 1.2 l/h/d, to equate it to the new normal year. To calculate the dry year uplift, we compared the 2023/24 summer uplift with the 2018/19 uplift. This showed we needed to increase the 2023/24 outturn PCC by 6 l/h/d to equate it to the equivalent DYAA PCC.

The difference between these two uplifts, **4.8 l/h/d** (6.0 l/h/d – 1.2 l/h/d) represents a more realistic difference between our expected NYAA and DYAA forecasts. This is summarised in **Figure 4.6.**

This also brings us more in line with other companies in the Southeast of England, but not affect either our investment plans or compliance with the government targets on DYAA PCC.

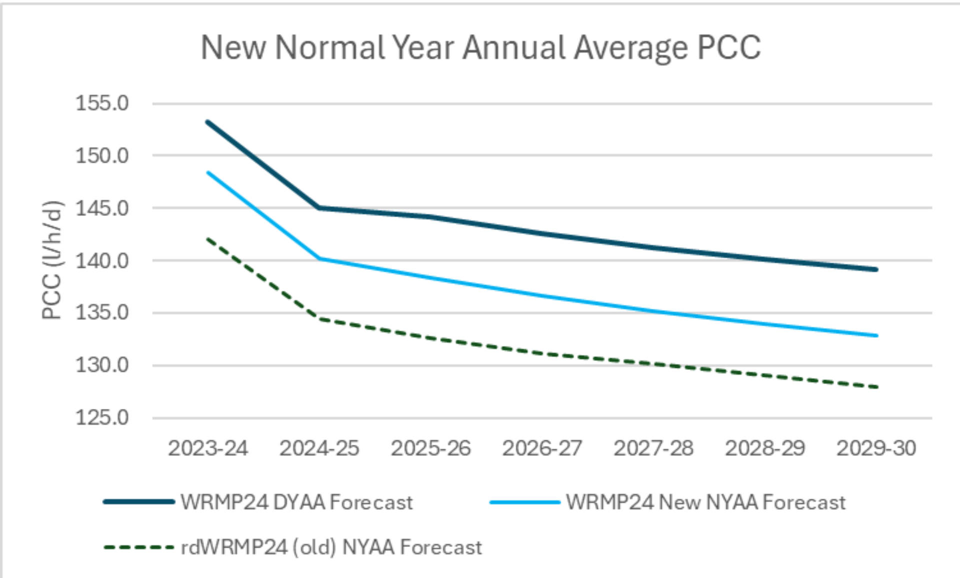


Figure 4.6: New NYAA PCC compared to the rdWRMP24 NYAA and DYAA forecasts (final plan forecasts)

For our **non-household consumption**, we predict we will achieve a position of **155.6 Ml/d by 2024/25**. This was based on the average non-household consumption both pre and post pandemic. The average non-household consumption between 2017/18 and 2018/19 was 156.9 Ml/d and between 2017/18 and 2019/20 it was 162.6 Ml/d (Table 4.2).

During the pandemic in 2020/21, non-household consumption significantly reduced to 127.7 Ml/d in response to nationwide lockdowns. By the following year, it was starting to increase to 147.3 Ml/d but had not yet recovered to pre-pandemic levels.

Consequently, for our WRMP24, we assumed non-household consumption would very slowly recover from the pandemic to reach of volume of 155.6 Ml/d in 2024/25, that was just above that seen in 2017/18.

For the minor components, we assumed our levels of Distribution System Operational Use (DSOU) would remain at similar levels to those seen in early AMP7. However, we planned to reduce our water unbilled volume by 2024/25, resulting in an overall minor components target of 14.9 Ml/d by 2024/25.

The sum of our projections for leakage, household and non-household consumption and minor components, produced our overall DYAA DI 2024/25 forecast of 896.0 Ml/d.

Household (HH) baseline demand forecast

4.43. Having determined the plan base year (2021/22) and forecast the position to the end of AMP7 (2024/25), the final step in the demand forecasting process is to develop our baseline demand for the longer term, from 2025 and 2100.

This is done by forecasting household consumption, non-household consumption, leakage and minor components that make up the total demand for water.

The forecast for household demand is detailed in this section. The forecast for non-household demand and our consideration of NAV's is detailed in section 'non-household baseline demand forecast'. The leakage and minor components forecast, and overall baseline DI forecast is explained in section 'Baseline Distribution Input forecast'.

To forecast baseline household consumption, we undertake two assessments. First, we forecast future population and properties and then, using this information, we forecast future baseline household consumption with our household consumption model.

Population and properties forecast

4.44. To provide a base to forecast future household consumption, the likely growth in population and the number of households forecast for the future, need to be understood.

To develop our population and housing forecast, we have participated in a project, carried out on behalf of the WRSE and WRE regional plans. The regional groups commissioned Edge Analytics to produce a set of Population & Property Forecasts which used the latest available Local Plan and ONS trend-based data, as well as other sources, including those from the Greater London Authority (GLA).

4.45. This work involved producing forecasts for a wide range of scenarios, by using a combination of trends (ONS, GLA), housing-led forecasts (incorporating housing need, housing requirements and actual planned scenarios) and employment-led forecasts, to account for the considerable uncertainty in the projections.

For the dWRMP24, this work was commissioned in 2020. The project used these three groups of forecasts to produce 19 main scenarios up to 2050. Three further projections (principal, high and low) were developed for each of the 19 scenarios for the period 2050-2100, during which growth was underpinned by fertility, mortality and migration assumptions. There were therefore 72 projections for each WRZ.

4.46. It would not be practical to model all 72 scenarios through the regional models. We therefore reviewed the results, alongside the other water companies in the regional groups, to determine which of these forecasts should be used to inform the draft WRSE regional adaptive plan. During this stage there was also close working with the WRE regional group to ensure that a similar approach was used for consistency across our supply area which straddles the two regional planning groups.

Since the 2020 delivery of the forecasts for the dWRMP, there have been a number of important data releases such as the Census 2021 results and more up to date Local Plan Housing Growth information. Therefore, in February 2023, updated population and property forecasts were produced to take account of the latest demographic and housing statistics for inclusion in the finalWRMP24.

The forecasts were produced for a 2021-2101 forecast period and for a sub-set of the 2020 scenarios produced for the draft. The scenarios produced for the final WRMP24 have been developed to forecast scenarios for low, medium, and high growth. These scenarios are summarised in **Table 4.5**.

Scenario Name	Description
Housing Plan P	A Housing-led scenario, with population growth underpinned by each local authority's Local Plan housing growth trajectory. From 2050 to 2101, growth under this scenario is trended in line with the Principal (-P) 2018-based NPP from ONS.
Housing Need H	A Housing-led scenario, with population growth underpinned by the trajectory of housing growth associated with each local authority's Local Housing Need (LHN) or Objectively Assessed Housing Need (OAHN). From 2050 to 2101, growth under this scenario is trended in line with the High migration (-H) variant of the ONS 2018-based NPP
ONS-18-Rebased P [note 're-based' refers to the fact this has been adjusted to ONS21 in the base year]	ONS 2018-based Principal sub-national population projection (SNPP), using a five-year history (2013–2018) to derive local fertility & mortality assumptions and a long-term UK net international migration assumption of +190k. This scenario has been rebased to the 2021 MYE. From 2050 to 2101, growth under this scenario is trended in line with the Principal (-P) 2018-based national population projection (NPP) from ONS.
ONS-18-Rebased L	ONS 2018-based Principal sub-national population projection (SNPP), using a five-year history (2013–2018) to derive local fertility & mortality assumptions and a long-term UK net international migration assumption of +190k. This scenario has been rebased to the 2021 MYE. From 2050 to 2101, growth under this scenario is trended in line with the Low migration (-L) variant of the ONS 2018-based NPP
OxCam-1a-r-P	New Settlement' 23k dpa scenario, with c.3.8k dpa above Housing-Plan distributed between Cherwell (20%), Aylesbury Vale (20%), Central Bedfordshire (40%), South Cambridgeshire (20%). From 2050 to 2101, growth under this scenario is trended in line with the Principal (-P) 2018-based NPP from ONS.
OxCam-1a-P	A Housing-led scenario, consistent with the OxCam-1a scenario, but with household representative rates for young adults returning to (higher) 2001 levels by 2039, remaining fixed thereafter. From 2050 to 2101, growth under this scenario is trended in line with the Principal (-P) 2018-based NPP from ONS.

Table 4.5: Population and property forecast scenarios developed for our WRMP24

4.47. OxCam-1a-P is an additional scenario produced for the final WRMP24 that was not included in the 2020 forecasts. **Appendix 4.3** includes the full details of each scenario and the property and population forecasts used in the WRMP24.

Figure 4.7 shows the outcomes for the scenarios used in the final WRMP24, compared to the equivalent scenarios from the 2020 forecasts that were applied in the dWRMP24.

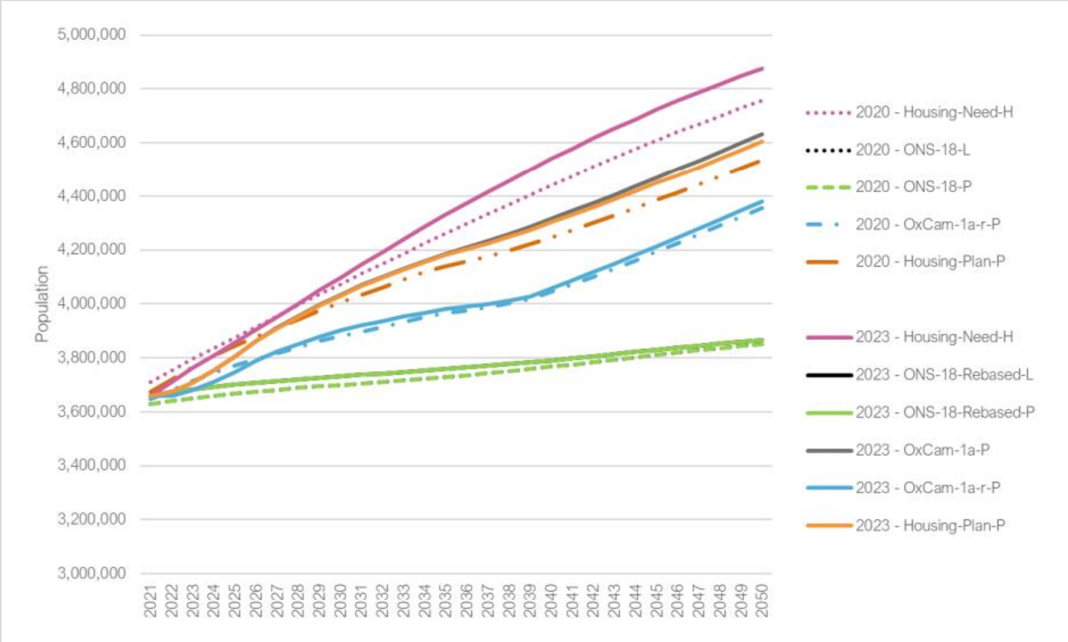


Figure 4.7: Comparison of growth scenarios between dWRMP24 and final WRMP24 (for WRZ 1-7)

4.48. This figure shows that the greatest change between our plans has been in the scenarios Housing Plan P and Housing Need H. Throughout AMP8, the 2023 scenarios forecast a slow rate of population growth than included in dWRMP24. However, by 2028 both plans have similar populations. From 2028 to 2050, it shows higher population forecast compared to the dWRMP.

In comparison, the rate of growth for ONS -18 rebased scenarios is lower in the WRMP24 compared to the dWRMP24 with 5.7% population growth in the WRMP24 compared to 6.2% in the dWRMP24.

4.49. The WRPG[62] requires the use of Local Plans as evidence in deriving a growth forecast and specifies that the forecast 'must not constrain planned growth by local councils and strategic housing developments'. Therefore, the principal housing plan scenario (Housing-Plan-P) has been used as the central scenario to inform the first 10 years of the WRMP24. This scenario has also been used in both the WRSE and WRE regional plans.

As part of the adaptive planning there are two branch points, one after 10 years in 2034/35 and a second five years after that. These branch points allow us to test different growth forecasts and through this process we have been able to incorporate a low forecast, which uses the ONS low growth projections and the maximum growth scenarios, which is a combination of the highest growth forecast for each WRZ to ensure the adaptive plan caters for the full range of plausible futures.

4.50. The selection of future 'situations' that cover the different levels of challenge from growth, climate change and environmental ambition is described in **Chapter 8**.

62 https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline

It is important to note that not all population is accounted for in official statistics. To take account of ‘hidden’ population such as short-term migrants and second addresses, we apply an additional allowance, based on a further study by Edge Analytics, which has been consistently applied by all WRSE companies. This analysis was carried out on behalf of the WRSE water companies, including our East region, although a similar analysis was carried out for WRE. The evidence was drawn from a mix of census, surveys and published research. This allowance totals an additional population across our supply area of 103,000 until 2024/25 and up to 130,000 beyond 2025.

4.51. Prior to their inclusion in the household consumption model, the population and property forecasts produced by Edge are rebased to the figures reported in the base year. As described in the sub-section: ‘Base year assessment’ we identify the number of properties on our billing system for our Ofwat annual return and this forms the starting point for the forecasts. As the property projections produced by Edge Analytics are based on national statistics, the number of properties reported does not account for things like unoccupied properties, fringe supplies as well as supplies for water used in construction, cattle troughs and garages which should not be counted as household properties. The projections produced by Edge analytics were therefore adjusted in the base year to account for this difference, but the end point of the forecast remains consistent with the original projections produced by Edge Analytics. Further detail can be found in the population and properties forecast (**Appendix 4.3**).

Changes in WRMP population and property forecasts

4.52. The population and property forecasts used in the WRMP19, dWRMP24 and final WRMP24 have been based on different datasets and taken at different points in time. Therefore, the forecasts included in each plan are distinct.

The differences between the source data for the forecasts, focusing on ONS and Housing Plan datasets, are described below.

4.53. **WRMP19**: These forecasts were based on the Office of National Statistics (ONS) sub-national population projections from 2016 Census data, and Local Plan Housing growth information from August 2017.

The ONS-16 projections used a five-year history (2012-2016) to derive local fertility, mortality and internal migration assumptions, and a long-term UK net international migration assumption of +165,000. The Housing Plan scenario used each local authority’s Local Plan housing growth trajectory and, following the final year of data available, projected housing growth using the ONS14 long term annual growth average (non-London areas) or the GLA Central scenario long-term average (London).

Hidden and transient populations were not available in the WRMP19 forecasts.

4.54. **dWRMP24:** These forecasts were updated using the ONS sub-national population projections from 2018 Census data, and Local Plan Housing growth information from August 2018.

The ONS-18 projections used the most recent five-year history (2013-2018) to derive local fertility and mortality assumptions. The long-term net international migration assumption was updated and increased by 35,000 to +190,000 people. In contrast to the WRMP19, ONS18 used a two-year history (2016-2018) to forecast internal migration assumptions, due to recent changes to the methodology used for its estimation which have only covered the latest two years. The Housing Plan scenario projected housing growth using both the ONS14 and ONS16 long-term annual growth average compared with the ONS14 average used in the WRMP19.

The dWRMP24 forecasts were rebased to the base year 2019/20. Hidden and transient populations were included to improve the accuracy of the long-term forecast.

4.55. **Final WRMP24:** These forecasts use the most up to date information available in line with the WRPG63. They use the ONS18 forecasts rebased to the 2021 mid-year estimate Census data. The forecasts are consistent across WRSE and WRE.

The Housing Plan scenarios used each local authority's Local Plan housing growth trajectory from December 2022. These forecasts were rebased to the base year 2021/22. Hidden and transient populations were included.

The impact of these changes is summarised in **Figure 4.8**.

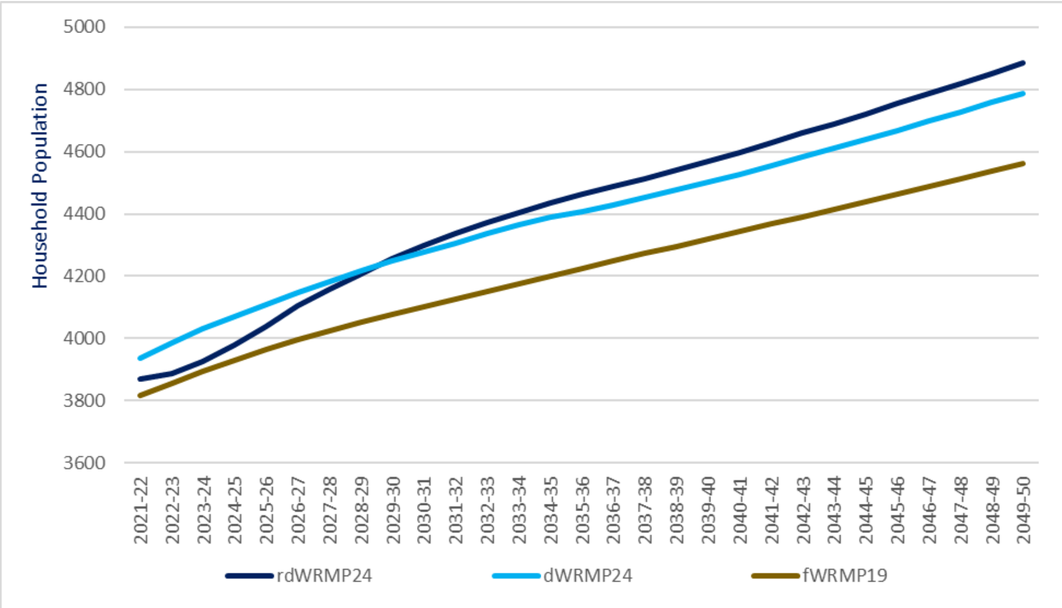


Figure 4.8: Housing Plan P household population comparison between WRMP19 and WRMP24

[63] Water Resources Planning Guidelines, 14th April 2023, 'https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline'

4.56. This figure shows that the main difference between the 2021/22 population in the dWRMP24 and WRMP19 was due to the inclusion of hidden and transients in the dWRMP24. For comparison, assuming the same hidden and transient population as the dWRMP24, the WRMP19 population forecast would include a similar population growth as the dWRMP24, particularly in AMP8. In both plans, 2021/22 population was forecast.

For the final WRMP24, population in 2021/22 is based on outturn values. Therefore, population starts at a lower level than forecast in the dWRMP24 in 2021/22. However, by the end of AMP8 in 2029/30, population in the final WRMP24 is aligned with the dWRMP24 and the WRMP19 (assuming hidden and transients are included). Beyond AMP8, the population growth in the final WRMP24 is 3.7% higher than that included in the dWRMP24 due to the use of updated census and local plan data. Both the dWRMP24 and final WRMP24 forecasts include hidden and transient populations.

Household Consumption Model

4.57. The Household Consumption Model is a multiple linear regression (MLR) model that outputs the baseline forecast for household consumption between 2025 and 2100. Two key inputs to the Household MLR model are the population and property growth forecasts.

Household consumption is affected by a complex mix of interacting drivers including: the make-up of the occupants (numbers, age, socio-demographics, their habits, practices, and behaviours), the property type, whether they pay on a metered or rateable value bill, and geography. Multiple linear regression (MLR) uses historic measured data on consumption from a sample of properties to model household consumption using these factors.

The MLR approach uses standard statistical processes; these are applied in an iterative manner exploring the model errors and uncertainty at each stage until a useable and robust model is derived. The resulting model has a number of model parameters; each has a coefficient that is derived from the model and there is residual error term. The residual is essentially the consumption component that cannot be explained by the model parameters. Residuals are used for estimating error and developing further modelling refinements. The Household consumption forecast (**Appendix 4.1**) explains the various steps undertaken to test and validate our MLR model and develop the HH demand forecast.

4.58. The MLR model has been developed using best available data from our universal metering programme (often referred to as the Water Saving Programme, or WSP) since its inception in 2015/16. This utilised the monthly property-level data at the point from the property being installed with a meter, to the point of switching to a metered bill, either through opting or automatically moving at the end of the customer journey period. This provided thousands of data points from which to explore the consumption relationships and build a valid model. The model has been segmented by property type using unmetered and metered categories, with explicit treatment of different types of household property likely to have different patterns of water usage. These include the below categories.

- **Optants** – these are customers who were previously on unmeasured tariffs and choose to have a meter installed; they will receive a bill based on their metered use straight away.
- **New builds** – these are new properties built in our supply area and the number was forecast to increase year on year.
- **Water Saving Programme (WSP) customers** – these are customers subject to compulsory metering; they receive a bill based on their metered use upon the completion of their customer journey unless they choose to opt for metered billing earlier.

4.59. The result of the modelling is our household consumption forecast, providing per household consumption (PHC) and PCC values per year, per zone, for both measured and unmeasured populations. We have produced a suite of different baseline forecasts which correspond to the range of growth scenarios being tested as part of our adaptive planning approach.

Because our housing and property forecasts for the WRMP24 and WRMP19 are based upon different methodologies, the resulting household consumption forecast scenarios are not directly comparable between the plans. However, the scenario which most closely corresponds with the plan-based scenario used for our WRMP19 is denoted as the Housing-Plan-P scenario in the WRMP24 modelling and uses local authority plan-based growth forecasts. Under that scenario, we can review the change in household consumption under dry year annual average (DYAA) and normal year annual average (NYAA) conditions.

At a company level, our forecast shows that, without intervention, under NYAA conditions, we expect household consumption to increase by 34% across the 75-year planning period (ending in 2100). This is equivalent to 182.3Ml/day. This is largely driven by a 55% increase in new properties in the forecast within our supply area.

Figure 4.9 summarises the measured, unmeasured and total household consumption in our dry year annual average baseline forecast and demonstrates the scale of the challenge we face. This shows that household consumption increases as population and properties increase. The reduction seen between 2021/22 and 2024/25 includes the demand management activity included in AMP7. The forecast from 2025/26 onwards reflects our baseline household consumption position without any demand management activity.

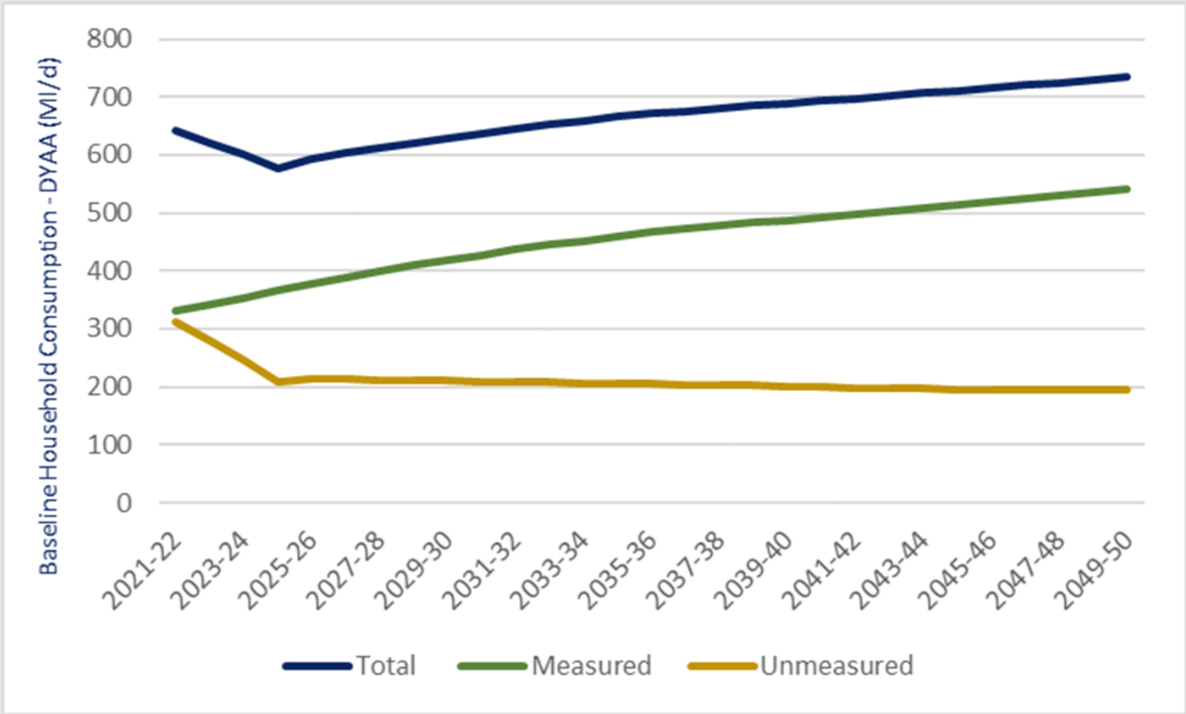


Figure 4.9 Forecasted total, measured and unmeasured household consumption under 'Dry Year Annual Average' conditions

Underlying PCC trends

4.60. Within our data we see an underlying trend of slightly increasing baseline PCC. In our WRMP24, DYAA PCC increases from 145.0 l/h/d in 2024/25 to 150.4 l/h/d in 2049/50.

The predominant driver for this is the forecasted decrease in occupancy rates. This is because, within a household, not all water usage behaviours link to the number of people living in that house. For instance, if you have two people living in a property rather than one, it is likely that you will double the number of showers, but you are unlikely to double the number of times you run the washing machine. Therefore, when developing our demand management strategies, we need to take this into account and ensure our strategies not only reduce current PCC but also counteract this baseline trend.

This general upward trend in PCC not only impacts Affinity Water but is true across the industry. **Figure 4.10** below shows our baseline PCC to 2050 without any demand management activity.

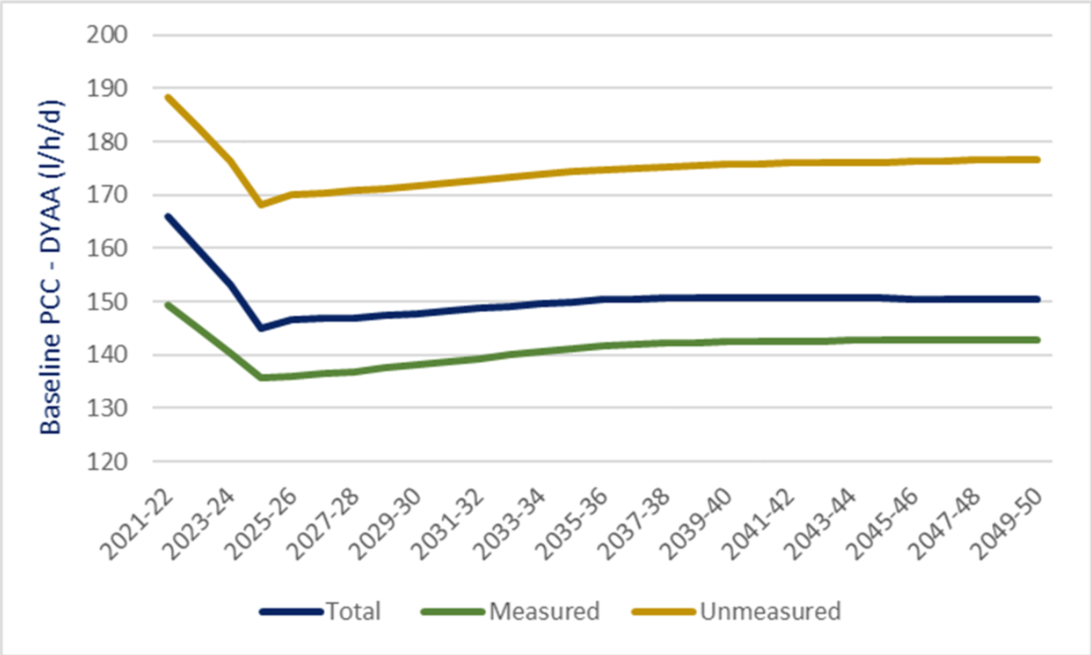


Figure 4.10: Total, measured and unmeasured PCC for 'dry year annual average' conditions

Non-Household (NHH) baseline demand forecast

4.61. Another major component of demand is consumption from non-household (NHH) properties. NHH demand makes up approximately 15% of our total base year demand.

Water companies are required to forecast the demand for water being used by NHH premises (such as businesses and industrial processes) and for the population living in communal establishments (for instance, hospitals, prisons, and educational establishments).

Forecasting of NHH demand is a component that historically has been carried out by water companies in different ways with differing levels of scrutiny. There has been limited technical guidance[64] produced compared to areas like household (HH) demand forecasting; therefore, to improve consistency in methodology across the companies in the southeast of England, a review of historic approaches used was carried out followed by a decision to commission a project in which Artesia developed forecasts for all the WRSE companies. The approach used is summarised below and the full details of the method can be found in **Appendix 4.2**: Non household consumption forecast.

4.62. A similar approach was taken for modelling both the NHH demand and the HH demand forecast. Artesia built a Multi Linear Regression (MLR) model for each of the six water companies at both a company and WRZ level.

[64] Forecasting water demand components - Best practice manual. UKWIR, 97/WR/07/01. 1997

In the same way as for our HH demand forecast, to model future NHH demand we needed to segment the properties. Whilst for HH properties this was done based on metering classification, for NHH demand the segmentation was based on industry types. The UK Standard Industrial Classification (SIC) codes were used for this segmenting to separate out those industries likely to have different underlying drivers for future NHH demand. The groupings chosen and a description of each are provided in **Table 4.6**.

Sector	Description
Agriculture and other industries influenced by weather	Based on SIC code A: includes agriculture, forestry and fishing industries. These types of NHH customers' consumption have a stronger relationship with weather than other sectors and so have been treated separately in the modelling, particularly in the context of climate change scenarios
Non-service industries (economy driven)	Includes industries with SIC codes B, C, D, E and F. These are industries such as manufacturing and construction. These industries have been grouped as they are likely to show trends related to the economy, but these trends are likely to differ to those in the service industry category
Service industries (economy driven)	Includes SIC codes G, H, I, J, K, L, M and N. These are industries such as retail, real estate, and financial sectors. They have been separated as they are more likely to show trends related to the size of the economy or employment, but the responses will be different to that of non-service industries above
Service industries (population driven)	Includes SIC codes O, P, Q, R, S and T. These are industries such as education and health and are more likely to be driven by population size than measures of economic output. Therefore, it is important to include them as a separate grouping
Unclassified	This final group accounts for non-households which may not readily be assigned to any of the other categories. When modelling this group, care was needed to avoid strong trends in this sector simply reflecting changes in data quality over time

Table 4.6: Segmentation groups used for non-household demand groups

4.63. As with the HH demand forecast, the first year of the forecast – 2021/22, has seen an unprecedented change in NHH demand due to the policies introduced to combat the COVID-19 pandemic. This has been reflected in the data, but we recognised that it has also created added uncertainty going forward because it is still not known what the enduring impacts will be from changes in working practices, such as increased working from home. This has been captured within our Target Headroom assessment.

Having segmented the properties, additional data was provided to Artesia for the modelling, including the categories outlined below.

- Weather data – including average daily rainfall and average and maximum temperatures by year
- Econometric data - this was provided by Oxford Economics and was formatted into employment and gross value added (GVA) by SIC group and region. Historic data was provided from 1991, and forecast data was provided to 2040

- Population forecasts – Artesia were provided with the forecasts produced for Affinity Water by Edge Analytics which included both residential population forecast and a communal population forecast
- Historic consumption – provided by SIC code

4.64. Using this data, the NHH forecast modelling process was carried out. This is divided into the steps outlined below.

- Build the MLR model based on past aggregated consumption data, considering Oxford Economic variables and potentially other factors
- Calibrate the model for the base year, in this case 2021/22, first by industry sector using the property consumption data, then by WRZ using the AR consumption
- Apply the MLR model and the calibration to future explanatory variables to estimate future NHH consumption

This has resulted in a slowly increasing demand forecast (7% increase over the 25 years between 2025 and 2050). This is a change from our WRMP19 forecast, which saw a declining trend. The results of the modelling can be seen in **Figure 4.11**

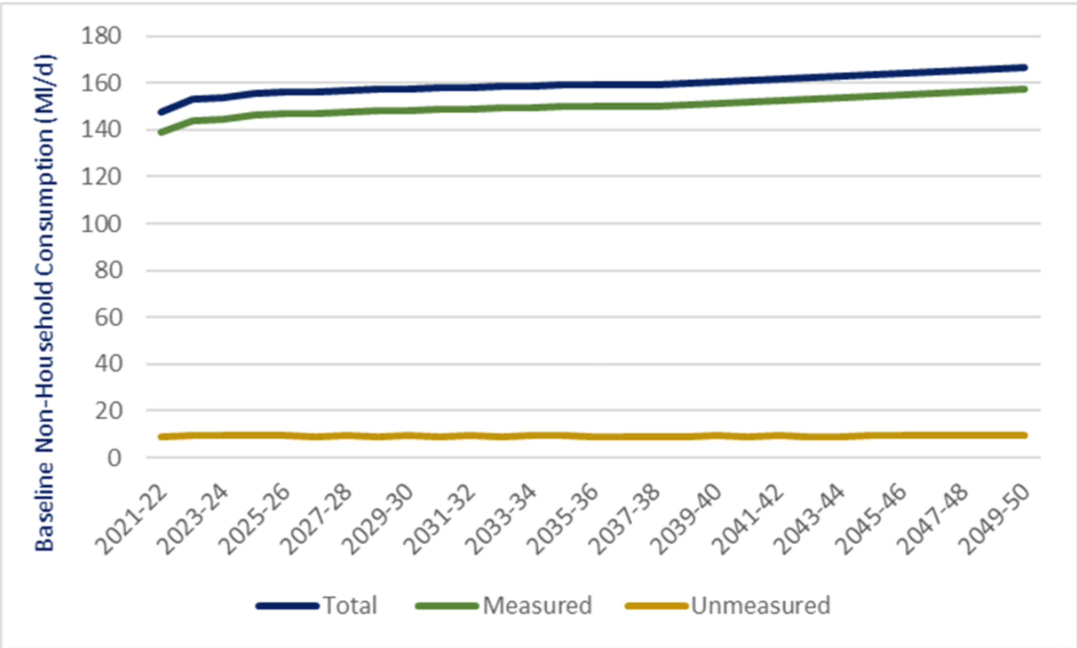


Figure 4.11: Forecast total, measured and unmeasured annual average non-household consumption

New Appointments and Variations

4.65. New appointments and variations (NAVs) are limited companies which provide a water and/or sewerage service to customer in an area which was previously provided by the incumbent monopoly provider such as a water company.

A new appointment is made when a limited company is appointed by Ofwat to provide water and/or sewerage services for a specific geographic area. The new appointee has the same duties and responsibilities as the previous statutory water company. A variation is where an existing appointed company asks Ofwat to vary its appointment so it can extend the areas it provides services to.

A NAV, therefore, involves one company replacing another as the appointee for a specific geographic area.

Affinity Water supplies three NAV companies; Independent Water Networks Ltd (IWNL), Leep Utilities and Icosa Water Services Ltd (IWC).

In the rdWRMP24 we did not separately account for NAV's in our water demand forecasts as the volume of demand from these appointments was only around 2.2 Ml/d in AMP8.

Similarly, non-public water supply (PWC) was not individually accounted for in our water demand forecast because the total amount of non- PWS demand across our company is only 1.3% of the PWS demand. Non-public water supply (non-PWS) is all the other water used by other sectors that hold licences to abstract water from the environment. Even if 10% of this changed and started to use our supply network, that would only equate to 1.2Ml/d.

In response to our rdWRMP24, the Environment Agency has requested that we include contractual volumes of NAVs in our forecast. This has been done because of the following reasons.

- Using contractual volumes ensures alignment between the NAV (WAFU) and incumbent (export).
- NAVs could theoretically take the full contract amount and not accounting for this, is a risk to security of supply e.g. the NAV may build more houses than planned or people may use more water than historical outturn figures.
- NAV growth is accounted for solely within the NAV plan.

This change has been included in our final WRMP24.

The total volume Affinity Water supplies to NAVs is included in Table 4.7

Region	Contractual Volume (Ml/d)
Central	6.4
Southeast	0.6
East	0.8
Total Company	7.8

Table 4.7: Volume of water supplied to NAVs

Distribution Input (DI) baseline forecast

4.66. The elements above, together with forecasts for leakage and minor components (operational and unbilled use), all combine to form the baseline demand forecast.

The baseline leakage forecast remains flat or at 2024/25 levels beyond 2025. This means that at a minimum, we will maintain leakage at 2024/25 levels into the future. The optimal strategy to reduce leakage below 2024/25 levels will be developed through the WRMP24 process as part of the demand reduction programme.

The forecast for minor components also remains flat at 2024/25 levels beyond 2025.

Figure 4.12 shows the overall baseline demand (DI) forecast to 2050 included in the WRMP. This forecast is based on housing plan growth (medium growth) and the components which contribute for DYAA conditions. It shows a general upward trend in DI which is consistent with the trends in the HH and NHH demand forecasts.

The overall baseline demand (DI) forecast becomes the starting position for the demand component of our future supply-demand balance.

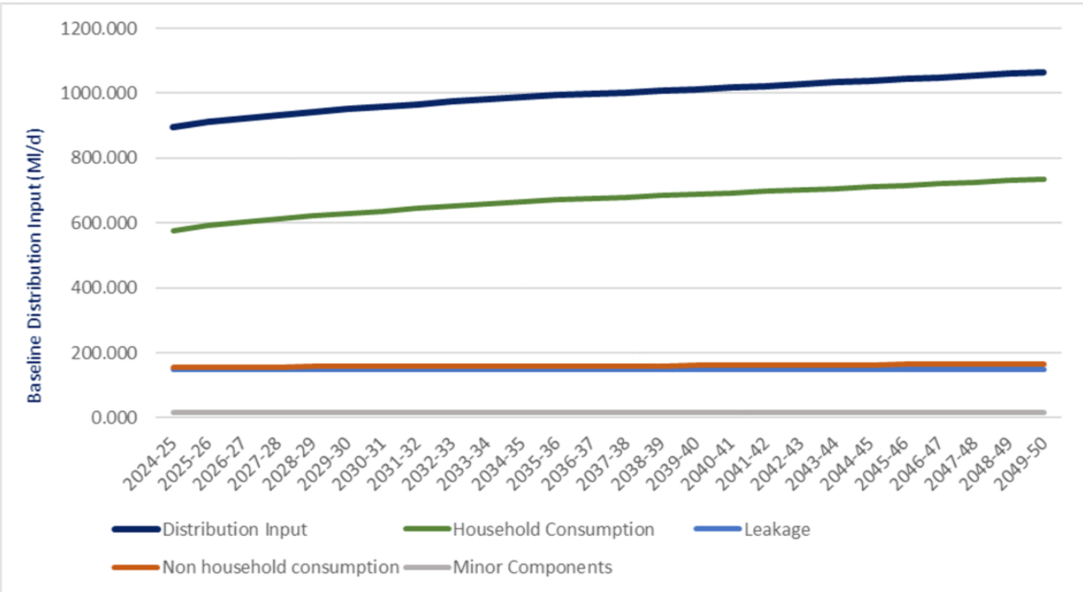


Figure 4.12: The baseline DYAA demand forecasts for housing plan and ONS growth forecasts

Target Headroom

Overview

4.67. Target Headroom is an allowance for uncertainty in our demand and supply forecasts which the WRPG requires is added to the demand-side of the supply-demand balance. It follows a well-tested methodology, as outlined in the UKWIR guidance document 'An Improved Methodology for Assessing Headroom (2002)'. We have used the same model as for WRMP19, with the inputs updated in specific areas as described under our 'changes to inputs' section below. This model uses 'Monte Carlo' analysis that takes uncertainties in the input elements of the supply and demand forecasts and generates a probability density function (PDF) of the resulting uncertainty that we face in the supply-demand balance. Details of the modelling method are provided in **Appendix 4.4**.

4.68. In line with the other water companies in WRSE and WRE we have also amended our results in accordance with the UKWIR Document 'WRMP 2019 Methods – Risk Based Planning' (2016) in two ways.

1. Our selection of the levels of certainty that we have used to generate the Target Headroom output are now less risk averse in the short term. This change has occurred primarily as a result of our greater understanding of the deliverability of our very ambitious current (2020-2025) demand management programme.
2. Because the WRSE model incorporates population growth and climate change within its adaptive planning branches, these have been excluded from the outputs at the appropriate points (2030 for population and 2040 for climate change). Similarly, we continued to exclude any uncertainty on licence capping or abstraction reductions and these are covered by the adaptive planning framework.

A summary of these output changes and the results are provided below. Details of the approach to excluding elements for the adaptive planning forecast are provided in **Appendix 4.4.**

Changes to model inputs

4.69. There have been three significant updates made to the model inputs. These have all occurred between the dWRMP24 and final WRMP24. The first update is where we have removed the Covid-19 impact allowance from Target Headroom and included it in our baseline household consumption forecast. The second update relates to supply-side climate change (component S8) which has been updated. The third update relates to the demand side, where the uncertainty ranges around the base year demand (headroom component D1), and demand forecast (headroom component D2, covering both household and non-household demand) were re-assessed. These incorporated the WRMP24 climate change assessment, dry year demand assessment (DYDA) population growth and NHH demand forecasts, as described in **Appendix 4.4**.

4.70. In the dWRMP24, there was significant uncertainty about the impact of the Covid-19 pandemic on consumption. To ensure this uncertainty did not reduce the accuracy of our baseline household consumption forecasts, we based our forecasts on data from 2019/20, prior to the Covid-19 pandemic. To cover the modelled residual behavioural change caused by different working patterns following the Covid-19 pandemic, we included a 10 Ml/d allowance in the Target Headroom.

In the final WRMP24, we have updated our household consumption forecasts using data from 2021/22, including the impact of Covid-19 recovery. Accordingly, the 10 Ml/d Covid-19 allowance has been removed from Target Headroom. The 'AMP7 commitments' section details the Covid-19 impact that has been included in our baseline forecasts.

4.71. For the supply side, we had already excluded all uncertainties associated with vulnerable and time-limited licences (components S1-3) in WRMP19, and there have been no significant changes to bulk imports other than the increase in the Grafham source, which is included as Deployable Output rather than a bulk import. Uncertainties in the accuracy of supply-side data (S6) used the same underlying assumptions as WRMP19, but with the DO values updated to the WRMP24 base year.

Component S5 (gradual pollution risk) was not updated as there have been no significant changes to the risks at our sources. Some change in future risks might be expected as sources are abandoned for environmental destination targets, but the replacement surface water sources such as the Grand Union Canal (see **Chapter 7**) will themselves carry a higher pollution/outage risk than most groundwater sources. Although the WRSE decision-making methodology (see **Chapter 8**) includes resilience metrics that account for the relative resilience when choosing between options, there is no Target Headroom allowance added to the forecasts for the selected options. Given the range of environmental destination and the range of utilisation of new sources between future situations, it would be impractical to forecast changes from the current (base year) inputs, so the base year risk inputs[65] have been used throughout the forecast period for component S5.

Changes to the risk 'glidepath'

4.72. In line with the UKWIR Risk Based Methods guidance, we considered the rationale for the risk glidepath we selected from the output Target Headroom distribution. As with outage, base year percentage confidence should lie in the range of 85% to 95%, depending on how quickly our supply-demand position might deteriorate, and how well we might manage that, if actual drought conditions deviate from our central estimates of supply and demand. The fact that we have no raw water storage and therefore rely heavily on

[65] The inputs to the Monte Carlo simulator used to generate Target Headroom are in the form of 'probability distributions' that have a mean (expected) value, with a range around that. For S5 the base year distribution contains an assessment of the risk to sources based on current understanding of pollution risks and contamination pathways

Temporary Use Bans and Non-Essential Use Bans means we are at a relatively high risk. However, having experienced recent significant dry year demand events and the fact that we have been able to include the 2018 event in our water resource modelling (see **Chapter 5**) counteracts this risk to a certain extent. We have therefore selected the mid-range percentile and used a 90% certainty for our base year allowance.

Because we have used adaptive planning, we do not expect that the risk allowance accounted for by Target Headroom should increase significantly over time, so we selected a 'glidepath' that kept the allowance reasonably constant over time.

Inputs to the adaptive plan

4.73. As noted above, we needed to exclude the allowances associated with climate change and population growth from our Target Headroom risk allowance because these were accounted for in our adaptive planning framework. We did this through a simple spreadsheet approach that removed the respective contributions using simple statistical calculations (based on the Central Limit Theorem and associated additive principles for probability distributions[66]). Technical details of the approach taken are provided in **Appendix 4.4**.

Results

4.74. The unadjusted glidepath Target Headroom totals for the Central, Southeast and East regions, expressed as a percentage of demand, are provided in Figures 4.14 and 4.15 below. However, the unadjusted glidepath was only used for the East region, as this was not evaluated through an adaptive planning model so did not inherently account for the allowances associated with climate change and population growth (see **Chapter 8** for further details).

[66] Where lots of probabilities added together tend to form a 'Normal' distribution, and the 'law of averages' means that the contribution of one element to that distribution is much smaller than the uncertainty range of that element when it is considered alone

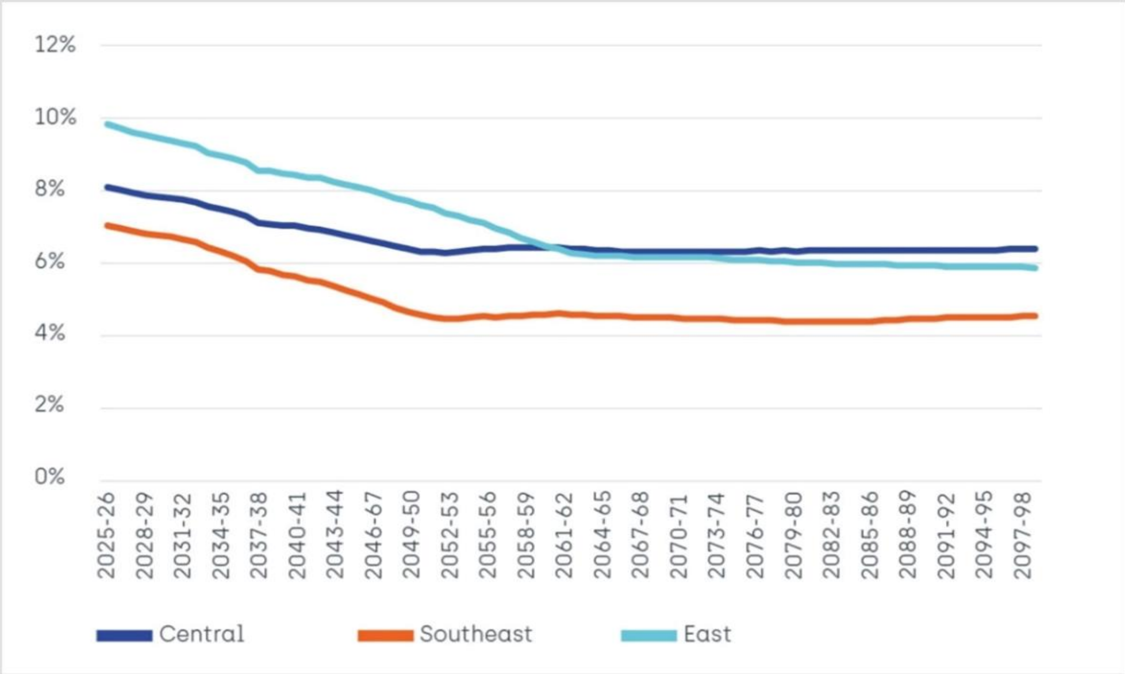


Figure 4.13: Target Headroom for the Central, Southeast and East regions expressed as a % of demand

4.75. The changes that result once population growth and climate change are removed are shown in **Figure 4.14** below. These are the figures that were used for the WRSE modelling, which incorporates adaptive planning branches within the investment model, so required the appropriate Target Headroom allowances.

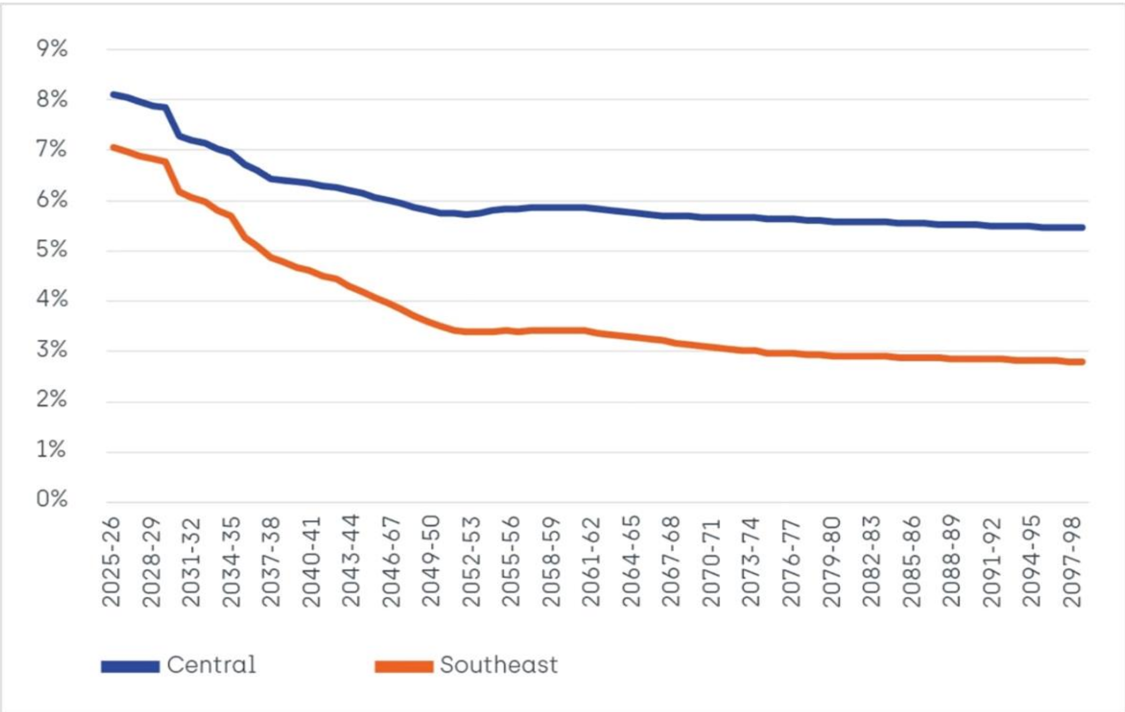


Figure 4.14: Target Headroom for the Central and Southeast regions expressed as a percentage of demand with the uncertainty around population growth removed from 2030 and climate change uncertainties removed from 2035

Potential strategies for demand management

4.76. When developing our demand management strategy, we used four stages of evaluation to ensure that we developed a strategy that represents best value to customers and the environment, within the context of the WRMP, whilst seeking to meet government and regulatory expectations. This process comprised of the following four stages of assessment.

- Options appraisal: broad evaluation of options to identify feasible options to reduce demand.
- Consideration of targets and expectations: identification of four candidate strategies for regional investment appraisal with WRSE and WRE that comply with regulatory expectations.
- Programme refinement: cost and delivery refinement of the demand options and strategy.
- Demand option optimisation: application of the Affinity Water Initial Demand Management Optimiser tool to evaluate the cost efficiency of the four WRSE demand management scenarios.

Each stage of assessment is described in detail below.

Options appraisal

4.77. This stage began with the assessment of the range of options that could be available to us, which we analysed to generate broad strategies for investment appraisal.

This approach was different to the one used for our supply options. Individual demand options provide very small yields in comparison to supply options and are generally highly interactive. For example, the inclusion of metering, particularly smart metering, will allow for better targeting of other water efficiency options which in turn would significantly change the performance and cost. Given the number of different combinations of small options considering individual demand management options within the larger investment modelling has, in the past, caused the model to become unstable. Instead, a very similar process was taken to appraise the individual demand options but in an isolated, demand management optimisation model.

For household and non-household consumption and leakage, we initially started with the WRMP19 long list of demand options and considered this alongside the latest technical guidance to identify a shortlist of options based on the following criteria.

- **Previously identified options -** we reviewed previously identified unconstrained options and compiled a list of potentially feasible options, plus a rejection register of options not included in the feasible list.

- **Local considerations and understanding from WRMP19** – for example, what has Affinity Water been funded for in AMP7, what were the feasible and rejected options in WRMP19, what fits with the Affinity and the wider regional water resources strategy?

- **Experience from recent projects** – in particular, the Water UK project (delivered by Artesia) which considered long-term pathways for reducing demand, based on a shortlist of interventions agreed by a steering group, comprised of water industry and regulatory representatives.

The outcome of the unconstrained options assessment was a list of feasible options and rejected options. The feasible demand management options are summarised in **Table 4.8** and include the majority of options we assessed.

4.78. These feasible options became inputs in the next stage of the process, where we optimised demand management strategies in the Affinity Water Initial Demand Management Optimiser tool.

Option Name	Option Type	Description
New Smart Meter	Household	New AMI meters on unmeasured properties, with associated behavioural change initiatives
Replacement Smart Meter	Household	Replacement of dumb or AMR meters with AMI on metered properties, with associated behavioural change initiatives
Wastage Repairs	Household	Repair of wastage detected in a household property following the installation of a smart meter. The repair is either done by the customer or by Affinity Water
Home Water Efficiency Checks (HWEC) and Flow Regulators	Household	Targeted home water efficiency checks following smart metering and/or, the installation of flow regulators to reduce water consumption
Tariffs	Household	Introduction of tariffs following the completion of the smart metering programme
New Smart Meter (NHH)	Non-household	New AMI meters on non-household properties
Business Water Efficiency Checks (BWEC)	Non-household	Targeted business water efficiency checks to reduce nonprocedural water consumption
Mains Replacement	Leakage	Replacement of ageing infrastructure
Active Leakage Control (ALC)	Leakage	Leakage detection and repair on distribution mains and customer supply pipes
USPL – new smart meter	Leakage	Leakage repair on the customer supply pipe following leakage detection from a new smart meter installation
USPL – replacement smart meter	Leakage	Leakage repair on the customer supply pipe following leakage detection from a replacement smart meter installation

Table 4.8: Feasible demand management options

4.79. The principal rejected demand management options not taken forward to the optimiser are summarised in **Table 4.9**.

Option Name	Type	Reason for Rejection
New Build Smart Meter	Household	Smart metering of new build properties has been included in our wider plan as part of the baseline household forecast.
Replacement Smart Meter (NHH) (as a standalone option)	Non-household	Unlike households, there is no evidence that businesses will make further savings without additional assistance when moving from dumb or AMR meter to an AMI meter. This option has been rejected as an option to *reduce* demand. However, smart metering data is essential to support the market-based engagement in water efficiency we have included as the core platform for our plan. So smart metering rollout to support this has been included as part of our baseline plan for asset management
Retrofitting existing properties with rainwater harvesting or greywater re-use	Household	Retrofitting existing properties with rainwater harvesting or greywater reuse is prohibitively expensive, and the actual volumetric impact is likely to be very small.
Installation of Water Butts in individual properties	Household	The installation of water butts has a high risk due to the arid nature of the risks to our supplies (i.e., they do not provide significant benefits during 2018 type summer events)

Table 4.9: Rejected demand management options

[Note – government led initiatives including water efficiency labelling, minimum standards for water using goods and enhanced regulations for new properties were handled separately in the investment modelling, as described later in this Chapter].

4.80. A summary of the savings and delivery constraints of the feasible options is in the section below titled 'Programme refinement'. **Appendix 4.5** provides further information regarding the supporting work.

Consideration of targets and expectations

4.81. As discussed in **Chapter 3**, demand management, including leakage reduction and water efficiency initiatives, is the first preference for our customers in meeting the supply-demand balance. Although this is not as important to our customers as affordability and the reliability of the plan, it is clear that, in terms of where we need to invest, there is a preference for demand management to be considered first.

4.82. This preference is reflected within political, regulatory and industry expectations.

In February 2023, Defra released their expectations for demand management in their Environmental Improvement Plan (EIP)[67].

This resulted in the following assumptions and targets being applied to create our demand management strategies for the rdWRMP24.

- **Leakage**: reduce 2017/18 leakage levels by 50% by 2050 with interim targets of 20% by March 2027 and 30% by March 2032.

- **PCC:** deliver a PCC of 110 litres per person per day by 2050 under the dry year annual average scenario. This requirement is specified in both the WRPG (Section 9.3.4) and EIP (page 105). **Non-Household**: reduce non-household water use by 9% by March 2038 and 15% by 2050. The EIP does not specify which year these percentage reductions apply. We have assumed this is 9% and 15% of 2019/20 non-household consumption.

- **Distribution Input**: reduce our Distribution Input per head of population by 20% from 2019/20 figures by March 2038 with interim targets of 9% by March 2027 and 14% by March 2032.

The EIP targets are summarised in **Table 4.10**

Target	Reduction from	2027	2032	2038	2050
		AMP8	AMP9	AMP10	AMP12
Leakage	2017/18	20%	30%	-	50%
PCC	-	-	-	122l/p/d	110l/p/d
NHH	2019/20	-	-	9%	15%
DI (per head of population)	2019/20	9%	14%	20%	-

Table 4.10: Environmental Improvement Plan 2023 targets

4.83. Additional guidance was considered to achieve the following elements.

- Include the benefits of efficiency labelling of water-using goods within demand forecasts (DEFRA announcement in 2021).

- Work with the water retailers and other stakeholders to contribute to the delivery of the Industry Action Plan to improve water efficiency in the business sector (joint EA-Ofwat open letter to the Water Efficiency Steering Group, 2021).

- Consider the implications of different rates of delivery of smart metering (Ofwat PR24 Long-term Delivery Strategy Methodology).

- Develop a consistent approach to address leakage on customers' own pipes (WRPG).

[67] Defra, Environmental Improvement Plan 2023, 7th February 2023, 'https://www.gov.uk/government/publications/environmental-improvement-plan'

- Align with the strategy and objectives of the UK Water Efficiency Strategy. The new UK Water Efficiency Strategy envisions a UK where all people, homes and organisations are water efficient. It aims to achieve this through 10 key objectives that focus on providing water efficiency education, advice and leadership which includes ensuring new homes are water efficient, plumbing losses in existing homes are repaired and water efficient fixtures installed, and businesses are incentivised to save water

Demand management scenarios

4.84. To incorporate the EIP targets for inclusion in the regional modelling, we agreed four demand management scenarios with WRSE. These four scenarios are called, 'low', 'medium', 'high', and 'high plus'. Similarly, the data from our Brett community was included in the WRE regional plan.

The purpose of these scenarios was for each company in WRSE to develop the best combination of their demand options, or 'basket of options' that could be used to meet the 'low', 'medium, 'high', and 'high plus' demand management pathway targets (PCC, leakage, NHH and DI).

This stage was important to ensure that the strategies we generated for investment appraisal by the regional groups, represented the most cost-efficient way of achieving the EIP targets. These were therefore generated using different combinations of the feasible options to achieve the required outputs from the optimiser tool.

The scenarios agreed with WRSE are summarised in **Table 4.11** below.

Scenario	EIP targets	Meter penetration	LTDS scenario
Low	No	Maximum 85% penetration. 15-year delivery to 2040	n/a
Medium	Yes	Maximum 90% penetration. 15-year delivery to 2040	n/a
High	Yes	Maximum 90% penetration. 20-year delivery to 2045	'Slow Technology' common reference scenario
High plus	Yes	Maximum 90% penetration. 10-year delivery to 2035	'Fast Technology' common reference scenario

Table 4.11 – Demand management scenarios for regional planning

4.85. The meter penetration of 90% represents 'full' penetration based on experience of our customer base. The remaining 10% is impractical to meter as it relates to either complex internal supply arrangements, or transient and unresponsive customers where the failure rate on visits is either too high, or we simply cannot gain access for meter installation. Going beyond the 90% meter penetration may not be possible and would require a much higher unit rate of installation.

In the regional planning model, each of these scenarios are mutually exclusive. For example, the low demand scenario cannot be selected in

addition to the medium scenario if it has already been selected.
Each scenario is also applicable to all Water Resource Zones within Affinity Water's area. That is, the medium scenario cannot be selected in WRZ1 and then the high scenario selected in WRZ2. If the medium scenario is selected it is applicable across WRZs 1-8.

In our final WRMP24 we have accelerated the metering programme to deliver a maximum meter penetration of 90% by 2035. This is detailed in **Chapter 9**.

Government initiatives and benefits

4.86. Although we have incorporated all reasonable elements of demand management in our programme, the evidence base that we have collated from England and Australia shows that this will not be enough to meet the household per capita consumption targets set out in DEFRA's Environmental Improvement Plan. Achieving the government target will therefore require governmental support. An important first step has already been provided by the announcement of water-efficient labelling on water-using goods. The details of this have not yet been decided, but based on experience from Australia, this can achieve substantial benefits.

Meeting the EIP targets will require further government action in two principal policy areas. These are outlined below.

- The introduction of minimum efficiency standards for water-using goods. Whilst this has been proposed in Australia, it has only been very partially implemented, but again has a significant potential to reduce demand.
- Better methods for implementing and policing requirements for water efficiency on new development by local authorities.

Water UK and Ofwat have previously produced reports on the benefits that might be expected from water labelling and minimum standards which we have incorporated into our planning assumptions and, when combined with implementation of standards for new developments, should allow us to reach the EIP targets. However, much of the analysis was based on theoretical modelling created in Australia, and more recent outturn evidence from Australian water companies has shown that this may be very optimistic. Our analysis of the range of potential savings and risks involved is provided in **Appendix 4.5.**

4.87. For the purposes of the WRSE regional plan, different implementation strategies for government interventions were tested by WRSE. It has been assumed that savings from water labelling, which is now a government policy, will occur from 2025 onwards. These strategies transition from one government strategy to another over a defined period and include the below categories.

- Hybrid A: low until 2040, medium from 2060.
- Hybrid B: low until 2040, medium from 2060 and high from 2080.
- Hybrid C: low until 2040, medium from 2050 and high from 2060.
- Hybrid C+: low from 2025, medium from 2030 and high from 2035 with a 15-year implementation policy to achieve 110l/h/d PCC).

- Hybrid C++: low from 2025, medium from 2030 and high from 2035 with a 10-year implementation policy to achieve 110 l/h/d PCC.
- Hybrid D: 110 l/h/d PCC across the region by 2050 through government. interventions by transitioning from low to medium and high to allow the target to be met (low from 2025, medium by 2040, high by 2075).
- Hybrid E: 110 l/h/d PCC across the region by 2040 through government interventions by transitioning from low to medium and high to allow the target to be met (low from 2025, medium by 2035, high by 2050).
- Hybrid F: low by 2030, medium by 2040.
- Hybrid G: low by 2030, high by 2040.
- Hybrid H: low for the entire length of the plan.

Typically, the length of time required to see the full government interventions reach their maximum effectiveness has been assumed to be 10 years for water labelling and 15 years for more challenging medium and high government interventions. The timescales for the medium and high government implementations were developed to provide sufficient time for the policies to work through local plans and for their policy positions to move into the marketplace to produce more efficient white goods. However, to achieve scenarios, C-G, the time to achieve full implementation had to be reduced from 15 to 10 years to generate the savings required within the timeframes stated. This introduces additional risk around implementation which has been covered in our Target Headroom.

Programme refinement

4.88. We used a variety of data sources to evaluate the benefits of activities associated with smart metering. These include:

- national studies carried out by UKWIR;
- savings evaluations from our AMP7 Water Saving Programme (metering programme, behavioural change and home water efficiency checks) and AMR meter trial; and
- savings evaluations from Anglian Water, Thames Water, Southern and South East Water.

4.89. A description of the evidence base used to refine our household strategy and define our preferred plan is provided in **Appendix 4.5**. In summary, we divided the savings associated with the smart metering strategy into four main components.

Behavioural change, which builds on the platforms and approaches we are delivering in AMP7, but uses the additional data that smart metering brings to provide more customer-specific and timely feedback on water use, and to enhance the message and impact. Incorporated within customer behaviour is customer wastage savings; where we make customers aware of wastage and plumbing losses, and customers fix it themselves. This is distinct from the wastage benefits achieved where we fix the wastage for the customer (see below).

- **Reduction in wastage**, where we use smart metering data to identify customers that are likely to be losing water through plumbing losses, 'leaky loos', etc and we fix the wastage for the customer. The forecast savings are estimated using a realistic delivery rate that ensures totals do not exceed 25% (which is the maximum likely proportion of properties with significant leaks, identified through Thames Water and Anglian Water data).

  Based on information gained from Anglian Water, we estimate the split is 75% customer behavioural change (to be allocated to smart metering) and 25% company actions (to remain in wastage).

- **In-home water efficiency**, which relates to the benefits of proactive contact and home visits to customers to install water-efficient devices, similar to the approach we have developed during AMP7. To date, we have used customer segmentation by group to help target visits, but, as we increase the number of home water efficiency checks (HWECs), we will need to move into less favourable groups. The role of smart metering in this case is to help us maintain the efficiency of those visits by providing better visibility of customers within water user groups that appear to be using more than the norm. We have therefore used current HWEC savings and assumed smart metering for this element will allow us to continue to deliver at the current level of efficiency.

- **Tariffs**[68], incorporates the benefits of 'smart' tariffs[69], which are planned to be introduced to further reduce the amount of water consumed by high and very high user groups once the smart metering network is in place. We currently have a new tariff trial that is underway which explores how we address very high user consumption[70].

4.90. When refining the strategy, the evaluation concentrated on how cost-effective different approaches and technologies might be in relation to these three elements, and how practical and affordable different delivery rates and strategies might be. They concentrated on the elements outlined below.

- How well lower cost 'Automatic Meter Reading +' (AMR+) approaches[71] might be in relation to the three areas of saving, in comparison to the more expensive 'Advanced Metering Infrastructure' (AMI) approaches.

- The level of maturity and reliability of different AMI technologies, and potential strategies that might be used to take advantage of developing more cost-effective methods.

[68] The 'super high users' are household customers with very high consumption, which are theoretically a key target for tariff-based demand management. However, they tend to be wealthy, so tariffs are not necessarily effective. We are therefore using more collaborative approaches to try and reduce their water use and help meet our current 2025 PCC targets
[69] 'Tariff strategies' involve pricing structures that increase the volumetric charge for water once household use passes certain thresholds. It is intended to discourage large summer use of water but can be difficult to design due to the need to avoid unintentionally penalising large families or vulnerable customers
[70] Further detail can be found here: https://www.affinitywater.co.uk/news/tariff-trial
[71] AMR+ uses similar meter stock to AMI, and records key outputs such as daily usage, continuous night use (i.e., signs of plumbing losses). However, there is no infrastructure to allow automatic transmission of data to a central point, so the data must be collected through 'drive by' downloads

- The feasibility and implications of different rates of delivery, testing strategies ranging from a single AMP (five years), through to a slower rollout over five AMPs (25 years).

4.91. For our non-household strategy, we used multiple sources of information to define the short and long-term ambition. These included the elements outlined below.

- Our own experiences of sector partnership-based approaches (smarter holiday homes and beverages) to understand how these specific opportunities can be rolled out to relevant businesses within AMP8.
- The experience of Thames Water in their Smarter Business Visits has been used to develop our Business Water Efficiency Checks (BWEC) option. A BWEC includes a free visit by one of our qualified staff to install water saving devices and provide personalised water saving advice to non-households. We have assumed that there will be a 10% uptake rate from business that are offered a Smarter Business visit based on Thames Waters' experience in AMP7. These visits are offered both through lettering and groundwork contact with the businesses.
- A retailer engagement project for longer-term, market-led opportunities. During AMP7, we have carried out two pilot initiatives with large businesses in the entertainment and food and drink sectors, which have allowed us to understand how co-working with larger, sector-specific companies can be used to deliver effective reductions, based on the installation of water-saving devices.

Demand option optimisation

4.92. The collation of demand options into the four demand management scenarios was facilitated by an 'Optimiser' tool built specifically for Affinity Water. This tool examined household demand management alongside leakage reduction benefits because many of the options (such as smart metering) affect both elements, therefore, they needed to be considered.

This Affinity Water Initial Demand Management Optimiser tool allowed us to evaluate component options based on total direct costs, with benefits (yield) based on the reduction in either household consumption, non-household consumption or leakage that each option can deliver (as a volumetric saving). The carbon costs for each demand management scenario were developed based on the outputs of the optimiser tool (see 'carbon assessment' subsection).

4.93. To develop each scenario, the EIP and Meter Penetration targets (as set out above in **Table 4.11**: Demand Management scenarios for regional planning), were entered as constraints into the Demand Management Optimiser. This told the optimiser to find the most cost-efficient combination of demand options to deliver these targets within these delivery constraints.

The optimisation confirmed that better consumption information gathered through smart metering combined with some form of analytical intelligence is required to support the development of demand management options to the level required by policy makers and our supply-demand challenge. Smart metering data alone will not achieve the full savings, and therefore needs to be interpreted to achieve the demand reductions. This common data and analytics process, integrated with the smart meters in combination with property and network data, will support intelligent demand reduction actions in households, DMAs and the trunk main system.

For our NHH customers, which include businesses and organisations that use water and can be supplied via retailers (as opposed to households, who are directly supplied by wholesale water companies), we considered a range of interventions, including our Business Water Efficiency Checks that would be delivered directly by Affinity Water to save water. However, we currently supply 72,148 non-household properties and, of these, 61,389 are billed across 26 retailers. We also supply three major airports (Heathrow, Stansted and Luton), football stadia, universities, care homes, shops, restaurants and cafes, as well as large office complexes and industrial estates. Although we will be able to target some properties for bespoke initiatives, we adopted a 'hybrid' approach, whereby we deliver BWECs similar to those we have been piloting in the current AMP (described in the case study later in this section), whilst implementing collaborative market-based approaches in the medium to long term.

Our leakage strategies were developed using the RPS Strategic Optimisation of Leakage Options for Water Resources (SoLow) tool. Similar to the process for the household demand strategy, the SoLow tool was used to find the cost optimal strategy required to deliver strategy targets, rather than to develop those targets. This model represents industry best practice for leakage strategy development, and includes all options for active leakage control, customer-side leakage reduction from smart metering, mains replacement and calm networks.

Based on the above analysis, we developed the four demand management scenarios for WRSE. For each scenario, the optimisation concluded that the most cost-effective way to deliver the four strategy levels, (low, medium, high, and high plus) was through Integrated Demand Analytics (IDA) - i.e., smart metering with associated behavioural change and water efficiency visits. Critically, this modelling concluded that the IDA rollout should start in AMP8 (2025) and, in effect, the costs to reach the relevant targets were higher if IDA is delayed until AMP9 (2030).

The evaluation of the cost effectiveness of the four demand management scenarios was carried out by WRSE using the investment tool described in **Chapter 8**.

As part of our SEA work, we have undertaken an environmental assessment of these demand management strategies and further information can be found in **Appendix 7.2.1.**

4.94. **Case Study: Five holiday parks in our East region: our partnership approach to reducing water consumption**

During the summer months, when people go on holiday and the population increases in certain areas, we know that the water consumption also increases, and we need to match this by maintaining supply. To help manage water use during these busy periods, we worked in partnership with five holiday parks in our East region, from July 2021 to November 2021. We went on to work with another holiday park in our East region and a site in our Southeast region, from November 2021 to April 2022.

We carried out several surveys on the holiday parks in our partnership programme and reviewed their survey responses to understand how much water they were using. As a result, we identified areas where the parks could reduce consumption by installing several water-saving devices, including:

- water-efficient shower heads,
- tap aerators to reduce the flow per minute,
- airgap valves on toilets to reduce usage per flush,
- urinal monitoring systems to reduce water wastage, and;
- flow restriction valves – providing just enough water for what is needed, helping sustain supply across the parks

The parks subsequently experienced results showed a 42% reduction in demand. However, it is important to note that the survey ran during the Covid-19 pandemic and lockdown in 2020.

In the longer-term, as part of our WRMP24, we have been collaborating with several other water companies as part of a WRE project. Our aim is to understand how we can engage with a wider number of businesses and organisations to enable us to realise larger reductions in water consumption. This is being achieved through a programme of engagement with retailers and NHH customers to test several proposals that will result in a reduction in NHH demand. The project is split into the following phases.

- Phase 1 - retailer interviews; surveys of retailers' NHH customers
- Phase 2 - meetings between retailers and wholesalers
- Phase 3 - in-depth interviews with NHH customers

Carbon assessment

4.95. The demand management options included in our demand management strategies will produce capital carbon while they are being installed and operational carbon while they are being used.
The approach to calculate the carbon from demand management has been updated since the dWRMP24 to improve accuracy and consistency across companies within the regional groups. The assessment for the final WRMP24 considers the quantities of different demand management interventions and applies these quantities to carbon models developed to represent the carbon intensity of each of the associated interventions.

For capital and operational carbon activities, the carbon assessment includes:

- cradle to built-asset boundary for capital carbon, and
- power consumption, transport, and maintenance for operational carbon.

Demand management carbon is calculated for three situations for each demand management scenario: the carbon emissions without capital carbon mitigations, carbon emissions with middle case carbon mitigations and carbon emissions with best case carbon mitigations. Capital carbon mitigations are the potential emission reduction estimates for most facets of construction, ranging from the type of steel that might be used in future pipelines to the distances travelled to install demand management devices.

An example to illustrate this approach is for pipelines. For mains replacement activity, 70% of the capital carbon emissions are attributed to producing the pipeline material. In the middle case (a moderate level of carbon mitigation ambition), approximately 7% of carbon could be reduced in the manufacture of ductile iron pipes in the next 15 years, increasing to 39% in 15 to 35 years. The requirement for contractors to use lower carbon materials thereby generating demand for these new materials can help to reduce the total carbon impact of mains replacement activity.

The carbon impact of our Reported Pathway demand management programmes is set out in **Chapter 9.** The details of the demand management carbon assessment are in **Appendix 8.4.**

Demand Scenarios

4.96. **Table 4.12** provides a summary of the four demand management scenarios applied to our baseline demand forecasts in the rdWRMP24. The volumes included are for company led demand reductions only (i.e., Government led reductions are not included here).

The main difference between our strategies is the pace of delivery of metering and water efficiency activity.

Scenario	EIP targets	Meter penetration	AMP8 (Ml/d)	AMP9 (Ml/d)	AMP10 (Ml/d)	Total to 2050 (Ml/d)
Low	No	85% 2040	39.4	67.6	95.9	139.7
Medium	Yes	90% 2040	50.1	84.0	119.2	160.6
High	Yes	90% 2045	48.9	80.3	112.2	160.6
High plus	Yes	90% 2035	50.1	91.6	119.2	160.6

Table 4.12 – Company led Demand management scenarios for regional planning – cumulative Ml/d

The refined strategies we have generated through this process and the associated level of savings and uncertainties have informed our approach and are set out under our Reported Pathway section in **Chapter 9**.

5. Water supply

5.1. Our water supply forecast describes how much water we can reliably supply to customers in our base year, and how this availability will change throughout the chosen planning period.

5.2. For our WRMP24, our baseline supply was assessed considering a 0.5% annual chance of failure caused by drought (i.e., a 1 in 200-year drought). However, we have also modelled more extreme drought occurrences, up to 1 in 500-year droughts, and we consider the implications of moving to a higher level of resilience in this chapter. Our assessment is consistent with the WRPG.

5.3. In line with the WRPG[72], we have produced a breakdown of our supply forecast that includes the following elements:

- Deployable output (DO): the amount of water that can reliably be abstracted from a source under certain conditions.
- Sustainability reductions (SRs): planned reductions in the amount of water that is abstracted from the environment, in particular from aquifers.
- Climate change impacts: the volumetric impact that climate change is likely to have on water resources.
- Bulk transfers: a transfer of water between neighbouring water companies that has been agreed through a bulk supply agreement or other contractual forms.
- Outage: a temporary loss of supply from one or more sources that causes a loss in deployable output.
- Treatment losses and operational use: the amount of water that is lost and/or used due to treatment processes and other operational uses.
- A supply forecast that combines all the elements above into Water Available For Use (WAFU): WAFU is the amount of water that is available to supply customers after all deductions have been applied.

5.4. The changes in baseline Deployable Output (before climate change adjustments and only accounting for abstraction reductions before 2025) between our final WRMP19 and this WRMP24 are summarised in **Tables 5.1 to 5.3** below. These tables concentrate on 'Average Deployable Output' (ADO), which reflects the capability of sources across a drought year (rather than just during the peak week of summer) and drives the supply/demand balance risk in all our WRZs.

[72] WRPG section 5

Element	WRMP19 Value for 2025/26 (Ml/d)	WRMP24 baseline 2025/26 (Ml/d)	Explanation and section reference
Like for like Deployable Output excluding drought measures	861.2	791.8	For WRMP24 we have calculated a system level Deployable Output in accordance with the UKWIR 'Manual of Source Yields'. The lack of raw water storage reduces system capability but generates a much larger benefit from TUBs and NEUBs – See 'Evaluation of System Level Deployable Output' below.
Benefits from drought management measures (temporary use bans and non-essential use bans)	15.7	81.3	
Other adjustments			None in this region.
Process losses and outage	-59.4	-46.3	Reduced following re-assessment – see 'Outage' and 'Process Losses' below.
Comparative water available for use	817.5	826.8	Overall increase primarily driven by the reduction in outage and process losses.

Table 5.1: Central region (WRZs 1-6) summary of changes in supply-side water available for use between WRMP19 and WRMP24 (ADO)

Element	WRMP19 value for 2025/26 (Ml/d)	WRMP24 baseline 2025/26 (Ml/d)	Explanation and section reference
Like for like Deployable Output excluding drought measures	45.8	44.19	Differences due to full system simulation modelling as above for Central. See 'Evaluation of System Level Deployable Output' below.
Benefits from drought management measures (temporary use bans and non-essential use bans)	0.66	1.68	
Other adjustments			None in this region.
Process losses and outage	-3.35	-6.29	Increased following re-assessment – see 'Outage' and 'Process Losses' below.
Comparative water available for use	43.11	39.58	Overall decrease driven by the increase in outage allowance.

Table 5.2: Dour (WRZ7) summary of changes in supply-side water available for use between WRMP19 and WRMP24 (ADO)

Element	WRMP19 value for 2025/26 (Ml/d)	WRMP24 baseline 2025/26 (Ml/d)	Explanation and section reference
Like for like Deployable Output excluding drought measures	43.09	40.37	Difference in DO is due to the re-evaluation of Ardleigh yield capability under a 1 in 200 drought by Anglian Water. TUBs and NEUBs benefits taken from system simulation modelling. See 'Evaluation of System Level Deployable Output' below.
Benefits from drought management measures (temporary use bans and non-essential use bans)	0.56	1.5	
Other adjustments	-2.06	-4.63	Sustainability reductions in 2025/26. Increased to 4.63 following AMP7 investigations.
Process losses and outage	0	0	No process loss allowance because losses included in Ardleigh yield assessment and no outage due to the very high groundwater licence peak capacity compared with average (see 'outage' below).
Comparative water available for use	43.65	41.87	Overall decrease driven by the increase in outage allowance.

Table 5.3: Brett (WRZ8) summary of changes in supply-side water available for use between WRMP19 and WRMP24 (ADO) evaluation of Deployable Output

5.5. We have a high level of water resources complexity in our Central region (see **Chapter 8**). As such, we have refined our approach to deployable output assessment and adopted stochastically generated[73] drought datasets to assess the conjunctive use capability of our sources. In all three of our regions; Central, Southeast and East, we followed the same general process for evaluating system level supply capability as follows.

- We assessed the variability in yield for individual groundwater sources, in response to drought stress and variability in flow for surface water sources (East region only).

- We defined the nature of the strategic supply system and developed system simulation models (Pywr software) to evaluate overall supply capability. We did not require a system simulation model of the Southeast region (Dour community) as it is entirely licence constrained and hence there is no interaction with hydrology or storage. However, this was still represented in the Pywr software t as were the rest of the sources within WRSE.

[73]Stochastic generation of rainfall and temperature data sets is a widely adopted approach within the water industry, which allows for the evaluation of resource system capability across a wide range of droughts. We used the outputs of the nationally based project, which generated spatially coherent data sets for all the water resource regions

- We evaluated the benefits of demand restrictions during drought conditions and included them in the system simulators (Central and East regions only).

- We simulated drought scenarios as time series and analysed them at the system level to determine how much water each Water Resource Zone (WRZ) could reliably supply under different drought conditions.

Drought Vulnerability Framework (DVF)

5.6. Our evaluation of drought risk is based on full stochastic system simulation modelling – i.e., consistent with DVF approach 1a[74]. Our Deployable Output assessments therefore cover the full range of duration and severity combinations required by the DVF.

5.7. The WRPG requires that we carry out a 'drought vulnerability assessment' in line with the EA Drought Vulnerability Framework (DVF) document. As described under the 'Evaluation of System Level Deployable Output' section below, we have already carried out full stochastic analysis at the system level. This means that the DO presented already accounts for the full interaction between our supply system and droughts of different duration and severity, in compliance with method 1a of the DVF methodology.

We have also carried out a full stochastic analysis of the way that our system might interact with key transfers from the Thames Water and Anglian Water supply systems. This covers all feasible severities and patterns of drought through the generation of 20,000 years of 'what is' rainfall analysis. This approach allows us to fully understand the variability in drought risk across different return periods and has shown that the main sources of uncertainty relate to system modelling rather than rainfall patterns. Specifically, the three main sources of uncertainty are:

- The source of historic rainfall data used to generate the stochastics.
- The 'lumped parameter' models used to generate the groundwater levels.
- The system simulation model set up, and specifically the size and timing of the demand peak in relation to the groundwater recession in a drought (Appendix 5.1).

5.8. Our analysis therefore gave us a strong understanding of Deployable Output uncertainty. We concluded that the levels of uncertainty included in Target Headroom for the supply side assessment, are reasonably reflective of the uncertainties we face, including those outlined above. We have not therefore carried out a separate DVF assessment within this plan.

Evaluation of individual source capabilities

5.9. Our Affinity Water supply area consists primarily of groundwater sources plus licensed or bulk supply agreement-constrained surface water sources.

[74] Drought Vulnerability Framework (ukwir.org) (page 31)

There is no significant surface raw water storage (i.e. reservoirs), except in our East region (WRZ8), where we share Ardleigh reservoir with Anglian Water. Surface water is therefore included in the PDO and ADO system simulation modelling inputs, as being equal to the licence and treatment constraints for those sources.

5.10. Our groundwater sources are a mix of licence, treatment-constrained and hydrogeologically-constrained sources.

Licence and treatment-constrained sources are those sources for which the amount of water that can be abstracted or put into supply, is either linked to a licence granted by the Environment Agency or dictated by the capability of the treatment infrastructure. Hydrogeologically-constrained sources are those groundwater supplies where variations in groundwater level can change the yield of the source, meaning their output capabilities vary according to drought severity.

To evaluate the capability of our groundwater sources, we use 'lumped parameter' groundwater models to evaluate the variability in groundwater levels during drought events. Lumped parameter models simulate the variation in groundwater levels, and hence groundwater yield, by linking aquifer behaviour to variable hydrological conditions, instead of representing groundwater sources as a constant output. In addition, we used the standard UK Water Industry Research (UKWIR) 'Manual of Source Yields' approach to understand how changes in groundwater levels can affect source yields.

5.11. Our assessment of individual source capabilities, under given levels of drought stress and associated groundwater levels, has not changed from our WRMP19. The only difference compared to WRMP19 relates to the update to the meteorological inputs – i.e. the rainfall and potential evapotranspiration (PET) timeseries that we have used to evaluate the drought stress that can be expected for our sources. We have continued to rely on 'stochastic' weather generation because this allows us to investigate the risk of more severe droughts, but these have now been generated on a regionally coherent basis by the WRSE and WRE regional modelling groups. This change to regionally coherent stochastic datasets has not changed the results of our water supply assessment.

5.12. Using this approach, we can determine how much water each hydrogeologically-constrained source can produce, as a seven and 30-day rolling average, for any rainfall and temperature timeseries. We combine this with our licence/treatment capacity constraints to define a source level supply capability for all our sources. This provides the inputs to the system assessment of Deployable Output.

Evaluation of system level Deployable Output (DO)

5.13. The calculation of Deployable Output (DO) is an industry standard approach that is used to describe the amount of water that can be reliably abstracted from a source under a range of conditions, most notably under dry year conditions[75] and delivered into supply. DO is calculated to be representative of the amount of demand that our water resources system could provide for under 'design' drought conditions, i.e. the drought severity that has been used to assess deployable output. It is derived based on the three components below:

- The yield or licensed capability of our sources - i.e. how much they can abstract at different times of the year based on different drought conditions.
- Treatment works or other production constraints – i.e. any factors associated with treatment and bulk distribution sites.
- The nature and profile of demand within our supply network.

5.14. Any one of these three components can act as a key constraint on our capability to supply water, which is why DO is used in water resources planning to understand the capability at a Water Resource Zone (WRZ) level, rather than simple licence or yield estimates for individual sources.

5.15. For each WRZ, we calculate both the amount of demand that we can supply as an average value across a design drought year, and the amount of demand we can supply during specific periods, when the customer demand for water is at its highest. The DO values that are representative of our ability to supply over those two different time periods are defined as follows.

- Average Deployable Output (ADO). This measure accounts for the ability of the system to manage volumetrically across the drought year, accounting for variability in both the resource base and customer demand throughout the drought event.
- Peak Deployable Output (PDO). This measure specifically examines the capability of the system during the week when demand reaches its peak during a drought year (usually during July in our case).

5.16. The simplest system level assessment of DO in our case is in our Dour community (WRZ7 – Southeast region), where most sources are licence-constrained and there is no sharing between WRZs. This means we can simply add together the individual source capabilities under the average and peak week conditions; we can then use that as the WRZ level DO. The adoption of this method is justified by the relatively simple supply system that is operated in this area.

5.17. For the Central (WRZs1-6) and East regions (WRZ8), we have updated our approach to one of full 'system simulation' evaluation using the Pywr water resource system modelling platform. Under this method, the capabilities of our individual sources are combined into a model that simulates how they perform during drought conditions. To understand the level of demand that is likely to result in system failure under different drought conditions, this type of model also considers how variability in customer demand interacts with those system constraints. We undertook this modelling development as part of the WRSE 'Regional System Simulator' (RSS) modelling programme.

[75] Dry year conditions are adopted as a 'worst case scenario' to ensure there is enough water to supply to customers

5.18. The model-build process of the RSS was undertaken and managed centrally by the WRSE regional group. Each company's designated representative sat on a Technical Working Group and was tasked with overseeing the direction of the project. The company level sub-models were used to evaluate WRZ level DO under the different drought design conditions covered by our WRMP.

5.19. Because our supply system for the Central region does not contain any significant raw water storage, the calculation of Average Deployable Output (ADO) is complex and reflects three possible modes of system failure that can occur in a drought year. These modes are described below.

- Failure during autumn minimum groundwater periods. This is where groundwater levels get very low and are unable to maintain outputs, even though demand is only running at seasonally low levels.
- Failure during the peak week demand period. This is where the seven-day abstraction stress on groundwater sources, is sufficient to cause a transient drawdown to below operationally suitable levels (referred to as 'Deepest Advisable Pumping Water Levels' (DAPWLs)).
- Failure during extended summer demand periods. This is where prolonged higher abstraction rates from groundwater sources caused by summer demand increases and causes boreholes to draw below the DAPWLs.

5.20. The ADO that is generated by the water resources assessment is a single figure that captures all these complexities in a single representative value which can be used in investment modelling.

Investment modelling is a term that describes the use of mathematical models to inform decisions around investment in either new water infrastructure or demand-side interventions. As detailed within the UKWIR Manual of Source Yields [76], the ***ADO is not a description of the capacity of the sources, but rather it is equal to the annual average level of demand that the water resource system can manage to supply under the design drought condition, without any of the above failure modes occurring.***

5.21. The baseline DO modelling carried out for our WRMP24 showed that the third failure mode tends to act as the constraint on ADO. We updated our demand profile to be equal to the 2018 extended dry summer event, which highlighted the vulnerability of our system to extended summer demand under low groundwater level conditions. We selected this 2018 event based on a Met Office assessment that concluded the likelihood of such events has increased by around 30 times, as a result of climate change, with a return period of less than 1 in 10 years under current climate conditions[77]. This means that 2018 is reflective of the demand patterns that we would expect to see during a critical drought year, given the impact that climate change has had on our weather and associated customer use. We did not use 2020 or 2022 as

[76] UKWIR 2016 'Manual of Source Yields' UKWIR report
[77] McCarthy et al 2019 'Driver of the UK Summer Heatwave of 2018' Met Office Report

both years (once normalised for the impacts of the Covid-19 pandemic for 2020) contained less of a weather-related demand event compared to 2018, so are not reflective of the design '1 in 10' year event required by the UKWIR Manual of Source Yields. A stylised representation of the nature of resource stress on our Central region under a 2018 type demand event that occurs at the same time as a groundwater drought, is shown in **Figure 5.1**.

Figure 5.1: A stylised representation of the nature of resource stress on our Central region

5.22. This affects both the nature of risk in our existing system, the capacity requirements and the nature of operational utilisation of new supply schemes, as described in **Appendix 5.1** and **Appendix 5.5**. For water resources investment purposes, it means that resource schemes which provide significant raw water storage, are particularly beneficial to our DO position. This is further discussed in **Chapter 9**.

5.23. The modelling we have carried out means we have a detailed understanding of the nature and intra-annual utilisation of transfers required from other companies or strategic schemes. This is further described in **Appendix 5.5.** We have also modelled the impact that the provision of storage, either from new schemes or neighbouring companies with significant storage (Thames Water and Anglian Water) has on both our DO and the available storage from those companies/schemes. We have done this across the full range of stochastically generated droughts, conjunctively between ourselves and the donating companies/schemes. For inter-company transfers, this assessment inherently covers the full range of drought durations and severity across both our resource system and the donating company system.

5.24. The East region does contain some storage via Ardleigh Reservoir, which is shared with Anglian Water. This means that the ADO is not as sensitive to fluctuations in demand patterns across the year as the Central region due to the availability of raw water storage for managing those fluctuations. The presence of storage also means that the system simulator was needed to evaluate the yield of Ardleigh and benefit of Temporary Use Bans (TUBs) and Non-Essential Use Bans (NEUBs)[78]. The system simulation model in the East region was also used for detailed resilience testing and optioneering in the face of licence-capping abstraction reductions, as discussed later in this chapter.

Levels of service and benefits of drought demand restrictions

5.25. As detailed in our drought plan, our drought triggers are based on groundwater levels in key observation boreholes that are located further away from abstraction influence. They are therefore primarily meteorologically based and hence, by definition, meet the stated Levels of Service.

5.26. The Levels of Service for drought interventions as detailed in our drought plan and replicated in **Table 5.4** below, have been used in this WRMP24. They have been used as the basis for our supply-demand and investment calculations, as required in the WRPG. These are the same for both household and non-household customers in our supply area.

Drought intervention measure	Level of service (frequency of imposition)
Media messaging and environmental triggers	1 in 5 years
Temporary Use Bans	1 in 10 years
Non-Essential Use Bans	1 in 80 years
Supply side Drought Orders and Permits (after 2025)	Not used - exceptional circumstances only (worse than 1 in 200-year event, rising to worse than 1 in 500-year event after 2040)
Standpipes and Emergency Drought Orders	Not used - exceptional circumstances only (worse than 1 in 200-year event, rising to worse than 1 in 500-year event after 2040)

Table 5.4: Summary of levels of service used in this WRMP24

5.27. In accordance with the WRPG[79], all DO values quoted in the sections above reflect the unrestricted levels of demand that can be met by our water resources supply system. Demand forecasts in the WRMP must also be stated

[78] Where a system has raw water storage, TUBs and NEUBs help to slow the rate of recession of reservoir levels by reducing demand. However, they come into effect after reservoir storage has already started to drop so only have an impact during part of the drought recession period, so the benefits to yield need to be modelled
[79] https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline

according to unrestricted demand. However, during drought conditions there is an obvious benefit from imposing TUBs and NEUBs and this needs to be accounted for in our planning, particularly as the lack of storage in our system means they have a direct benefit to stated DO.

5.28. DO is calculated as being equal to the level of *unrestricted* demand that can be satisfied by the system, under all reasonable conditions. The imposition of restrictions during severe drought therefore increases DO by a percentage amount. This is broadly similar to the percentage reduction in demand that is expected due to TUBs and NEUBs during the extended summer stress event described earlier on in this chapter.

5.29. The benefits of TUBs and NEUBs are therefore calculated as part of the DO evaluation process and passed as identified options into the options appraisal modelling. Since they are interventions that do not have any costs attached to them, TUBs and NEUBs are always selected as part of the Best Value Assessment (BVA), but are fully visible to stakeholders as a separate option in order to provide transparency in the option selection. The monthly profile of demand savings that TUBs and NEUBs produce and that we used within the system simulators, was the same as that quoted in our Drought Plan – i.e. 5% as an annual average, but increasing up to 9% in June and August and 11% in July.

5.30. As detailed in our drought plan, our drought triggers are based on groundwater levels in observation boreholes located further away from abstraction influence. The frequency at which these thresholds are breached, therefore relies entirely on meteorology/drought. As a result, the stated Levels of Service for the frequency of drought interventions as stated in the Drought Plan, are not affected by the mix of supply or demand schemes we use to maintain our supply/demand balance.

5.31. The most recent drought event in our regions occurred during 2022, when neighbouring companies such as Thames Water introduced Temporary Use Bans (TUBs - also referred to as hosepipe bans). However, as this was a single year event, it did not result in groundwater levels that were low enough to affect our resources or trigger thresholds for demand restrictions. As such, the event was not particularly significant for Affinity Water. Our 'lessons learned' document for the event is provided in Appendix 3 of our Drought Management Plan[80]. It shows that actions such as calls for restrictions and media campaigns were triggered and delivered successfully, but groundwater levels did not breach our level 2 drought plan thresholds, so TUBs were not triggered.

5.32. As described earlier in section 5.21, our system is vulnerable to long duration demand side events and the summer of 2018 was more stretching for us than that of 2022.

[80] https://www.affinitywater.co.uk/docs/Drought/2023/Drought-Management-Plan-Appendices.pdf

Generation of Baseline Deployable Output

5.33. There are many inter-connections between the WRZs within our Central region. Therefore, it was important to use the Pywr system simulator in a way that allows any spare water within WRZs that are in surplus at a given level of demand, to be transferred to WRZs that are in deficit, provided internal transfer constraints are not breached.

5.34. As a result, we developed the '5 stage process' described in **Appendix 5.1** to calculate Deployable Output in WRZs 1-5, with and without TUBs and NEUBs. In summary, this process works by calculating the DO for the most vulnerable WRZ, considering its own resource base and the availability of transfers. The level of demand at failure is then fixed for this WRZ before moving onto the next WRZ, where demand is increased until the point of failure. This method allowed us to understand how our WRZs can act conjunctively during drought conditions, given the transfer constraints and different demand profiles that exist across our Central region.

5.35 The capability of our surface water abstractions in WRZ6 depends on aggregate licence for annual average output and maximum treatment capacity for the peak week DO. These values are the same as those used in our WRMP19. Since transfer of surplus water from WRZ6 into WRZs1-5 is one of our primary solutions to shorter term supply-demand risks, it is important that we can state the capability of WRZ6 in a way that is compatible with the WRZs 1-5 ADO critical need. We therefore carried out a separate engineering evaluation of treatment capability during a one to three-month critical summer drought period.

5.36. The assessments of DO for our Dour community (WRZ7 – Southeast region) and Brett community (WRZ8 – East region) were straightforward. The assessments use a simple sum of groundwater capability for the Dour and a 'Scottish Method' DO assessment for Brett (see UKWIR Manual of Source Yields for a description of this industry standard approach).

Results

5.37. The WRPG requires that we increase our level of drought resilience from the 1 in 200 years that we will plan for in 2025 (i.e. we do not have to rely on standpipes or emergency drought orders for any drought event up to and including a 1 in 200 year level of severity), to 1 in 500 years by 2040. The resulting DO under each drought event is provided in the tables below.

Central region (WRZs 1- 6)

5.38. The results of our baseline ADO analysis and PDO analysis for the Central region (WRZs 1-6) are provided in **Tables 5.5 and 5.6** below.

Scenario	1 in 500	1 in 200	1 in 100
ADO without demand savings (i.e., without TUBs and NEUBs accounted for) (baseline) (Ml/d)	677	678	689
ADO with demand savings switched on (Ml/d)	742	744	748

Table 5.5: Results of our baseline ADO analysis for our Central region

5.39. As noted previously, this represents the annual average demand level that generates a 30-day rolling average failure, given a 2018 style demand profile. It includes the available imports from Thames Water and Anglian Water, as detailed in **Chapter 9**.

5.40. It should be noted that during the draft WRMP consultation process, Anglian Water confirmed that they also intend to move to a 1 in 500-year level of resilience in 2040. Therefore, whilst the impact on our own resources from the change in resilience is small (2Ml/d), the reduction in effective yield at Grafham means that our annual average allowable take from Grafham reduces from 91Ml/d down to 68Ml/d in 2039/40 (i.e. a 23Ml/d reduction) and continues at that level for the rest of the planning period.

5.41. WRZ6 DO is the same as we used in our WRMP19, with a total annual average capability of 205.01Ml/d and a Peak Week capability of 262.2Ml/d. Currently, the capability during the summer peak month is limited to around 200Ml/d only. This includes an allowance for outage, so on an equivalent basis, it is only around 207Ml/d, which is just above the annual average. To allow the ADO surplus to be transferred to WRZ4 in accordance with the investment model, it is therefore necessary to ensure that WRZ6 can treat 240Ml/d during the critical summer months period[81]. The options for doing this are described in **Chapters 7 and 9** (the Wey treatment enhancement scheme).

Scenario	1in500	1in200	1in100
PDO without demand savings (baseline) (Ml/d)	741	759	790

Table 5.6: Results of our baseline PDO analysis for our Central region

[81] An 'ADO' of 207Ml/d means that the system can support this level of demand as an average across the whole year. During a 2018 type event the average summer demand is 16% higher than this annual average, so to support an ADO of 207Ml/d, the Wey treatment works need to be able to generate 240Ml/d over the summer period

Dour community (WRZ7 - Southeast region)

5.42. The sum of the individual source capabilities for the Dour community are provided in **Table 5.7** below.

Scenario	1in500	1in200	1in100
ADO without demand savings (baseline) (Ml/d)	42.7	44.2	44.6
PDO without demand savings (baseline) (Ml/d)	54.3	56.6	59.4

Table 5.7: ADO and PDO analysis for our Southeast region (Dour community)

Brett community (WRZ8 - East region)

5.43. For the East region, the groundwater licence includes the requirement to provide river augmentation at 2.16 Ml/d under dry conditions. The resulting ADO (without licence capping) across different drought return periods is shown in **Table 5.8**. It needs to be noted that these figures exclude the licence capping for "no deterioration" which will be imposed in late AMP7. This capping will decrease the 1 in 200 ADO from 30.06Ml/d to 25.43Ml/d on the proviso that the 2.16Ml/d river support requirement is not at the expense of ADO (25.43 + 2.16 = 27.59Ml/d total GW output including river support). This is the value used for the groundwater DO in our East region. This is licence constrained so is unaffected by drought return period.

Component	Worst historic ADO	1 in 200 ADO	1 in 500 ADO
Groundwater sources	30.06	30.06	30.06
Minus river augmentation	-2.16	-2.16	-2.16
Ardleigh import (includes 2022 climate change)	13.06	10.32	8.66
Total	40.96	38.22	36.56

Table 5.8: ADO across different drought return periods for East region (Brett community)

5.44. As with the Grafham import in our Central Region, the effective yield of Ardleigh reduces when both we and Anglian Water move to a 1 in 500 year level of resilience in 2040. This is shown in the **Table 5.8** and included in the WRZ import figures used in the supply/demand balance and WRMP Table 3.

Our role in achieving sustainable abstraction

5.45. Flows in the Chalk rivers in our area are dictated primarily by the amount of seasonal rainfall that we get. In particular, the amount that percolates through to and recharges the Chalk aquifer. Some of this 'recharge' is released from aquifer storage through the bed of the streams over time and provides differing levels of baseflow, that are related to how much aquifer recharge there has been. Hence flows reduce or even disappear naturally in some reaches as a result of dry weather or drought.

5.46. However, in some catchments we also abstract from those Chalk aquifers via our boreholes. This affects groundwater levels and, in some cases, can affect the baseflow within the streams and rivers. Where this has a detrimental impact on the health of the stream, as described through the ecology, quality or geomorphology of the river, then we regard that the abstraction is unsustainable and we need to reduce or even cease the abstraction to help restore that stream or river to a healthy condition. The definition of 'unsustainable' will require further exploration and definition with stakeholders through AMP8 (2025-2030), as described in our Monitoring Plan in **Chapter 9**. For this plan, we have used the requirements of existing legislation (the Water Framework Directive) and guidance from our regulators, along with testing of parameters that underpin that guidance to evaluate ranges of abstraction reduction need. This is further set out in the following sections.

Explanation of our role in supporting River Basin Management Plans and Water Framework Directive compliance

Water Industry National Environment Programme (WINEP) investigations

5.47. For our WRMP24, we have sought to understand and plan for the needs of the water environment in the long term as required by the WRPG (Section 1). This supports our commitment to ensuring that all our abstractions are environmentally sustainable. We have worked closely with the Environment Agency (EA) to understand what this means in practice, in terms of the range of Chalk groundwater abstraction reductions that are needed to achieve this aim. This range of long-term targets was initially developed by the EA National Framework and the local EA area officers. We worked with them to carry out sensitivity-testing on the underlying assessments and to schedule the reductions into a practicable plan. This plan targets the highest priority catchments first and allows us to monitor and learn as we go, to ensure we achieve the desired environmental outcomes.

The Water Industry National Environment Programme (WINEP) methodology is designed to turn this strategic ambition into specific actions for the next five years.

Introduction to the AMP7 WINEP

5.48. As part of the WINEP work for AMP7, the EA have asked us to investigate 15 surface water and six groundwater bodies distributed across the three regions, as shown in **Figure 5.2**. The objective of the investigations is to ascertain whether making use of any of the licence that we have historically not required, may lead to WFD status deterioration. We are also investigating the impact of abstracting the full volume of a small number of sources in different waterbodies. To fulfil the requirements of this work, we are using regional EA groundwater models (Hertfordshire Chalk, Essex, Cam-Bedford-Ouse and East Kent). We are also undertaking multiple model runs to understand the impact of our abstractions.

Figure 5.2: Map showing groundwater bodies under investigation under the 'No Deterioration' requirements in AMP7

No Deterioration – licence capping

5.49. During the course of ongoing engagement with the EA, it defined the deterioration of a water body as 'a change in the WFD class from the existing class to a lower, or worsening of, any element within the lowest class', as outlined in the latest River Basin Management Plan (RBMP).

During pre-consultation discussions, the EA requested we adopt the last RBMP baseline period of 2010-2015 (six calendar years) as the Recent Actual (RA) baseline. We have indicated to the EA that, because all our licences work on a fiscal year basis, the RA calculations have been undertaken for the six-year period from April 2010 to March 2016. See **Table 5.6** for our Central region, **Table 5.6** for our Southeast region and **Table 5.7** for our East region.

5.50. The letter issued by the EA to all water companies on 15 November 2021 established three categories of environmental scenarios, which will lead to two possible options for licence changes, which are as follows.

- Recent Actual Average (average of RA annual figures);
- Max Peak (maximum annual figure within the RA period).

5.51. The three environmental scenarios in **Figure 5.2** differ, based on the WFD status, the effect of abstractions on the waterbodies and groundwater abstraction growth (occurred or planned), compared to the RA baseline period.

Environmental scenario	Licence Change
• Flows in a water body do not support good ecological status (GES); or • A groundwater body is at poor quantitative status; and • There is evidence that the ecology is damaged by abstraction; and • There is planned growth	• Cap licences at recent actual average abstraction rates
• Flows in a water body do not support good ecological status; or • A groundwater body is at poor quantitative status; but • There is no planned growth	• Cap licences at maximum peak abstraction rates
• Flows in a water body support good ecological status; or • A groundwater body is at good quantitative status; and • Planned growth is likely to cause deterioration to poor status	• Cap licences at maximum peak abstraction rates

Table 5.9: Environment Agency guidance on licence capping (extracted from letter of 15 Nov 2021)

5.52. We have therefore calculated the average groundwater abstraction during the RA six-year period 2010-2016 (April 2010 – March 2016), compared it to the average of the period April 2016 – March 2021 and assessed whether there would be any planned groundwater abstraction growth up to 2030. No filtering for any outages took place at this stage, although the EA guidance allowed for removal of ‘unrepresentatively low periods of abstraction’.

5.53. **Table 5.10** shows the calculated figures for the Central region. The numbers indicate that, from the baseline period (2010-2016) to date (2016-2021), there has been no overall increase in groundwater abstractions, in the Herts and North London (HNL) EA area (Mid Chilterns, Upper Lee and North Essex Chalk water bodies). Similarly, there has been no substantial increase in abstractions for the Upper Bedford Ouse water body.

The numbers show the volumetric risk to potential licence/normal DO/1 in 200 DO reductions if the capping is at Recent Actual, compared with the potential licence/normal DO/1 in 200 DO reductions if the capping is at Max Peak.

Licence Volumes at Risk based on Recent Actual (evaluation based on the average of 2010-2016 abstraction)			Licence Volumes at Risk based on Max Peak (evaluation based on the maximum weekly abstraction in the period 2010-2016)		
Risk to Average Licence	Risk to Normal DO	Risk to 1:200 DO	Risk to Average Licence	Risk to Normal DO	Risk to 1:200 DO
82.61	46.29	27.86	82.61	46.29	6.02

Table 5.10: Recent actual & max peak GW abstractions calculations for Central region

5.54. Most of our waterbodies are not in good WFD status according to the EA WFD assessments because they are failing on several parameters (e.g. water quality, river morphology and biodiversity). Notably this also includes ‘flow, not supporting good status’ which is considered to be affected by groundwater abstraction. However, based on the EA guidance as presented in **Table 5.6,** there is no planned growth in abstraction so our licences should be capped at Max Peak. We can implement this by using aggregate six-year rolling licence caps on our sources, to protect these catchments from a deterioration in status. These will be set at Recent Actual values, but with an allowance to abstract up to the Max Peak values within that rolling period in any one year. Any changes from the proposed licence capping set out above, are likely to be small and are not expected to be material to WRMP24.

5.55. It should also be noted that the current ‘No Deterioration’ assessment compares the 2010-2016 RA period with 2030, but the principle of ‘No Deterioration’ will stay in place and is likely to be fully enforced by the EA beyond 2030. This is when demand and hence abstraction may start to increase. It is also likely that criteria for capping the licences will become more stringent in the future and there is the potential for licences to be capped at RA rather than Max Peak.

5.56. The theoretical impact of Recent Actual & Max Peak capping of our groundwater abstraction licences in the Southeast and East regions are shown in **Table 5.11**. If the 1 in 200-year drought DO is considered, capping our licence volumes in these regions based on Recent Actual, would result in a net loss of DO that is higher than if the Max Peak scenario was selected.

	Licence Volumes at Risk based on Recent Actual Average of 2010-2016			Licence Volumes at Risk based on Max Peak Max year in 2010-2016		
	Risk to Average Licence	Risk to Normal DO	Risk to 1:200 DO	Risk to Average Licence	Risk to Normal DO	Risk to 1:200 DO
Southeast region East Kent GW bodies	**27.77**	**14.44**	**11.74**	**20.41**	**8.69**	**6.11**
East region North Essex Chalk Brett & Stour catchments	**6.03**	**5.98**	**5.58 (<2) see below**	**5.27**	**5.22**	**4.83 (<2) see below**

Table 5.11: Recent, actual & max peak GW abstractions calculations for the Southeast and East regions

5.57. Although the above volumes are theoretically at risk, correspondence with the EA Kent and South London team has confirmed that the environmental investigations and abstraction reductions have already been implemented within our Southeast region. This means that further capping of licences is not required in AMP7 or AMP8. Several of our licences within the Dour catchment are time limited and their sustainability will be reviewed in AMP8 as part of the licence renewal process. If further reductions are identified as being required at this point, the implementation of any reductions would take place in subsequent AMPs (AMP9 and beyond).

5.58. For our East region, a 5.58Ml/d reduction has been agreed with the EA following an AMP7 WINEP investigation and options appraisal, which will be incorporated into the five-year rolling licence cap. Since this will not affect the annual average, we have investigated the impact of the reduction on the resilience of this water resource zone through the Pywr model, described previously. This indicates we will be able to manage the reduction without impacting Level of Service commitments using existing resources and infrastructure changes already planned in AMP7. Therefore, the impact on ADO is effectively less than 2Ml/d, based on the 2030 supply-demand balance for this WRZ. The resilience testing and conjunctive use options investigated through the Pywr model are described in **Chapter 7**.

5.59. We have also been in discussion with the EA area offices (predominantly Hertfordshire and North London) in relation to the groundwater body investigations. The EA have indicated that licence capping should take precedence over the longer-term ‘environmental destination’ reductions described below. However, it has been agreed that any groundwater body investigation which identifies the need for further sustainability reductions beyond those agreed for implementation in AMP8 will take place in AMP9, or beyond in line with the environmental destination scenarios described previously.

The agreed volumes for reduction of abstraction within the AMP8 Water Industry National Environment Programme (WINEP) are provided in **Table 5.12**.

WRZ	1 in 200 ADO	1 in 200 PDO
WRZ1	4.08	0.00
WRZ2	0.60	1.40
WRZ3	8.52	1.95
WRZ4	0.00	0.00
WRZ5	7.19	6.00
WRZ6	0.00	0.00
WRZ7	0.00	0.00
WRZ8	0.00	0.00
Total	20.39	9.35

Table 5.12: AMP8 WINEP abstraction reductions based on 1:200 (excluding any ADO licence relocation figures)

5.60. We have used the 1 in 200 year return period since for AMP8, the plan remains at a 1 in 200 year drought resilience. As described above, the WRZ8 reductions due to capping will take place in the end of AMP7 (so zero with regards to AMP8 SRs) and no reductions will take place in WRZ7 in either AMP7 or AMP8.

Longer-term environmental destination

5.61. The concepts of environmental destination and environmental ambition were introduced by the EA for the WRMP24 round of planning. This was to support regional groups and individual water companies to take account of long-term environmental water resources needs when developing their plans.

Environmental destination is the total volume of abstraction reductions that is likely to be needed by 2050 to improve the current status of the environment.
Environmental ambition is the pace at which each water resources region decides to reach the environmental destination targets[82].

5.62. The initial targets for our environmental destination were set by the Environment Agency. These were based on their analysis of the Catchment Management Strategy (CAMs) ledgers and policy around Environmental Flow Indicators (EFIs). These generated three levels of abstraction reduction, which are described below.

[82] Meeting our future water needs: a national framework for water resources - GOV.UK (www.gov.uk)

- 'Business as Usual' (BAU) - this reflects the application of the current policy and excludes catchments where previous investigations have indicated that abstraction reductions are not warranted from a cost/benefit point of view.
- 'Business as Usual plus' (BAU+) - as above, but with abstraction reductions associated with several of the excluded catchments reimposed.
- 'Enhanced' - as above, but with additional measures to protect currently undesignated vulnerable habitats.

5.63. These analyses were carried out by the EA using their CAMs ledger approach and the simplified assumption that the benefits from groundwater abstraction reduction are the same during low flow conditions as they are during normal and high flow conditions in the river. As discussed in the next section, there is good evidence to suggest that this is not the case in all catchments, because surface-groundwater interactions are more complex than this. We therefore worked with the EA to understand the range of sensitivity of the abstraction reductions proposed under BAU and BAU+ to surface-groundwater mechanisms.

5.64. This resulted in three levels of abstraction reduction that were evaluated in the WRSE investment modelling used to identify our preferred WRMP24:

- Low – equivalent to the BAU scenario, but at the lower end of sensitivity to surface-groundwater interactions.
- Medium – equivalent to BAU at the EA default surface-groundwater assumptions. This is also within 1Ml/d of the BAU+ scenario if the lower end of sensitivity to surface-groundwater interactions is used in the calculations.
- High – equivalent to the Enhanced scenario with the EA default surface-groundwater assumptions.

5.65. The three environmental destination scenarios discussed above apply to the 2050-time horizon, but do not describe the strategy and timing for achieving those abstraction reductions. We therefore worked with the EA to develop and agree a strategy that outlines the timing and delivery, by source, (where appropriate) of those scenarios. This concept is described below and was developed based on the following three principles:

- We are committed to progressively ending unsustainable abstraction[83] where this is identified. Where there are known potential impacts, then sources are scheduled for reduction in AMP8 (2030), or as soon as is practicably feasible. Beyond this, the strategy is designed to allow for investigation and reduction in abstractions identified as unsustainable across all catchments that have been identified by the environmental destination work.

- Our abstraction reduction strategy is adaptive and designed so that abstraction is reduced on a progressive, catchment-by-catchment basis. This will enable us to learn about observed benefits as the programme of

[83] This is not a formally defined phrase, but effectively means that we will end abstraction where it is causing unacceptable damage to the water environment

source reductions progresses. This will allow continuation, reduction, or cessation of the programme as appropriate, based on this improved information.

- Our abstraction reduction strategy is intended to provide a balance between the pace at which we end unsustainable abstraction and affordability, using the adaptive approach, as described above. This will allow us to incorporate monitoring and learning so that we only reduce abstraction where it will have a meaningful benefit on Chalk stream health, and we do so in a manner that ensures risks, such as groundwater emergence, can be managed.

5.66. The rationale and purpose of this strategy is described in **Appendix 5.4**. The resulting location and scheduling of abstraction reductions across our Central region is as shown in **Figure 5.3**.

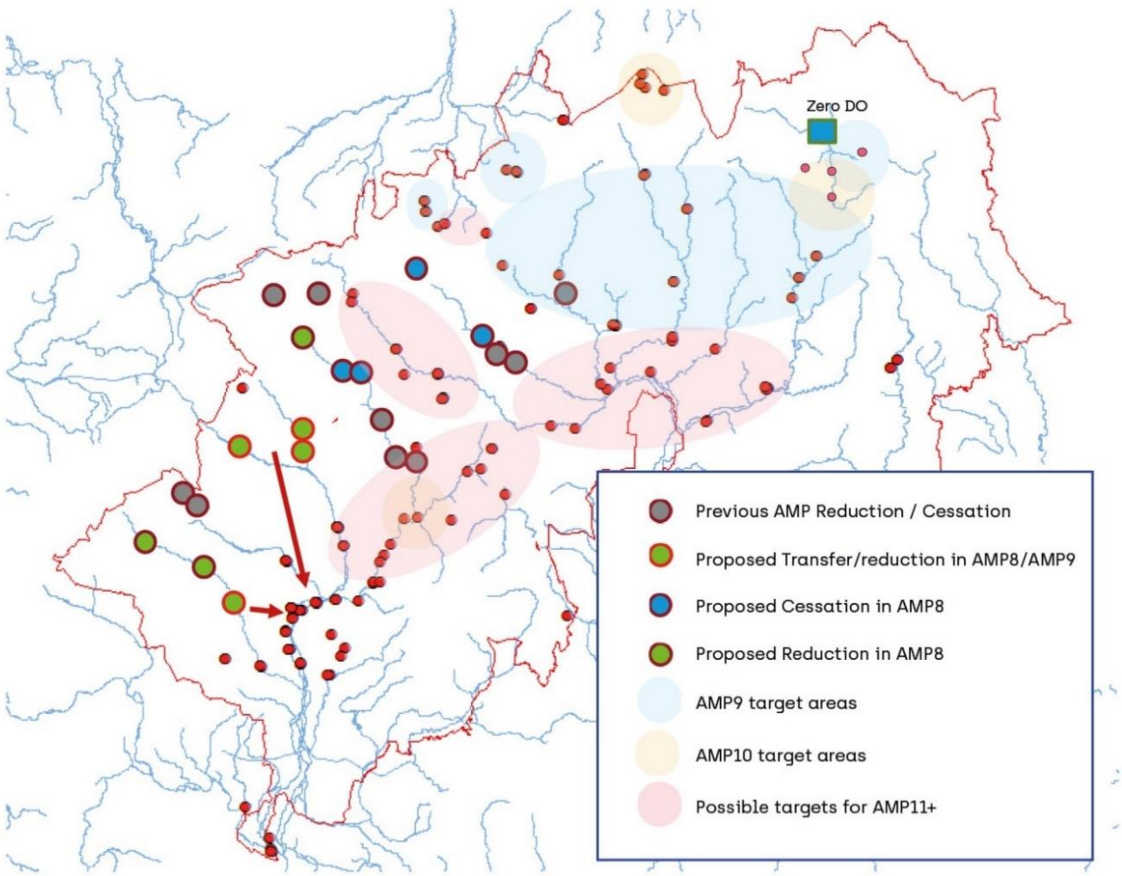


Figure 5.3: Environmental destination – our strategy for the Central region

As shown in Figure 5.3, our strategy for the Central communities concentrates initially (2020-2035) on only the Upper Colne and Lee, along with their tributaries (these are shown by the 'previous SR', AMP8 reductions and AMP9 reductions locations in the Figure). We also look to reduce abstraction in the Ivel and Cam. This is further supported by a licence transfer scheme that is designed to move abstraction away from the headwaters of the Colne and into the Mid-Colne below the Maple Lodge sewage works effluent discharge, where river flow is higher. More detail of our proposed strategy for accelerating abstraction reductions in the Colne, Lee and Ivel is provided below.

5.67. For the Southeast region, we have worked with the EA to better define the long-term ambition, because of consultation feedback. This is detailed in **Table 5.13**.

5.68. Reductions for the East region have been identified through our AMP7 (2020-25) WINEP investigations and will be in place by 2025/26. Significant further reductions will only be required under higher scenarios where the catchments that have been supported require further levels of protection.

5.69. This strategy results in the following range of environmental destination scenarios used by WRSE in the investment modelling described in **Chapter 8**. It should be noted that there is no sustainability reductions required in WRZ6.

WRZs 1-5	2029	2034	2039	2044	2049
	AMP8	AMP9	AMP10	AMP11	AMP12
Company alternative	20.39	65.15	94.23	110.76	126.76
Company central	20.39	65.15	104.83	140.56	187.16
BAU	20.39	68.15	107.13	143.89	185.79
BAU+	20.39	75.87	126.05	181.38	255.31
Enhanced	20.39	75.87	133.05	189.28	275.81
WRZ7	AMP8	AMP9	AMP10	AMP11	AMP12
Company alternative	0.80	0.80	0.80	3.00	4.40
Company central	0.80	0.80	0.80	3.00	4.40
BAU	0.80	0.80	0.80	3.00	4.40
BAU+	0.80	3.00	4.40	5.20	5.20
Enhanced	0.80	3.00	4.40	8.20	16.00

Table 5.13: Environmental destination for Central and Southeast regions – range of reductions (Ml/d)

NOTE: It should be noted that under the higher environmental destination scenarios there are significant reductions, or even complete cessation of abstraction of the groundwater sources in WRZ2 in the 2040 to 2050 period. This includes the Clay Lane sources. Those sources also experience most impacts from climate change, loss of DO associated with drought resilience and hydrogeological constraints during dry year summer events (which means ADO is lower than a simple summary of source MDO allowances). To avoid 'double counting' of these impacts, a reconciliation allowance has been included within the investment modelling that prevents the ADO in WRZ2 from falling below zero. This is significant for the 'high' (enhanced) environmental destination scenario, at around 24Ml/d. This means the effective net impact of the source reductions in 2050 for the Central region is around 253Ml/d from a supply-demand point of view.

WRZ8	DO reduction by 2050 (Ml/d)
BAU	0.73
BAU+	0.73
Adapt	6.99
BAU++	6.99
Enhanced	15.03

Table 5.14: DO reductions for the East Region (WRZ8)

5.70. Our environmental destination work is progressing alongside our WINEP investigations and options appraisals. The environmental destination requirements utilise the current EFIs based on the predecessor groundwater models to the Hertfordshire Chalk model in our Central region. As part of our ongoing work, we will work with the EA to refine the EFIs as well as the surface-groundwater factors. Based on available evidence, we consider that the range of reductions presented in **Table 5.13** provides a reasonable reflection of the likely range of groundwater abstraction reduction in our Central region (see **Appendix 5.4**). It covers both the range of EA scenarios and the variability in surface/groundwater interactions that underpins the abstraction reduction values generated from those scenarios. We will review and update future sustainability reduction requirements in our WRMP29 and beyond, which will include revisions to the above tables.

Acceleration of abstraction reduction and the 'Chalk Streams First' concept

Chalk Streams First and Accelerating Abstraction Reduction

Our Chalk streams are precious, particularly in the upper reaches where there are fewer physical man-made changes and better water quality. Our regulators and environmental stakeholders support our objectives to cease unsustainable abstraction as quickly and affordably as we can. We have therefore worked with and taken feedback from the Environment Agency, Natural England and stakeholders such as Chalk Streams First (who are primarily focused on the Colne and Lee catchments in our area) and RevIvel (who are focused on the Ivel) to:

1. Define what is meant by 'unsustainable' abstraction.
2. Find ways to use other resources through water capture and transfers to allow us to address deficits as early as we can.

Within this section we discuss the concept of re-capturing water that is released through abstraction reduction in the upper catchments via existing intakes in the lower reaches of the Rivers Colne, Thames and Lee. This water can then be transferred back to supply those customers that currently rely on the Chalk groundwater. We also highlight the amount and timing of abstraction reduction that we have planned over the next 27 years within the upper reaches and tributaries of the Colne, Lee and Ivel.

In **Chapter 7** we outline the options that were considered for capturing and transferring water and in **Chapter 9** we provide our preferred strategy for capturing and transferring water.

5.71. As noted by the 'Chalk Streams First' group of NGOs, the reduction in abstraction from upper Chalk catchments has the potential to result in increased flows downstream under certain conditions and in certain locations. This can potentially allow us to accelerate the pace of abstraction reduction across the Colne catchment in two innovative ways.

- Evaluating and incorporating these increased flows when considering the benefits of supply options seeking to use surface water abstracted from the River Thames or River Lee.
- Using the increases in flows in rivers to increase groundwater abstraction in lower catchment areas, without harming the environment. We refer to this as 'licence relocation.'

5.72. In relation to the first element, we measure the benefit to our water resources through Deployable Output. This represents the amount we can use from our sources under design drought conditions, as described in above. We have worked with Thames Water Utilities (TWU) and the EA to understand the benefit to TWU's Deployable Output from our abstraction reductions, which we have then sought to transfer as described in **Chapter 9**. This work is described in **Appendix 5.6**. We currently estimate that the benefit to TWU's DO is around 17% of the reductions we experience in relevant Chalk groundwater sources (i.e., if we reduce by 100Ml/d, then TWU's surface water DO increases by 17Ml/d).[84]

For rdWRMP24, our analysis has concluded that the benefit to Deployable Output is 17% of the abstraction reduction. However, if further monitoring and modelling shows that the actual benefit is a greater percentage than this, we have ensured the infrastructure options described in **Chapter 9** are flexible enough to allow any additional benefit to be realised as soon as they are confirmed by further studies and operational experience.

5.73. Our estimates of the amount of baseflow benefits that we might expect to see in the Chalk rivers are conservative (i.e. they ensure we do not over-estimate the benefit). This is because we have included them in the investment modelling described in **Chapter 8** as an automatic benefit to DO that Thames Water Utilities (TWU) receives once we cease abstraction. This means that TWU will defer investment and accept the potential risk to their customers' security of supply by incorporating these benefits within their own WRMP24, so they need to be conservative to satisfy their primary duty of security of supply under the Water Act.

5.74. These estimates will be reviewed as more detailed information becomes available via monitoring data and enhancement of groundwater models. There may be a positive outcome to the potential risk, which is outlined within the appraisal of our WRMP24 alternatives set out in **Chapter 9**. Nevertheless, even this conservative estimate represents a benefit of between 16 and 24 Ml/d to TWUs DO from our lower and mid environmental destinations. Due to the existing and planned connectivity between us and Thames Water contained within this WRMP24, Thames Water can share these benefits with us, through a number of stages of our planned 'Connect 2050' programme, which provides the necessary infrastructure upgrades throughout the 2025-2050 period (see **Table 5.13** below that describes the pace of abstraction reduction in the relevant catchments).

[84] Because many of the sources included in our environmental destination are in other catchments or areas that are not expected to benefit flows in the Colne or Lee this equates to around 13% of our total subtraction reductions. Details of these calculations are provided in **Appendix 5.6**

5.75. For the River Ivel we have assumed a higher rate of benefit (32%), because of the different hydrogeology and dip of the Chalk strata in that catchment (which is located on the northern side of the Chalk escarpment. The water that flows down the Rivers Hiz and Ivel should help abstraction and hence yield at Grafham Water which we can use, provided this does not exceed the capacity of the infrastructure to transfer it. We are currently investigating the hydrogeological behaviour of the catchment. For this WRMP, we have therefore assumed that the planned reductions of 17.4Ml/d which we have included for those catchments (they form part of the summary figures described previously for the Central region) should effectively offset the estimated climate change reductions that Anglian Water have anticipated within the planning horizon (5.6Ml/d) and hence allow us to maintain the full use of our Grafham yield.

5.76. As well as considering the surface water benefits, we have worked with the EA to assess the feasibility of moving average deployable output (ADO) from upstream groundwater sources in the River Colne's tributaries, to downstream sources contained in the Lower Gade and Middle Colne. Artificial discharges from wastewater treatment works and the size of the rivers at this point, mean they are much less vulnerable to low flows. Our groundwater modelling has shown that the net impact on those flows would be negligible.

5.77. This is proposed to take place in AMP8, to accommodate an ADO relocation of c14Ml/d, with no changes to peak DO. We have completed groundwater and flow modelling plus initial environmental assessments, and the scheme appears viable from an environmental point of view. Discussions are ongoing with the EA and Natural England regarding potential impacts on the Colne Valley lakes system and particularly the designated sites. These discussions will continue into the early part of AMP8 as part of the WINEP. At this stage, the EA have indicated that the abstraction reductions in the Colne tributary catchments associated with this scheme are voluntary, rather than being a core WINEP requirement for AMP8. We have also agreed with the EA that the transfer should be assumed to be limited to 10 years. This allows the benefits to the upper catchments to be accelerated but does not risk the ambition to enhance flows in the Middle Colne, which feature in the BAU+ scenario in the longer term. This represents an acceleration of proposals, as ultimately the Blackford Group licence is planned to be returned to its current value. We have therefore developed our plan so that this acceleration is optional and outside of the strategic investment needs – except for the schemes enabling works, as presented in **Chapter 9,** as this temporary acceleration does not affect the rest of the plan.

5.78. The 'lower end' of the overall abstraction reductions that we anticipate delivering within the tributaries of the Colne, Lee and Ivel from 2023 through to 2050 are provided in **Table 5.15**. This includes the abstraction reductions we are committed to delivering in the current (2020-25) period.

Catchment	2020 Deployable Output (Ml/d)	Cumulative reduction by the end of each period						
		2020-25	2025-30	2030-35	2035-40	2040-45	2045-50	Final percentage reduction
Colne tributaries	72.6	17.4	45.5	45.5	47.0	47.0	48.0	66%
Upper Lee and tributaries	116.1	15.9	21.2	43.5	49.4	60.1	75.1	65%
Ivel and Hiz	20.4	0.0	0.0	8.0	11.6	17.4	17.4	85%

Table 5.15: Summary of the **lower** scenario cumulative abstraction reductions in the tributaries and upper reaches of the Colne, Lee and Ivel

5.79. This lower range scenario represents a reduction from current levels of abstraction of 66% in the Colne tributaries, 65% in the Upper Lee and tributaries and 85% in the Ivel/Hiz. The reductions are front end loaded, with most of them (70%) occurring before 2035. As described in **Chapter 9**, this is achieved through contributions from the Grafham transfer upgrade (being delivered now), the transfers that reflect the CSF concept in the 2025-30 period and the Grand Union Canal transfer in the 2030-35 period.

This could be increased as shown below under the middle and higher environmental destination scenarios. As shown in the **Table 5.16**, the strategies are similar until 2035, after which they could increase the level of reduction if our monitoring and analysis (as described under the Monitoring Plan in **Chapter 9**) require it.

Catchment	2020 Deployable Output (Ml/d)	Cumulative reduction by the end of each period						
		2020-25	2025-30	2030-35	2035-40	2040-45	2045-50	Final percentage reduction
Colne tributaries	72.6	17.4	45.5	47.0	49.0	49.0	49.0	67%
Upper Lee and tributaries	116.1	15.9	21.2	45.7	51.6	71.4	98.2	85%
Ivel and Hiz	20.4	0.0	0.0	8.0	11.6	17.4	17.4	85%

Table 5.16a: Summary of the **medium** scenario cumulative abstraction reductions in the tributaries and upper reaches of the Colne, Lee and Ivel

Catchment	2020 Deployable Output (Ml/d)	Cumulative reduction by the end of each period						
		2020-25	2025-30	2030-35	2035-40	2040-45	2045-50	Final percentage reduction
Colne tributaries	72.6	17.4	45.5	47.0	48.0	48.0	49.0	67%
Upper Lee and tributaries	116.1	15.9	21.2	43.5	53.4	73.2	98.2	85%
Ivel and Hiz	20.4	0.0	0.0	8.0	11.6	20.4	20.4	100%

Table 5.16b: Summary of the **higher** scenario cumulative abstraction reductions in the tributaries and upper reaches of the Colne, Lee and Ivel

We are aware that reducing groundwater abstractions can carry a risk of groundwater emergence and increased surface water flows during flood events. We have already had engagement with the EA and GLA on this issue and have an AMP8 WINEP investigation that will examine the risk of groundwater emergence from abstraction reductions. We will continue with our investigations and engagement as the abstraction reduction programme proceeds, as outlined in our Monitoring Plan in Chapter 9. The most obvious way to manage this is through licence conditions (or Section 20 agreements) where we abstract groundwater under high level/flow conditions. Currently, we have not included any costs for associated infrastructure to do this, as it is envisaged this can be achieved using existing abstraction infrastructure.

Climate change

5.80. The DOs generated using the above methods are representative of the reliable outputs that could have been achieved in the past (but with current levels of demand and abstraction). However, the DOs that might be available in a current or future drought could vary in response to the changing climate. The impact of climate change on supply was evaluated using the common approach adopted across the WRSE region[85]. This allowed us to understand how our supply capabilities could vary across a range of 20, carefully selected future scenarios, to represent the range of uncertainty identified through the UK Climate Projections 2018 (UKCP18) global climate models.

5.81. The selected approach was designed to be compliant with the EA Supplementary Guidance on Climate Change and used the EA commissioned report which reviews UKCP18 and approaches to climate change assessment, to support the climate change vulnerability assessment.

[85] https://www.wrse.org.uk/media/kbekodcv/wrse_file_1335_wrse_ms_climate-change.pdf

The climate change modelling assessment, which was commissioned by WRSE jointly with Affinity Water, found the use of 28 total Regional Climate Model and Global Climate Model projections to be the most suitable for the region. This is because these provided spatially coherent assessments of the impacts and covered the range of temperature and rainfall changes seen in other UKCP18 products. This project produced bias-corrected timeseries of rainfall and PET (from which change factors were also calculated) from the RCM projections, and calculated rainfall and temperature (from which PET was calculated) change factors from the 28 GCM projections.

5.82. These change factors were applied to the same probabilistic timeseries (200 per combination of timeline and emissions scenario) that were used to generate the baseline DOs. This provided a range of impacts at different points in time (2020- 40; 2040-60; 2060-80; 2080-2100). Scaling in the WRMP was then applied by interpolating between those mid points. We treated all probabilistic projections as being equally likely. In the absence of other information, we also treated the 28 spatially coherent projections as equally likely.

The climate change scenarios that were used all reflected the RCP 8.5 emission scenario. For the PR24 business plan, it was necessary to identify which of those scenarios were reflective of the Ofwat 'low' common reference scenario, which is represented by the median change factors generated by the RCP2.6 emissions scenario. This was done by generating monthly change factors for the UKCP18 probabilistic data, and then identifying which run of the RCP 8.5 scenarios matched in terms of PET and rainfall. From this analysis, we identified that WRSE model run '20' closely matched the RCP 2.6 median, so this was used in the PR24 business plan comparison described in **Chapters 8 and 9.**

5.83. Baseline Vulnerability Assessments (BVA) have been undertaken where the DO impact from climate change is used and an assessment of the uncertainty (as a %) between the wet and dry range, to classify whether a zone is high, medium, or low vulnerability.

5.84. The categories are summarised as follows.

- Highly Vulnerable Zones to climate change where both the 'mid-range' forecast impacts and the uncertainty between 'wet' and 'dry' scenarios is large.
- Medium Vulnerability Zones were those WRZs where the most likely mid-range impact was small (<5% of WRZ DO), but where the range of predictions between the 'wet' and 'dry' suggested substantial uncertainty (up to 15% of WRZ DO).
- Low Vulnerability Zones, where the impacts of climate change are small and the uncertainty between 'wet' and 'dry' scenarios is also low (<5% of total WRZ DO). These WRZs are therefore considered to be low vulnerability.

A summary of the results of our BVA is provided in **Figure 5.4**.

WRZ	Impact (Mld)	% of WRZ DO (ADO)	% uncertainty of range (based on variance of wet / dry scenario on source water)	Difference Wet/Dry scenario	Comment/Rationale (uncertainty)	BVA Classification
1	-1.20	1%	Groundwater and licence constrained	Small		3 Low
2	-43.28	35%	Groundwater and licence constrained	Large	*Relates to the Clay Lane group which is hydrogeologically*	1 High
3	-6.25	4%	Does not include for Grafham - is this taken into account elsewhere?	Small		3 Low
4	0.00	0	Groundwater and licence constrained	Small		3 Low
5	-2.64	5%	Groundwater and licence constrained	Small		3 Low
6	0.00	0	Groundwater and licence constrained	Small		3 Low
7	-1.16	3%	Groundwater and licence constrained	Small		3 Low
8	0.00	0	Groundwater and Ardliegh(Ardliegh is deemed low impact due to the proportion of take by Affinity Water)	Small		3 Low

Figure 5.4: Baseline Vulnerability Assessment (BVA)

5.85. A brief explanation of why the zones fall into each classification is as follows.

- Groundwater and licence constraints result in low impact from climate change and low variance between wet (winters) and dry (summer).
- The Clay Lane sources experience most impacts from climate change; the loss of DO is associated with drought resilience and hydrogeological constraints during dry year summer events.
- Where groundwater sources are impacted by drought, this relates to 2- or 3-year dry winters where the impact accumulates through a sustained lack of winter recharge, which is not a strong feature of climate change risk.
- The assessment assumes that future loss of groundwater will be replaced by the GUC option which means that the new source of water will be resilient to climate change.

Water Resource Zone	Climate Change Impact (Ml/d) by 2100 (absolute change) from reported pathway (WRSE scenario 909)		
	1 in 500	1 in 200	1 in 100
WRZ1	-1.20	-1.25	-1.38
WRZ2	-43.28	-45.06	-49.78
WRZ3	-6.25	-6.51	-7.19
WRZ4	0.00	0.00	0.00
WRZ5	-2.64	-2.75	-3.04
WRZ6	0.00	0.00	0.00
WRZ7	-1.16	-3.18	-3.69
WRZ8	0.00	0.00	0.00

Table 5.17: Climate change impact on DO

5.86. The results of our climate change impact on DO modelling (**Table 5.17**) do not differ significantly from the results of investigations for WRMP19. Zones 4, 6 and 8 do not have a noticeable impact from Climate Change. Zones 1, 2, 3, 5 and 7 are all impacted by climate change with the most significant DO impact in Water Resource Zone 2.

The 'median' of the generated range was used to evaluate the impact of climate change under our central forecast. The wettest and driest from the range were used to represent our upper and lower bound predictions. A summary of the impacts of climate change on our source capabilities is provided in **Table 5.15**. These are taken off our baseline DO in accordance with the WRPG requirements. This represents a slight reduction in climate change allowances in comparison to WRMP19, which included a total reduction of 41Ml/d in ADO across our Central Region (WRZs 1-6) by 2080.

Bulk transfers

5.87. We have several existing arrangements that enable us to rely on the quoted DO up to our stated Levels of Service (1 in 200-year drought resilience), including bulk supply agreements or similar contracts with neighbouring companies for bulk water imports. We also have arrangements to export water in bulk to neighbouring companies. **Table 5.18** provides a summary of the existing bulk transfers and their associated contractual volumes. These volumes represent the respective capacity under the applicable agreement or arrangement, rather than utilisations that can vary depending on specific circumstances and needs.

Please see **Appendix 5.7** for more information on the transfers between Thames Water and Affinity Water.

ID	Providing company	Receiving company	Maximum capacity at average (Ml/d)	Maximum capacity at peak (Ml/d)
1	Anglian Water	Affinity Water WRZ3	91.00	109.00
2	Thames Water	Affinity Water WRZ4	12.00	24.00
3	Thames Water	Affinity Water WRZ4	0.20	0.20
4	Thames Water	Affinity Water WRZ4	2.00	2.00
5	Thames Water	Affinity Water WRZ6	2.27	2.27
6	Cambridge Water	Affinity Water WRZ5	0.30	0.30
7	Affinity Water WRZ3	Anglian Water	0.14	0.14
8	Affinity Water WRZ6	South East Water	36.00	36.00
9	South East Water	Affinity Water WRZ7	2.00	2.00
10	Southern Water	Affinity Water WRZ7	0.07	4.00

Table 5.18: Summary of existing bulk transfers and associated contractual volumes

5.88. We have a statutory arrangement with Anglian Water for a supply from Grafham Water Reservoir to our WRZ3. The maximum amount of water we are entitled to take, under average conditions, is 91 Ml/d. However, historically, we have only used Grafham water in zones where the pipes are already 'conditioned' to take the water. When we have temporarily used Grafham water in areas not typically served by the transfer, we have observed changes in taste, odour, and discolouration of supplies due to the different chemical nature of the water. To ensure we can maintain our statutory duties for drinking water quality once we allow Grafham-derived water to be distributed more widely within our network, we are already in the process of installing a conditioning plant at Sundon (point of entry to our supply system). This will ensure that the full 91 Ml/d average capability can be transferred. The construction of the conditioning plant is completed and will enter service in late 2024. Our WRMP24 therefore assumes that the new conditioning plant will be in operation by the first year of our planning period (2025/26). As such, we have used the full average capacity of 91 Ml/d within our investment modelling. This supply can also increase its transfer up to 109 Ml/d during peak demand conditions and this has been included within the Pywr modelling when calculating the overall DO for our WRZ3.

5.89. We have two existing groundwater derived imports to our Southeast region (WRZ7), from South East Water at Barham (2 Ml/d average and peak) and Southern Water at Deal (0.07 Ml/d average and 4 Ml/d peak). These imports are both subject to ongoing agreements.

5.90. In our East region (WRZ8), we operate a shared reservoir with Anglian Water as part of a mutual statutory arrangement. We are entitled to take 50% of the output from the reservoir but have agreed a share of 70/30 in favour of Anglian Water, until March 2025. As illustrated in our WRMP19, we will revert to a 50/50 share from April 2025 with the aim of maximising this resource in the event of a drought. This equals 8.6Ml/d as ADO under a 1 in 500 year drought for our WRZ8. We have therefore included this new allocation in our investment modelling and planning tables.

5.91. We also retain several emergency inter-company connections that can provide additional resilience, but these are not large enough to be considered bulk transfers. They are used to meet customer demand in instances when our normal supplies are insufficient, for example, during periods of drought, high demand or outage.

Outage

5.92. Outage is defined as a 'temporary loss of deployable output' within the UKWIR report 'Outage allowances for Water Resource Planning' (UKWIR, 1995). Outage events can be classed as 'planned' because of the need to carry out maintenance or 'unplanned' caused by events such as pollution of a source, power, or system failures. The WRPG requires that companies provide outage calculations for each WRMP.

Methodology

5.93. WRSE commissioned a methodology for regionally consistent outage recording and calculations.

The objectives of this methodology were as follows.

- Complete a review and gap analysis, to understand the current interpretations and methods for each company's reporting of outage against regulatory requirements and forecasting of outage allowance for WRMPs and regional plans.
- Propose a means to provide consistent adherence to the latest guidelines and develop a consistent methodology for the recording and calculation of outage and forecasting outage allowances.

5.94. A WRSE Outage Modelling Tool (OMT) template was produced. This template was used to process historic data in each WRZ in Central and Southeast regions and calculate the most appropriate outage allowance. The OMT was used to screen and process outage events in line with the WRSE-consistent methodology.

5.95. For our East region (WRZ8), there was no need to collect detailed outage data historically, because of a significant surplus in the supply-demand balance and substantial headroom in licences, which results in most outage being recovered fully within a short time. However, future sustainability reductions could potentially generate a deficit in this zone. This means that an outage assessment is required. Whilst there is a lack of detailed event data, outage can be inferred historically through a knowledge of how the sites are operated.

Although abstraction is often below average DO, due to a lack of demand, there is an optimal abstraction regime from every source. If this falls below a threshold at any given source, it is very likely that the loss of output was due to a legitimate outage event.

Further detail on the outage assessment carried out for our three regions can be found in **Appendix 5.2**.

Our outage allowance

5.96. The results of the outage modelling for Central and Southeast regions for both DYAA and DYCP are illustrated in **Table 5.19** and **Table 5.20**. The results are broken down by WRZ and distribution percentile.

WRZ	MC P70 Ml/d	MC P80 Ml/d	MC P90 Ml/d	MC P95 Ml/d
WRZ1	3.1	4.4	7.1	8.9
WRZ2	1.0	1.1	1.3	1.5
WRZ3	9.7	11.0	12.7	14.3
WRZ4	5.6	6.6	8.9	11.5
WRZ5	2.9	3.4	4.1	4.8
WRZ6	0.1	0.1	0.2	0.2
WRZ7	1.6	2.0	2.6	3.1

Table 5.19: Results of outage modelling for Central and Southeast regions for DYAA

WRZ	MC P70 Ml/d	MC P80 Ml/d	MC P90 Ml/d	MC P95 Ml/d
WRZ1	3.5	4.1	4.8	5.5
WRZ2	2.9	3.3	3.9	4.6
WRZ3	5.0	5.8	7.2	8.1
WRZ4	3.4	3.9	4.8	5.8
WRZ5	1.8	2.1	2.6	3.0
WRZ6	2.4	2.7	3.4	4.4
WRZ7	0.4	0.5	0.6	0.7

Table 5.20: Results of outage modelling for Central and Southeast regions for DYCP

5.97. For our WRMP24, we have generated a probabilistic model that complies with the recommendations contained in the 2017 UKWIR WRMP 2019 Methods – Risk Based Planning Guidance. This states that 'although academic theory might suggest a lower percentile, practicalities associated with physical resource management and the management of drought risk indicate that a planning allowance in the range of 75% to 90% should be used'.

This guidance indicates that if there is any potential correlation between outage and drought risk, then the upper end of this range should be used, with higher percentiles if there is a notable correlation (coefficient > 0.25). We have determined that most of the outage risks do not relate to hot weather or periods of low flows/groundwater levels, but the lack of storage, spare abstraction and treatment capacity means that perceived risks will be high, going into a drought.

The UKWIR guidance makes it clear that, in the absence of correlation between outage and drought, perception over risk during a drought event should be the guiding consideration. As a result, we have opted to use the 90th percentile of the outage probability range. A comparison between the WRMP24 and the WRMP19 assessment is provided in **Table 5.21** below. To aid the comparison, the outage values are presented at the 95th percentile as for WRMP19.

WRZ	Planning scenario	WRMP19 P95 Outage Ml/d	rdWRMP24 P95 Outage Ml/d	Difference Ml/d	WRMP19 1:500 DO Ml/d	Difference as % of DO
WRZ1	DYAA	5.76	8.9	3.1	104.26	3.0%
WRZ2	DYAA	4.03	1.5	-2.5	117.4	-2.2%
WRZ3	DYAA	12.5	14.3	1.8	149.23	1.2%
WRZ4	DYAA	15.86	11.5	-4.4	258	-1.7%
WRZ5	DYAA	2.84	4.8	2.0	54.39	3.6%
WRZ6	DYAA	6.72	0.2	-6.5	205	-3.2%
WRZ7	DYAA	1.33	3.1	3.5	45.8	7.6%
Total	DYAA	49.04	44.3	-3	934.08	1%
WRZ1	DYCP	1.2	5.5	4.3	139.18	3.1%
WRZ2	DYCP	0.59	4.6	4.0	157	2.6%
WRZ3	DYCP	2.7	8.1	5.4	173.3	3.1%
WRZ4	DYCP	2.31	5.8	3.5	263.04	1.3%
WRZ5	DYCP	0.75	3.0	2.3	63.62	3.5%
WRZ6	DYCP	2.88	4.4	1.5	262	0.6%
WRZ7	DYCP	1.01	0.7	-0.3	52	-0.6%
Total	DYCP	11.44	32.1	20.7	1110.14	2%

Table 5.21: A comparison between the WRMP19 and WRMP24 Outage assessments

5.98. The differences in outage values between WRMP19 and rdWRMP24 are due to the following reasons.

- An additional five years of outage event data in all WRZs (circa 80% increase in the number of events).
- Accounting for operational outage recovery in the calculation of DYAA allowance for WRZ6. The significantly lower DYAA outage values at WRMP24 are due to DYAA outage recovery applied at WRMP24 at the surface water sources, where peak DO is significantly higher than average DO.

Finally, as we did in WRMP19, we have assumed zero outage for our East region (WRZ8) on an annual average basis and have not calculated outage for peak. This is because abstraction reductions within the region mean that the average groundwater group DO is both licence constrained and has a very high peak to average ratio, and can be conjunctively used with the storage in Ardleigh. Any outage at a single borehole or source, can therefore be supported by increased output that can then be recovered on an average basis.

Treatment losses

5.99. Treatment losses represent a minor component of our water supply, accounting for less than 2% of the water we normally put into supply. We have not updated the assessment undertaken for our WRMP19, because it remains representative of the most likely losses from our treatment processes.

Drinking water quality

5.100. Water quality considerations are an essential part of water resources planning. They may:

- put at risk, from diffuse or point source pollution of raw water, the amount of water available to us to treat and supply;
- constrain how we transfer water within our water supply area.

As part of our planning process, we have reviewed the implications that any risks to water quality might have on our WRMP24. This evaluation includes risks to our current sources and consideration of the water quality implications of new supply options. Through the WRSE resilience framework (see **Appendix 8.2**), we have identified where there are water quality risks that could affect the resilience of our existing network and evaluated the interactions between these and the potential water resources investments in our regions. These are described within **Chapter 9**. The water quality implications of new water resources have been considered through both the design of new schemes (which include all required mitigation to ensure wholesome water supply) and within the WRSE resilience framework. Resilience scores of different strategies are described within **Chapter 9**.

Invasive Non-Native Species (INNS)

5.101. Although the risk of spreading INNS through water courses is significant on a national level, potential INNS risks (terrestrial and aquatic) associated with our current operations and management of our sites are being managed through our Biodiversity Programme. The risk from INNS is therefore confined to our new proposed sources and transfers, as explained in **Chapter 7**.

Other issues

5.102. As detailed in WRMP19, there is a risk to our groundwater supplies in the Blackford Group caused by the construction of the High Speed 2 rail tunnel. This is associated with potential aquifer disturbance and hence turbidity. This is being managed in the current AMP7 period (2020-25) through the development of additional transfers from Thames Water at Perivale and Cockfosters, along with temporary shutdown and peak licence transfer within the Blackford Group. The relevant work on HS2 is programmed to be complete prior to the start of the WRMP24 period, and any residual aquifer disturbance that affects our sources will be managed through appropriate new treatment plant, which will be funded by HS2 under covenant.

5.103. Following feedback from the EA as included in the Defra letter dated 21st August 2024, we have been asked to include an adaptive scenario in our final plan to mitigate the potential impact of the River Thames Scheme (RTS) on the deployable output (DO) of our Chertsey groundwater source.

The RTS involves the construction of a new river channel in two sections – running from Egham Hythe to Chertsey and the River Thames at Laleham to Littleton North Lake. These two channels will provide additional capacity for the River Thames during periods of high flow, thereby decreasing the risk of a flood event on nearby properties. Consequently, these two additional channels will require minimum sweetening flows, which may impact on the DO of our CHERG Groundwater source, in our Wey community.

As outlined in **Chapter 9** of our WRMP24**,** our AMP8 strategy is driven by utilisation of existing surplus water in our Wey community. This strategy is focused on addressing deficit risk associated with abstraction reductions elsewhere in our Central region. The additional pressure created by the potential DO loss at Chertsey GW source (and potentially Walton too) from RTS could result in a deficit in our Central region.
From the proposal currently put forward by the RTS, we will expect a derogation in the order of 27 Ml/d during average and up to 41 Ml/d during peak demand conditions. This impact is expected from the construction all the way to completion of the RTS, currently estimated in Winter 2030, however, there is still significant uncertainty regarding the operation of the scheme.

At the time of writing this section, further modelling work is being undertaken by consultants working on behalf of the RTS. The output of this work is expected to inform the risk on the DO of our sources in the area, so we can be more confident in the impact the scheme. We will continue to work closely with the RTS and the EA to further quantify such risks. Following feedback from DEFRA, we will look to report on the scheme through the annual review process.

6.Our baseline supply-demand balance

6.1. The main aim of a water resources management plan is to achieve a balance between the supply of and demand for water. We calculate the baseline supply-demand balance for each of our water resources zones (WRZs) as follows.

- **Water available for use (WAFU) or supply.**
- Minus **Water demand** (Distribution Input, (DI)).
- Minus **Target headroom.**

6.2. Water Available for Use, or WAFU, is the water that is available for supply within each WRZ, and it is equal to the Deployable Output (DO) minus outage and treatment losses, plus or minus the net imports and exports from the WRZ (as set out in the WRPG).

6.3. The WAFU calculation is the key initial calculation used for water resources investment, where a supply-demand balance of zero represents the point at which we can be confident we can provide a resilient water supply to our customers, as required by our statutory obligations. Although surpluses can be reported, the plan should show ways of utilising the surplus as part of the supply-demand solution.

6.4. We calculated a baseline supply-demand balance for each WRZ and combined them to produce a baseline supply-demand balance for each of our supply areas. As discussed in **Chapter 4** and **Chapter 5**, forecasts of both supply and demand are inherently subject to large uncertainties, particularly in light of the long-term abstraction reductions that are being considered using the environmental destination forecasts. We have therefore provided a summary of this range throughout the planning period and for the 2050-time horizon (when environmental destination reductions are expected to be complete). Please refer to **Appendix 5.4** for more detail on our environmental destination.

Our Central region (WRZs 1 - 6)

6.5. For strategic level water resources investment appraisal, our Central region can be separated into two parts – WRZs 1-5, which are north of the River Thames, and WRZ6, to the south of the River Thames. Overall, the Average Deployable Output (ADO) condition demonstrates the highest deficit in all years in our Central region, and this is the focus of our assessment in **Chapter 6**. The PDO deficits in WRZ 1-5 are related to peak weeks and local operational stresses which are generally managed through the maintenance of peak capability over the course of annual licences. Additionally, local transfer schemes to distribute trapped surplus are proposed, which is described further in **Chapter 9**.

6.6. The mid-range forecast baseline supply-demand balance for these two parts of our supply areas, is provided in **Figure 6.1** and **Figure 6.2** below. Because of the uncertainties around growth and environmental destination on abstraction reduction, the range of imbalance for WRZs 1-5 is very large, which means the overall range for the Central region is also very large. This range is shown for supply and demand separately across the planning horizon in **Figure 6.3** and quantified for the 2050 position using a 'waterfall' plot, as illustrated in **Figure 6.4**.

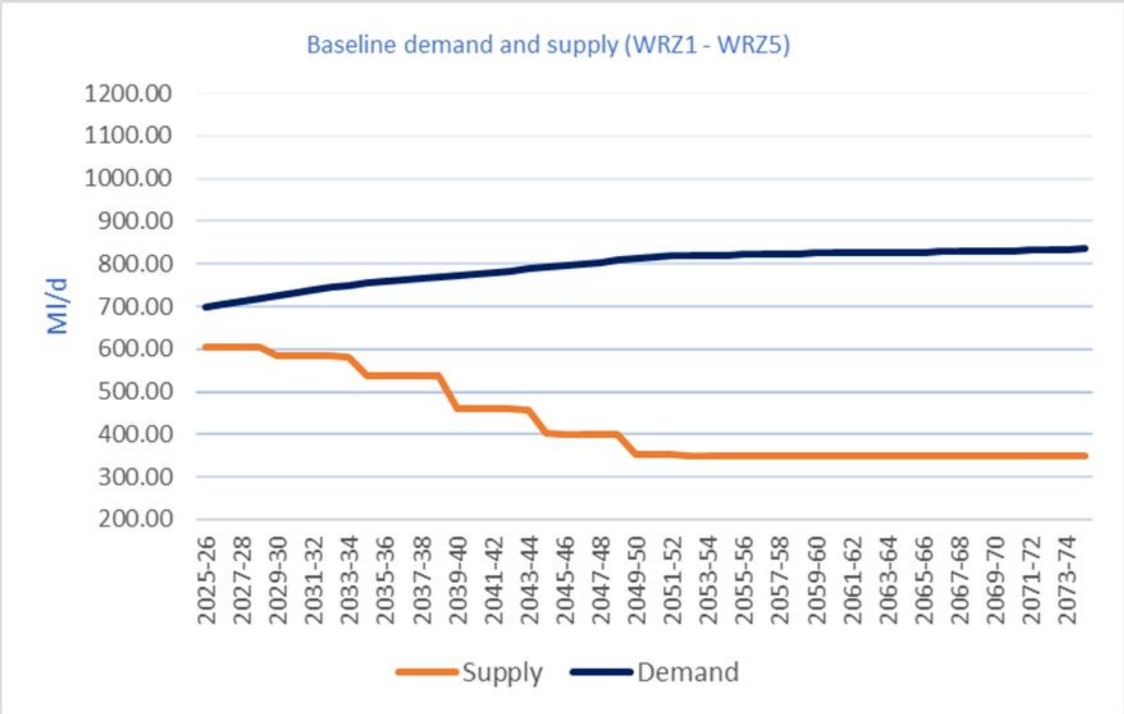


Figure 6.1: Supply-demand balance mid-range forecast for WRZs 1-5

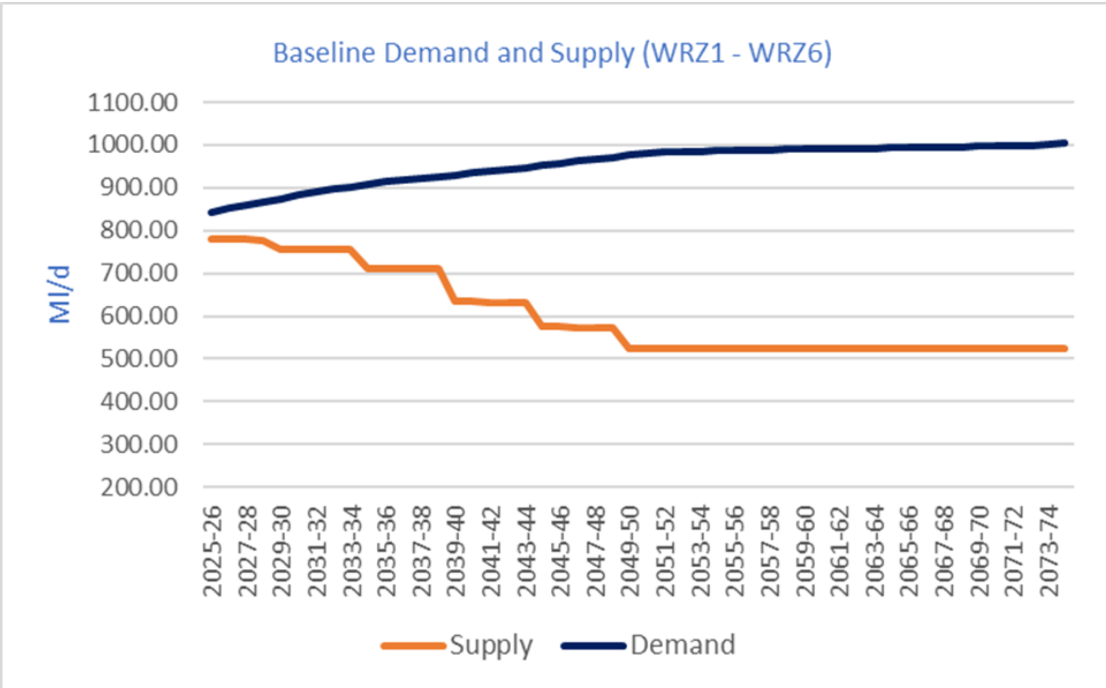


Figure 6.2: Supply-demand balance mid-range forecast for WRZs 1- 6

6.7. **Figure 6.1** and **Figure 6.2** show a significant reduction in supply from 2030 to 2050. For example, in **Figure 6.1** the reduction in supply is from approximately 650 Ml/d to 450 Ml/d (which equates to approximately 200 Ml/d) between 2025 and 2050 in WRZs 1-5. These reductions correspond to the phased environmental destination volumetric reductions set out in **Chapter 5**. The tail of the reduction in supply is then quite small to the end of the planning horizon.

6.8. **Figure 6.3** shows the supply and demand uncertainty across the planning period inclusive of the various environmental destination forecasts, which is broken down further in **Figure 6.4** over time as contributions from growth and environmental destination.

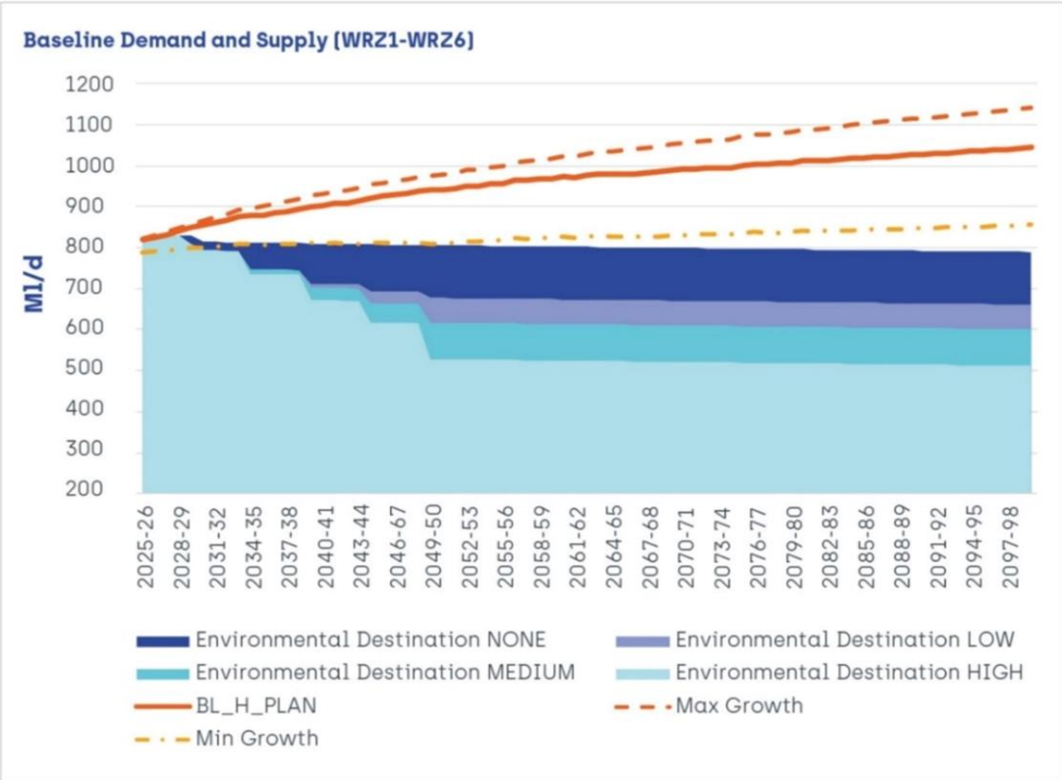


Figure 6.3: Supply and demand uncertainty across the planning period for the Central region[86]

6.9. The full range of uncertainty is displayed in **Figure 6.4** showing that this is quantified as a difference between low and high growth in demand of 126Ml/d and a range in the loss of supply volume of 149 Ml/d, meaning a total uncertainty range of 275Ml/d by 2050.

[86] Includes benefits with drought restrictions (i.e., TUBs and NEUBs)

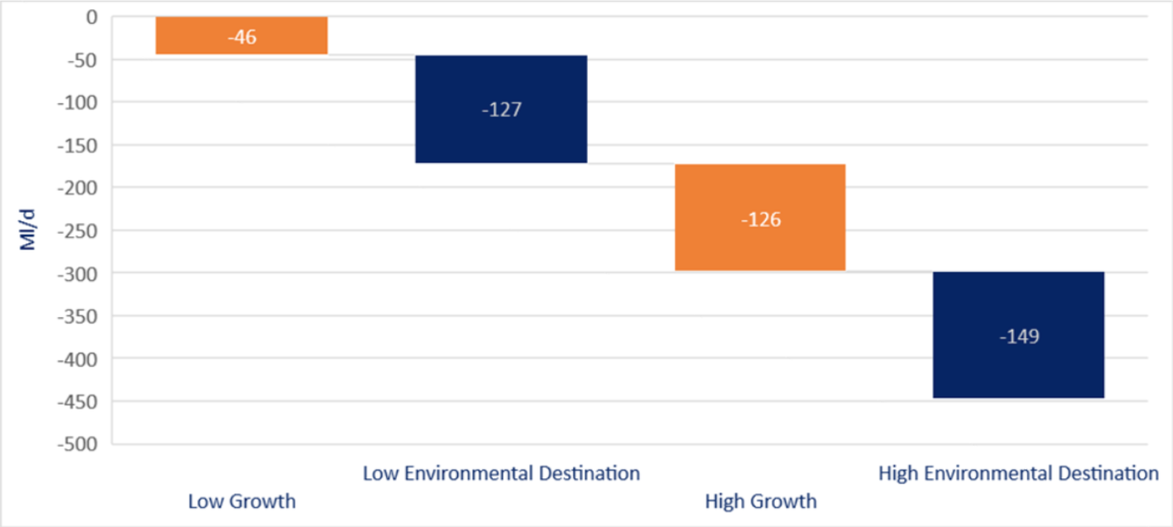


Figure 6.4: Supply and demand uncertainty quantification for the Central region in 2050

Our Southeast region (Dour community- WRZ7)

6.10 The Dour community is driven by peak week (PDO) risks, with the PDO balance significantly worse than the ADO balance. The mid-range forecast baseline supply-demand balance for the PDO condition is provided in **Figure 6.5**. The range of uncertainty in this WRZ is dominated by environmental destination, but only the Enhanced scenario in this case. The range of uncertainty in 2050 is quantified using a 'waterfall' plot, as provided in **Figure 6.6**.

6.11. **Figure 6.5** and **Figure 6.6** show that there is a surplus in WRZ7 (11 Ml/d) that reduces to -13 Ml/d. Uncertainty between low and high growth in demand is around 3Ml/d and low and high environmental destination is 12 Ml/d, meaning a total uncertainty range of 15Ml/d by 2050.

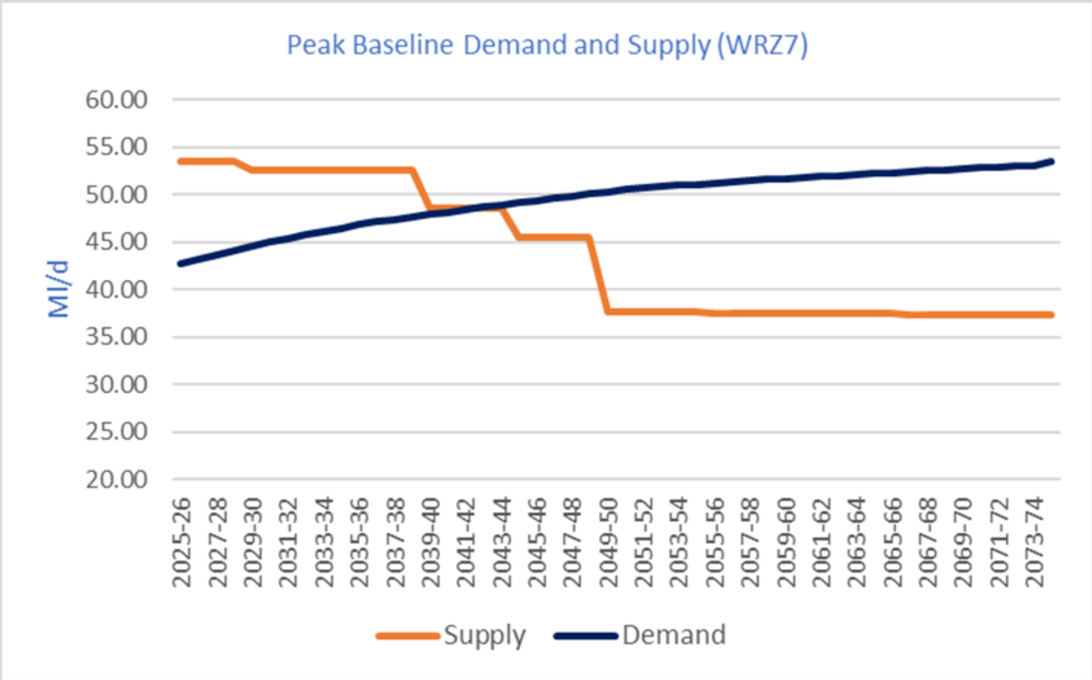


Figure 6.5: Supply-demand balance mid-range forecast for Southeast region

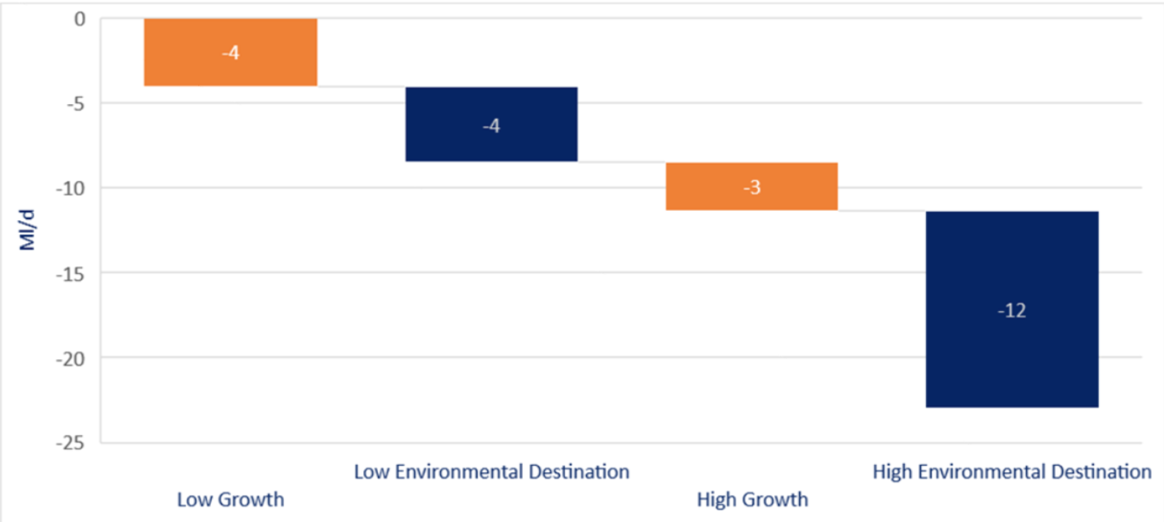


Figure 6.6: Supply and demand uncertainty quantification for Southeast region in 2050

Our East region (Brett community - WRZ8)

6.12. Since daily licences for the Brett group groundwater sources are much higher than the five-year rolling capability, particularly after WFD licence capping, the risk of deficits in the supply-demand balance in this zone is dominated by the ADO condition. As noted in **Chapter 5**, the near-term risk (at 2030) has been subject to detailed resilience testing, and this demonstrated that ADO WAFU is just sufficient to meet demand plus target headroom in that year. This is reflected in the mid-range forecast graph shown in **Figure 6.7**.

Figure 6.7 shows that a supply-demand deficit occurs by 2040 in WRZ8; the deficit increases over time to approximately 6 Ml/d by 2075.

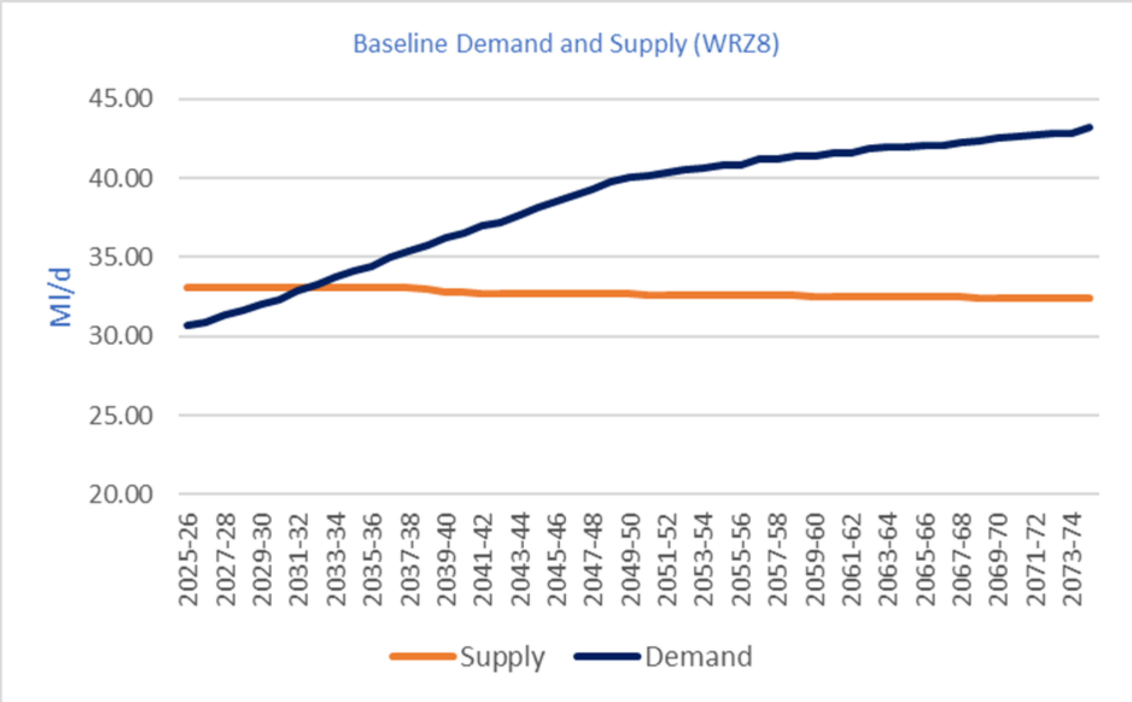


Figure 6.7: Supply-demand balance forecast for WRZ 8

6.13. A summary for the three regions is as follows.

- In the Central region, the range of ADO deficits in supply are large. Therefore, the task is to pursue a full range of demand-side measures whilst also appraising a wide variety of supply-side solutions.
- In the Southeast region (Dour community), the issue is peak demand, but not until later in the life of the plan. The deficit increases with the scale of environmental destination, which will increasingly require more supply options to resolve (including potential imports).
- In the East region (Brett community), the issue is again ADO, however this is not until 2040. This requires an alternative solution that is not reliant on groundwater from within the existing group licence.

Chapter 7 explains the work we have undertaken to address the options requirements to meet the supply-demand challenges set out in **Chapter 6**.

7. Our options

7.1. In this chapter we take the work explained in the previous chapters and identify a range of options to address the supply-side requirements for water in the period of the WRMP24. **Chapter 4** explains the demand for water as we assess it and the demand options; **Chapter 5** identifies the water supply forecast at the current time. The supply-demand balance is explained in **Chapter 6**, and in this chapter, we look at how supply-side options have been identified in our supply area.

7.2. The process we follow to address the issues that we have identified in the preceding chapters, once options from managing demand have been taken into account, are explained below under the identification, appraisal, screening and option development headings.

Our approach to option identification and appraisal

7.3. This chapter focuses on our supply-side options, which include strategic and non-strategic supply options, such as reservoirs, water transfers and reuse options. This chapter also includes a description of our approach to developing WRMP enabling schemes (and how we can make best use of existing resources), along with nature-based solutions which are important for supporting the resilience of the catchments from which we abstract water.

7.4. Our demand and supply-side options support our aim to promote what we refer to as a 'twin track approach' and this is aligned to the customer feedback that we have received (outlined in **Chapter 3**).

In undertaking our options work we have challenged ourselves to think innovatively. We also provide examples of water trading, licence relocation and shared infrastructure options with neighbouring companies, supported by catchment scale hydraulic modelling to identify new options in our East region (Brett community). Our work includes an assessment of options for all our WRZs, and we have provided an expanded sub-section on our East region options work to address the requirement from our WRMP19 (where previously it had not been included).

Appraisal screening and option development

7.5. Our new baseline supply-demand balance set out in **Chapter 6** indicates that, even with demand management measures, without action, there will not be enough water to meet our future challenges. This means we will need to seek near and long-term solutions appropriate to each water deficit and these are set out below.

7.6. A range of deficits in WRZs 1-5 are driven largely by uncertainty related to environmental destination and the difference between high and low growth forecasts (WRZ6 is in surplus) that require both near term and long-term solutions.

In WRZ7 (Southeast region), under the high environmental destination scenario, deficits are triggered where almost all the existing Chalk groundwater sources will no longer be available for use. In WRZ8 (East region), near-term resilience solutions and potentially a long-term supply demand solution are required to meet our environmental destination.

7.7. We therefore need to identify investments that may be able to increase our available supply of water. This process is known as an 'options appraisal'. An options appraisal begins with the identification of options, followed by the application of screening criteria and, finally, the definition of feasible options for programme appraisal. All our options are subject to this process.

7.8. For a more detailed explanation of our supporting options appraisal work please read our supply options technical report (**Appendix 7.1**) which we have made available on our online engagement site. This report explains the options in more detail and provides additional information about our screening process and results.

7.9. At each of the three stages, we apply criteria to the refinement of our options available for programme appraisal as follows.

- **Unconstrained options stage** - all theoretically possible options are considered
- **Options screening stage** - all unconstrained options are screened to create a shortlist of feasible options
- **Feasible options stage** - all feasible options are developed, evaluated and assessed for construction, operation, environmental and social costs.

7.10. The options screening and feasible options stages have been informed by the work undertaken for our Strategic Environmental Assessment (SEA), Habitats Regulations Assessment (HRA) and Water Framework Directive (WFD) assessments, described in more detail further on in this chapter. Our SEA, HRA and WFD assessments are provided in **SEA Appendix 7.2.0** which can also be found on our online engagement site.

7.11. **Table 7.1** and **Table 7.2** provide a summary of the number of each supply option type along with a comparison with our WRMP19 assessment of the unconstrained options. Please note, our WRMP24 nature-based solutions and resilience options are explained separately within this chapter because these options do not directly provide volumetric supply-side benefits.

Unconstrained options			
Supply option types	**Number of options (WRMP24)**	**Number of options (WRMP19)**	**Key supporting rationale**
Surface water e.g., reservoirs, river flow augmentation	74	56	An increase in surface water options due to additional variants of schemes
Groundwater e.g., constructing new boreholes, improving borehole performance, drought options	139	111	An increase in the number of groundwater options due to alternatives to Chalk source options
Transfers e.g., within and between our zones and from neighbouring companies (including canals)	224	134	A significant increase in new transfer options to explore ways of moving any existing surplus to zones in deficit, along with expanding on transfer routes for different options
Treatment e.g., new treatment works and process	24	17	Alongside increasing transfers, more treatment solutions are explored
Effluent reuse e.g. recycling waste water from wastewater treatment works (indirectly)	25	10	Consistent with exploring ways to reuse water where new sources of water are constrained
Third party e.g., licence transfers, multi-sector and water trading concepts	29	Included in transfers and groundwater options	
Desalination e.g., treatment of sea water or brackish sources of water to suitable drinking water standard	24	18	Fairly comparable as only two WRZs are coastal with limited potential for new options
Other e.g., includes groundwater licence relocation	79	0	An example of exploring innovative alternative ways to meet supply demand challenges in the near to medium future
Total	618	346	A significant increase in the number of options explored to meet the long- term challenges

Table 7.1: Supply options unconstrained list and comparison with WRMP19 (non-SRO)

Feasible options				
Supply option types	**Number of constrained feasible options WRMP24**	**Number of options 'screened out' WRMP24**	**Number of feasible options (WRMP19)**	**Key supporting rationale**
Surface water e.g., reservoirs, river flow augmentation	11	63	8	The low number of constrained feasible options reflects the limited ability to develop small reservoirs within vulnerable chalk catchments where flows are not available
Groundwater e.g., constructing new boreholes, improving borehole performance, drought options	7	132	29	Only LSG groundwater options remaining where indicative assessment shows that impacts are manageable
Transfers e.g., within and between our zones and from neighbouring companies (including canals)	85	139	57	An increase in the number of feasible transfer options, though the number of transfer options screened out reflects the maturity of option concepts
Treatment e.g. New treatment works and process	2	22	6	New treatment works options are generally now explored through the RAPID scheme programmes
Effluent reuse e.g., recycling wastewater from sewage treatment works (indirectly)	4	21	7	The reduction reflects the limited ability to develop reuse options within vulnerable chalk catchments where flows are not available
Third party e.g., licence transfers, multi-sector and water trading concepts	5	24	Included in transfers and groundwater options	
Desalination e.g., treatment of sea water or brackish sources of water to suitable drinking water standard	3	21	7	Only Southeast and East region desalination options remain feasible and in limited numbers
Other e.g., licence relocation	28	58	0	Retained in order to support accelerating environmental destination
Total	145	480	114	An overall increase in the number of feasible options which reflects the additional work undertaken for WRMP24

Table 7.2: Supply options feasible list and comparison with WRMP19 (non-SRO)

7.12. The key points drawn from the comparison between final WRMP19 and the WRMP24 options are as follows.

- There is a significant overall increase in the number of unconstrained options and feasible options available for model selection. This is primarily due to the inclusion of additional new transfers and new transfer routes.
- Additional options to explore DO relocation and licence sharing are also being considered as part of our plan developed through engagement with regulators, CSF, and other respondents.

Our feasible options have been sufficiently developed to enable us to use the following information types for each option.

- An option description, including expected yield and any dependencies on other options.
- An estimate of time required to investigate and implement the option (with an earliest start date). We have also improved our understanding of the option development stages for the strategic scale options since WRMP19 and have included planning stages to allow for adaptive planning.
- A risk register for each option, including a risk and uncertainties assessment associated with the option yield, cost and deliverability. These are linked to estimates of optimism bias.
- Option costs for 80 years that include construction and operating costs.
- Other factors that may be relevant to the scheme such as including the impact of climate change on the option yield.
- Environmental assessment of options (SEA, HRA, WFD and INNS), including natural capital and biodiversity net gain.
- A water quality risk assessment which has been undertaken to support the scoping of water requirements for the options; this is summarised within Appendix 7.3.
- An assessment of climate change impact on option yield, which is summarised in **Appendix 7.4.**

A summary of the key option information for all our supply options can be found in **Appendix 7.5** (option dossiers).

Costing of options

7.13. All our options are costed consistently using the same source unit cost-base and the methodology for option costing was aligned for WRMP24 with neighbouring companies.

Section 5 of Appendix 7.1 sets out in more detail how we developed our option costs, the Capex, Opex and carbon cost models and the detailed costing approach for assets. The Gate 2 draft decisions for all our SROs indicate support for the robustness of the costs developed for our options.

Environmental assessment of options

7.14. The feasible options were subjected to the following environmental assessments (with a non-technical summary also available as **SEA Appendix 7.2.0**).

- **Strategic Environmental Assessment (SEA)** - the SEA considered the effects of options on a range of environmental and socio-economic themes (including air, biodiversity, climatic factors, historic environment, landscape, material assets, population and human health, soil and water), see **SEA Appendix 7.2.1.**

The SEA work was informed by the other assessments outlined below.

- **Habitats Regulations Assessment (HRA)** - the HRA considered the effects of the options on European sites (this includes designated Special Areas of Conservation (SACs), proposed and designated Special Protection Areas (SPAs) and proposed and designated Ramsar sites), see **SEA Appendix 7.2.2.**

- **Water Framework Directive (WFD)** - the WFD assessment considered the impacts of the options on water bodies in terms of achieving environmental objectives (risk of deterioration or a failure to achieve 'good status'), see **SEA Appendix 7.2.3.**

- **Invasive Non-native Species (INNS)** – this assessment considered the potential risk of options introducing and/or spreading INNS, see **SEA Appendix 7.2.4.**

- **Natural Capital (NC)** - the NC assessment considered the impacts of options on natural assets (e.g., soil, air and water) and the benefits (ecosystem services) that flow from these assets (e.g., water purification and carbon storage), see **SEA Appendix 7.2.5.**

- **Biodiversity Net Gain (BNG)** -the BNG assessment considered the potential biodiversity losses and gains for terrestrial and/or intertidal habitats as a result of options, see **SEA Appendix 7.2.5.**

The findings of these assessments formed a key part of our decision-making process. They are explained in greater detail in **Chapter 9**, as part of the best value plan development.

7.15. The findings of the SEA (informed by the HRA, WFD & INNS), BNG and NC assessments were translated into metrics that were then fed into the multi-criteria optimisation for options selection and the programme appraisal stage. The metrics used are outlined below.

- **SEA Positive** - a numerical value that represents the sum of the predicted positive effects (major positive = +8, moderate positive = +4, minor positive = +1, neutral = 0)

- **SEA Negative** - a numerical value that represents the sum of the predicted negative effects (major negative = -8, moderate negative = -4, minor negative = -1, neutral = 0)
- **BNG** - the total net change in habitat units as a result of the option, the total amount of habitat units that would need to be purchased to achieve the required 10% net gain
- **NC** - the overall change in value (£/year) for those ecosystem services that can be monetised, i.e., the sum of any changes to carbon storage value, natural hazard management value, food production value, etc.

The metrics provided were then normalised into a defined scale so that the option scores could be compared against each other. When running the investment model, this allowed runs to be calibrated according to those options that provide the most benefits or to exclude options with the highest environmental risk.

Making best use of existing resources and enabling new supplies

7.16. The main focus of the regional and WRMP options appraisal was to identify transfers from other companies and new regional resources that could be used to increase supply capabilities for each of our WRZs. However, that is only one element of the solution. We have also therefore included three additional option considerations in our WRMP24 to enable the use of existing resources. These are considered alongside the main supply-side options appraisal and summarised as follows.

- Our Central region WRZs are geographically closer and hydraulically partially connected through our strategic mains network. Therefore utilising any existing surplus capacity within individual WRZs is expected to represent a best value option to addressing deficits. Whilst the main options appraisal contains intra-regional transfers as far as possible, the infrastructure evaluation required to support transfers of existing surplus is complex and needs to be refined outside of the regional modelling.

- The main WRMP options appraisal and subsequent modelling only considers transfers between WRZs. In practice, the loss of existing abstractions and growth in the network means that sub-WRZ enhancements are required to the network. Where relevant these network enhancements have been allocated to the relevant water resource schemes. However, in practice many of the connections are common to a number of potential water resource developments and there are interactions with the needs of the Water Industry National Environment Programme (WINEP) and resilience enhancements. The strategy to integrate all these network enhancement needs is described in the 'Connect 2050' section below.

- Additional solutions are required to support the innovative licence transfer proposals described in **Chapter 5**.

As part of our options work, we are accelerating those options that make best use of existing resources. These are designed to free up trapped surplus and have shorter lead-in times and include asset enhancements and network modifications.

7.17. Alongside transfers that enable this outcome, we are also assessing whether relocating licences from sources located in more sensitive upper reaches of Chalk catchments to sources located in less sensitive parts of the catchments downstream, could help to accelerate implementation of reductions in abstraction. This would help deliver environmental benefits faster. By relocating abstractions to downstream locations where the rivers are less vulnerable to low flow impacts,, it may be possible to delay deployment of SRO options.

7.18. Several transfer and treatment options have also been explored to find ways of releasing surplus water at our River Thames abstractions (visible as an existing surplus in our Wey community (WRZ6). All these options explored new conveyance routes to our Pinn community (WRZ4).One of the main challenges of doing this was finding routes that avoid the following significant existing infrastructure constraints:

- Heathrow Airport;
- existing water supply reservoirs (Thames Water) and associated existing tunnels and transfer main (Affinity Water);
- main roads (including the M25);
- local towns (human habitation); and
- environmental assessment (SEA).

Figure 7.1 provides a summary of the various possible start and end locations and conveyance routes to our Pinn community that we have assessed.

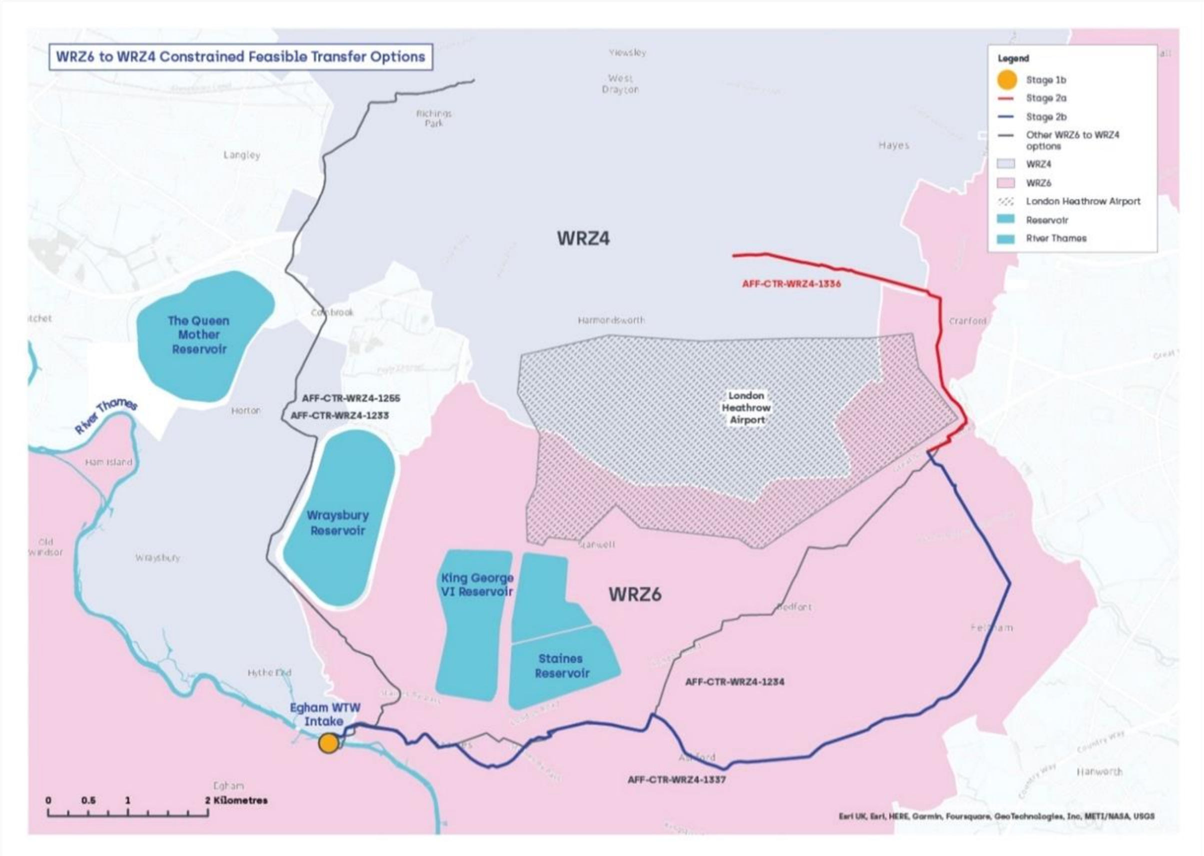


Figure 7.1: WRZ6 to WRZ4 constrained feasible transfer options

7.19. We have also appraised solutions to enhance treatment capacities at our River Thames sources located in WRZ6 to determine the most appropriate means of increasing the flow through these works and to cost these options. These costings have enabled us to plan best value strategies to the meet supply-demand balance needs in the future. By understanding the incremental costs required to release additional treatment capacity at the three water treatment works (WTWs), we can choose a package of investments that meet the future needs of Affinity Water while ensuring best value for money for our customers.

7.20. The key interzonal transfer options have been shared with WRSE and are represented within the WRSE modelling; we have used the costs for treatment solutions within our WRMP24 where required and updated the WRSE database for our final plan.

Other transfers are required at both inter-WRZ and sub-zonal levels to support our water resources development during the 2025-2050 period. Because of the integrated nature of these requirements with WINEP and resilience enhancements, this has been optimised through the Connect 2050 process described later in this section, rather than as discrete WRMP options.

Co-ordinating our WRMP options work with WRSE and WRE

7.21 Although we assessed a wide range of options to explore best use of existing supplies, these, together with Demand Management Options, are not sufficient to meet the medium to longer term supply demand challenge. We therefore needed to assess how the wider range of supply-side options that we identified and screened to a feasible list, could solve our medium to long term supply demand deficits.

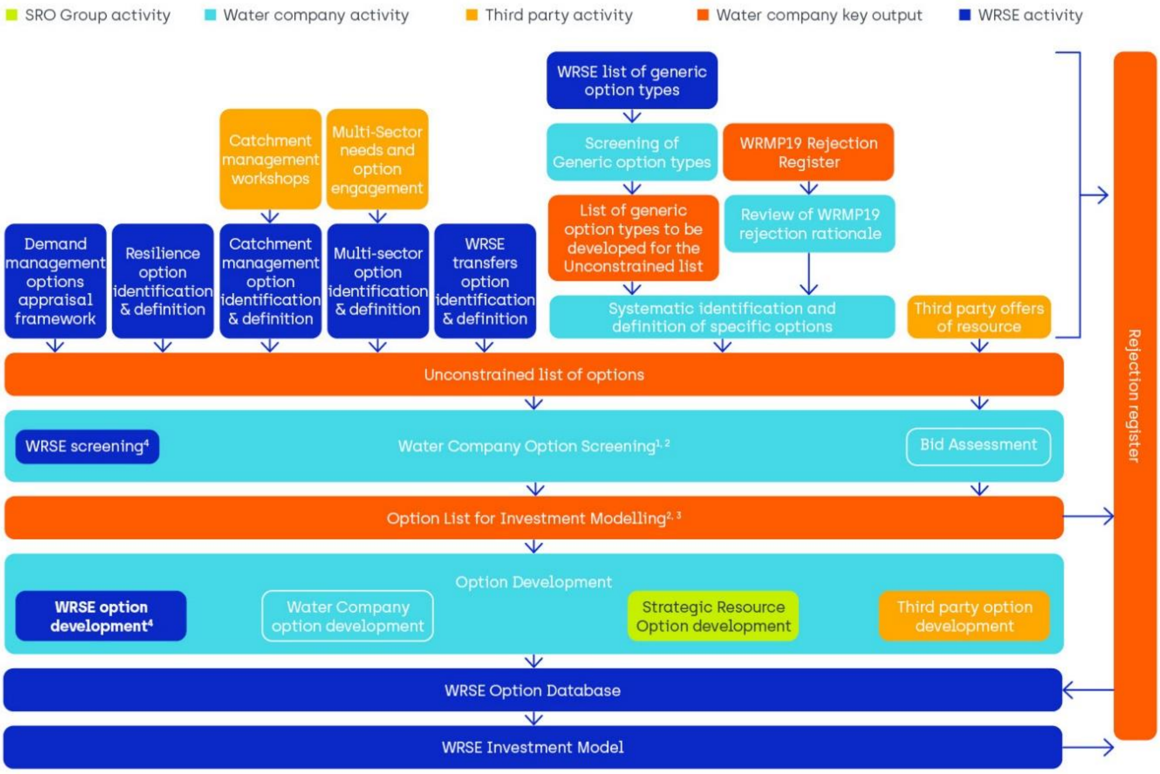
7.22 We listened to the feedback on our WRMP19 from regulators who wanted better consistency across water companies' approaches to optioneering; we have achieved this by co-ordinating our supply-side options work with other water companies through the regional planning groups. This complies with the requirement for regional collaboration described in the Water Resources National Framework. We share all our options data with WRSE who store it in the regional options database. This ensures a consistent single source of information across the regional plan and our WRMP24. Whilst this approach was not adopted by WRE for their regional plan, we have ensured that our options identification and development work for WRZ8 was fully consistent with all our WRMP24 options activities and is made available to WRE.

7.23. The regional planning co-ordination task included the following activities in WRSE.

- The water companies undertook a review of the approach to rejecting options and cost development and aligned their approaches for consistency.
- The identification stage of new options occurred both at regional and company level; WRSE identified the options relevant to us, which include:
    - two drought resilience options
    - 17 water transfers
    - four multi sector options.
- Within the context of the WRSE options work, ten of the WRSE options were rejected; for example in the case of the transfers, these schemes were deemed too immature in their development stage, or the water sources were too unclear for the schemes to advance to feasible option stage. The rejection rationales are summarised in **Table 5** of the WRP tables[87]. The remaining seven were available for the modelling. Option summaries are contained within **Appendix 7.5**.
- As part of our SRO work, we also developed new options and these were included within the WRSE modelling as part of our WRMP24 information sharing activity.

[87] https://affinitywater.uk.engagementhq.com/4398/widgets/28286/documents/33803

Figure 7.2 sets out how the WRMP water company options activities were undertaken and co-ordinated alongside the WRSE activities[88]. The diagram shows how we share our options information with WRSE, which is a critical consistency task for the regional modelling (on which the WRMP decision-making process is based).



Note 1: Screening processes will vary between companies and may include a one or two stage approach, company specific feedback has been provided to improve robustness of option screening
Note 2: The Option List for Investment Modelling may be the full Feasible List of options, or a Constrained Feasible List, where this has been agreed with stakeholders (including the EA), provided that care is taken when constraining the Feasible List to ensure options that could benefit other companies are not rejected at this stage.
Note 3: Demand management options are represented as strategies comprising baskets of consumption and leakage reduction options combined by Water Companies to achieve different levels of total demand reduction
Note 4: WRSE option identification, screening and development activities focused upon catchment management, multi-sector and strategic transfer options

Figure 7.2: Flow diagram showing WRMP water company options activities alongside WRSE activities.

Customer support for options

7.24. The recent customer research outlined in **Chapter 3** demonstrates that our approach is aligned with the feedback received from our customers. In particular, the responses to our research indicated that customers want water companies to progress demand solutions first, along with exploring better ways to utilise existing resources to ensure this happens, as a pre-requisite to advancing and commissioning new strategic scale supply-side resource options.

[88] Taken from the WRSE Options Appraisal report (Appendix 8.3).

7.25. For each WRMP we update our assessment of a wide range of supply-side options to explore ways to meet the medium to longer term challenges and to provide options that contribute towards national, regional and local needs. To achieve this for final WRMP24, we have been working across two scales of supply-side options.

- **Our Strategic Resource Options (SROs).** These are generally large-scale (in excess of 50 Ml/d) and involve collaboration with other water companies. The progression of these larger-scale options is assessed by the Regulators' Alliance for Progressing Infrastructure Development (RAPID); a partnership made up of three water regulators – Ofwat, the EA and the Drinking Water Inspectorate (DWI).

- **Our Non-Strategic Resource Options (Non-SROs).** These smaller-scale options do not have a threshold or criteria applied to them and usually do not involve other water companies.

We have considered the full range of supply option types for our WRMP24 and, where options are determined as feasible, both SRO and non-SRO supply options are included within the modelling.

7.26. To read more about our supporting technical work please refer to **Appendix 7.1** which provides the unconstrained and feasible option lists along with the rejection rationales for all options we have screened out.

A summary of the range of option types that have been assessed are listed in **Table 7.3**. These option types represent options that were identified and appraised for all the WRZs.

Option Type	Description
Transfers (including strategic-scale schemes)	Inter-zonal, intra-zonal, inter-company (and inter-regional) including canals
New resource options (including strategic scale schemes)	Reservoirs, reuse, desalination, groundwater (Lower Greensand Group only)
Drought permits	Removed from WRMP24 – see note below
Other	Water trading (licence sharing concepts), multi-sector, dewatering, asset enhancements and network modifications, licence and DO re-location
Non-supply options	Resilience and nature-based solutions (catchment management options). Neither option types provide a direct volumetric supply benefit and are therefore not included as supply options

Note: Consistent with previous stakeholder feedback on our WRMP19, we have removed the need to rely on supply side drought permit or order options in the WRMP for droughts less severe than 1 in 200.

Table 7.3 Supply option types

Our Strategic Resource Options (SROs)

7.27. Our SRO feasible options are shown in **Table 7.4**, which provides a summary of each scheme component and the range of different options within each type for feasible options. Each SRO option is a combination of source (surface water or water reuse), transfer and water treatment option types set out in **Table 7.3**.

SRO	Source	Conveyance	Treatment	Deployable Output Benefit Ml/d
T2AT (P7.35 - 7.38)	River Thames (SESRO / STT) SESRO	Sunnymeads to Harefield	Harefield	50, 100
		Maidenhead to Harefield	Harefield	50, 100
		Sunnymeads to Iver 2 to Harefield	Iver 2	50, 100
		Lower Thames Reservoirs to Iver 2 to Harefield	Iver 2	50, 100
		Walton to Iver 2 to Harefield	Iver 2	50, 100
	River Thames (Teddington DRA scheme within London Effluent Reuse SRO)	Teddington to Harefield	Harefield	50, 100
	River Thames (Mogden effluent reuse scheme within London Effluent Reuse SRO)	Walton to Iver 2 to Harefield	Iver 2	50, 100
	River Lee (Beckton effluent reuse scheme within London Effluent Reuse SRO)	Beckton Indirect Reuse to North Mymms to Brookmans Park (HDZ)	WTW at King George V reservoir – treated transfer to North Mymms	50, 100
GUC (Para 7.31 - 7.34)	Severn Trent – Minworth	Route 3	Leighton Buzzard	50, 100
A2AT (Para 7.39 - 7.42)	SLR	Etton to Sundon to Preston	SLR WTW (SLR SRO Scope) Sundon Conditioning	50, 100
		Etton to WRZ5	SLR WTW (SLR SRO Scope) WRZ5 Conditioning	50, 100
	Fens Reservoir	Fens Reservoir to WRZ5	Fens Reservoir WTW (Fens Res SRO Scope) WRZ5 Conditioning	50, 70
	River Trent	River Trent to Rutland Water to WRZ3	R Trent INNS Removal New Rutland WTW Sundon Conditioning	50, 100

Table 7.4: Our SRO feasible option list for Affinity Water related schemes

Figure 7.3: An updated summary map of our SROs

7.28. Alongside our draft WRMP we provided full descriptions of our SRO options and the optioneering process in our RAPID Gate 1 submission information. This information was updated with Gate 2 information which was made publicly available in November 2022 as part of the RAPID process, alongside the dWRMP24[89]. This Gate 2 information has been incorporated into the options for the final WRMP24.

7.29 As indicated above, Thames Water are developing several strategic resource options that potentially affect our WRMP24. These are outlined below.

- **Severn to Thames Transfer (STT).** This pipeline brings water from the River Severn across to the River Thames. There are also a number of support options across the Midlands and Northwest of England that can increase flows in the River Severn, which are being developed by Severn Trent and United Utilities.
- **Teddington, Mogden and Beckton reuse schemes**. These transfer recycled water into the River Thames, which we could potentially utilise through the Eastern Thames to Affinity Transfer option. There is also the ability for the scheme to work sourced by the Teddington Direct River Abstraction (DRA) option.

[89] https://affinitywater.uk.engagementhq.com/strategic-resource-options

7.30. Since we are not engaged in the development of these schemes, they are not described in detail here, but the costs, environmental impacts and resilience for all these sources are incorporated into the WRSE options database and investment model. All costs and metric appraisals presented in this document are consistent with WRSE and WRE.

Descriptions of the schemes that we are contemplating – in each case with other water companies - are described below along with a summary of current progress.

- Anglian Water have undertaken the screening of the South Lincolnshire and Fens reservoir options. This work relates to our WRMP with respect to the availability of source water in the WRE region for water supply within the WRE region and as a potential source water for transfers into WRSE.

- The Longden Marsh option is an example of an option that had been identified as a potential source option for Affinity Water. We have specifically discussed this with Thames Water (as it is an option in their WRMP) as a support option for STT (and Severn Trent Water). Our understanding is that this option was screened out due to flood risk at Tewksbury and flood plain encroachment. We would not consider attempting to create a separate option linked to Longden Marsh as viable, if it has already failed as a support option for an SRO that has passed through its initial Gates. This is especially the case for our Central region where we have outlined how we already have sufficient new SRO options.

We will continue to look for such opportunities going forward but where a scheme is a neighbouring company's source option that has undergone screening and rejection and we have understood the results through discussions with the neighbouring company, we would not subsequently duplicate the work unless we found there to be some reason to do so.

Updated Gate 2 costs in the WRSE model

7.31. Since the draft WRMP24 submission we have continued to update and improve our SRO cost assessments for Gate 2. This meant there was a task to update the WRSE option costs for two of our SROs so that the final WRMP modelling aligns to the very latest SRO cost. As well as general improvements in costs associated with better scheme definition, a number of more substantial changes to scheme were introduced into the final WRMP assessment as a result of the Gate 2 activities.

- GUC and Minworth - the Gate 2 submission considered how the project could be built using a phased approach so the updated cost in the WRSE model for the phased approach represents an upfront weighting of the scheme's Capex. Phase 1 would look to buy the land and construct the civils sufficient for both phases in order to avoid multiple site visits and disruption for customers/local communities, whilst also allowing the scheme to be delivered in a more economical way through phasing.

Costs for the supporting Minworth scheme were also updated to reflect the better understanding of discharge consents and associated wastewater treatment needs

- T2AT - at Gate 2 it was found that the WTW location was more expensive than at Gate 1. We included the updated higher cost as the default for the WRSE model and we provided a range of land cost estimates to ensure that we were able to understand if the costs were material to the decision-making process. Sensitivity testing of the model described in **Chapter 8** using lower end costs, concluded that the selection of the T2AT was not sensitive to the higher land cost adopted for the WRMP24.

The Grand Union Canal Transfer (GUC)

7.32. The GUC strategic transfer was included in the WRMP19 and has since then been developed into one of our most innovative SROs; it utilises existing infrastructure to transfer water from the Midlands to our supply area. This transfer will take treated water from Severn Trent's Minworth site, via a new closed pipeline transfer (circa 15.5km) to a location on the canal near Atherstone in Warwickshire. The transfer will utilise the existing canal structure, passing through the Coventry Canal, the Oxford Canal and the Grand Union Canal, with a small number of pump and lock upgrades required. Water would be abstracted at a location near Leighton Buzzard and stored, before being treated at a new Water Treatment Works onsite, and then transferred to our supply area.

7.33. Updates since our WRMP19 are outlined below.

- We have carried out extensive work on this option since WRMP19 through the RAPID gated development programme. Under that programme, we have been funded to carry out the investigation and development activities that will be required to take the scheme (if selected in WRMP24) through to planning application. We have expanded the scope of this option to ensure we take the best route from Minworth into the canal. An options appraisal for routing was undertaken that began with a list of six routes; this has now been concluded and we have identified one single route for Gate 2 in November 2022.

- We identified an abstraction location in our WRMP19 which was a generic site in WRZ1, near Berkhamsted. As part of the options appraisal, we considered eight abstraction locations; this has now been concluded and in Gate 2 we have identified one single abstraction location at Leighton Buzzard. This decision was based on a series of technical considerations and criteria available at Gate 2 reporting level, and also received strong regulatory support to avoid Chalk stream interactions downstream of Tring (therefore mitigating for the associated environmental risks).

- Stakeholder engagement with canal user groups, local authorities and regulators has commenced and is ongoing. We have also started to explore ownership and operating models, and financing/contract structures.

Minworth reuse

7.34. The Minworth reuse SRO provides the source water for the GUC schemes and will develop additional treatment capacity at the existing Minworth Wastewater Treatment Works (WwTWs). This additional treatment would facilitate and enable the outflow from Minworth (a minimum of 450Ml/d in dry weather conditions) and be partially diverted to support the Grand Union Canal strategic transfer (up to 115Ml/d). There is also a support flow component for the Severn Thames Transfer (115Ml/d) should it be pursued. There is, therefore, an inter-dependency between these three SROs and the flows on the River Trent. Although environmental legislation set out by the Environment Agency (Catchment Management Abstraction Strategies or CAMS) states water is available in this catchment, there is a 'Hands-Off Flow' constraint relating to navigation and a number of downstream licences tied to it. We are exploring this constraint through modelling to understand how the operation of this scheme may cause impacts (including in-combination environmental impacts). Alongside this, we are also beginning to explore bankside storage options which could potentially mitigate this issue.

7.35. Updates since our WRMP19 are outlined below.

- This option was not stand-alone at our WRMP19 and was included within the GUC scheme only. Since then, we have separated it from the GUC to be considered as a support scheme for GUC and/or the Severn Thames Transfer to allow us to consider the interdependencies and to assess the potential in- combination impacts.

- The most significant change to the scheme since the dWRMP24 has been the introduction of new water quality data which has been collected to support the SRO development. It is clear that some determinants are present in very small concentrations – this generates high uncertainty as to the level of treatment required at Minworth and remains an ongoing topic of discussion as part of the RAPID programme. Our Gate 2 submission has provided more information on this topic and the solution to address the requirement. The WRMP modelling accounts for the resulting sensitivity around the impacts on cost and the selection of alternatives.

- There are currently multiple uncertainties around engineering considerations of this scheme, owing to ongoing work with regards to policy for discharge into new water courses. We are working with the EA to seek further clarity on this, but we now have a much clearer understanding of the different possible iterations of this option, which have been reported at Gate 2.

The South East Strategic Reservoir Option (SESRO)

7.36. SESRO is a fully bunded reservoir, which would be located in Oxfordshire. During periods of high flow in the River Thames, water would be abstracted from the river at Culham and transferred to the reservoir by tunnel. The water would then be stored in the reservoir. During periods of low flow in the river, water would be released back to the River Thames, through the same tunnel, for re-abstraction further downstream, for treatment and then supply to customers. SESRO is one of the sources that can support the Thames Water to Affinity Water Transfer.

7.37. Updates since our WRMP19 are outlined below.

- The RAPID gated process has meant that there has been extensive further development and understanding of the SESRO option. A full cost re-evaluation was carried out which demonstrated that previous costs were robust with less than 10% movement. Environmental fieldwork and water quality sampling/modelling was carried out and relevant hydraulic and flood risk studies undertaken. More work has also been undertaken on considering the additional benefits that the scheme could deliver, e.g., recreational, environmental and flood mitigation benefits.

- Master plans have been developed to weigh up these additional benefits and define a suitable concept design, including the preferences for amenity and environmental design.

The Thames to Affinity Transfer option (T2AT)

7.38. This option would consist of a new water transfer from Thames Water to Affinity Water. Two physical routes have been considered as equally valid at Gate 2; the routes are included within the modelling to support the WRMP assessment, although the exact infrastructure requirements will depend on the regional source of water that supports the new transfer option.

The western route would be facilitated by shared use of the existing Thames Water's Lower Thames reservoirs. The source water would come from the River Thames, using a raw water transfer from Thames Water's existing Lower Thames reservoirs system (via an existing raw water tunnel to Iver) to a new water treatment works in the vicinity of Affinity Water's existing works at Iver, for onwards transmission to Harefield. The raw water abstraction could be supported either by releases from a Thames Valley reservoir (SESRO), or from the supported elements of the Severn Thames Transfer.[90]

The eastern route would be supported by future London Reuse SRO resources at Beckton or Teddington (via the Thames-Lea tunnel). A new raw water transfer from the River Lea upstream of King George V reservoir would transfer the required water to WRZ3.

7.39 Updates since our WRMP19 are outlined below.

- Ongoing monitoring of water quality at the offtake locations for all major options and algae within Lower Thames Reservoirs.

[90] The Severn Thames Transfer can supply existing surplus water from the River Severn, but this is not reliable during the summer months under even moderate drought events. The nature of our supply risk and lack of raw water storage described in **Chapter 5** means that the unsupported transfer does not provide us with reliable DO benefits, so we can only use those sub-options based on releases from Vyrnwy Reservoir or Severn Trent effluent support

- All desk-based assessments are now complete and an environmental assessment of the River Thames is underway with recent completion of water quality modelling scenarios.

- The Gate 2 option refinement work identified two combinations of source, conveyance and delivery point:

- **Lower Thames Reservoir Transfer:** the abstraction from Lower Thames reservoirs system (Wraysbury and Queen Mother reservoirs) via an existing AFW tunnel; raw water will be diverted to the proposed Iver 2 WTW for treatment; drinking water will be transferred to Harefield service reservoir. This option is also referred to as the 'Wraysbury option'.

- **East London Reuse Transfer:** a new abstraction point on the River Lee; water would be treated near King George V reservoir and treated water conveyance would be to North Mymms and Brookmans Park.

One of the key advantages of the Wraysbury scheme is that it offers significant **conjunctive use benefits,** as it would allow us to access the existing raw water storage that Thames Water have in Wraysbury reservoir. The nature and evaluation of this benefit is technically described in **Appendix 5.6.** In simple terms, the provision of storage helps to remove the summer demand stresses that currently drive our ADO capability, as described in **Chapter 5**. This means that we can achieve a given level of ADO benefit from the scheme whilst Thames Water only lose half of that equivalent ADO. For example, to gain 50Ml/d from the Wraysbury option, Thames Water only need to give up an amount of storage equal to a 25Ml/d loss from their London system DO.

Thames Water have stated that this is only viable if SESRO is constructed and, without the additional storage that SESRO provides, we will not be able to utilise this option. The reason for this is because the storage lost to Thames Water under this option causes an unacceptable maintenance and resilience risk if it is not replaced. In order to support our bulk supply, Thames Water will have to reserve the relevant storage and not use it in order to preserve capability for Affinity Water in the summer, irrespective of their own resource or operational position. The storage cannot therefore be used for managing maintenance or operational needs by Thames Water in the same way as it can if it is managing its own demand on the system. If SESRO is constructed, then this recovers the necessary storage availability and returns Thames Water's London system back to an acceptable level of resilience.

The South Lincolnshire Reservoir option (SLR)

7.40. The SLR scheme is a new proposed reservoir in South Lincolnshire. The reservoir would be supported by new abstractions from the River Witham and River Trent and provide additional water supply to Anglian Water and, potentially, Affinity Water through the Anglian to Affinity Transfer (for which the SLR is the source option). As well as providing a resilient water supply for the east of England, the reservoir concept has been defined in close collaboration with stakeholders from different sectors and aspires to provide wider multi-sector benefits.

7.41. Updates since our WRMP19 are outlined below.

- This option was not fully developed at WRMP19 (there was no preferred concept design, no preferred site, etc).
- At Gate 1, we presented three designs with their associated costs which reflected different levels of ambitions around bringing in multi-sector benefits (agriculture, flood risk and engineering).
- The site selection process and concept design for Gate 2.
- Design configurations have been explored with multiple stakeholders to explore ways of option co-creation.
- Water quality monitoring on the River Trent is ongoing.

The Anglian to Affinity Transfer option (A2AT)

7.42. This SRO consists of a new treated water transfer from Anglian Water to Affinity Water. The source water that has been selected as preferred at Gate 2, 'SLR to WRZ5', is the proposed South Lincolnshire Reservoir, which is being investigated as a separate SRO. Water would be transferred from the SLR to the vicinity of an existing facility at Etton for onwards conveyance to Affinity Water's WRZ5. Two routes have been considered for engineering concept design: an eastern route via Huntingdon and a western route via Grafham.

As part of the scheme development, a particular focus has been given to renewable energy as a way to mitigate both embedded and operational carbon.

7.43. Updates since our WRMP19 are outlined below.

- This option was linked to the SLR in our WRMP19, although we treated it as a potential new bulk import or as an offset to allow us to take more at/from Grafham.

- We undertook optioneering work to ensure the best combination of source, conveyance and delivery point was selected. A screening methodology was identified and applied to a long list of options.

- Options that involve Grafham were discounted. Four options were presented at Gate 1:
    - River Trent via Rutland
    - SLR to WRZ3
    - SLR to WRZ5
    - Fens to WRZ5

- Option refinement work for Gate 2 selected SLR to WRZ5 as the preferred option. As part of this, two routes are now being investigated and costed.

- Updated and appropriate allowances for conjunctive use benefits. Since A2AT is supported by reservoir storage, it provides conjunctive DO benefits similar to those for Wraysbury and the London storage described above.

Concentrating on optioneering and cost-efficiency

7.44. To assess how to incorporate new sources of water into the existing local water network we have updated our Supply 2040 project from WRMP19 and developed a new holistic strategy which we refer to as Connect 2050.

The 'Connect 2050' Concept

Connect 2050 is the name we have given to the programme of strategic network development that we are incrementally developing over the 2020-2050 period, which includes:

- Upgrading treatment and transfer facilities to maximise the use of existing sources to support WRZs 1-5, including the Grafham transfer (in 2020-2025) and the spare resources we have in our WRZ6 (2020-2030) (see the previous 'making best use of existing resources' section in this Chapter).

- Increasing bulk supply capabilities with Thames Water to allow better access to regional resources as they become available, including the use of additional resources released into the River Thames and River Lee as per the 'Chalk Streams First' concept described in **Chapter 5**.

- Transferring water to where it is needed to support abstraction reductions throughout the period. This includes support for licence relocation schemes and movement of water to where it is needed within WRZ1 in the short term (AMP8), and strategic infrastructure to facilitate the movement of water from strategic resource options in the medium to long term.

We developed the strategy to be both holistic across the range of needs that water resource issues might place on the system between now and 2050, and efficient to maximise affordability to customers. The process reflects the following three aspects that were identified through the draft WRMP consultation as being most important to stakeholders.

1. The trunk mains, pumping stations and transfers that are developed to support movement of water in the Central Region need to be form a network strategy that is efficient and optimal for customers.

   The Scope of Connect 2050 has addressed this requirement by optioneering the strategy through MISER using a wide range of future scenarios and value engineering to generate a 'low regrets' approach.

2. The network strategy needs to reflect and be integrated with the requirements of our WINEP and resilience needs, whilst clearly showing which part of the strategy relates to which need.

   The Scope of Connect 2050 has addressed this requirement by including both of these needs in the MISER assessment, so the strategy represents a holistic approach. All schemes have then been clearly allocated to drivers once the strategy has been developed.

3. The bulk transfers and network strategy need to support rapid implementation of our abstraction reduction programme and allow us to make use of water that is made available in the in the lower Thames, Lee

and Ivel by our abstraction reductions (i.e. in line with the Chalk Streams First strategy described in Chapter 5).

The Scope of Connect 2050 has addressed this requirement through the strategy facilitating additional import capability with Thames, supporting Wey to Pinn transfers and allowing for licence transfer within AMP8. It then facilitates the use of the strategic options, which include further transfer of water from the Thames, from AMP9 onwards.

The options appraisal process used to derive the strategy is described in the section below, and the resulting preferred strategy is described in **Chapter 9**.

7.45. The process for developing the Connect 2050 preferred strategy can be summarised as follows.

1. The supply system as planned for 2025 (i.e., including the AMP7 WRZ6 to WRZ4 transfer of 17Ml/d and the Grafham transfer upgrade to 91Ml/d, plus the AMP7 WINEP abstraction reductions) was set up in the MISER network optimisation tool.
2. Peak week Deployable Outputs under different levels of drought severity were generated for each source using the PyWR water resource model (incorporating climate change at the different time horizons described below) and incorporated into MISER.
3. Anticipated demands (after demand management) and abstraction reductions were added for specific time horizons (2027, 2029, 2034 and 2050) and MISER was then run to identify levels of deficits in hydraulic demand zones (our main sub-WRZ level network units, basically single towns and surrounding areas). This was done for both severe droughts with TUBs and NEUBs in place, and for 1 in 10-year events without demand restrictions. Different strategic resource options were added as appropriate for the scenarios that were developed. Node to node trunk main reinforcement and pumping station schemes were developed to address those demand deficits and the results fed into a value engineering workshop. The nature, timing and frequency of different trunk mains schemes were analysed in the value engineering workshop to identify the most optimal 'least regrets' approach to connecting our system, to reflect the changing water resource situation over time. Schemes were proportionally allocated between WRMP, WINEP and resilience need as described below.

7.46. Connect 2050 used an assessment of pre-defined time horizons to reflect the impacts of the key challenges on the ability of the network to cope with the stresses being placed on the system. This means the Connect 2050 project can capture the impact of AMP8 WINEP and future environmental destination forecasts in the supply-demand balance and identify any local deficits that need to be allocated to resilience rather than the WRMP. It also considered the likely levels of increase in DO that Thames Water might experience due to our abstraction reductions and the benefits to river flows, to determine how this might best be transferred and used in our system. To understand more about the supporting technical work on Connect 2050 please see **Appendix 7.6.**

7.47. Up to 45 scenarios were assessed, taking into account four timescale horizons, environmental destinations, different SRO configurations and demand scenarios to consider what infrastructure is likely to be required and the key differences and drivers between the various scenarios. The four timescale horizons were identified for modelling in our Pywr water resources model and then in our strategic network model:

- 2027 – initial baseline, post AMP7 delivery
- 2029 – full set of AMP8 sustainability reductions implemented
- 2034 – just after delivery of the first potential SRO
- 2050 – delivery of a second SRO, and to test different levels of environmental destination scenarios

7.48. As an outcome of the work, 49 mains enhancement projects were proposed in different configurations for various scenarios. The value engineering workshop then reviewed when and why these projects were triggered to understand the 'least regrets' approach to development. It also accounted for the geographical locations and distance between the assets, spare capacity of existing assets, ability to maintain the assets after implementation, the environment where the new assets will be located, the route (for pipework) and the potential impact on the community. Further details on the option screening can be found in **Appendix 7.6.**

The final outcome of this exercise, which was re-visited after the draft WRMP to account for the delay in the Uttlesford Bridge licence change and the increased demand management targets referred to in **Chapter 4**, is provided in **Chapter 9**.

Our East region options

7.49. In our final WRMP19 we set out the requirement to undertake an options appraisal for our Brett community (WRZ8). The need is based on the uncertainty associated with near and longer-term reductions in supply through WINEP and environmental destination. We have undertaken this options appraisal as part of the preparation for WRMP24 (see **Appendix 5.3** – this appendix is available on request).

Both unconstrained and feasible options were identified, and the screening of these options was consistent with the methodology used for our other options in our other WRZs. Transfers, water reuse, desalination and new reservoir options were all considered, many of which are joint water company options with Anglian Water and Essex & Suffolk Water.

7.50. Given the interconnected nature of the water resource management challenges that the water companies face, which crosses water company boundaries, the near-term driver for potential solutions identified the need for additional modelling to support the testing of additional options at catchment scale. This is discussed below:

A summary of the key points from the assessment

In the problem characterisation stage we undertook the actions outlined below.

- the Pywr model was run without any options to assess the current baseline system. The modelling indicated that the baseline could be resilient to between 3 and 6 Ml/d of groundwater reductions, depending on the failure criteria used.
- the lost groundwater resource due to licence capping is offset by greater reliance on Ardleigh Reservoir, based on a more dynamic sharing arrangement.

The model was also used to evaluate the potential for conjunctive use and transfer options using existing resources in neighbouring water companies. However, none of these produced a meaningful benefit to the Deployable Output or resilience of WRZ8, with the exception of the River Colne Augmentation option. This is currently a drought option for Anglian Water and requires further investigation by Anglian Water and the local EA team to determine the feasibility of this scheme as a long-term WRMP scheme. It was not therefore considered to be a viable option for development in WRMP24.

7.51 The detailed modelling work undertaken for the East region enabled us to assess actions and solutions that could be implemented under a range of sustainability reductions. The WINEP investigation and subsequent options appraisal has concluded that a cap to Recent Actual (RA) on our Brett group licence is needed to alleviate pressures on the local environment. This cap, along with a volume of 2.16 Ml/d ring-fenced for river support, will be implemented as a five-year rolling licence of five times the recent actual abstraction rate and will translate to a total reduction of 4.63 Ml/d in AMP7, compared with the groundwater deployable output quoted in WRMP19. Our modelling shows that we can accommodate this licence reduction provided that the flexibility allowed by the five-year rolling average licence is maintained and no annual cap is imposed on our Brett group licence. The EA has confirmed this position and therefore no additional investment is required in the short-term in our East region.

Case study - Brett Catchment Modelling supporting options appraisal for WRZ8

The aim of this project was to produce a catchment scale model that allows us to test a range of hydrological scenarios to help identify a near-term solution that bridges from the current operational status to a longer-term solution (2030 onwards). The main driver for this is the cap on Affinity Water East region group licence that will need to be implemented by 2025.

The key advantage of using this model was to identify near-term solutions to meet the specific and geographically defined supply-demand issue and provide additional information on the scale of option required, that is not possible without the modelling.

We used a Pywr water resources allocation model, which aligns to the regional simulator model (in WRE) and allows for efficient modelling of large stochastic datasets.

The model used WRMP19 input data for supply, demand, headroom and outage, with the notable exception of Ardleigh Reservoir deployable output which has been modified in line with the WRMP24 assessment carried out by Anglian Water. The rest of the WRMP19 data is representative of the current supply-demand situation in this catchment. The stochastic flow data is using new Anglian Water rainfall – run-off models and scaled River Colne and Stour flows.
Three stages of modelling were developed as follows:

Modelling Stage	Data being used (number of years)	Failure criteria definitions	
		Failure criteria (i) Demand centre failures	Failure criteria (ii) Demand centre failures and Ardleigh LoS3 events
Problem characterisation	Using historical data (119 years)	Any demand failure events during the 119-year period	Any demand failure events or Ardleigh LoS3 events during the 119-year period
Solution search			
Robustness testing	Using future stochastic data (19,200 x 12 years)	Frequency of any demand failures at any demand centre exceeding a 1 in 500-year return period	Frequency of any demand failures at any demand centre exceeding a 1 in 500-year return period or Frequency of Ardleigh LoS3 events exceeding a 1 in 200-year return period

Other sector and third-party options

7.52. As part of our work on identifying and appraising new supply options we also reviewed the potential for new multi-sector options. These options could take the form of water trading options and the co-creation of new joint supply options to potentially meet the needs of both our customers and other sector demand.

The WRSE regional plan considers other sector needs for the whole region and assessed options to meet these needs. Within the regional context, the other sector demand for water within our WRZs is comparatively low with respect to the wider regional and national picture; the main opportunities comprise energy licences on the River Thames, small-scale agriculture licences, some third-party groundwater abstractions and the Canal & River Trust (CRT) schemes.

7.53. Further information on the work we undertook to identify these options is provided in **Appendix 7.1**. The below bullet points outline a summary of this appendix.

- Four variants of a Didcot water trading scheme were assessed and one scheme is included as a feasible option; this was, however, removed at a later stage by RWE Energy due to very recent changes in energy requirements and demand for water cooling due to the changes in the energy markets and potential new markets in the technology sector.

- Given the flow constraints within our Chalk catchments, only the Roding sub-catchment (in WRZ5) could support a feasible agricultural storage option and one peak distributed storage concept option was developed to include several existing small agricultural licences.

- A third-party borehole recovery scheme with the CRT has been progressed and remains feasible along with the Brent Reservoir option.

- The GUC options with the CRT have been further advanced via the RAPID programme (as described in paragraphs 7.31 to 7.34) and it is worth noting that this option is also a third-party multi-sector option (with the navigation sector).

- An assessment was also made of the opportunities to identify appropriate abstraction/discharge licences for water trading through liaison with Transport for London (TfL), however, no areas of overlap exist within our WRZs and no options could be identified.

Nature-based Solutions (NbS) for enhanced water resources

7.54. Water companies are an important set of stakeholders in planning for and achieving improvements to the health of catchments; resilient catchments benefit all, including water abstractors' ability to provide safe and secure water supplies. Our intention is to integrate NbS holistically, at a catchment scale, to support the objective to create resilient catchments.

7.55. To do this, we are delivering the 'Catchment Assets for Water' (CAfW) partnership project alongside South East Rivers Trust (SERT), as well as other key stakeholders. These include Catchment Partnerships, Wildlife Trusts, Natural England, county councils, the Environment Agency and conservation groups. We have adopted an approach that focuses on restoring ecosystems – by boosting water retention across landscapes, improving the long-term stability of groundwater levels and river base flows through spatial planning, targeting and quantification to estimate the impact of nature-based solutions.

The CAfW project aims to develop an evidence-led, catchment-scale approach to delivering nature-based solutions for increased resilience of water resources. This will build upon work conducted by SERT through the European Regional Development Fund sponsored PROWATER project, where the approach was developed and trialled in our Little Stour catchment, in Kent.

7.56. The programme will incorporate outputs from the WRSE and WRMP consultation processes to help inform the final list of outputs proposed for PR24. The work is undertaken as part of our WINEP programme.

Our approach

7.57. The CAfW project will be undertaken through a mainly desk-based assessment using data provided by Affinity Water and the other partners involved. The outputs will be accessible through the catchment partnerships. Furthermore, there will be engagement with local catchment partnerships to create familiarity with the approach, taking account of local knowledge and data, and supporting the partnership in using and applying outputs down the line. While the focus of the work will be on natural assets for water resources, the CAfW project will aim to take account of water quality and biodiversity as well as wider benefits, where possible.

To support this ambition, our Catchment and Biodiversity team have been exploring the delivery of different NbS options and piloting their implementation in our catchments during AMP7. These pilot schemes are supported with detailed monitoring, such as infiltration monitoring, to assess the additional benefits to DO through enhanced aquifer recharge that can be achieved through different NbS. We are also monitoring wider benefits including water quality and biodiversity. In addition, we are evaluating the Natural Capital benefits of delivered NbS schemes to further support the justification for investment and implementation of targeted landscape-scale NbS.

Co-ordinating the WRMP with WRSE and the PR24 processes

7.58. Several NbS concepts were included within the WRSE emerging plan published for consultation in January 2022. Those concepts remain part of the WRSE draft plan submission and our WRMP24 to support the development of wider holistic catchment solutions alongside WINEP and our long-term environmental destination.

We do not however currently recognise a DO volumetric benefit for these options, though we do recognise that they can offer wider catchment benefits. We also expect to be able to produce some high-level indicative volumetric benefits as part of the CAfW approach (in the form of additional estimates of infiltration as groundwater recharge from the proposed measures). These indicative benefits will be supported by evidence gathered from pilot NbS schemes delivered in AMP7.

7.59. **Table 7.6** provides a list of the concepts with their potential (non-DO) benefits that we included within WRSE; it is a reasonable list of the types of options that have been put forward for PR24. This list is based on our understanding of the potential benefits that could be realised by these types of solutions.

Name	Description of NbS and benefits	WRSE link
North Mymms and sources; Clay Lane group (Upper River Colne) holistic catchment management	Building on catchment management schemes developed in AMP5, AMP6 and AMP7, this will be a holistic catchment management scheme built around improved understanding of risk posed by karst geology. Focusing on water quality resilience to reduce pesticides, nitrate and turbidity in the Upper River Colne, Mimmshall Brook and Essendon Brook catchments. Primarily developing measures with farmers and other landowners to improve soil health, reduce contaminant losses to water and focused mitigations (e.g., constructed wetlands) upstream of high-risk karst features to capture contaminants and wider ecosystem services (flood risk, drought resilience, biodiversity, soil health). Options could include the restoration of the Water End SSSI The outputs of the CAfW project will be used to implement specific NbS options in target locations identified through the modelling and NbS opportunity mapping	Portfolio 1
Landscape scale projects: Upper River Lea	This is an area of thin chalk soils vulnerable to nitrate pollution; predominant land use is arable agriculture. It is also an area covering several chalk stream catchments. Continuing existing AMP7 schemes for nitrate being delivered at a landscape scale with a focus on soil health/management and regenerative agriculture using catchment trading of ecosystem services (EnTrade/LENs). This option evolves the current water quality focus to implementing measures that hold more water on the land, improving recharge and DO. Along with wider ecosystem services benefits (agricultural sustainability, biodiversity, access and recreation etc forming a holistic process for Landscape scale projects. Partnerships in the water industry (Anglian Water/Cambridge Water) and wider agricultural supply chain (e.g., Nestle/3Keel East Anglia LENS project) to strengthen this process. The outputs of the CAfW project will be used to implement specific NbS options in target locations identified through the modelling and NbS opportunity mapping	
River restoration	This is a generic option that would explore a river restoration, explore opportunities to look at other benefits, or cover wider spatial extent. E.g., habitat creation, flood risks.	
Landscape scale projects: River Colne	This is an area covering several chalk stream catchments in the Chilterns AONB; predominant land use is arable agriculture. The lower section of the River Colne is more urban alongside the Colne Valley Regional Park Targeted NbS will be delivered at a landscape scale with a focus on soil health/management and regenerative agriculture working together with the catchment partnership, Thames Water, Natural England and conservation groups. This option evolves the current water quality focus to implementing measures that hold more water on the land improving recharge and DO, along with wider ecosystem services benefits (agricultural sustainability, biodiversity, access and recreation etc., forming a holistic process for Landscape scale projects The outputs of the CAfW project will be used to implement specific NbS options in target locations identified through the modelling and NbS opportunity mapping	
River restoration	As above	

Landscape scale projects: Lower River Thames DrWPA (Egham; Iver; Walton and Chertsey)	Continuation and expansion of the existing AMP7 water quality schemes for pesticides being delivered at a landscape scale with a focus on soil health/management and regenerative agriculture using catchment trading of ecosystem services and/or Payment for Ecosystem Services (PES) schemes. This option evolves the current water quality focus to implementing measures that increase wider water quality resilience (pesticides, nitrate, turbidity to protect sources and reduce demand on imports. This option will also invest in wider ecosystem services benefits (agricultural sustainability, biodiversity, access and recreation etc. forming a holistic process for landscape scale projects. Partnerships in the water industry (Thames Water/South East Water) and other partners, including: EA, NE, FWAG, Wildlife Trusts, Forestry Commission to strengthen this process	
Landscape scale projects: East Kent Chalk (Broome; Kingsdown; Drellingore; Dover Priory; Ottinge; Connaught etc.)	This option proposes expansion of the current AMP7 schemes for nitrate, expanded to be delivered at a landscape scale with a focus on soil health/management and regenerative agriculture, using catchment trading of ecosystem services. It evolves the current water quality focus to implementing measures that hold more water on the land, improving recharge and DO, along with wider ecosystem services benefits (agricultural sustainability, biodiversity, access and recreation etc. forming a holistic process for landscape scale projects. Partnerships in the water industry (Southern Water/South East Water) and the SERT Prowater project) to strengthen this process.	

Table 7.6: Concepts and options included in the WRSE emerging plan ('Portfolio' is a term used by WRSE and is provided here for reference to the regional plan).

7.60. In **Chapter 9** we provide a summary list of the Nature Based Solutions (NBS)that we are taking forward as part of our business plan submission. We have not included costs for these options as part of our final WRMP24 submission and the actual schemes put forward for PR24 may differ from the concepts outlined here. A formal cost benefit assessment for the options put forward have been submitted as part of our PR24 submission.

Working with wastewater companies on concepts to meet multiple needs

7.61. The wastewater services in most of our Central region are serviced by Thames Water (TW) (and, to a lesser degree, Anglian Water). The Dour community (Southeast region) is serviced by Southern Water and the Brett community (East region) by Anglian Water. As part of the development of our WRMP24 options, we have been working closely with the sewage undertakers to try to identify solutions that could align with outcomes on both sets of plans. The following is a summary of the status of these activities:

The recent draft Thames Water Drainage and Wastewater Management Plan (DWMP) submission provides a summary of the ways that we explored addressing strategic issues that overlap both plans. This includes the effluent reuse option at Maple Lodge and Blackbirds STWs (on the River Colne), where we worked with Thames Water to explore the feasibility of utilising planned headroom at the works to support either increased abstraction downstream or an offset for sustainability reductions. The options were subsequently screened out due to the existing catchment flow requirements downstream which would not allow for additional abstraction.

There are currently no plans to develop opportunities across both sets of plans with Anglian Water, however, we will continue to work with Anglian Water in the northern parts of the Central region to ensure alignment with regards to our WINEP programme where catchment flows are dependent on discharges. As described in **Chapter 9**, the option for recycling of wastewater at Colchester also forms one of the key schemes that will enable Anglian Water to address its own supply/demand imbalances and therefore support transfers from Anglian to our East region (Brett community).

We will continue to engage on Southern Water's DWMP with respect to their investment plans for assets in our groundwater source protection zones in our Southeast region (Dour community). Treated effluent returns from small local works are also often important from a catchment water balance perspective and therefore maintenance of our existing supply base.

Summary and next steps for our options work

7.62. Within this chapter we have outlined a wide range of options to meet a number of WRMP requirements, including options to meet the long-term supply-demand deficit, ways to accelerate solutions to near-term environmental challenges and strategies for integrating new strategic resources into the existing network.

All the feasible supply options described within this chapter have been included within the optimisation modelling for programme appraisal stages of the WRMP. We have also explained why some options that we have considered are not included within the regional model but remain important solutions to meet the challenges we face.

7.63. As part of our outreach work to identify and develop options with third parties, we also undertook an 'Official Journal of European Union' (OJEU) Notice in 2019. We asked potentially interested parties to come forward with ideas to support our options work, although no substantial proposals emerged from this activity. We will continue to seek new third-party options through our Bid Assessment Framework (BAF).

We have also made our BAF more accessible to interested parties since WRMP19, by making it available on our online engagement site. Through our dWRMP24 activities, we have updated our BAF and our options screening process, in accordance with our commitment to make as much of this information as accessible as possible.

8. The decision-making process

8.1 Our primary duty for the WRMP24 is to meet the requirements of the Water Industry Act 1991 in respect of the provision of a resilient supply of water and fulfil the related Regulations[91] and Direction[92]. As described in **Chapter 6**, we have a considerable forecast deficit, primarily driven by ADO conditions, in the Central region (WRZs 1-6). We also have a forecast ADO deficit for the East region (WRZ8). For the Southeast region (WRZ7) we do not have a forecast deficit under 'Business as Usual' environmental destination, but there may be a peak deficit later in the planning period if we need to match higher levels of environmental ambition.

8.2 As described in **Chapter 4 and Chapter 7**, we have a range of demand-side and supply-side options we can potentially use, to address these deficits. The WRPG describes the methods and assumptions that need to be followed when compiling our WRMP24. We therefore need to decide on our preferred investments in a way that is transparent and complies with all the requirements of the WRPG. There are two key requirements from the guidance that have underpinned our decision-making process, these are as follows.

- We have developed a set of **best value** principles (informed by both our customers and stakeholders - see **Chapter 3**) that we have used to decide on our preferred WRMP24. This means that, whilst the WRMP24 needs to be 'cost efficient', it is not necessarily the lowest cost option, but should consider the trade-offs between costs, environmental and social objectives. It should also account for other aspects such as the reliability and deliverability of options, in a way that reflects customer and stakeholder feedback.

- The investment models that we have used inherently include **adaptive planning** within the assessment. This means we consider a wide range of future conditions and select the plans that provide the best balance between near-term affordability and longer-term risk management, given the scale and delivery times associated with our key options.

Summary of WRMP19

8.3 We adopted both above principles in our Water Resources Management Plan 2019. This formed an adaptive plan which set out how we might respond to the emerging challenges at the time. This focused on the same issues identified in this WRMP24. Namely, to develop a robust plan that could manage the uncertainties we faced around demand forecasts and demand management, and the need for reducing abstraction from Chalk groundwater sources. A summary of the adaptive plan generated in WRMP19 is provided in **Figure 8.1**.

[91] The Water Resources Management Plan Regulations 2007
[92] Direction to Affinity Water from DEFRA 2022

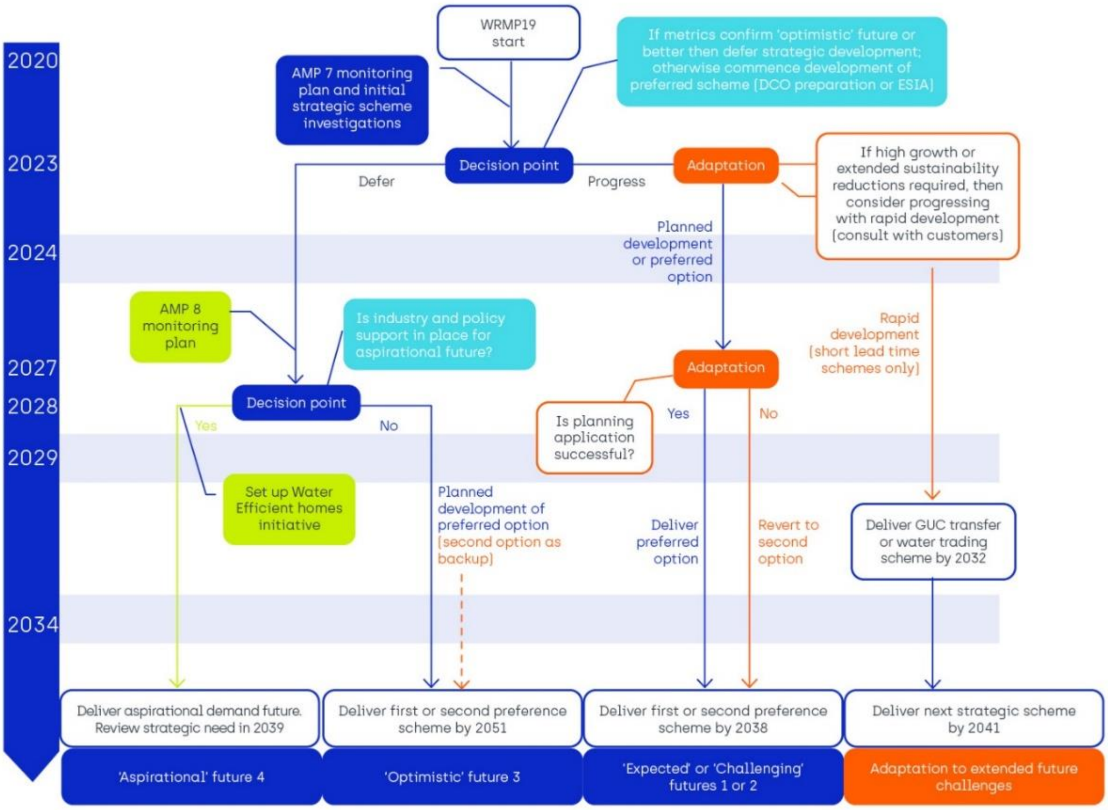


Figure 8.1: Summary of WRMP19 adaptive plan

8.4 We are on track to deliver the key 2020-25 demand requirements identified in WRMP19. These are detailed in **Chapter 9**.

We are on track to deliver our WINEP abstraction reduction commitments. These are supported by the development of the Sundon conditioning plant, which allows us to maximise usage of the existing Grafham transfer, and the Stage 1 Egham to Iver transfer scheme. Both are also on track for delivery.

Changes from WRMP19 and the requirements for updated decision-making

8.5 As described in **Chapter 4**, our short-term Target Headroom has reduced in comparison to the WRMP19. This is primarily because we now have greater certainty over the demand management programme. Overall, this reduction balances out the increases in demand and leakage described above, so our supply-demand position is forecast to be close to that reported in WRMP19 for 2025. This should allow us to achieve the key short-term objectives identified in that document, which is to deliver our 2020-25 abstraction reduction targets and cease to rely on drought permits and orders for any drought less than 1 in 200-years in severity.

8.6. For the longer term, the WRPG requires us to consider whether any update to our WRMP19 is required. The scale of the environmental destination that has been identified with our environmental regulators in **Chapter 5** means that we are now in a position where we need to follow the right-hand branch of the WMP19 adaptive plan. For WRMP19, the preferred solution was therefore to deliver the Grand Union Canal option as soon as possible, followed by co-development of the South East Strategic Reservoir Option (SESRO) with Thames Water.

8.7. Our WRMP19 was our first use of adaptive planning and it demonstrates the robust, long-term nature of such a planning process. However, for our WRMP24, the development of the National Framework for Water Resources by the EA has resulted in two key changes that mean we have had to re-visit our decision-making process and hence re-evaluate the appropriateness of the WRMP19. These two changes are outlined below.

- The scale of the environmental destination challenge is now better defined in the long term. The size of the challenge is much larger than even the 'extended future challenges' scenario assumed in WRMP19 (which was up to 40Ml/d in the Central region).
- The WRPG states that it now expects that company WRMPs should closely reflect the outcomes of the regional modelling process. Whilst we worked with Thames Water to develop our WRMP19, this was done largely in parallel to WRSE and WRE, with some reconciliation against their long-term findings. Both regional groups have now significantly strengthened their assessment and modelling capabilities in response to the EA National Framework requirements. This is to the point where we consider it is now appropriate to fully utilise both region's evaluations as the core evidence to support our decision-making. The regional plans have also identified and allowed us to quantify the interactions with other water companies beyond Thames Water and helped identify options for regional collaboration that provide a more robust WRMP24 for both Affinity Water and each region as a whole.

8.8. Based on the above, we consider that WRMP19 does need to be updated and this chapter details the decision-making process we have followed to generate our WRMP24. This process has been used to develop a 'best value', 'adaptive' WRMP24 that seeks to find an appropriate balance between environmental, social and economic needs, while accounting for a deeply uncertain future. The greater involvement with regional modelling has helped us work in an integrated way with partner water companies across the east and southeast of England and ensure that the proposed WRMP24 represents best value for both Affinity Water on an individual basis, and for the wider regions as a whole.

8.9. The description of the decision-making process contained within this chapter is outlined below.

- The key principles we have used to underpin our decision-making process.

- The complexity of the assessment method we need to make robust decisions (referred to as our 'problem characterisation') and the compatibility of the regional assessments with that need.
- A summary of the decision-making approaches used in the WRSE and the WRE regional plans. This includes the methods used to evaluate the environmental impact of alternative plans at the 'portfolio' level.
- How we have used the regional plan outputs in our WRMP24. This includes the representation and use of alternatives, with their associated portfolio-level environmental assessments (SEA, WFD, HRA, BNG, carbon impact).
- How we have refined that strategic level plan to generate our final WRMP24.

8.10. As noted previously, in addition to the Water Industry Act 1991 and WRMP Direction 2022, our WRMP24 must comply with key legislative requirements around SEA, WFD, and HRA. It must also comply with the government targets such as those set out in the 25-year Environment Plan and the Environmental Improvement Plan (EIP) published in February 2023.

8.11. Reflecting the WRPG and National Framework, the identification of the 'best value' strategic investment plans is carried out by the regional groups, in our case, WRSE and WRE. We have worked closely with both organisations to make sure that the methods they have used align with our key principles, as described above, and provided them with the inputs (supply and demand forecasts plus options) that they need to run their assessments. The WRPG states that "if your plan is affected by a regional plan which has specific metrics, you should use the same metrics in your WRMP, for transparency". It also states that "you should consider whether any additional metrics are required in your WRMP" and "using the same metrics is only relevant to those parts of your plan directly affected by a regional plan". For Affinity Water we were fully involved with the derivation and consultation of metrics for WRSE and WRE, so do not consider that any additional metrics are required. However, there have been some qualitative decisions that we have made when refining the resilience risks, shorter-term transfer schemes and the 'downstream' infrastructure required to support the longer-term strategic schemes in the Central region (WRZs 1-6) and East region (WRZ8). These are described under the 'Refinement of the strategic plan' text below.

Defining the problem

8.12 The WRPG contains requirements of the types of decision-making tools that should be used within our WRMP24, with reference to the UKWIR 'Decision Making Tools' document, when deciding upon the preferred modelling approach. This document recommends that we undertake a 'problem characterisation' assessment to help us decide on the modelling approach that should be used. Its recommended approach is to determine the scale and complexity of the water resources planning problem that we face and use that to decide on our approach to the modelling that underpins our decision making.

8.13. The 'problem characterisation' comprises two elements. The first element is the size of the gap between supply and demand (the ‘deficit’); and the second is how difficult it will be to address this deficit given the nature of our supply system and demand base.

The problem characterisation comprises of a set of evaluation questions that describe the problem complexity and size of need. These are carried out on a semi-qualitative basis in accordance with the UKWIR ‘Decision-Making Tools’ guidance. The scoring for WRMP24 is described in **Appendix 8.1**, where we have updated our scores for our Central Southeast and East regions in accordance with:

- the change in the scale of need (see **Chapter 6**);
- improved understanding of our water resources modelling (see **Chapter 5**); and
- potential degree of inter-connectivity across the South East, as described above.

Across all three regions, we saw an increase in strategic need and complexity factor scores. However, only the Southeast region has changed categories. This process is set out in **Appendix 8.1**. The final assessment matrix from this process is replicated in **Table 8.1**.

Problem characterisation		**Strategic needs score (‘How big is the problem?’)**			
		0-1 (None)	2-3 (Small)	4-5 (Medium)	6 (Large)
Complexity factors score (‘How difficult is it to solve?’)	Low <7		East		
	Medium 7-11		Southeast		
	High (11<)				Central

Table 8.1: Final assessment process for WRMP24

Problem characterisation – Central region

8.14. The problem characterisation for our Central region falls into the ‘high’ complexity factor category and ‘large’ Strategic Need category. These are the same scores for the area set out in our WRMP19. The regional ‘adaptive planning’ modelling now developed by WRSE therefore represents an extension and increase in sophistication of the approach that we initially developed in WRMP19.

Problem characterisation – Southeast and East regions

8.15. The Southeast region has increased from a 'low' Complexity Factor in our WRMP19 to a 'medium’ Complexity Factor in our WRMP24 and retained a 'small' Strategic Need category. The East region is characterised as having ‘low’ and ‘small’ Complexity Factor and Strategic Need categories respectively; this is no change from WRMP19. There is therefore no significant change in the Problem Characterisation scores.

8.16. However, the availability of regional modelling for our WRMP24 means that we did effectively have access to sophisticated planning for both regions. For the East region (WRZ8) there are some short-term abstraction reduction and capping proposals that involve a change in licence that could bring us close to deficit in the shorter term. As described in **Chapter 5,** the nature of this question meant that we used the Pywr sub-regional water resource model for that evaluation, rather than an investment modelling tool.

Planning adaptively to meet future uncertainty

8.17. The future is highly uncertain. The Covid-19 pandemic (which resulted in modelled increases in demand of around 9%) and political changes to immigration rules have shown that current and expected future demand for water can change quickly. Although we have a good understanding of the risks from climate change and the needs of the environment to reduce abstraction, quantifying the impact that this will have on our available supplies of water is also very uncertain. In the rounds of planning before WRMP19, we simply accounted for this with a risk allowance, namely, our Target Headroom.

8.18. However, the problem characterisation shows that the scale and complexity of the issues that we face in water resources planning meant that we needed to formally recognise and incorporate adaptive planning within our decision-making process, as used in WRMP19. Working with WRSE, we enhanced the sophistication and optimisation capability of this approach for our WRMP24.

8.19. The need for adaptive planning means that we can't simply rely on the risk allowance provided by Target Headroom, which would be the alternative approach. We need to use modelling approaches that allow us to understand how we can cope with different long-term futures, whilst ensuring that we take appropriate enabling actions within the short term. Therefore, we have adopted an adaptive approach. This is inherently included within the decision support modelling described below.

The approach developed for our WRMP24

8.20. Our strategic decision-making process was therefore carried out using the modelling and governance that was developed by the WRSE and WRE regional groups. The locations and makeup of those groups is shown in **Figure 8.2** and **Figure 8.3**.

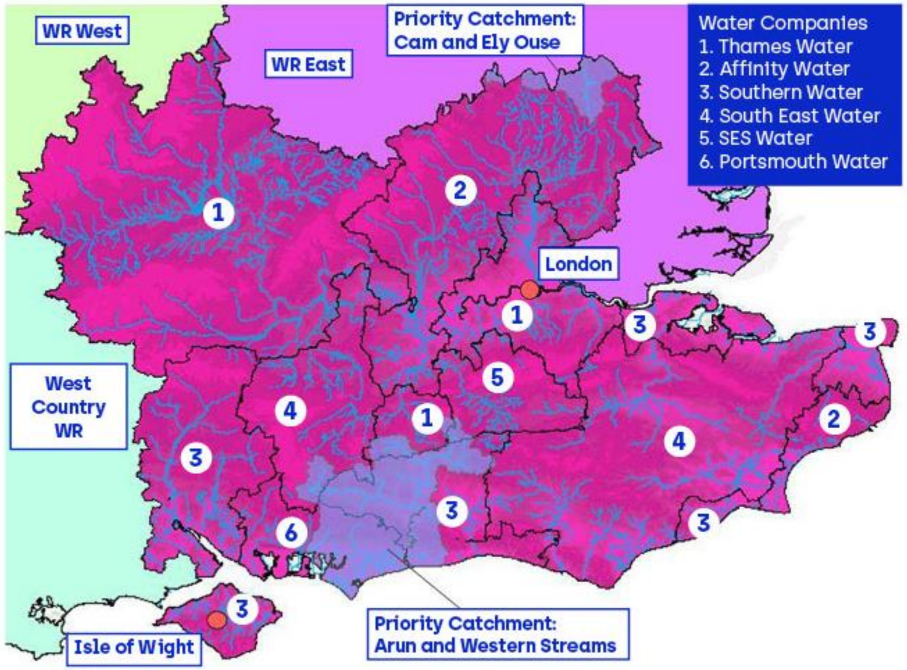


Figure 8.2: Water Resources South East (WRSE)

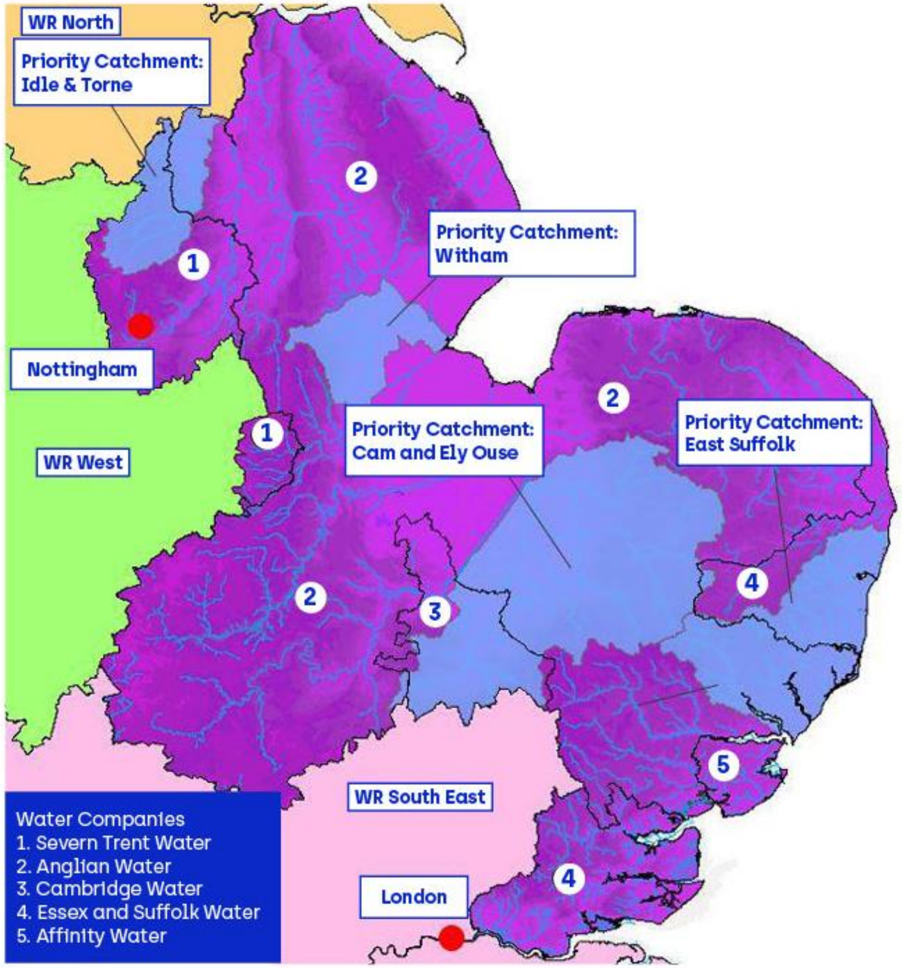


Figure 8.3: Water Resources East (WRE)

8.21. We reviewed a range of investment programmes that examine how we might efficiently deliver the different potential objectives, whilst still meeting relevant 'must do' criteria. We compared these against customer and stakeholder preferences and expectations collectively, with other water companies in each region, before collaboratively deciding on a 'best value' plan. The metrics and criteria used in the regional decision-making process are described in the ‘Strategic regional planning and decision-making’ section below. The preferred adaptive plan, along with the range of alternatives that we considered when making our decisions, are outlined further on in this chapter.

8.22. Although the regional plans are reflected in our WRMP24, we have added further ‘tactical’ detail in some areas to support and interpret the findings. These mainly concentrate on plan details that are required in the shorter term (2025-30) within our Central region (WRZs 1-6), and East region (WRZ8). These additional details include aspects such as upgrades at existing treatment works required to support transfers, and resilience testing of the East region system to understand the implications of short-term abstraction reductions. They allow us to make best use of existing resources and start work on abstraction reductions more quickly through the use of concepts such as ‘Chalk Streams First’, as described in **Chapter 5**.

8.23. We also needed to ensure that the short-term transfer options that form the initial stages of development in our Central region are designed to provide ‘best value’ for customers by integrating with our existing network and provide an efficient distribution system for future strategic schemes. We refer to this as our ‘Connect 2050’ network options appraisal, as described in **Chapters 5 and 7**.

8.24. Our decision-making process within this chapter therefore comprises of the following.

- The Strategic Regional Decision-Making Process for WRZs 1-7 (WRSE) and WRZ8 (WRE).
- A refinement of our short-term plans and ‘downstream’ infrastructure needs. For our Central region (WRZs 1-6), this includes the ‘Connect 2050’ network options assessment. For our East region (WRZ8), this stage includes a resilience assessment of the short-term impact of abstraction reductions within this region.

These are described in turn below.

8.25. We played a key part in developing the regional plan decision support modelling tools used in WRSE, to ensure that the modelling could support our WRMP24 decision-making process. As noted above, our Central region (WRZs 1 to 6) contained the greatest need for complex tools to support adaptive plan decision-making, so the key requirement from WRSE was that the overall evaluation process and modelling platform could support formal adaptive planning.

8.26. The overall process that we developed in collaboration with the other WRSE companies as a result of this need (as published in the WRSE regional plan) is shown in **Figure 8.1** below. We consider that this meets our needs as set out above, because it has allowed us to identify the best value, adaptive set of strategic solutions that best serve our needs whilst interacting collaboratively and efficiently with surrounding water companies. It also helped us to identify and describe the implications of alternative plans that might be developed in light of the options and transfers available from surrounding water companies. Therefore, we have relied upon this modelling to support the WRMP24 process. The assurance framework that we used to validate the robustness of the modelling process is described in **Chapter 10**.

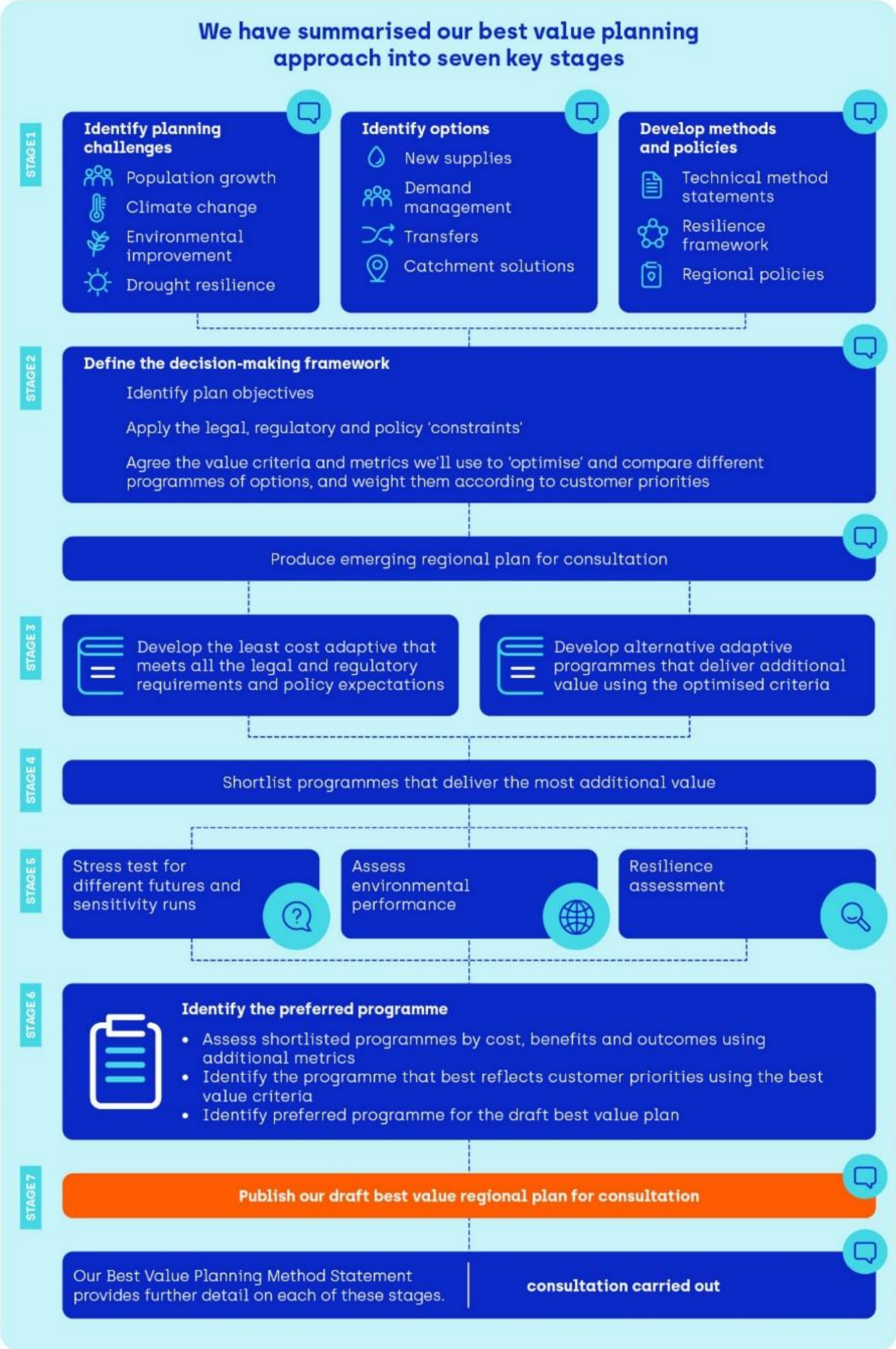


Figure 8.1: Stages of development of the WRSE regional plan

Stage 1 of the process effectively represents the generation of inputs by the water companies involved in WRSE. Our supply, demand and options are described within **Chapter 4, Chapter 5 and Chapter 7**. The resulting scale of the baseline supply-demand challenge is described in **Chapter 6.**

Stage 2 of the process was the creation of the 'best value' planning objectives, which were tested with customers and stakeholders. These were developed to ensure we can meet our statutory and policy requirements, which resulted in the generation of a set of 'must do' criteria. A supporting set of environmental and social metrics that could be optimised through investment modelling, were developed in consultation with stakeholders. The 'must do' and 'optimised' metrics were organised into the following four 'objectives' to help understand the main drivers of need across the potential investment plans.

- Deliver a secure and wholesome supply of water.
- Deliver environmental and social benefit.
- Increase the resilience of water systems.
- Deliver at a cost that is acceptable to customers.

8.27. The final set of metrics that were used in the best value assessment, including their status, are set out according to the four categories in **Table 8.2**.

Deliver a secure and wholesome supply of water to customers and other sectors to 2100

Value criteria	Definition	How we'll measure it (metric)	Criteria type	Data source	Method statement/ document
Meet the supply demand balance	All the water resource programmes that we consider for the regional plan must meet the supply demand balance so there –is no water shortfall in any of the water companies' supply areas over the planning period. This is a legal requirement.	Public Water Supply - supply demand balance profile (Ml/day)	Constraint	Final supply demand balance for public water supply	Regional planning tables
	The regional plan is also looking to address the future needs of other sectors. We've worked with representatives of sectors that rely heavily on water in our region to understand how much additional water they need the regional plan to deliver to meet their future needs.	Provides additional water needed by other sectors (Ml/day)	Constraint	Non-public water supply demand forecast	Multi-sector
Leakage	The South East water companies have committed to reducing leakage by 50% by 2050. All the water resource programmes that we consider for the regional plan will achieve this target.	50% reduction in leakage by each company by 2050 from 2017/18 baseline (%)	Constraint	SE water companies Annual Review 2017/18	Options appraisal
	There are options that would reduce leakage further over the planning period. We will develop programmes that include leakage reduction beyond 50% and use this criterion to assess and compare the performance of the shortlisted programmes.	% leakage reduction above 50%	Constraint	Option level assessment	Options appraisal
Water into supply	All the water resource programmes we consider will include options to reduce water use. At present there is no formal target for water consumption that we can include in our plan so we will develop programmes that include different levels of consumption reduction and use this criterion to assess and compare the performance of shortlisted programmes. Defra is considering a metric or target to encourage a reduction in the amount of water used. We'll revisit this if it is set to make it a constraint within the plan. In that event, anything beyond that target will be used to demonstrate performance of the shortlisted programmes.	Distribution Input (DI) per property (litres per day)	Optimised	Option level assessment	Options appraisal
Customer preference	We have conducted research into customer priorities and preferences for different option types. This produces a score, and we will use this criterion to assess and compare the performance of shortlisted programmes. In addition to using this criterion to assess best value, we will engage with customers to help us consider the application of weightings to the different criteria and identify the preferred programme.	Customer preference for option type (score)	Optimised	Customer research	Customer engagement

Deliverable at a cost that is acceptable to customers

Value criteria	Definition	How we'll measure it (metric)	Criteria type	Data source	Method statement/ document
Programme cost	This represents the total cost of delivering all the options in the water resource programme. It uses the standard HM Treasury rate to calculate the total programme cost. We will use this criterion to assess and compare the performance of the different water resource programmes.	Net Present Value (£m) using the Social Time Preference Rate (STPR)	Optimised	Option level assessment	Option appraisal
Intergenerational equity	This criterion also looks at the total cost of the programme but calculates it using a lower HM Treasury rate that spreads the cost of the programme over the planning period delivering best value for both present and future generations. We will use this criterion to assess and compare the performance.	Net Present Value (£m) using the Long Term Discount Rate (LTDR)	Optimised	Option level assessment	Option appraisal

Deliver environmental improvement and social benefit

Value criteria	Definition	How we'll measure it (metric)	Criteria type	Data source	Method statement/ document
Strategic Environmental Assessment (SEA)*	Regional plans are non-statutory but we will apply the SEA criteria. The SEA informs the decisionmaking process through the identification and assessment of the effect a plan or programme will have on the environment. We will use the SEA to calculate the individual scheme scores. This does not replace the SEA process.	Programme benefit (score max) Programme disbenefit (score min)	Optimised	Option level assessment	Environmental assessment
Natural capital	Natural capital can be defined as the elements of nature that directly and indirectly produce value or benefits to people (now or in the future). There isno statutory target to increase natural capital, but it is an aspiration of the UK Government's 25-year Environment Plan. We will calculate the increasein natural capital that the different water resource programmes deliver and use this criterion to assess and compare the performance of different programmes.	50% reduction in leakage by each company by 2050 from 2017/18 baseline (%)	Optimised	Option level assessment	Environmental assessment
Abstraction reduction	Reducing abstraction from sensitive water sources is one element of how the regional plan will deliver environmental improvement. We will use our investment model and technical environmental work to optimise this, considering affordability, the expected benefits that will be derived and the timing of delivery	% leakage reduction above 50%	Constraint	Environment Agency scenarios and water company scenarios	Environmental assessment
Biodiversity	Improving biodiversity is required under a range of different legislation and policy and assessing the biodiversity net gain of our water resource programmes is a requirement of the Water Resources Planning Guideline. It is also an SEA objective. We will develop a net gain score** for each of our different water resource programmes and use this criterion to assess and compare the performance of different programmes.	Distribution Input (DI) per property (litres per day)	Optimised	Option level assessment	Environmental assessment
Carbon	The water industry has committed to achieving net zero operational carbon emissions by 2030. There is also an objective to reduce embodied and operational carbon emissions as part of the SEA. We will show how different water resource programmes seek to balance the additional carbon created through a combination of minimising emissions by considering alternative construction techniques and/or materials and by carbon offsetting schemes. The cost of this is included in the total programme cost but we will also use the cost of carbon offsetting to assess and compare the performance of different programmes.	Cost of carbon offsetting (£m)	Optimised	Option level assessment	Environmental assessment

Increase the resilience of the region's water systems

Value criteria	Definition	How we'll measure it (metric)	Criteria type	Data source	Method statement/ document
Drought resilience	Water companies currently plan for a severe drought to occur once in every 200-years. The National Infrastructure Strategy3 set a requirement for this to increase to once in every 500-years, increasing the level of resilience, this has been endorsed by HM Treasury. All the water resource programmes we produce will achieve this level of resilience. We will use the Best Value planning approach to identify the optimum time we can achieve this increased level of resilience..	Achieve 1 in 500-year drought resilience (date achieved)	Constraint	This is included as a requirement in the National Infrastructure Strategy	Regional planning tables
Resilience assessment Reliability	Reliability is the ability to withstand short term shocks without actively changing the performance of the system.	Programme reliability score	Optimised	Resilience assessment	Resilience Framework
Resilience assessment Adaptability	Adaptability is the ability to make a shortterm change in performance of the system to accommodate the impact of a shock and recover.	Programme adaptability score	Optimised	Resilience assessment	Resilience Framework
Resilience assessment Evolvability	Evolvability is the ability to modify the system function to cope with long term trends.	Programme evolvability score	Optimised	Resilience assessment	Resilience Framework

Table 8.2: WRSE best value metrics

Whole Life Carbon assessments were completed by consultants Mott MacDonald using their Moata Carbon Portal (MCP). The methodology is detailed in **Appendix 8.4**.

The Natural Capital Assessment methodology follows a three-stage process. First, defining the Natural Capital baseline. This is achieved through determining the zone of influence for each option and then the baseline was developed using open-source data as described in NECR2853 to generate a Natural Capital account of the stocks within the Affinity Water regions.

The second stage of the methodology is to conduct Option Level Natural Capital Assessments, which focus on the following ecosystem services: Carbon Sequestration (Climate Regulation), Natural Hazard Management, Water Purification, Water Regulation, Biodiversity and Habitats, Air Pollutant Removal, Recreation & amenity value and Food production.

Finally, the results are reported as a single discreet monetised value reported in £/year generated, by combining the outputs of each of the five monetised natural capital metrics to provide a single cost / benefit figure.

For the Biodiversity Net Gain methodology, a biodiversity baseline was developed from spatial data sets of habitats inventories and assessed in line with the Defra BNG 3.0 Metric. The natural capital baseline map was used to identify the existing land use and calculate the biodiversity value of the footprint of each option prior to construction. The post construction land use was used to calculate the post construction biodiversity score.

The biodiversity metric is reported as a single score for each option, showing the percentage change in biodiversity net gain units for each option according to the metric.

Further details on both Biodiversity Net Gain and Natural Capital Assessments can be found in **Appendix 8.5**.

8.28. The following metrics were considered 'must' do as a result of legislative or policy requirements.

- We must balance supply and demand at the stated level of drought resilience (able to manage a 1 in 200 years severity of event without emergency drought orders or permits, rising to being able to manage a 1 in 500 years drought event in 2040).
- Achieve 50% leakage reduction and the demand management targets as set out in the Defra Environmental Improvement Plan (although the implications if these targets cannot not be met was tested, as described later).
- Meeting the abstraction reductions as set out in **Chapter 5** (based on different scenarios that match those described in **Chapter 5**).

We recognise that the ambition set out in this plan is likely to involve significant investment and hence rises in customer bills. Affordability to customers was therefore prioritised by ensuring that all generated plans were optimal in terms of net present cost across the region, and any unacceptable impacts of this Regional NPC decision making on bills for Affinity customers were considered during the development of the preferred plan in Chapter 9. As described below, the configuration of the investment model also ensured that scheme utilisation across the range of likely meteorological conditions (ranging from normal years to severe drought) was included in the calculations, and the adaptive planning element of the model ensured that the plan represented the 'least regrets' regional solution, which is designed to provide the best balance of costs between current and future customers.

We calculate the comparative costs of each potential plan using 'net present cost' (NPC), as outlined in the HM Treasury Green Book. This effectively sums the total expected capital investment (covering annuity repayments and financing costs) and operational cost of the options that are included over the life of the plan. This includes the following key calculation elements.

- We use the HM Treasury 'Social Time Preference Rate) to reflect the preference for society to defer investment where it is reasonable to do so. This means that expenditure in the future is more affordable than expenditure today. Effectively that means expenditure towards the end of the plan (in 2050) has only half the cost impact of expenditure in the first year of the Plan (2025) when calculating the NPC.
- Operational costs take into account utilisation across a range of conditions. The investment model considers how much of the scheme is required under 1 in 2 (normal year), 1 in 100 and 1 in 200-year events, and then weighs the utilisation to generate the expected average operational costs for each scheme.

8.29. By making these calculations, we ensure that the preferred plan represents the most efficient way of meeting the requirements that we have defined through the other metrics, and hence makes the plan as affordable to customers as it can reasonably be. We refer to this as generating the 'cost efficient' plan.

Stage 3 of the process involved the use of the Investment Model (IVM) to determine the 'cost efficient' plans that would best reflect the different objectives.

We refer to this plan as 'cost efficient' rather than 'least cost', as it supports a range of futures, including varying environmental destinations. The overall plan represents the lowest cost way (in NPC terms) of adapting to these future uncertainties. The IVM is inherently adaptive, as it considers the most cost-efficient way that the regional needs can be met *given the defined range of future uncertainties.*

8.30. Our 'adaptive plan' has four elements, as outlined below.

- A preferred set of *pathways* that show how we invest and build in response to changing conditions. One of the pathways (the 'reported pathway') is chosen and quantified in our Water Resource Plan (WRP) tables.

- The short-term *activities* (construction planning applications, procurement activities etc) that we need to start now, and the longer-term *investments* in each pathway.
- Any *preparatory actions* we need to take now to allow us to keep the longer-term options open.
- A *monitoring plan* that identifies how we will track the situation and what will 'trigger' us to take an alternative pathway.

8.31. The *pathways* are the key new element for our WRMP24 and are used as a means of giving certainty in the context of adaptability. The investment model allows us to understand what strategies we should adopt in the longer term for each of a range of future 'situations'[93] and, critically, what the 'optimal' shorter-term activities and preparatory actions should be, given those uncertainties.

Through WRSE we have adopted a 'real options' investment approach to developing its adaptive plan. Under 'real options', each supply-side solution is separated into modular components as far as possible (planning then construction, with different phases of development where possible). The investment model uses these to both solve all branches of an adaptive plan simultaneously, to provide the most cost-efficient or best value solution for the need identified in each branch and determine which sets of actions and components of solutions need to be developed in the short term (before the branch points) to serve those long-term solutions.

This type of analysis has been used rather than the 'robust decision-making' approach used by WRE[94] because it allows us to concentrate on the timing of schemes and the way that they should be connected, rather than starting off by considering the most robust solution that we should have in place by the end of the plan (which is the basis of the robust decision-making process). We have done this because there are policy-driven changes that alter the supply-demand balance in a stepped way, at multiple points in the timeline, with a considerable range of uncertainty. This can be solved by a range of discrete schemes of widely varying size and capital/operational cost types with multiple transfer options between the six WRSE companies.

8.32. The timing of schemes can therefore have a large impact on costs to customers and the environment, particularly because it means schemes later in the programme can be deferred or even avoided altogether, if future conditions turn out to be favourable. This means that options with a better cost/benefit ratio do not necessarily represent the best options for the region once timing and uncertainty are considered. Stakeholders made it clear throughout the WRMP19 process and the WRSE-led preparation for WRMP24, that the timing of options is very important and we would need to demonstrate that flexibility and adaptability was appropriately considered when deciding upon our preferred WRMP24.

[93] The term 'situations' is used explicitly by WRSE to refer to the different supply-demand balances that result from uncertainties in externally driven factors over time
[94] See the 'Strategic regional planning and decision-making – WRE region' section later in this chapter for a description and justification of the WRE RDM decision-making process

8.33. ‘Real options’ addresses this need in two key ways. These are outlined below.

- Under ‘real options’, each supply-side scheme is separated into modular, component parts where possible (e.g. the GUC scheme can be delivered as a 100Ml/d scheme, or two dependent 50Ml/d schemes), and the development is separated into planning and construction for larger schemes.
- The investment analysis inherently separates potential futures into discrete ‘branches’ and solves the problem based on those branches. Critically, it determines the most cost-effective developments in the near term that are needed to support those longer-term branches. This is explained in more detail below.

8.34. The range of uncertainty around the supply-demand balances for the WRSE region is large, because of climate, growth and environmental destination uncertainty. **Figure 8.5** shows the possible range of baseline supply-demand balances that result from the uncertainties that exist within the key drivers of water resource stress in the region. This comes from the combination of individual company supply-demand balances. The drivers of this range for Affinity Water WRZs 1 to 7 are described in detail in **Chapter 6**.

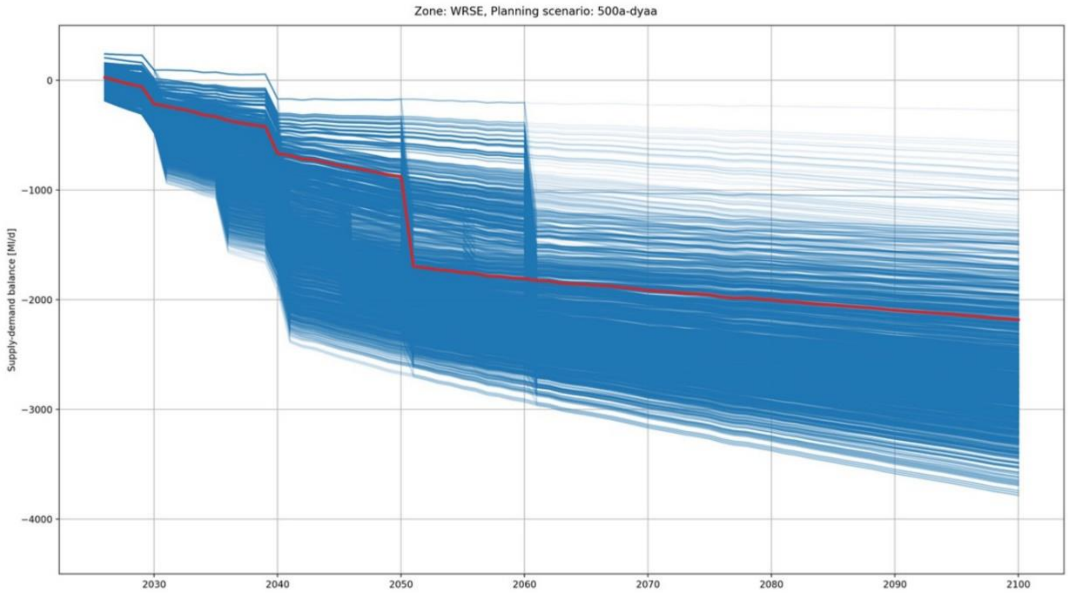


Figure 8.5: Possible range of baseline supply-demand balances for the WRSE region

8.35. As part of the WRSE process, we selected a total of nine branches to describe this range. These were derived based on combinations of the three key drivers of externally driven uncertainty in the supply-demand balances, namely:

- population and housing growth;
- climate change impacts on Deployable Output for existing systems; and
- levels of abstraction reduction associated with delivering environmental destination ambitions.

For each of these key drivers, three specific forecasts were selected following consultation with regulators and stakeholders, as described in **Table 8.3**.

Driver	Forecast change		
	High	Medium	Low
Growth (see Chapter 4)	Housing Plan with Oxcam Arc, with Housing Need tested in the very highest scenario	Housing Plan forecast	ONS18 forecast, with ONS18 low tested in the very lowest scenario
Climate change (see Chapter 5)	Scenario 6 (upper quartile driest)	Median	Scenario 7 (upper quartile wettest)
Environmental destination (see Chapter 5)	'Enhanced' scenario	'BAU+' with lower groundwater/surface water interaction[95]	'BAU' with lower groundwater/surface water interaction

Table 8.3: Forecasts based on key drivers

8.36. The final nine situations were therefore made up of representative combinations (three forecasts' times three drivers) of these driver specific forecasts within each plan, as shown in **Table 8.4**.

Situation	Growth forecast	Environmental destination	Climate change impact
1	Housing Plan max	High	High
2	Housing Plan with Oxcam	Med	Med
3	Housing Plan with Oxcam	Low	Low
4	Housing Plan	High	High
5	Housing Plan	Med	Med
6	Housing Plan	Low	Low
7	ONS21-Primary	High	High
8	ONS21-Primary	Med	Med
9	ONS21-Primary	Low	Low

Table 8.4: The nine housing plan 'situations'

8.37. To make the plan 'adaptive' the forecasts were introduced in two stages over time, which we refer to as the 'branch points' (see Figure 8.7. below). There were two main factors that were used when deriving the timing of the branch points.

- WRMPs run on five-year cycles, so branch points would typically occur at the start/end of an AMP period
- For regional plans there are two options to set branch points:
    - risk-based trigger: when do the future uncertainties exceed Target Headroom?
    - policy decision-based trigger: when can a policy decision regarding the environmental destination be made?

[95] As described in **Chapter 5**, this is within 1 Ml/d of the BAU forecast with higher groundwater/surface water interaction, so represents a good mid-point of the likely range

8.38. Following consultation on the emerging regional plan, the branch points were changed in response to stakeholder feedback[96] and regulatory expectations[97], so that the branch points occur earlier in the planning horizon. **Figure 8.6** provides a copy of the response from WRSE and **Figure 8.7** illustrates the final set of situations and branch points that were used as the baseline for the investment model.

Extract taken from WRSE's response document

As part of the online questionnaire, WRSE asked respondents: "We've described our adaptive planning approach and the scenarios we've included in our adaptive planning pathways. Do you agree that we have planned for the right scenarios in each of the pathways, with a wide enough range for each of our key challenges, through our adaptive planning approach?".

Responses to this question again reflected the views expressed on individual options selected as part of the emerging regional plan, with respondents who disagreed with the question amounting to approximately 83% of those who responded to this question (excluding blanks and 'don't knows'), with the remainder agreeing (11%) and/or providing narrative comments.

Many of those disagreeing with the question, including GARD [Group Against Reservoir Development] and its supporters, considered that the plan had adopted worst case scenarios for population and housing growth which were inflating the requirement for additional water resources, particularly to 2040, and that unnecessary infrastructure will be built as a result. There was opposition to the single pathway to 2040, with respondents considering that this was not adaptive, highlighting that options being selected for that period (notably SESRO) included some of the largest, most damaging and least flexible elements of the strategy. There was a preference expressed for a plan that prioritised most flexible solutions immediately before committing to enormous and costly infrastructure projects that cannot be adapted.

Those expressing support considered that planning for a range of scenarios was the right approach, with a central pathway based on planned housing growth, and a high pathway necessary as a 'worst case' scenario allowing for uncertainty and flexibility. WRSE's approach was considered to provide flexibility to tailor solutions with sufficient lead in times to address changing circumstances.

Figure 8.6: Responses received from WRSE consultation on 'Emerging regional Plan' regarding branch points

[96] Emerging regional plan - WRSE Consultation Response document: May 2022
[97] PR24 long-term delivery strategies - Ofwat

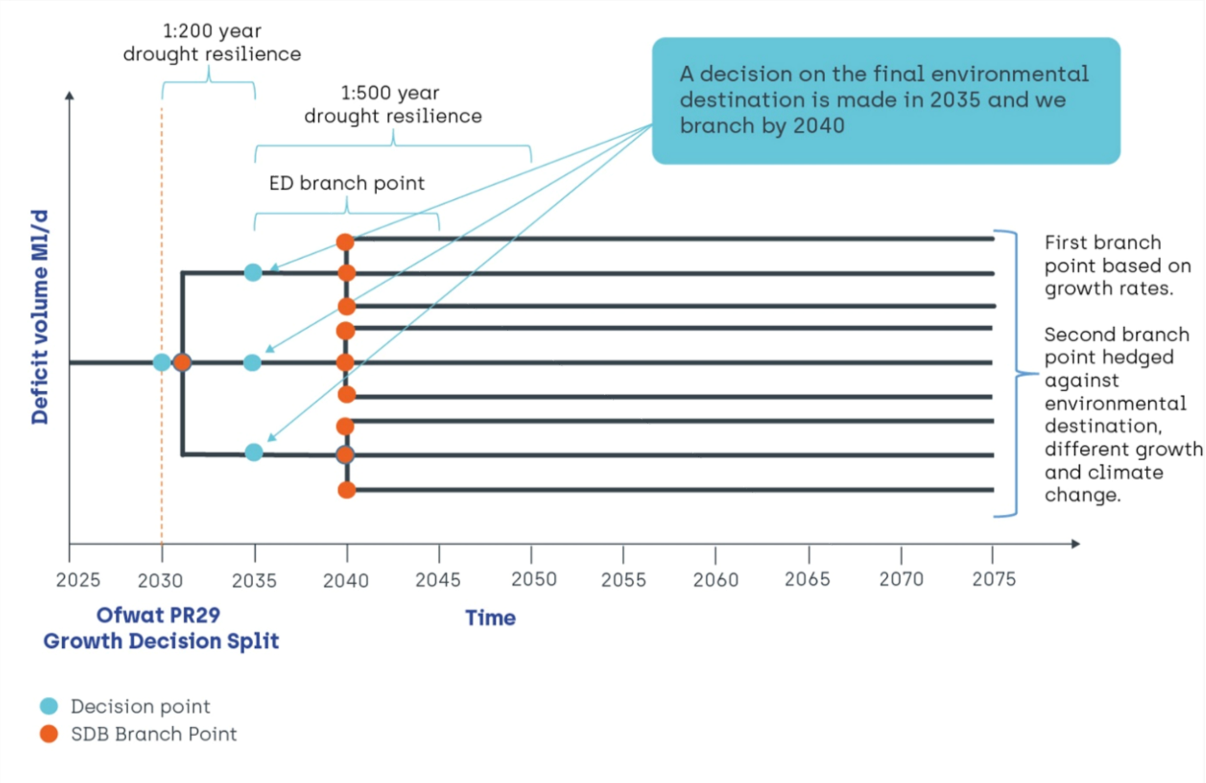


Figure 8.7: Summary of the supply-demand situations and branch points used in the WRSE Investment Model

8.39. It should be noted that the investment model actually splits the branches in accordance with the way that planning and investment would occur. For example, if the decision is taken at the start of AMP9 (2030-35) that future growth assumptions can be limited to ONS18, then WRMP34 would be prepared on that basis. The investment identified for AMP9 would still progress as planned until this new plan is approved.

Conceptually, the approach is straightforward – the model looks to see if it makes economic sense[98] to defer investment until after 2030 and only includes investment in the 2025-2030 period if it makes economic sense, once all the futures after the 2035 and 2040 branch points are considered. We are effectively making the decision now (in our WRMP24) to start on low regrets investment[99] where the modelling analysis indicates it is 'best value' to do so.

The investment model that we have used provides a 'least regrets' answer to the range of uncertainties we face in the future. It calculates the programme of options that provides the lowest cost NPC and best performance against metrics across all nine branches, whilst ensuring that this includes a common pathway before 2035 so it is deliverable. Effectively it answers the question:

[98] Early investments make 'economic sense' in this case if they lower the overall probability weighted Net Present Value across all the branches. All branches are given an equal probability of occurrence, so costs in 2025-2030 are worth three times as much as costs in the individual branches between 2030-2035, which in turn are worth three times as much as the individual branches in 2035 onwards

[99] 'low regrets' investments are effectively those early investments where it makes economic sense to proceed

Should I 'hedge my bets' against future uncertainty by starting larger, long lead time strategies and options that are more efficient but require more substantial investment and may not be fully utilised, or wait and only invest in smaller initiatives that have shorter lead times but tend to be less effective and less cost efficient?

The 'least regrets' Plan provides the optimal balance (according to the probability weighed NPC and chosen metrics) between those two extremes.

The branch points we have used in the modelling are risk based – i.e. they reflect the point at which uncertainty tends to exceed statistically based, realistic risk allowances (in this case as expressed through Target Headroom – see **Chapter 4**), rather than strategy or option lead times. This is because we, and the WRSE region as a whole, have a range of options with very different lead times and it would tend to artificially bias the assessment towards certain types of options if we based the branch point on option lead times. The risk-based approach is more 'neutral' and hence is a more balanced approach to inform and support decision making.

8.40. For the next water resources management plan (WRMP29), we will need to update our understanding of the futures and decide whether to progress with investment in the 2030 – 2035 period. There are no branches, including in relation to growth, until 2030 as we have the statutory duty to plan for resilient supplies, and the WRPG clarifies that this includes allowing for Housing Plan growth. We therefore need to account for this in the short term, but as allowed for in the WRPG, we have then incorporated lower growth projections (ONS21-P) in our planning after 2030. This means that we will not constrain growth in the short term but are not assuming that higher growth will continue and hence drive investment in the longer term.

This approach resulted in the branches shown in **Figure 8.8** being used as the supply-demand balance forecasts across our Central region. The branches in the Southeast region (WRZ7) are much smaller in terms of deficit and are dominated by the high environmental destination scenarios – i.e., situations 1, 4 and 7 are the only branches where there is a forecast deficit once the preferred demand management strategy is implemented.

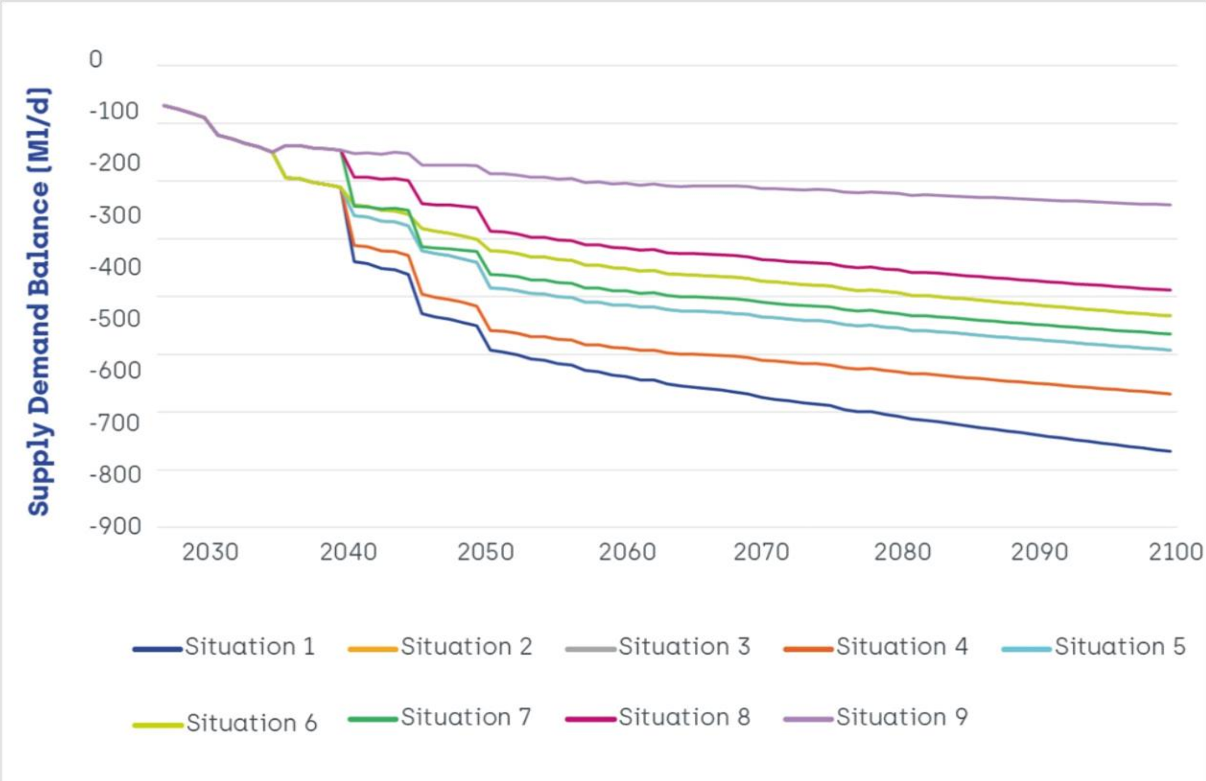


Figure 8.8: Branches of potential future supply-demand forecasts for our Central region

8.41 Our WRMP24 encompasses all branches and pathways, and alternatives are reviewed 'in the round' within **Chapter 9** – i.e. the preferred plan is compared with alternatives that also cover all nine branches. The key focus for this WRMP is to decide which investments need to start in the next five years to support the adaptive response in the longer term.

8.42. For regulatory reporting purposes we have selected 'situation 4' as the 'reported pathway' and used this to populate our WRP Tables. We have selected this pathway based on regulatory feedback during pre-consultation, because the EA requested that our reported pathway accounts for both housing plan growth and BAU+ environmental destination. As indicated above, for us, pathway 4 contains the enhanced environmental destination scenario, but as shown in **Chapter 5,** this is only 20Ml/d (8%) higher than the BAU+ scenario with default EA impact assumptions. We have not referred to this as the 'preferred pathway' in this document, as the plan is adaptive and accommodates all pathways. By reporting pathway 4 in our tables we have, however, demonstrated that that we are able to adapt to and meet all the environmental destination scenarios required by the EA. All environmental destination scenarios are the same until 2035 and our WRMP24 covers adaptations for all future needs, including the maximum growth and enhanced environmental destination in situation 1.

8.43. The investment model includes the WRZs across the region and existing links between them and evaluates the available options to generate solutions for solving supply-demand deficits across the 50-year planning horizon. These options include the demand management strategies described in **Chapter 4**, along with existing and potential new transfers between WRZs and key supply nodes.

8.44. In simple terms, the investment model optimises cost across all the planning branches, given that the first five years needs a consistent set of initial investment actions. These actions can then support the different investment plans required, across each of the future branches, as they occur.

Technical details of the model concept and approach are provided in **Appendix 8.2** to this plan.

8.45. To support a robust evaluation of alternatives, we ran the investment model multiple times to examine how the investment plan changed as the inputs to the values used in the adaptive framework change. The alternatives assessment runs fell into the broad categories outlined below.

- Alternatives assessment, incorporating:
  - Specific sensitivity assessments – e.g. certain large schemes removed, or costs altered for particular options.
  - Policy and global sensitivity assessments – this involved testing the implications of timings around policies associated with drought resilience and environmental destination, as well as the sensitivity to key economic inputs such as discount factors. Success and government support on demand management is also a key uncertainty that has been tested.
- Best value runs, as described in **Appendix 8.2**. These were carried out after the initial sensitivity assessments and examined the trade-off between increasing cost and better performance against the optimisable best value metrics.

8.46. The sensitivity assessments were guided by the initial 'cost efficient' plan output and consultation feedback from stakeholders to our draft WRMP24. The parameters and results of those runs are therefore described in **Chapter 9** and form the basis of the alternatives assessment used to derive our preferred plan.

8.47. **Stages 4 to 6.** Stages 4 to 6 of the process, shown earlier in this chapter, effectively concentrate on the evaluation of the alternative plans as developed through Stage 3.

The alternatives that were considered are described in **Chapter 9** under the relevant 'alternatives and trade-offs' section, along with the reasons why key decisions were made around the shortlisting and subsequent final selection of options. We used a variety of reporting tools to understand the results of the WRSE analysis, which we have used to present the alternatives assessment within **Chapter 9**.

8.48. As well as simply considering the overall cost and best value performance of candidate plans, when carrying out our final assessment we also took into account 'risk and regret' factors when considering alternative plans with similar value outcomes. This process used the modelled best value metrics to understand the overall delivery risk and likely acceptability of candidate plans as a whole.

Once we had identified the final few alternative plans, we considered how plans perform under individual futures and respond to key policy and delivery risks. We looked for the best balance between low regrets and delivery risk

Low Regrets. Consider how the plans meet the principles of 'low regrets' adaptive planning (as set out by Ofwat in their Long-Term Delivery Strategy guidance) - examine the drivers of investment under different futures and qualitatively consider the implications of the differences between plans

Delivery Risk. Consider the key policy assumptions that underpin the investment planning and how the different plans might mitigate any risks. Consider plan-level delivery risks and the mitigations that are available within each plan

Figure 8.9. Deciding between candidate plans

8.49. We also reviewed the wider water quality implications that might result from the alternative strategic plans[100] and the interaction of the schemes contained in those alternative strategic plans to determine how these might interact with the **existing resilience issues** that we have in our supply system. We refer to these as 'resilience hotspots' and they consist of parts of the network where we know there are customers at higher risk of supply failure for reasons other than water resource availability. This is an important link to our separate business plan process, as it identifies the linkages between supply system investment plans and the WRMP24.

8.50. We carried out this analysis using the resilience framework we developed with other companies across WRSE[101], which attributes the same scoring and scaling approaches to evaluating the severity and magnitude of these 'hotspots' as is used for the resilience metrics that are applied to new water resource options.

8.51. During the refinement stage, a proportion of the shortlisted plans were also assessed for **in-combination environmental effects** in accordance with SEA criteria.

[100] The strategic plan is the adaptive plan that we identified from the WRSE modelling. It contains all the preferred WRSE water resources options and the preferred demand management strategy. We then refined this through more detailed analysis of the nature of the early investments and the required connectivity of our network to develop our final dWRMP24, as described later in this chapter

[101] See Appendix 8.2

The final stage of the process was to then re-run the best value optimisation with the core elements of the preferred plan mandated as appropriate, to determine how this plan could be fully optimised against the best value criteria.

'Strategic' regional planning and decision-making – WRE region

8.53. For our East region (WRZ8), we used WRE to run a collaborative process of alternatives assessment and optimisation in a similar way to WRSE, although as noted previously they used 'Robust Decision-Making' rather than a 'Real Options' analysis. This process meant that the preferred plan was identified as the one that performs best at a fixed point in time (2050), and simpler economic assessment was then used to schedule the schemes that were identified.

8.54. Most of our supply-demand need and therefore investment risk is contained within WRSE, with only our East region (WRZ8) directly relevant to the WRE modelling process. However, we also used the WRE modelling to undertake specific assessments to understand the impact on Anglian Water in Water Resources East, if they transferred additional water to us via the Anglian to Affinity Water Strategic Resource Option. This was important because although the WRSE model contained this option, the costs and environmental impacts of the transfer were based on an assumption that it would be supported by the proposed South Lincolnshire Reservoir. In practice, the 'true' impact to the WRE region would be the incremental impact on their overall plan of providing us with the transfer – i.e. we needed them to answer the question: 'what other extra investment would WRE have to include if they used the South Lincolnshire Reservoir to provide us with the source water for the transfer?'

8.55. For our East region (WRZ8), the overall need was small in relation to the WRE strategic need and scale of sub-regional schemes that are available. We therefore relied on the WRE process to identify the best value option that could be used in the longer term to address the supply-demand deficit that we might face under higher environmental destination scenarios, in partnership with Anglian Water and Essex & Suffolk Water.

Reconciliation with long-term planning in the PR24 business plan

8.56. The PR24 business plan also contains strategies for the long-term development of water resources and is one of the important 'other plans or programmes' that we need to take into account according to the WRPG.

For our PR24 business plan, Ofwat has set out its expectations in relation to long-term management of assets through its 'long-term delivery strategy' (LTDS) guidance. This requires that long-term plans consider a range of 'common reference scenarios' that represent future scenarios that need to be considered separately in isolation and combination when developing an adaptive plan. These scenarios and how they relate to the WRSE future 'situations' are described in **Appendix 8.2**. They contain the following elements.

- High and low climate change 'concentration pathways'.
- High and low growth (equivalent to Housing Plan and ONS-Primary. scenarios as described in **Chapter 4**).
- A fast and a slow technology scenario. For the WRMP this relates to a faster smart metering rollout (delivery by 2035) and a slower rollout (delivery by 2045).

Overall, these result in a smaller range of future uncertainty than accounted for under our main adaptive plan above. These scenarios were analysed by running the same investment models as described under the adaptive planning above, but the runs were single scenarios where a cost-efficient plan was identified for each. The results of these runs are provided in **Chapter 9** and taken into account when developing the preferred adaptive plan for our three regions.

Refinement of the plan for our Central region

8.57. Although the WRSE assessment generated a coherent strategic level regional plan, there are several aspects of planning that we identified during our WRMP development and pre-consultation with stakeholders, that could not be included in that modelling process. These required the following more detailed evaluation and policy consideration from an Affinity Water point of view when generating the WRMP24.

- The refinement of the WRSE selected demand management strategy, into a more staged and detailed delivery plan.

- Local supply system investments that would be needed to support the potential licence relocation options identified in **Chapter 5 and Chapter 7,** to help accelerate and improve flexibility around environmental destination in the short term. We also considered how this might be regulated given the current uncertainties in the viability of that concept.

- The evaluation of sub-WRZ level inter-connectivity that would be required to enable the strategic changes to the supply system that would result from the main alternative plans. This is commonly referred to as the evaluation of 'downstream' infrastructure needs in water resources planning. We did this through the 'Connect 2050' process (see **Chapter 7**), as we needed to understand how the different abstraction reduction and water resource strategies affected our options for transferring water within our Central region, and how that could most cost effectively integrate with our main short-term options for transferring water between WRZs 6 and 4. We incorporated any major differences between strategies when making our final decision on the preferred plan.

These refinements form part of our preferred plan, as described in **Chapter 9**.

Refinement of the plan for our Southeast region (WRZ7)

8.58. For Southeast region (WRZ7), the lack of investment need outside the 'high' environmental destination strategy meant there was no need for near-term refinement of the investment model results. Since there was no investment in the near term, there was no need to refine the early part of the plan.

Refinement of the plan for our East region (WRZ8)

8.59. For East region, the short term WFD licence capping and WINEP reductions result in a supply-demand balance that is close to zero. However, the impact on this region is complex and there is a risk that this change could require investment, even though there is still a very small surplus. We therefore used the Pywr model described in **Chapter 5** to carry out a system simulation-based resilience assessment of the region and nearby Anglian Water and Essex & Suffolk systems under drought stress conditions, to determine if there is a risk to Levels of Service following the licence capping. The conclusions of this analysis are provided in **Chapter 9**.

9. Our ‘best value’ plan

9.1. Our WRMP24 ‘best value’ plan consists of four main elements:

- Demand management: an integrated demand management strategy that encompasses households, non-households (commercial properties) and leakage. Our demand management strategy also includes potential government initiatives relating to water use in appliances and water consumption in new properties.
- Strategic level supply schemes; these schemes represent the best value for development in the near term.
- Supply network modifications and smaller supply schemes; these represent the best value to manage needs in the short term and to support the strategic supply schemes in the longer term.
- Adaptive Strategy; our strategy, derived from regional level assessments is adaptive. This means that it allows us to monitor supply and demand conditions and modify our investments accordingly to deliver the best value for our customers.

These elements are described in this chapter for each of Affinity Water’s supply regions – Central region (Misbourne, Colne, Lee, Pinn, Stort and Wey communities), Southeast region (Dour community) and East region (Brett community) – and shows how these elements operate together to form our WRMP24 plan.

Demand management strategy

9.2. Our plan is underpinned by demand management. It forms at least 50% of our strategy to achieve our environmental ambitions whilst managing pressure on water resources from growth. In some of the predicted futures, where we face less of a deficit, demand management forms up to 70% of our plan.

Chapter 4 details the four demand management strategies developed for inclusion in the WRSE and WRE regional models. These strategies are called ‘low’, ‘medium’, ‘high’ and ‘high plus’. The demand reduction volumes included in these strategies were developed using evidence from existing initiatives in English and Australian water companies. This evidence applied to the demand reductions that we can achieve and the reductions that need support from government-led initiatives. The detail included in each strategy such as the type of demand options and the evidence for the associated demand reductions, is provided in **Chapter 4. It should be noted that the ‘high’ and ‘high+’ strategies relate to the speed of implementation of strategies rather than the absolute content of the demand management strategy – i.e. the ultimate benefits are the same across the ‘medium’ to ‘high +’ strategies.**

The purpose of these strategies was for each company in WRSE to develop the best combination of their demand options that could be used to meet the demand management pathway targets set out by Defra in the Environmental Improvement Plan (EIP)[102]. The demand management activity included in each of these strategies for our East region has been included in the WRE regional plan.

The modelling carried out by WRSE to develop our 'best value' plan has shown that our 'medium' demand management scenario is required for the reported pathway for the WRMP24 and is the Best Value solution given the policy targets and ambition that we have.

The 'medium' demand management scenario allows us to achieve our environmental ambitions, whilst managing pressure on water resources from growth. It includes both company and government assisted demand reductions to meet the EIP targets for PCC, non-household consumption, leakage and Distribution Input. These targets are achieved with demand management activity centred around our smart metering programme for both household and non-household customers.

The detail for each component of the 'medium' demand management strategy, is described in the following sections. This includes the costs and benefits for the household, non-household and leakage reductions included in our plan and our programme to achieve the EIP targets. It also includes the alternatives and trade-offs that have been considered and the risks and uncertainties associated with our demand management strategy.

Alternatives and trade-offs

9.3. For each component of our demand management strategy, we have considered the alternatives and trade-offs.

For household consumption, our main alternatives consideration was around smart metering and their role in the refinement of our water efficiency programme and introduction of tariffs. This assessment included three components, the pace of rollout, the type of meter and the type of technology.

The pace of rollout was modified in each of the demand management strategies supplied to WRSE. Our 'low' strategy included a maximum meter penetration of 85% by 2040. Our 'medium' strategy included a 15 year roll out to achieve 90% meter penetration by 2040. Our 'high' strategy which equates to the slow technology scenario in PR24, includes a 20-year roll out. Our 'high plus' strategy, aligned with the fast technology scenario in PR24, includes a 10-year roll out to achieve 90% meter penetration by 2035.

The type of meter and the type of technology were fixed in each of the four demand management strategies. **Chapter 4** details our assessment to include fully smart meters (AMI) in our demand management programmes.

[102] Defra, Environmental Improvement Plan 2023, 7th February 2023 'https://www.gov.uk/government/publications/environmental-improvement-plan'

9.4. Our decision-making to derive our preferred smart metering strategy considered the evidence from service providers and other water company experiences to date, and balanced this against affordability, opportunity, and delivery risks.

Table 9.1 provides a summary of the key alternatives that we considered as part of the strategies we supplied to WRSE.

Strategy Element	Alternatives considered	Strategy considerations and trade-offs
Timescale for delivery and coverage	Delivery timescales between 10 years and 20 years. Meter penetration between 85% and 95%	Fast delivery (10 years) may not be practical and result in wasted costs, but delivery over a long time (20 years) may mean we lose the ability to defer large supply schemes. We have tested the implications of this under the 'fast' and 'slow' technology reference scenarios described under the 'PR24 Long Term Delivery Strategy' section. Experience from the current 'water saving programme' indicates that there are approximately 10% of properties that are not feasible to meter. This may be because a customer's internal supply pipe has been built into a new wall or a new kitchen setting which would require significant damage to access. It may be due to a block of flats with a central supply to multiple dwellings in one building (i.e. central hot water systems), or it may be due to internal access issues. As we advance in our metering programme rollout, it is more likely that we encounter the requirement for more internal installations where an external installation has not been possible.
Approach to smart metering	Consider strategies based on AMR+ and AMI (see **Chapter 4**), with hybrid approaches based on deferral of AMI	AMR+ is lower cost and can theoretically support the water efficiency and wastage reduction benefits, only missing out on behavioural change benefits. However, detailed discussions with both Anglian and Thames Water indicate that there would be data download issues associated with our primarily below ground meter stock that mean benefits will not be as good as AMI based approaches.
Technology preferences	Examined different types of 'fixed network' technologies as well as alternative NB-IoT approaches	Technology asset class strategy appraisals concluded that 'NB-IoT'[103] could be the most cost-effective approach, but there are concerns about reliability and whole life cost effectiveness due to battery life issues. Innovation is ongoing in this sector so this may change over time.

Table 9.1: A summary of the smart metering alternatives considered

9.5. For non-households, we focused on rolling out the approach that we have successfully trialled in the current 2020-25 period, namely, our sector

[103] 'NB-IoT' refers to 'narrow band – internet of things' and effectively relies on devices that are installed on meters that connect directly to mobile phone networks. 'Fixed networks' rely on radio transmission to multiple receiving masts that are installed and dedicated to the smart metering network

partnership approaches supported by the initial stages of smart meter rollout. Beyond this, the WRE research has shown that market innovation supported by the information gathered through smart metering, will be required to achieve non-household water efficiency to any significant extent. Further details are provided under the preferred non-household demand management strategy section.

9.6. The alternatives analysis for the leakage strategy focused on the most cost-effective way to achieve the EIP commitment of 50% reduction by 2050. This was determined for each of our demand management strategies using the optimisation tool described in **Chapter 4**. The best value combination of measures included in the 'medium' demand management scenario are described under the preferred leakage strategy section.

As part of our alternatives assessment, we considered the potential to reduce leakage beyond 50%. To achieve this level of reduction, mains replacement beyond the level we have included in our plan, is required. However, the AIC of additional mains replacement is significantly more expensive (over four times the cost) than the AIC of the supply side options that are available to us. As such, a reduction of leakage beyond 50% does not represent good value for money for our customers. In addition, it includes significant societal and carbon impacts that are associated with large scale mains renewal for leakage control.

Household strategy – company-led activity

9.7 Our 'medium' or reported pathway demand management strategy includes both company-led and government-supported demand management reductions.

Our company-led options include four categories of demand reduction activity:

- Smart Metering: the installation of new smart meters on existing unmeasured properties and the replacement of basic or AMR meters on existing measured properties.
- Water Efficiency: Home Water Efficiency Checks (HWEC) or visits to assist customers with behavioural changes within the home to save water. This includes the provision of water-saving devices.
- Wastage Reduction: company led activity to assist customers to reduce wastage within their home.
- Tariffs: introduction of tariffs following the completion of our smart metering programme roll out.

A full description of each demand management option is provided in the subsections below.

The underpinning evidence base, and assumptions are described in **Chapter 4** and our Demand Management **Appendix 4.5**.

Table 9.2 summarises the activities, costs and benefits for each demand reduction activity in our strategy. These savings combined deliver the PCC reductions we have included in our plan. Costs are presented in 2020/21 prices.

For AMP8 we have incorporated a stretch ambition into our media campaigns (currently labelled under the banner 'Save our Streams') to achieve a further 17.9 Ml/d or 4.5 l/h/d reduction in PCC. This contributes to our overall Metering Behavioural change saving of 24.6 Ml/d in AMP8.

Component (rounded to nearest 100)	Delivery period			
	AMP8	AMP9	AMP10	AMP11&12
Total AMI meters(nr)*	379,132	1,059,632	0	-
Newly metered properties (nr)*	71,600	143,470		-
Replacement metered properties (nr)	304,584	909,162		-
Total metering cost in period (£m)	£46.28	£276.5		
Benefits of metering behavioural change (cumulative Ml/d)	**24.6**	**45.2**	**54.7**	**57.3**
Benefits of 'smart' tariffs (cumulative Ml/d)	0	0	6	6
Number of HWECs in period	92,000	131,000	135,000	257,000
Benefits of HWECs (cumulative Ml/d)	**2.1**	**9.2**	**13.9**	**13.9**
Cost of HWECs in period (£m)	£5.79	£8.70	£9.10	£14.40
Benefits of wastage/ plumbing losses (cumulative Ml/d) – includes 'leaky loos' etc.	**0.9**	**3.7**	**5.4**	**6.3**
Cost of wastage/plumbing fixes in period (£m)	£1.60	£2.20	£2.70	£4.20
Total cumulative benefit company activity (Ml/d)	**27.6**	**58.1**	**80.0**	**83.5**
Total in period costs (£m)*	**£53.67**	**£287.40**	**£11.8**	**£18.6**

Table 9.2: Preferred household strategy delivery profile

**Note: These figures exclude optant meters and meters associated with new households that we will install as a matter of course (i.e., covered by developer services). Under the Housing Plan growth forecasts this will require 488,000 additional meters by 2050. They also exclude replacement meters in AMP8 where basic meters are being upgraded to AMR.*

Metering Programme

In our WRMP24, we determined that delivery of our smart metering programme should be phased over 15 years to conclude in 2040. This was because:

- It provided a practical rate of delivery with an average of 100,000 smart meters installed per annum. This was considered an ambitious target which would exceed the rate we have achieved to date.
- Delivering over a period of 15 years was fast enough to ensure that the benefits are in place, before the rate of delivery of environmental destination might be accelerated within the Centra region (2040-2050). At the same time, it was considered conservative enough to allow us to take advantage of technological developments and hence reduce costs to customers.

In our final WRMP24, we have accelerated our smart metering programme to conclude within 10 years, by 2035. This was in response to the recommendation from the Environment Agency in our letter from Defra in January 2024.

Due to our reliance on demand management early on in our plan, and the criticality of smart metering in delivering our household demand reductions, we agree with the Environment Agencies recommendation. Therefore, we have made the following changes in our final WRMP24:

- We have reduced our 'customer journey', from the current 24 months to 12 months. The customer journey refers to the length of time from when we inform a customer that they are due to move to a measured tariff to the time when they become measured. This will allow us to bring forward customer savings on behavioural change and wastage (internal plumbing losses, including 'leaky loos') by a year.
- We have accelerated our meter installation programme to deliver all smart meters by 2035. This involves bringing forward our WRMP24 AMP10 installation programme and implementing it in AMP9, doubling the number of meters planned for AMP9.

We propose to use our AMP8 programme to fully develop the technology, processes and commercial arrangement to allow us to increase the level of smart metering in AMP9. We note that there is a risk to full delivery by 2035 resulting from the ability to carry out the number of 'digs' that are potentially required to construct new meter boxes outside of customer homes, where the existing box is not suitable for the smart meter. Currently, this represents between 30% and 35% of installs. Digging out the circa 350,000-meter boxes required to deliver the 1.1 million smart meters in AMP9 will require a significant number of streetworks permits from Local Authorities for the resulting install rate of around 350-meter boxes per day and may cause widespread disruption to customers. We therefore consider there is a risk that 175,000 installs remain in AMP10, which comprises half the new meter box 'digs'. We will commit to investigating new technologies such as vacuum excavators in AMP8, which could potentially allow for much less disruption and streetworks permits and update our forecasts for WRMP29 to include more installs in AMP9 if this is feasible.

Table 9.3 summarises our final meter installation programme for WRMP24 and the resulting meter penetration. This is split between our proactive metering programme and new build properties.

Our proactive metering programme includes the below.

- Newly metered – Compulsory properties; refers to current unmeasured properties that receive a compulsory meter to commence their 12-month customer journey to become a measured property.
- Newly metered – Optant; properties refer to current unmeasured properties who opt or choose to become a measured property.

- Replacement meters – Dumb to AMR; refers to our proactive programme to replace a portion of dumb meters with AMR meters. This occurs AMP8 only in areas where smart metering infrastructure is not yet available.
- Replacement meters – Dumb/AMR to AMI; refers to our proactive meter replacement programme where dumb and AMR meters are upgraded to fully smart meters.

As detailed in **Chapter 4**, both new meter installations on existing unmeasured properties and the replacement of basic and AMR measured properties with an AMI meter, result in demand savings. This is through customer behavioural changes and through customer repair of wastage issues in the home.

Meter installations that do not result in a reduction in demand, are part of our asset maintenance programme. This includes meter installations for customers who opt to have a meter, replacement of basic or AMR meters with another AMR meter, or the installation of an AMI meter on a new build property. These meters are not included within our demand management strategy for demand reduction, but they do contribute to our overall meter penetration and smart meter penetration.

Number of meter installations by type	AMP8	AMP9	Total by 2035
Newly metered – Compulsory	71,600	143,470	215,070
Newly metered - Optant	2,950	2,200	5,150
Replacement Meters – Dumb to AMR	20,868	0	20,868
Replacement Meters – Dumb/AMR to AMI	304,584	909,162	1,213,746
Total Proactive Meters (AMR&AMI)	**400,002**	**1,054,832**	**1,454,834**
New Build Properties*	132,000	104,600	236,600
Total Smart Meter Installations	379,134	1,159,432	1,538,566
Total Meter Installations	532,000	1,159,432	1,691,432
Meter Penetration excl voids	80%	90%	
Smart Meter Penetration excl voids	22%	85%	

Table 9.3: All household meter installations to 2035

*New Build properties under Housing Plan P (medium) growth

Our forecast total meter penetration and smart meter penetration is shown in **Figure 9.1**.

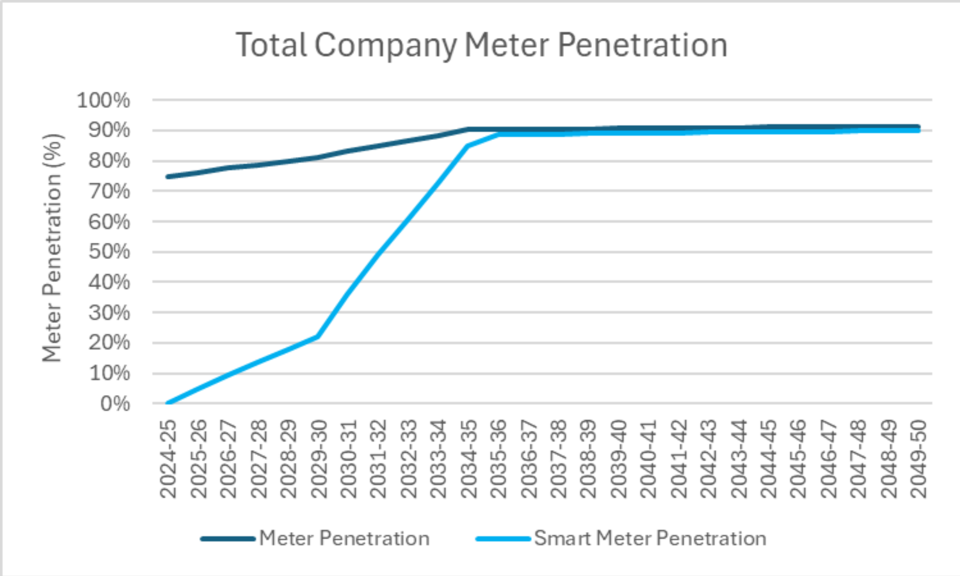


Figure 9.1: Meter penetration to 2050

Figure 9.1 shows that by 2030 we will achieve an overall meter penetration of 80% and smart meter penetration of 22%. This is an increase from our forecast 2024/25 position of overall meter penetration of 75% and smart meter penetration of 0%.

At the completion of our smart metering programme in 2035, we will have achieved 90% meter penetration. This is due to the 1.2 million smart meter replacements we plan to install between 2024/25 and 2035.

As detailed earlier, we expect 10% of properties to remain unmetered at the completion of our smart metering programme. This is due to some properties remaining unfeasible for metering because of physical constraints. These constraints may be due to internal supply pipe access issues or central and multiple supplied to many dwellings, which occurs in many large blocks of flats. In these circumstances, a meter cannot be installed because it is too destructive to do so such as if a new wall or kitchen must be removed for access and meter installation. In some cases, it is not cost-efficient to install a meter due to the requirement for multiple meters per dwelling because of a central hot water system in a block of flats.

9.8. In terms of the approach, our cost effectiveness analysis showed that deferring AMI[104] would only save around £12m in AMP8 (2025-30), but with an opportunity loss of 5-9Ml/d savings and risk of delay to the non-household programme. Consequently,the amount of money saved per Ml/d of benefit lost, is much smaller than other investments that we could do to make up the shortfall, so it is not cost effective to try and defer the programme. We have therefore adopted a full AMI strategy as our preferred programme.

9.9. Our review of technological approaches confirmed that NB-IoT is not currently reliable or cost effective enough for rollout in AMP8 (2025-30). Our preferred final strategy therefore begins with fixed networks (Long Range Wide Area

[104] Advanced Metering Infrastructure (AMI) refers to the ability for Automatic Meter Read (AMR) meters to automatically transfer data to a central point

Network, or 'LoRaWAN') in that initial period, but at a slightly slower rate (304,600 meters) that concentrates on the District Metered Areas (DMAs) where fixed network approaches are likely to be most cost effective. This will improve affordability to customers and allow the development of our customer interface and information processes at a manageable rate. Our plan is then to move over to NB-IoT for the remaining 5 years of the rollout. This is dependent upon the maturity of the technology, but development funding and collaborative working to improve effective battery life in NB-IoT is included in the 2025-2030 plan.

9.10. Delivery of smart metering is accompanied by the following support activities that promote the three areas of potential efficiency gains described in **Chapter 4**. These activities have also been bought forward to complete more activity by 2035 in response to our accelerated metering roll out.

- **Behavioural change**. We have already commenced programmes for customer behavioural change in the current 5-year period (2020-2025) as part of the 'sustained action on water efficiency' project described in WRMP19. Beyond AMP7 (2025 onwards) there are two stages to our behavioural change activities. Following internal review and consultation feedback on the draft WRMP, in AMP8 we have included a 'stretch' ambition that looks to extend the campaign approach that we have implemented in AMP7 (e.g., 'Save our Streams'). This is planned to achieve a further 4.5 l/h/d reduction in per capita consumption. This will be supported by our smart metering rollout, which we will use to better understand how we can interact with customers on a one-to-one basis using the information gained and utilise that to achieve the behavioural change that we have planned through the smart metering programme. We have included costs for data management, insight and customer interaction platforms within our programme. This will support the improvement in interactions with customers, allowing more bespoke messaging based on their patterns of water use to suggest ways that they can save water and help the environment. Importantly we will also use smart metering data to inform customers of high usage that appears to be internal leaks or plumbing losses (including 'leaky loos'). Where customers address the issue themselves, we consider that this is behavioural change rather than company-led wastage reduction. We have therefore allocated 75% of these wastage reduction benefits to behavioural change.

- **Facilitating in-home water efficiency and installing flow restrictors**. Home water efficiency checks (HWECs) continue to represent the most effective way of achieving substantial in-house efficiency, although many customers are also now agreeing to install flow restrictors at their properties. Flow restrictors can be installed in the meter chamber of a home as a retrofit measure or as a new installation. They work by eliminating flow variations caused by pressure fluctuations in the supply system. The flow controller can be set at varying flow rates, from 5 to 23.4 litres per minute and have been proven to reduce customer water consumption. Flow restrictors are particularly beneficial for medium to high consumption properties, as they can achieve savings in water consumption without the customer noticing a significant difference to their water usage.

- **Reducing wastage and plumbing losses.** Industry evidence from the Thames Water and Anglian Water smart metering initiatives, indicates that most benefits are achieved through rapid and accurate feedback to customers, who repair leaks within their properties themselves, as described above. Based on Anglian Water's experience, around 25% of leaks warrant direct company intervention in the form of support to find and fix the leaks within the home, and these have been allocated under this category. We have also included repairs of plumbing losses as part of our HWEC programme and free repairs outside of the HWEC programme to some customers with larger leaks to enhance the programme.

Household strategy – government-led activity

9.11. Regulators have indicated that there is national support for a target of 110 l/h/d DYAA PCC by 2050. This has been included in the EIP as a PCC target for each company. To meet the stretching nature of the EIP target in our supply area, we have had to include government supported demand management reductions in addition to our company-led reductions.

Government-supported demand management reductions include three areas: water labelling with no minimum standards, water labelling with minimum standards and full government support to include water labelling with minimum standards and enhanced support on new developments. The volumes and timing attributed to each of these areas are summarised in **Table 9.4**.

Chapter 4 and **Appendix 4.5** detail the source of data for our government-led reductions and the different scenarios tested by WRSE.

Government-led savings (l/h/d)	Saving after 10 years	Saving after 25 years
Water labelling (no minimum standards)	3	6
Water labelling with minimum standards	6	12
Full government support (water labelling with minimum standards and enhanced support on new developments)	9	24

Table 9.4: Timing and benefits of government-led initiatives

9.12. The government-led scenarios tested by WRSE include profiles with a mix of 'low', 'medium' and 'high' savings. We assumed water labelling would occur from 2025 onwards following the announcement that it would be government policy for implementation from 2024/25. We have then assumed that minimum standards and enhanced support on new developments will be introduced through a series of future policy initiatives.

The WRSE scenario used to achieve 110 l/h/d DYAA PCC by 2050 was C+. This scenario included a water labelling only or 'low' saving of 6 l/h/d commencing in 2025/26, with 2 l/h/d realised by 2030 and the full savings realised within 15 years. It included a further 'medium' saving of another 6 l/h/d commencing in 2031 to be fully realised in 2045. Following this, a 'high' saving of an additional 12 l/h/d commencing in 2036 and fully realised by 2050. In total, the C+ profile included the full government support savings of 24 l/h/d by 2050.

The timescales for the medium and high government implementations were developed to provide sufficient time for the policies to work through local plans and for their policy positions to move into the marketplace to produce more efficient whitegoods.

Table 9.5 summarises the C + profile of government-led demand savings included in our WRMP24.

C+ Scenario: Government Intervention Savings – cumulative net PCC benefit beyond company initiatives (l/h/d)	Saving after 5 years	Saving after 10 years	Saving after 15 years	Saving after 20 years	Saving after 25 years
	2030	2035	2040	2045	2050
	2	6	14	20	24

Table 9.5: Timing and benefits of government-led initiatives – Scenario Government C+

9.13. The scenario used to test the impact of 'no government' interventions on our 'best value' plan were 'government H'. This profile included water labelling only or 'low' government savings of 6 l/h/d, commencing in 2025/26 and fully realised by 2040.

Table 9.6 summarises the H profile of government-led demand savings used in the scenario testing of our 'best value' plan.

H Scenario: Government Intervention Savings – cumulative net PCC benefit beyond company initiatives (l/h/d)	Saving after 5 years	Saving after 10 years	Saving after 15 years	Saving after 20 years	Saving after 25 years
	2030	2035	2040	2045	2050
	2	4	6	6	6

Table 9.6: Timing and benefits of government-led initiatives – Scenario Government H

Non-household strategy

9.14. Our regulators have signalled that they expect non-household demand management to contribute meaningfully to WRMPs, and that market-based innovation in this sector is supported. The alternative, which would only comprise of direct onsite intervention by us, would not be able to deliver against regulatory expectations. Our preferred strategy for non-households is therefore designed around the concept that we roll out smart metering to non-household properties and use the AMI data to share usage patterns.

Following this, we will eventually set up a market where retailers, service providers and non-household customers can use the data and supporting analytical tools to identify cost-effective interventions and help to implement effective incentive approaches. This approach has been identified as the most likely to succeed in generating the required innovation by the WRE 'Blue Marble' research project[105] that we have been part of, and is based on four 'propositions':

1. Reduce leakage on business premises (alterations and subsidised repairs)
2. Enable businesses to reduce water use (self-audits, retailer audits and BWEC's)
3. Encourage water recycling (audits and business plan developments)
4. Encourage businesses to consider water efficiency actions (incentive approaches to provide rebates, supported by information and accreditation)

In the short term (AMP8), our approach will focus on propositions one and two, where we are able to implement required initiatives and have demonstrated viable case studies through our AMP7 'Smart Holiday Parks' and Whitbread projects. Non-household demand in our supply area comprises service sector businesses or large institutions, such as schools and hospitals. Our AMP7 pilots and the recent experience of Thames Water have shown that targeted audit-based approaches, where we work directly with certain types of large institutions or multiple sites for a single hospitality company, are effective at reducing demand.

The experience of Thames Water in their Smarter Business Visits has been used to develop our Business Water Efficiency Checks (BWEC) option. A BWEC includes a free visit by one of our qualified staff to install water saving devices and provide personalised water saving advice to non-households. We have assumed that there will be a 10% uptake rate from business that are offered a Smarter Business visit based on our own experience and Thames Waters' experience in AMP7. These visits are offered both through lettering and groundwork contact with the businesses. These examples have shown that savings of up to 10,000 l/d are feasible, although the number of suitable organisations is limited. We have therefore allowed for 200 collaborative projects across AMP8, with an estimated 1.5% saving on non-household DI.

9.15. Beyond AMP8, the intention is to develop and utilise data and services sharing platforms that will allow market-based delivery against all four pillars of the strategy. This will include the introduction of services to promote water recycling through retailers (proposition 3) and identify rebate approaches that do not have the same problems surrounding the burden of proof that retailers and non-household customers identified as a key issue during the Blue Marble research (proposition 4). The availability of data and a marketplace for services is also intended to allow customer leakage reduction (proposition 1) and audit type initiatives (proposition 2) to be delivered more efficiently and extend to a greater range of customers. The requirements, costs and benefits of this are much less certain.

[105] Appendix 3.3

A summary of the activities, costs and benefits for non-household reduction is provided in **Table 9.7**

Component	Delivery period				
	AMP8	AMP9	AMP10	AMP11&12	Total
NHH Meter Replacements - AMI (nr)	18,800	18,900	18,800	-	56,500
NHH Meter Replacements - AMI Benefit (Ml/d) cumulative	0	6.2	12.4	16.1	16.1
NHH Meter Replacements - AMI Cost (£ million)	£1.63	£6.0	£6.0	-	£20
BWEC (nr)	200	200	200	400	1,000
BWEC Benefits (Ml/d) cumulative	2.0	2.0	2.0	2.0	2.0
BWEC Cost (£ million)	£2.0	£2.0	£2.0	£4.0	£10.0
Total Benefits (Ml/d	2.0	8.2	14.4	18.1	18.1
Total Cost (£ mill)	£3.63	£8.0	£8.0	£4.0	£30

Table 9.7: Non-household strategy to 2050 (numbers are rounded to the nearest hundred)

Leakage strategy

9.16. Leakage reduction is a priority for Affinity Water, customers and regulators. In line with the EIP targets, we have included a commitment to deliver a 50% reduction in leakage by 2050.
A summary of the savings achieved in each year of the forecast according to the individual leakage reduction activities, is provided in **Figure 9.2**.

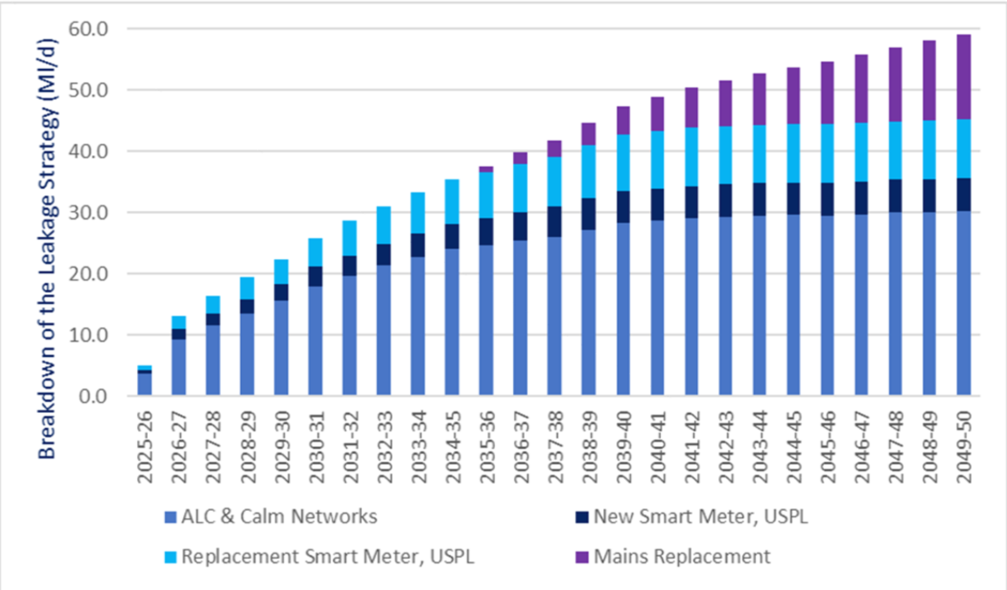


Figure 9.2: Summary of the benefits provided by the different elements of our leakage strategy over time

9.17. Costs for leakage reduction fall into two broad categories:

- Active leakage control (ALC) and Calm Networks and Smart Metering (USPL component only), which encompasses various activities involved in finding and fixing leaks within the network. This includes fixing leaks on the communication and supply pipes that connect our customers to the network. It also includes installing smart meters to directly detect USPL at a customers' property and to more accurately account for consumption to increase the efficiency of our ALC programme.
- Mains renewals, which help prevent leakage recurrence and breakout within the network.

Active leakage control is by far the most cost-efficient element, but it can only take us so far. The costs of the leakage reduction through active leakage control and calm networks, and mains renewals is £21m over the 2025-2030 period.

These 'active leakage control' measures (including ALC and calm networks and smart metering USPL) contribute 76% of the demand reduction required to achieve the 50% reduction target by 2050. The remaining 24% is achieved through mains replacement. The mains replacement for leakage not only achieves the leakage reduction due to the removal of leaking pipes, but it also achieves a reduction in the background leakage (effectively the minimum level of 'weeps and seeps' that active leakage control can reach). Current background leakage levels are above the 2050 target at present, so without mains renewals, the target would not be achievable irrespective of the amount of active leakage control we undertake. The replacement of mains also impacts the natural rate of rise of leakage, meaning that it takes less effort to maintain leakage at the previous year's level, saving around £800k in active leakage control by 2050.

9.18. There is a law of diminishing returns in the active leakage control, even with the significant technological investment that we have included. As noted previously, this means that reducing leakage below 50% will be expensive and disruptive, because it will need to rely entirely on mains renewals. The cost of this is over £20m per Ml/d of water saved, which is more than four times that of our supply-side options and gets less cost effective the lower we have to drive leakage (the programme must replace progressively less leaky and replace more difficult mains). We have therefore not included leakage reduction beyond 50% in our WRMP24, as we consider this would be disruptive to our communities and unaffordable for our customers.

Environment Improvement Plan (EIP) targets

9.19. The four sections above, 'Household strategy – company-led activity', 'Household strategy – government-led activity', 'non-household strategy' and 'Leakage' have detailed the costs, benefits and volume of demand reduction activity included in our demand management strategy.

The purpose of this section is to show that our demand management strategy achieves the EIP targets.

Due to the stretching nature of the targets, we have had to incorporate all reasonable demand management activities across households, non-households and leakage.

Figure 9.3 shows the total demand reductions delivered by our demand management strategy.

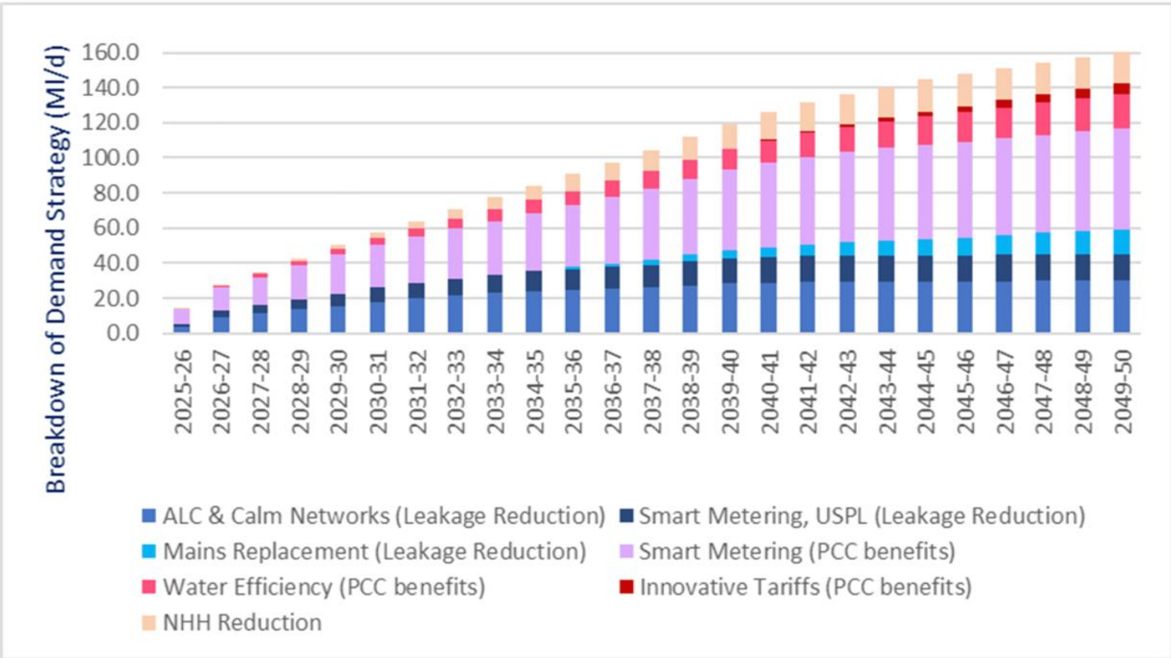


Figure 9.3: Overall benefits from our demand management strategy

Chapter 4 summarises the EIP targets. For PCC, the EIP states that we must reduce household water use to 122 l/h/d by 31st March 2038 and achieve 110 l/h/d dry year annual average household water use by 2050.

Figure 9.4 shows that with government support we forecast a DYAA PCC of 122.0 l/h/d by 2037/38 and a DYAA PCC of 108.9 l/h/d by 2050. This includes 117 Ml/d of government led savings in addition to 83 Ml/d of company-led savings by 2050.

Without government support, we can achieve a PCC of 133 l/h/d (DYAA) by 2050. Without any demand management activity, our 'baseline' PCC would be 150.1 l/h/d (DYAA) in 2050.

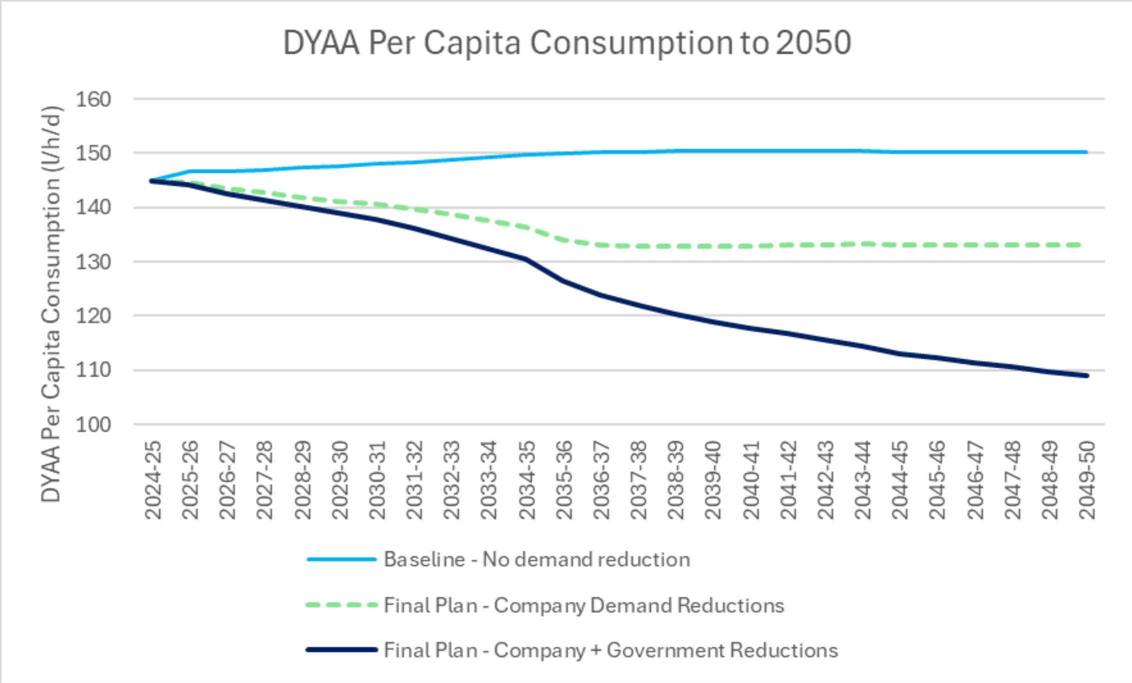


Figure 9.4: Company-level DYAA PCC with and without government support

For Non-Household, the EIP states that we must reduce non-household water use by 9% by 31st March 2038 and 15% by 2050.

Figure 9.5 shows that we achieve the EIP targets with a 13.6% reduction in non-household consumption between 2019/20 and 2037/38 against a target of 9%, and a 15% reduction by 2050.

To achieve the 2037/28 target, we plan to deliver 12 Ml/d of non-household consumption activity and the majority of this, 10 Ml/d, will be delivered between 2030 and 2038. By 2050, we plan to deliver a total of 21.8 Ml/d of activity to achieve the non-household consumption reduction of 15%.

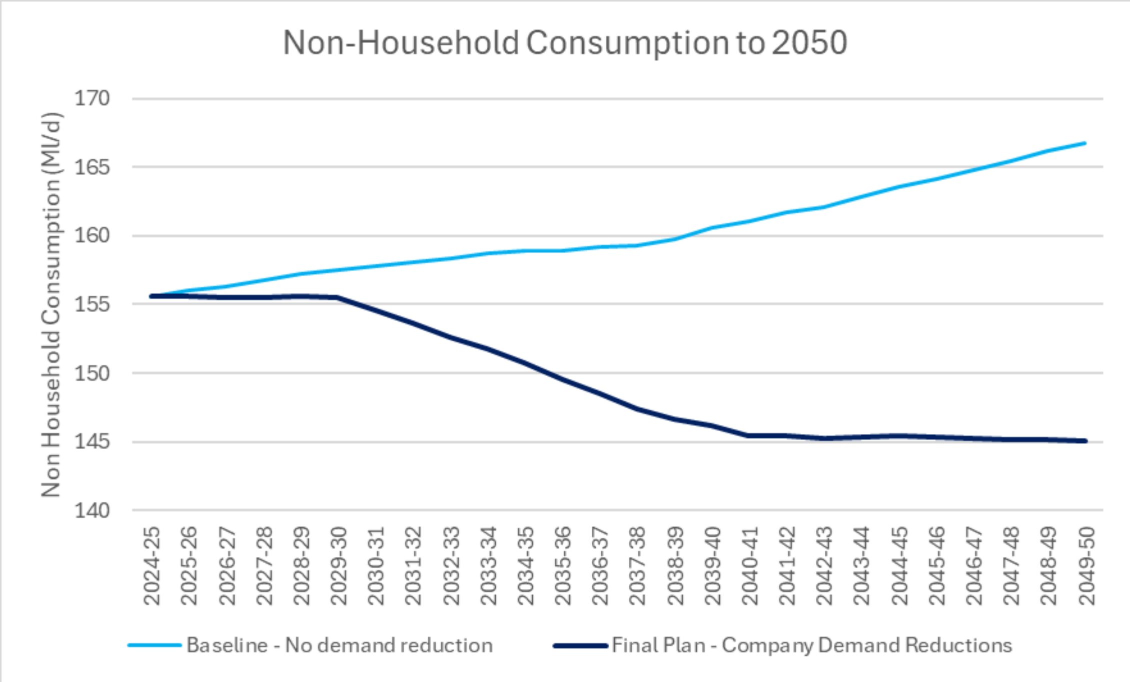


Figure 9.5: Company-level non-household consumption reduction

For leakage, the EIP states that we must reduce leakage by 20% by 31st March 2027, 30% by 31st March 2032 and 50% by 2050. These reductions are measured against our 2017/18 leakage levels.

Figure 9.6 shows that we achieve a 24% reduction in 2017/18 leakage by 2027, a 33% reduction by 2032 and a 50% reduction by 2050. This is achieved through the delivery of 13 Ml/d of leakage reduction activity by 2027, 28.6 Ml/d by 2032 and 59 Ml/d by 2050.

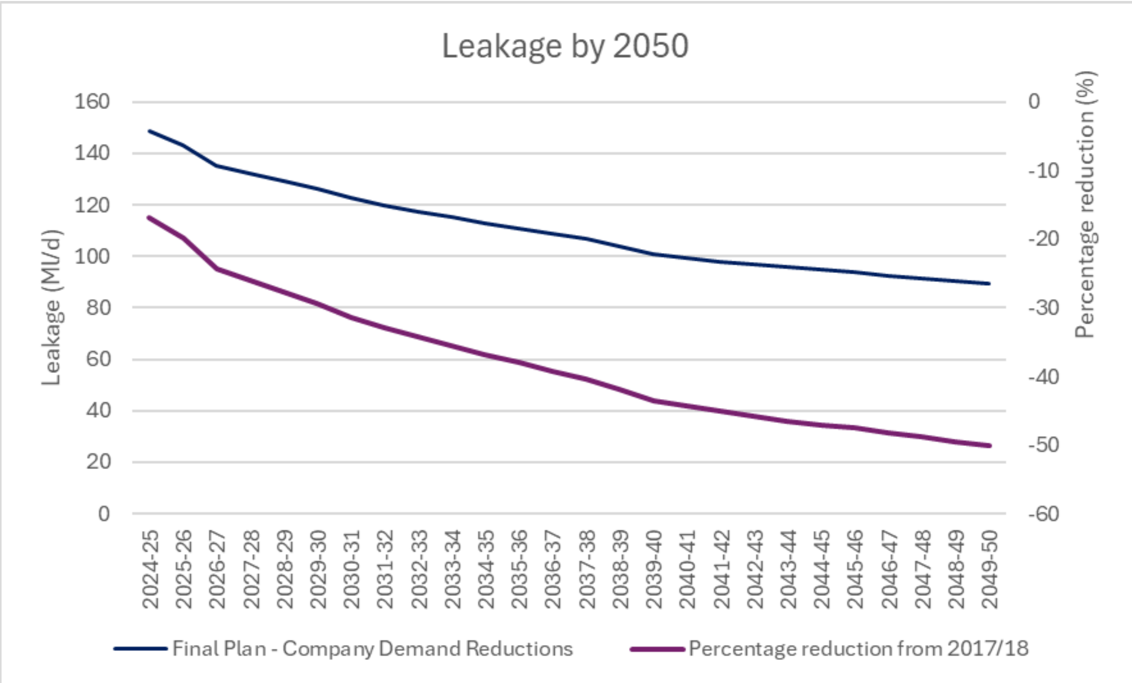


Figure 9.6: Leakage reduction profile as percentage from the 2017/18 reported value

For Distribution Input (DI), the EIP states that we must reduce the use of public water supply per head of population by 9% by 31st March 2027, 14% by 31st March 2032 and 20% by 31st March 2038. This is measured as reductions from the 2019/20 baseline report year.

Figure 9.7 shows that with government assistance, DI is reduced by 30.9 Ml/d from the baseline position in 2027, 85.9 Ml/d by 2032 and 181.3 Ml/d by 2038. By 2050, we reduce DI by 281.7 Ml/d from the baseline position.

Figure 9.8 shows that, per head of population, the reduction in DI is 13% by 2027, 18% by 2032 and 24.7% by 2038. We achieve a 20% reduction in DI per head of population by 2034 and a 35.6% reduction by 2050.

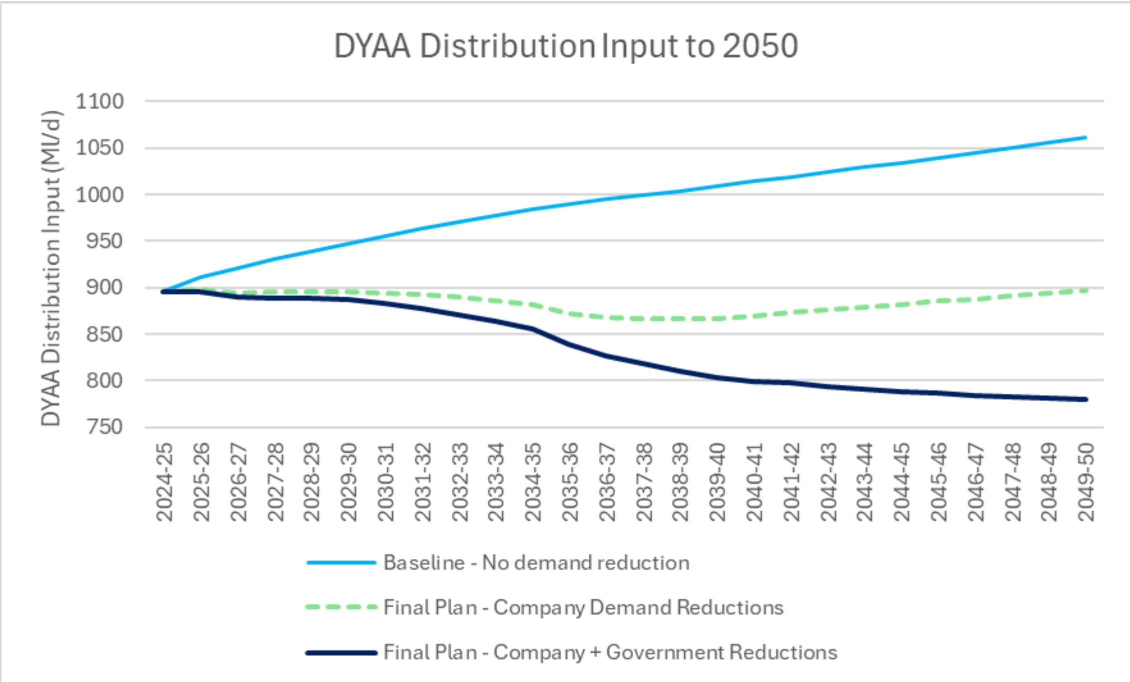


Figure 9.7: Company-level Distribution Input reduction

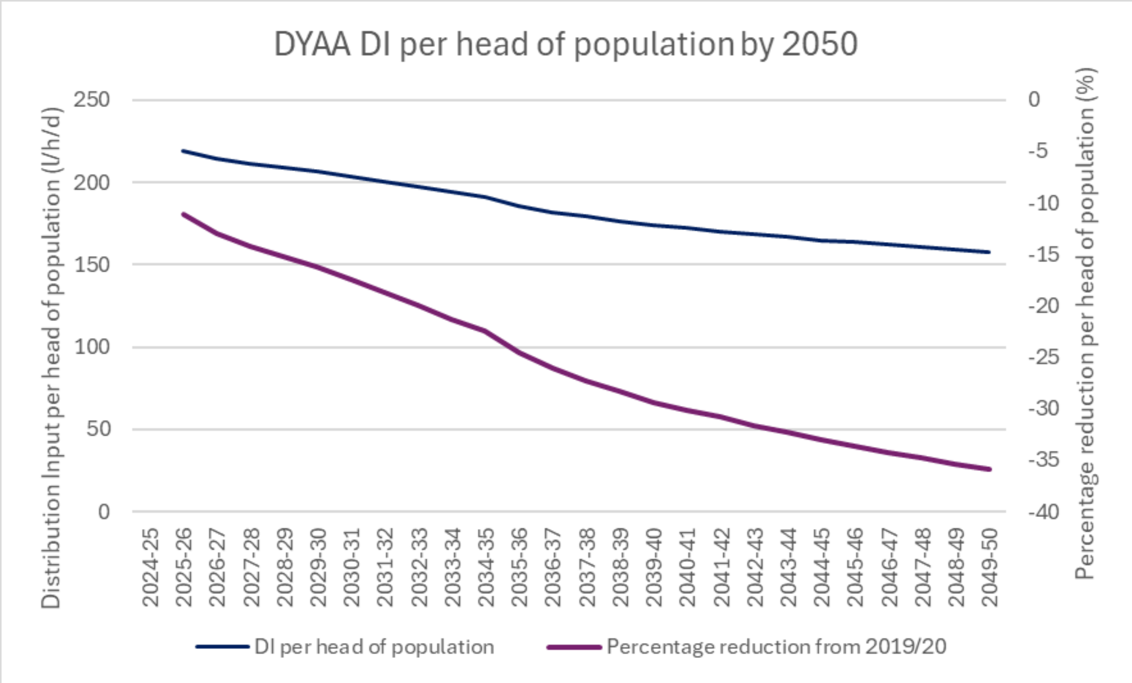


Figure 9.8: Company-level Distribution Input reduction per head of population

Demand management benefits, key risks and uncertainties

9.20. Although our evaluations have been evidence-based as far as possible, we recognise that there remain significant uncertainties regarding the potential savings modelled for demand management options. In **Table 9.8**, we set out the risk levels for the main areas of uncertainty.

Option type	Risk level	Rationale
Smart metering-led strategy	Generally **Low risk. Medium risk** for behavioural elements (5-6 l/h/d, or 4% on PCC)	Savings based on evidence, although where the saving relates to behavioural changes or 'smart tariffs' there is more uncertainty that the saving will be realised, because we are forecasting what might be feasible once our significant AMP7 programme is completed.
Government interventions	Water labelling **Low risk (6 l/h/d)** Remainder **Higher risk (18 l/h/d)**	There are obvious risks in relation to government support. Water-use labelling is considered low risk following the government announcement which confirmed water labelling would be included in their policy. It is also based on international evidence and is therefore tried and tested. The remainder is higher risk because there is currently no commitment from government, and it lacks any evidence base.
Non-household demand savings	First 2% **Low Risk** Remainder **Higher risk (to achieve 15 % of non-household demand)**	The first 2% is considered low risk because we have demonstrated a successful pilot approach to implementing sector-based approaches. The remainder to achieve a 15% reduction in non-household by 2050 is higher risk because it is based on untested market innovation approaches.

Table 9.8: The main risks associated with the different demand management options

9.21. This indicates that just over 24 l/h/d of our household demand savings are at medium or high risk of non-delivery. This equates to 120Ml/d of the programme by 2080 (based on population affected and the daily rate of saving), of which most of the risk (90Ml/d) lies with government initiatives around minimum standards for water-using goods and water efficiency in new homes. These standards are not yet government policy and there is no reliable evidence on savings for minimum standards from international experience.

9.22 In addition, most of our non-household strategies rely on market innovation-led approaches. Although we have carried out relevant research with WRE to confirm the validity of such approaches, the likely level of success is currently very uncertain. This equates to a further 13 Ml/d of the demand management programme at high risk.

9.23. Overall, this means 103Ml/d of savings are considered high risk (by 2080), with 100Ml/d at high risk by 2050. There is a further 30Ml/d where there is medium risk around the levels of savings (by 2050). These uncertainties were included when making key decisions within the supply-side adaptive plan, as described below.

Demand management, progress on delivery of our AMP7 commitments

Since the publication of the rdWRMP24, we have undertaken our annual returns for 2022/23 and 2023/24. This allows us to provide a comparison against our predictions and report on progress towards delivery of our AMP7 commitments.

Table 9.9summarises the total company annual return values for 2022/23 and 2023/24 and compares them against the DYAA forecasts in the WRMP. The annual return figures are outturn, meaning they represent the company demand under the weather conditions of that year. This is addressed further in the PCC subsection below.

Table 9.10 then summarises the 2024/25 target and the volume of demand reduction required in year 5 of AMP7 to achieve that target.

Table 9.9 shows that the slight variance (<1% for 2022/23 and <2% for 2023/24) between the annual return and WRMP forecasts distribution input is primarily driven by higher-than-expected non-household demand and, to a lesser extent, the unbilled consumption proportion of minor components.

Crucially, 2023/24 household consumption is within 0.2 Ml/d of the WRMP forecast, highlighting the effectiveness of our metering and water efficiency activities throughout AMP7.

Table 9.10 shows that a large reduction in DI is predicted for year 5 of AMP7, and this is driven by expected reductions in household consumption.

The subsequent subsections discuss each of these components in detail and report progress towards delivery of the 2024/25 and AMP8 targets.

Annual Return and Predicted (DYAA) Ml/d	2022/23 Annual Return	2022/23 DYAA Prediction	Variance	2023/24 Annual Return	2023/24 DYAA Prediction	Variance
Distribution Input	**948.8**	**942.8**	**6.0**	**937.3**	**919.9**	**17.4**
Leakage	150.7	153.5	-2.8	153.5	149.6	3.9
Household Consumption	611.6	621.2	-9.6	601.7	601.5	0.2
Non-household consumption	166.6	153.2	13.4	161.8	153.8	8.0
Minor components	19.9	14.9	5.0	20.3	14.9	5.4
PCC (l/h/d)	157.0	159.8	-2.8	154.0	153.2	0.8

Table 9.9: 2023/24 Annual Return and WRMP24 predictions

Demand Reduction in 2024/25 Ml/d	2024/25 DYAA Prediction	Demand Reduction Required
Distribution Input	**896.0**	**41.3**
Leakage	148.5	5.0
Household Consumption	577.0	24.7
Non-household consumption	155.6	6.2
Minor components	14.9	5.4
PCC (l/h/d)	145.0	9 l/h/d

Table 9.10: Demand reduction required to achieve 2024/25 targets

Leakage

Between 2019/20 and 2022/23, in years 1 to 3 of AMP7, we successfully reduced leakage by 28 Ml/d. This included a 10.8 Ml/d reduction in during the pandemic in 2020/21 and a 13.7 Ml/d reduction between 2020/21 and 2021/22 (**Figure 9.9).**

In 2023/24, we exceeded our PR19 leakage performance commitment with a 3-year rolling average reduction of 18.3% against a target of 17%. However, on a 12-month basis, this meant a slight increase in leakage from 150.7 Ml/d in 2022/23 to 153.5 Ml/d in 2023/24 (**Figure 9.9**).

The increase in 12-month leakage in 2023/24 was due to:

- Recovery of the impacts of the harsher than average winter weather from the 2022/23 winter until May 2023.
- A rapid and above average change in soil moisture deficit due to a dry spring followed by hot temperatures in June.The associated ground movement, in our extensive clay soil areas caused widespread breakout of low volume leaks. Due to the widespread nature of the breakout, it was slow to recover; we must survey a wider area and detection of lower volume leaks is less efficient than larger leaks, with full recovery of the breakout by the start of winter 2023/24.

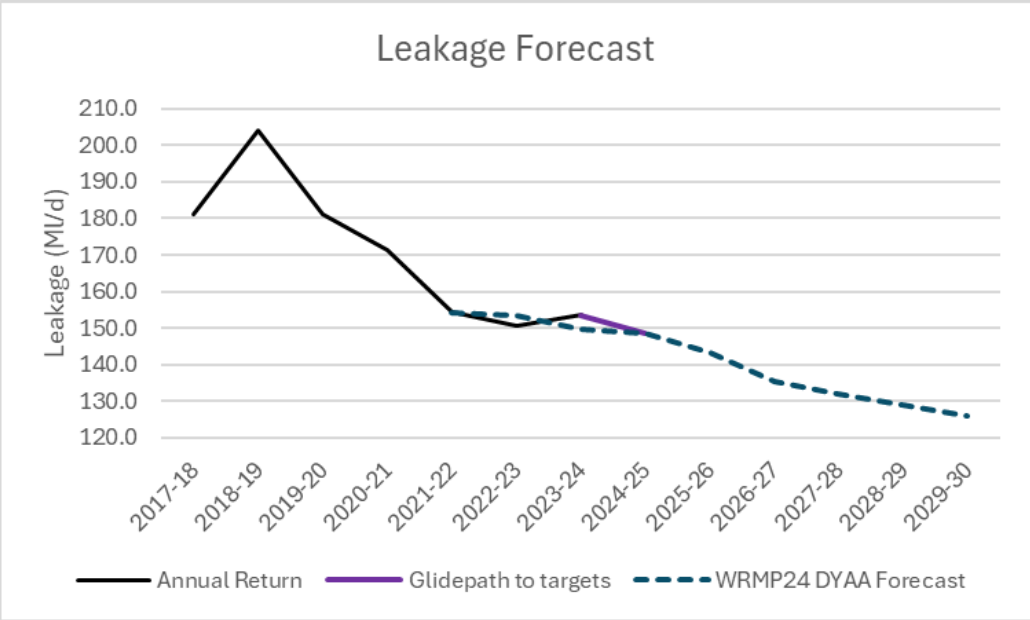


Figure 9.9: Glidepath to achieve the WRMP24 DYAA leakage forecast

Table 9.10 shows that we need to reduce leakage by 5 Ml/d in 2024/25 to achieve our WRMP target. Given the significant leakage reductions, we delivered in years 1 and 2 of the AMP, and our full recovery from the widespread breakout in 2023/24, we are confident we can deliver a 5 Ml/d reduction in 2024/25. In addition, to achieve our PR19 commitment of a 20% reduction in the 3-year annual average leakage, we need to reduce the 12-month leakage to 145.0 Ml/d by 2024/25. This exceeds the WRMP forecast of 148.5 Ml/d.

Per Capita Consumption (PCC)

The total company per capital consumption (PCC) has decreased by 3 litres per person per day from 157.0 l/h/d in 2022/23 to 154.0 l/h/d in 2023/24.This is a significant increase on the reduction seen just after the pandemic, between 2021/22 and 2022/23 which decreased PCC by 1 litre per person per day.

The decrease in PCC highlights the success of our metering programme and corresponding water efficiency campaigns.Specifically, we have continued to invest in our highly successful Save our Streams campaign.

Although we have seen a reduction in PCC in 2023/24, outturn PCC remains 0.8 l/h/d above our rdWRMP24 Dry year Annual Average Forecast (DYAA) (**Table 9.10**). Given the nature of the weather in 2023/24, we have converted the 2023/24 outturn PCC to a normal year and dry year equivalent to enable a direct comparison. This shows that the NYAA PCC in 2023/24 was 154.7 l/h/d and DYAA PCC was 159.5 l/h/d (**Figure 9.11**).

Although this is higher than forecast, we have good evidence to show that we are currently on target to achieve the required reductions, and any apparent difference is due to a lag in reporting outturn figures in comparison to actual customer demand. This is based on four pieces of evidence:

1. We are on track with our metering programme, HWEC's and 'Save our Stream's behavioural change programme.
2. We expect the benefits of the current intensive behavioural change programme will take one to two years to be reflected in the reported PCC figure. That is, there is a 'lag' between achieving the savings in customers' homes and the figures reported in the Annual Return (AR). This occurs because AR data uses metered data based on a customer's billing cycle which will represent an average of the customer consumption from three to 15 months ago. An example of the impact of this is shown in Figure 9.10.
3. In the annual return we expect to see 30% of the actual savings in the year they are achieved, 65% of the savings in the next year and 5% of the savings the year after. The actual savings vary according to the exact assumptions around the timing of the lag and the reductions.

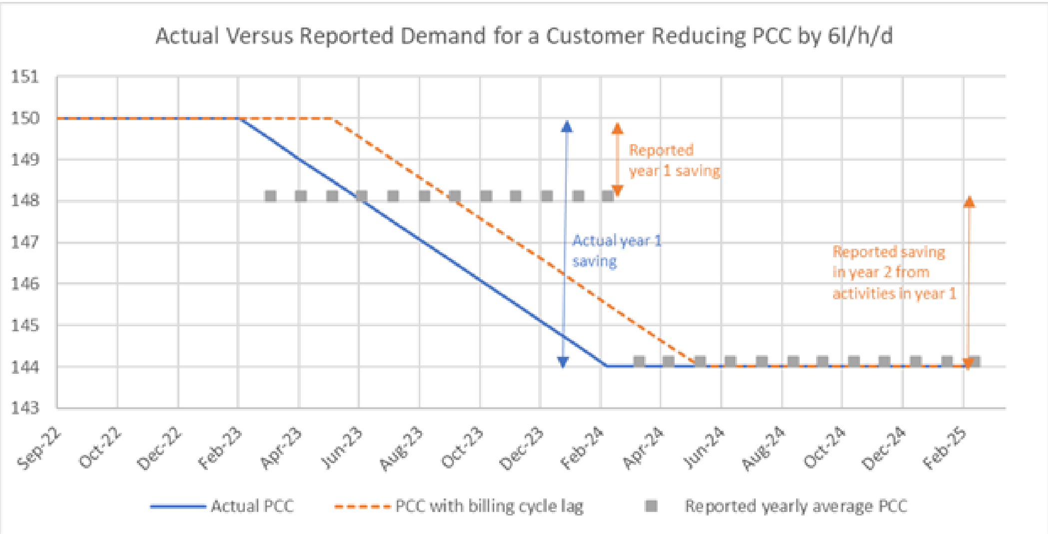


Figure 9.10: Illustration of the implicit lag in reported benefits of demand management on PCC

1. The winter DI[106] between December 2023 to February 2024 was 25 Ml/d lower than the previous winter DI (November 2022 to March 2023). Similarly, the November to December 2023 DI was 19 Ml/d lower than the November to December 2022 value. Leakage has been effectively steady between these two periods, which indicates the change is due to a reduction in underlying (i.e. not weather related) household demand.
   Winter DI is used to make this comparison because water use in this period is not affected by weather and therefore any differences in demand should be visible. Although there is a 'lag' in reported PCC, any reductions from water efficiency will be reflected in the DI profile across the year as this is a measure of how much water is produced by our works in any given day.

[106] Excluding leakage spikes

This shows that there has been a real reduction in household consumption due to our water efficiency activity.

2. The Behavioural Change (Save our Streams) team have carried out advanced machine learning based analysis of all customers who has used our water saving tool and signed up to the programme or been made aware of/given water saving advice. This work estimates that we have achieved at least 25 Ml/d of consumption reduction through our behavioural change and water efficiency activity in 2023/24 using extensions to the activities we have already implemented in the current year. This aligns with the savings we have seen under point 3 above.

Based on these four pieces of evidence, the expected glidepath of actual annual average PCC compared with the rdWRMP24 DYAA and NYAA PCC is shown in **Figure 9.11.** The glidepath to targets is the PCC expected if we see similar weather patterns to those in 2023/24.

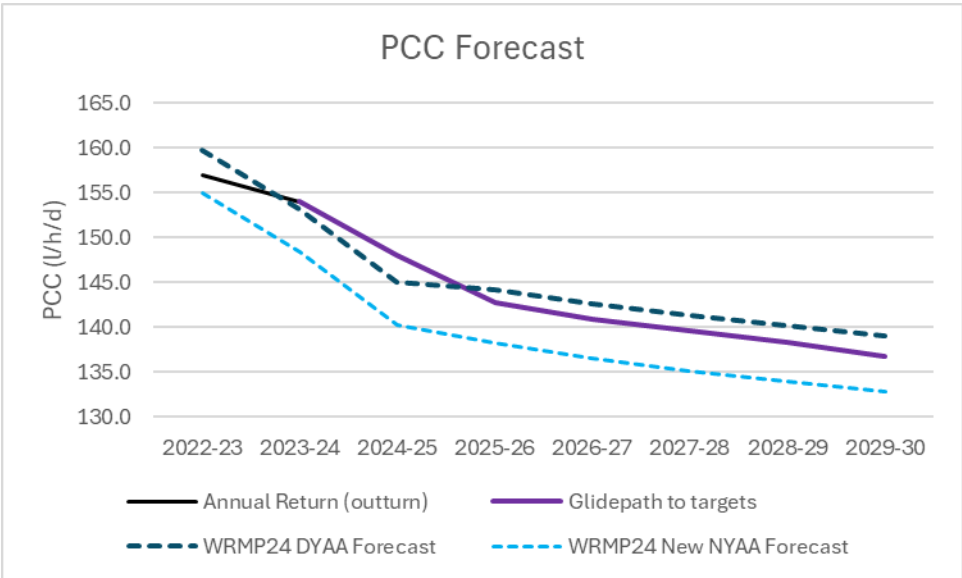


Figure 9.11: Projected PCC based on the AR24 annual return compared with the rdWRMP24 forecast range.

Figure 9.11 shows that, due to the 'lagged' nature of annual reporting it may appear that we will be tracking above DYAA expectations in the short term. However, by 2025/26, we expect the PCC to be below the WRMP24 DYAA forecast and almost mid-way between the New NYAA forecast and DYAA forecast by the end of AMP8.

Specifically, if 2023/24 is representative of a typical 'median' year from the more recent records, we expect:

- End AMP7 (2024/25) outturn PCC to be 148.0 l/h/d. This is 3 l/h/d higher than the WRMP24 DYAA PCC (145.0 l/h/d) and 8 l/h/d higher than the new NYAA target PCC (140.2 l/h/d).
- Due to the 'lagged' nature of annual reporting, the gap between the outturn PCC and new NYAA target is quickly reduced. By 2025/26, it falls to 4.4 l/h/d (PCC of 142.7 l/h/d).

This equates to a gap between expectations and the DYAA forecast of +12 Ml/d at the end of AMP7, reducing to -10 Ml/d below the DYAA forecast and +16 Ml/d above the new NYAA forecast by the end of AMP8. This is well within the Target Headroom risk allowance we have included for demand uncertainties, which are 50% of the total Target Headroom allowance. This means any shortfall is covered by our risk allowances, giving us time to catch up through stretch ambition on PCC if required.

Non-household consumption

The WRMP24 forecast assumed non-household consumption would very slowly recover from the pandemic to reach a volume of 155.6 Ml/d in 2024/25, that was just above that seen in 2017/18.

However, in 2022/23, non-household consumption increased by almost 20 Ml/d compared to the previous year, indicating a much faster recovery of the sector (**Figure 9.12**).

Since we have not been funded to reduce non-household consumption within AMP7, we forecast our end of AMP7 position will be reduced from 2023/24 but slightly above our WRMP24 forecast.

However, due to the opportunities available to quickly reduce non-household consumption, we are confident we can achieve reductions in Years 1 and 2 of AMP8 to meet our WMRP24 targets towards the middle of the AMP (**Figure 9.12**).

Throughout 2024/25, we are collaborating across the industry to establish our non-household delivery programme early. We aim to be able to identify and work with non-household properties from year 1 of AMP8 to deliver the forecasted non-household consumption reduction savings included in our forecasts.

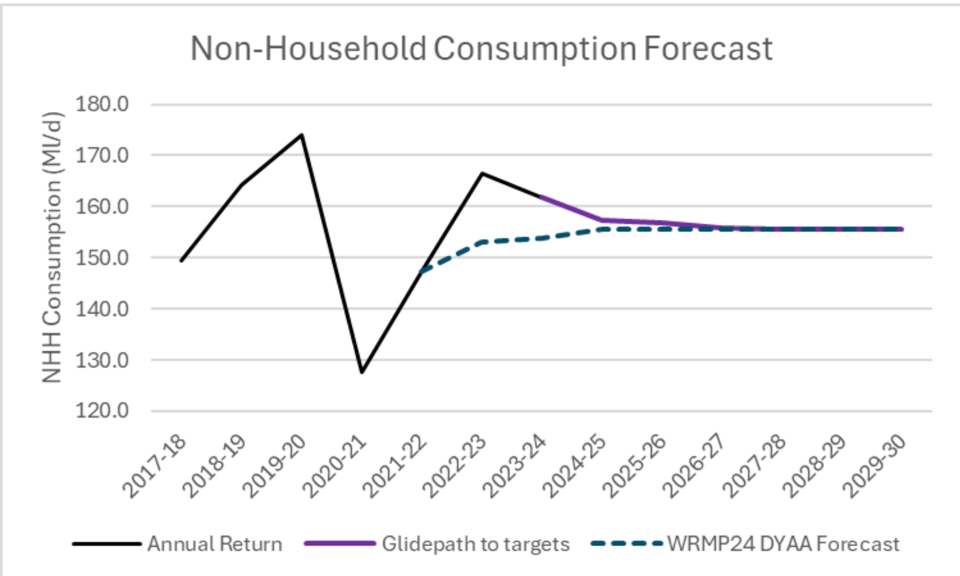


Figure 9.12: Glidepath to achieve the WRMP24 DYAA non-household consumption forecast

Distribution Input

The subsections above have explained each of the components that make up Distribution Input and our progress towards delivery of the 2024/25 and AMP8 targets.

Although we were within 1 and 2% of the DYAA target for 2022/23 and 2023/24 respectively, we acknowledge that there is a large reduction in PCC that will be required to keep below this target in the 2024-2030 period. We have carried out internal analysis through our 'Save our Streams' behavioural change programme that indicates we have sufficient plans in place to achieve the required savings, but because of the 'lagged' nature of annual reporting, it may appear that we will be tracking above DYAA expectations in the short term (**Figure 9.13**).

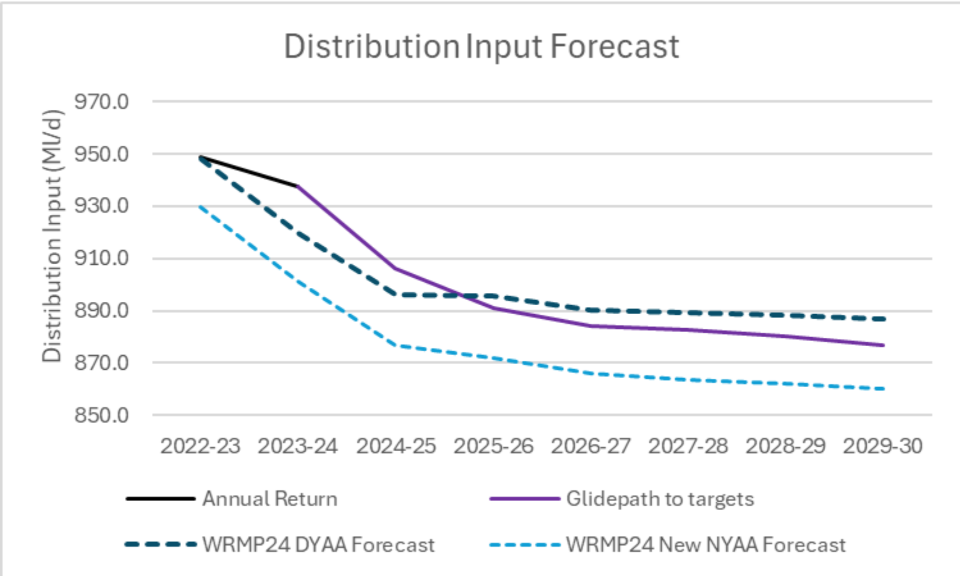


Figure 9.13: Glidepath to achieve the WRMP24 DYAA DI forecast

In addition, we have included an allowance for demand uncertainties in our Target Headroom risk allowance, which are 50% of the total Target Headroom. This means any shortfall is covered by our risk allowances, giving us time to catch up through stretch ambition on PCC if required.

Based on this, we do not consider that we need to re-calculate or re-state the AMP8 starting position. We will continue to review our demand position monthly and follow our Monitoring Plan to ensure we can meet our commitments.

Supply strategy for our Central region

9.24 The supply strategy across our Central region is driven by the large challenges that we face in relation to restoring sustainable abstraction in our Chalk catchments and meeting population growth. As well as the strategic needs these challenges generate for large schemes, it is important that we make the best use of our existing resource base and the smaller, short-term options that are available to us. We also need to ensure that we account for the impact that different potential strategies have on our strategic trunk main distribution and water treatment systems. These plans for the distribution strategy need to provide value to customers and allow us to take advantage of the benefits offered by the 'Chalk Streams First' concepts, including the licence relocation schemes described in **Chapter 5** and **Chapter 7**.

9.25. Our supply strategy for the Central communities is therefore described in five stages:

- Development of the short-term plan to enable abstraction reduction and make best use of existing sources where it is best value to do so, as part of an integrated strategy that covers transfers and water resource network optimisation throughout the 2025-2050 period (our Connect 2050 strategy).
- An evaluation of the trade-offs and alternatives that we have considered for our long-term strategy, with due regard to other companies in the WRSE region and the implications of the 'downstream' network modifications required to support the different strategies, as identified by Connect 2050. This includes an evaluation of the solutions required under the Ofwat 'Common Reference' scenarios required for PR24, and the implications of that to our adaptive plan.
- The role of our long-term strategy within the national context, described through the regional reconciliation process.
- Our preferred long-term strategic plan, based on the above.
- Refinement and description of our adaptive plan in the shorter term, including risk mitigation.

Development of our near-term (2025-2030) supply strategy and internal transfer needs beyond 2035

9.26. The WRSE level modelling described in **Chapter 8** included, as inputs, all the potential transfers between our WRZs and with other companies, and all potential new resources that both we and our neighbouring water companies could develop. The supply-side options and transfers from other companies that were identified as 'best value' for the medium to long term strategy are described under the 'WRSE regional strategic alternatives and trade-offs' section below.

However, the WRSE modelling only identifies the inter-WRZ level transfers, new supply schemes and transfers from other companies that are required across the planning period. We need to ensure that the supply side strategy is connected across our Central region throughout the planning horizon at the intra-WRZ level and is integrated with our WINEP and resilience needs as described in **Chapter 7**.

The Connect 2050 strategy is focused on addressing deficit risks in hydraulic demand zones as they develop following abstraction reductions (demand management was able to offset growth in the model, so this did not create additional transfer requirements except at a local level in the AMP8 period). This was designed to address deficits as they occurred under the different scenarios, so was agnostic as to the type of water resource scheme that is being used to provide that water, although the location of the main strategic resource option inputs does affect the strategy as described later.

A summary overview of the final optimised strategy for development between 2020 and 2050 is provided in **Figure 9.14**. This includes the schemes (shown in red) that have already been funded and are already being constructed prior to 2025, which allow for the transfer of 17Ml/d of existing surplus from WRZ6, and its distribution to required hydraulic demand zones in WRZ4. The expansion of the Grafham import at Sundon is also being funded and delivered in AMP7.

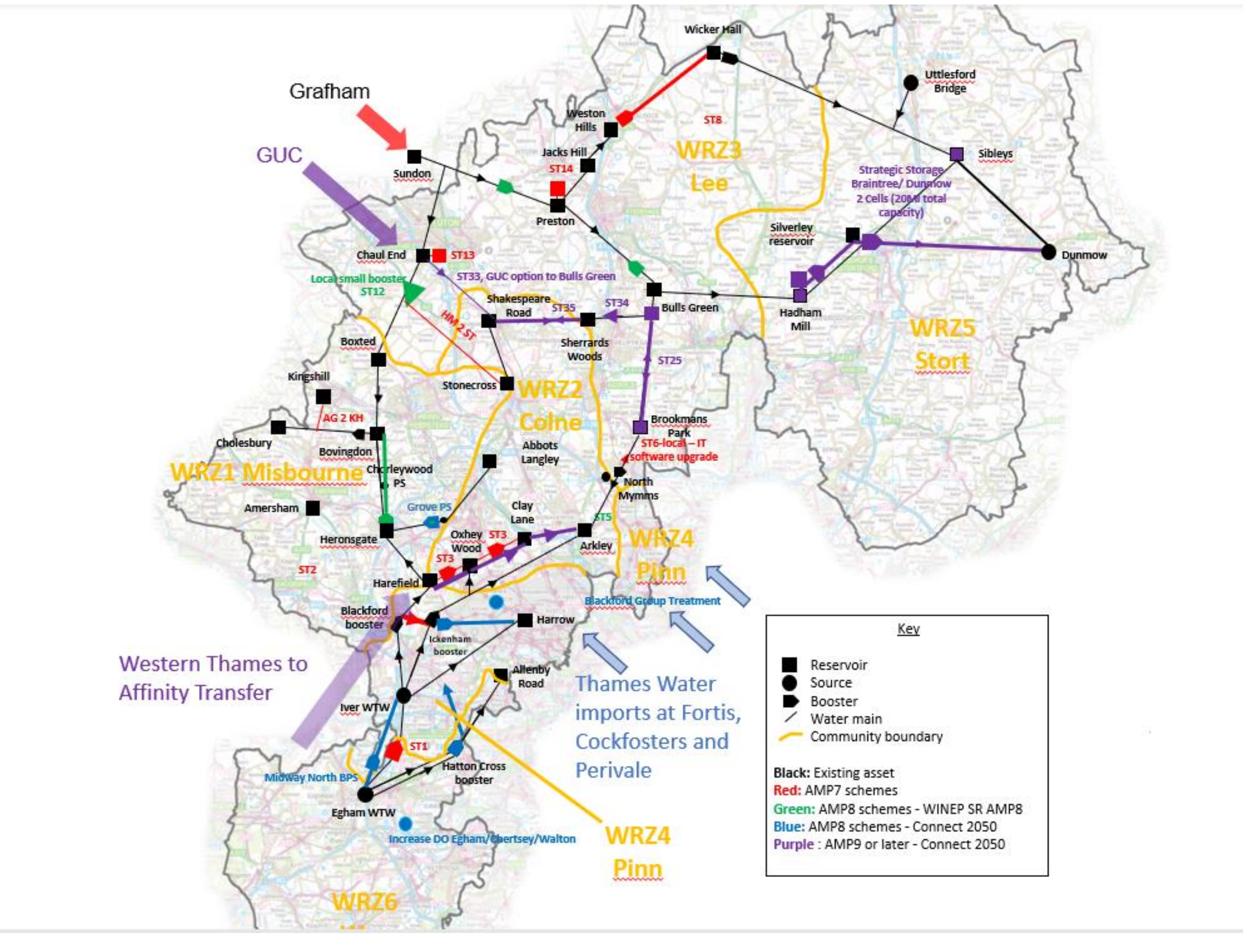


Figure 9.14: Summary of the supply network transfer links created under the Connect 2050 strategy

9.27. These future network developments required under the preferred strategic water resource strategy (see WRSE regional strategic alternatives and trade-offs below[107]) can be summarised as follows:

[107] The preferred strategic resource strategy consists of the development of the Grand Union Canal in 2032 followed by the western Thames to Affinity transfer in 2040.

- **2025-2030**: incorporates the WRZ6 to WRZ4 transfer, plus a proportion of Arkley to Harrow scheme. It also includes the Blackford Group treatment upgrades to support the licence relocation scheme and treatment works upgrades in the Wey community[108] to support the WRZ6 to WRZ4 transfer.

- **2030-2040**: incorporates the main Luton South (HDZ) to Bulls Green (HDZ) set of upgrades to facilitate transport of the GUC supply into the HDZs where it is needed. The initial (low cost) Arkley north scheme is triggered in this period to facilitate transfer from WRZ4 northwards.

- **2040 onwards**: incorporates the final Bulls Green (HDZ) to Sibleys and Stansted (HDZ) set of upgrades (up to 30Ml/d), including service reservoir storage. The Brookmans Park link is also required unless the longer-term environmental destination focused on the Mid Colne and hence the Clay Lane sources.

The key advantages of the Connect 2050 strategy are that it makes use of existing resources, both within our Central region and neighbouring water companies, and it means that we do not have to wait until we deliver strategic resource schemes to deliver our environmental ambitions in terms of abstraction reductions. The MISER modelling and value engineering approach means it is designed to keep pace with the proposed environmental destination strategy in a way that is most affordable to customers.

9.28. For the 2025-2030 schemes, we needed to examine options at a more detailed tactical level to ensure that we:

- Value engineered the options to account for 'real life' operational issues and constraints such as single points of failure, existing peak demand risks and water quality needs.

- Can achieve our licence relocation proposals, as described in **Chapter 5**. These are inherently low cost (£14m to deliver 14Ml/d worth of benefit), have low carbon emissions, a very small construction footprint and, if our initial modelling and assessments of surface and groundwater impacts are confirmed, have negligible environmental impact. They therefore present the Best Value next stage (post 2025) of development to facilitate chalk stream abstraction reductions in the Colne tributaries.

- Have the bulk supply capacities and transfers required to facilitate other aspects of the integrated catchment water resource management that we discussed with stakeholders such as Chalk Streams First and described under the Connect 2050 objectives in **Chapter 5**.

To support river flows and help with affordability, we agreed with the EA that we should defer the Uttlesford Bridge River support licence change until AMP9 (2030-35), which means the Hadham to Sibleys scheme that featured in our draft WRMP can be deferred. This defers £43m of expenditure, allows more

[108] See **Appendix 5.8** (available on request)

time to investigate and confirm whether the licence change is best for the environment and means that we can design and build the full scheme to the right size to support the eventual abstraction reductions that are planned across the Stort community (WRZ5). The remaining schemes in AMP8 have been refined and clarified following consultation feedback on the draft plan and are summarised according to need and main regulatory driver in **Table 9.11** below.

Scheme name	Description and benefit	Cost and regulatory driver
Midway North	Additional pump capacity to allow up to 25Ml/d to be transferred through the existing Egham to Iver main (it extends the 17Ml/d capability under the AMP7 Egham to Iver scheme by 8Ml/d through the installation of an additional pump). We have carried out the required hydraulic modelling to confirm that this is viable. However, this does increase the operating pressures within the main, so exacerbates the existing single point of failure risk to our Heathrow supply if it is not mitigated by constructing the Egham to Iver reinforcement scheme below*.	£1.85m. Fully allocated to WRMP as this promotes a transfer between two WRZs.
Egham to Iver reinforcement	Reinforcement of the trunk mains that take water around to the east of Heathrow. This both mitigates the single point of failure risk for Heathrow and extends the overall WRZ6 to 4 transfer capacity by 20Ml/d, up to 45Ml/d in total.	£56.58m. Fully allocated to WRMP as this promotes a transfer between two WRZs.
Wey treatment enhancement	Treatment enhancement in our Wey community, consisting of £6.5m of additional GAC treatment capacity at our Chertsey and Walton works to allow them to support the WRZ6 to 4 transfer at the required capacity during extended summer peak demand events such as 2018. This event forms the demand side of our water resource modelling described in **Chapter 5**, and currently the treatment capacity is not able to run at the rates required by the modelling to provide the ADO transfer rates stated in the WRMP Table 3.	£6.5m. Fully allocated to WRMP as this promotes a transfer between two WRZs.
Blackford Treatment and Grove Value New Booster Pump	The treatment and pumping upgrades in the Blackford Group that will allow us to treat and distribute the 14Ml/d ADO that we are seeking to relocate from the upper catchment. These upgrades have been integrated with the local WINEP schemes (which will be included in our PR24 business plan) to ensure that the system is integrated across the different requirements and the WRMP/business plan.	The Blackford group treatment upgrades is required to support abstraction reductions in WRZ1, so has been allocated to WINEP.
Arkley to Harrow trunk main	Although in the WRMP tables it is theoretically possible to transfer 39Ml/d overall between WRZ4 and WRZ1, this is under current operations and cannot be supported with the new Heronsgate to Bovingdon trunk main that is required in WRZ1 to support abstraction reductions in the Chilterns chalk streams, as it would cause low pressure problems in Watford. This scheme represents a more cost-effective approach for transferring water between Harefield (WRZ4) and Heronsgate (WRZ1) than a direct reinforcement would. By supporting Harow it allows a 'virtual' transfer via WRZ2 and into Watford, at a lower cost than the direct route.	The scheme has been allocated 50% to WRMP (£14.3m) and 50% to WINEP, as it allows the existing quoted capacity for the WRZ4 to WRZ6 transfer to be maintained once the WINEP scheme is in place.

Table 9.11: Remaining AMP8 schemes

**Note: we carried out extensive optioneering to determine the most cost-effective approach for transferring additional water from Egham to Iver. A partial reinforcement for the route to the east of Heathrow was considered, but this only supported 10Ml/d and could not be combined with the Midway north booster pump because of the increased single point of failure risk to Heathrow. An alternative route to the west of the M25 was also considered but was found to be undeliverable as it ran parallel between a railway, overhead HV cables and the toe of Wraysbury reservoir embankment.*

9.29. As well as our own transfers, the 2025-2030 strategy incorporates changes to existing transfers to and from other water companies. The WRSE regional planning confirmed that the Best Value strategy should include the expansion of transfer capacity from Thames Water into WRZ4 (Pinn). This also has the advantage that it allows us to make use of water released into the Colne and Lee by accessing the DO increases that Thames Water can expect from our abstraction reductions. We reviewed the options for transfers with Thames Water and concluded that re-purposing the transfers that we have developed at Perivale and Cockfosters to temporarily support the HS2 scheme represents the best option for accessing additional water. We have developed a joint document with Thames Water to describe the future use of these transfers and ensure alignment between the two companies (see **Appendix 5.7**).

In addition to the Thames Water transfers, we have agreed with South East Water that we can reduce the export from Egham we currently provide to them from 36Ml/d, down to 26Ml/d from the start of AMP8 (2025). This supports the WRZ6 to 4 transfers described above. A summary of these changes to bulk supplies in AMP8 is provided below.

ID/reference	Providing company	Receiving company	Maximum benefit at average (Ml/d)	Maximum benefit at peak (Ml/d)
HS2 (Perivale)	Thames Water	Affinity Water WRZ4	10	10
HS2 (Cockfosters)	Thames Water	Affinity Water WRZ4	5	5
WRZ6	Affinity Water WRZ6	South East Water	10	10

Table 9.12: Short-term changes in existing transfers

9.30. Beyond 2030, the strategy is straightforward, consisting of linkages that are primarily designed to connect the GUC import to the rest of WRZ3 and on to WRZ5, plus the longer-term support for the Thames to Affinity scheme.

Although the developments described above are the best approach to supporting the preferred WRSE water resources strategy, we also considered the network enhancements that would be required to support the alternative water resource strategies identified in the next section. This was used to determine if there were any significant differences in the 'downstream' network requirements that might influence our selection of the Best Value resource strategy.

Most of the potential alternatives did not affect the ultimate configuration of the supporting network. Under the 'no SESRO' alternative strategies, water would be sourced from either the Severn to Thames transfer or the Teddington Direct River Abstraction (DRA) scheme and East London Transfer post 2040. In practice, this makes no difference to the Connect 2050 requirements, because the East London Transfer enters our system at North Mymms, which is south of the upgrades required at Bulls Green.

9.31. The alternative plan that would affect the Connect 2050 strategy would result from the introduction of Beckton reuse or desalination as an alternative to the GUC. This would effectively require a reversal of the Chaul End to Bulls Green scheme, so would not change the overall quantity of new trunk mains required for the Connect 2050 strategy.

WRSE regional strategic alternatives and trade-offs

The ‘cost-efficient’ (least cost) plan

9.32. As described in **Chapter 8**, our decision-making process began with an evaluation of the most cost- efficient solution for the WRSE region (i.e., the solution with the lowest monetary cost given the environmental destination included in the regional plan). This was run with the set of core WRSE constraints described in **Chapter 8**, which include the below.

- The demand management ambition successfully delivered, including government support and hence the high-risk component of 103Ml/d.
- The schemes that passed through the options appraisal process available for development.
- Costs of carbon, fully monetised and included in the investment model, to provide sufficient carbon mitigation to meet net zero targets. Drought resilience set to provide 1 in 200-year levels of resilience by 2030/31 and 1 in 500-year levels of resilience by 2040/41.
- A ‘reverse trade’ (i.e., where we take less from Grafham to facilitate additional water availability in WRE) to WRE of 27Ml/d between 2032 and 2040.

9.33. Through the WRSE planning forum we have agreement with South East Water to reduce our existing export to them from Egham treatment works (in WRZ6) by 10Ml/d. This reduction will be implemented from 2025 onwards and provides us with an additional resource capacity that we can use to transfer water from Egham (WRZ6) north to the Pinn and Misbourne communities (WRZs 4 and 1) to support groundwater abstraction reduction.

This ‘cost-efficient’ plan was based purely on monetary net present value across all the possible future pathways. Importantly, for long lead items such as the Grand Union Canal or SESRO, it assumes a modular approach that allows the size and timing of the scheme to change up until the point at which construction commences. The designing and consenting stage is separated in a modular way from the construction, and schemes can be reduced in scale or deferred, if appropriate, when a branch point is reached, provided construction has not started by then.

On a regional level, the ‘cost-efficient’ plan is shown on the ‘bubble plot’ in **Figure 9.15** below, limited to the schemes that provide water to us.

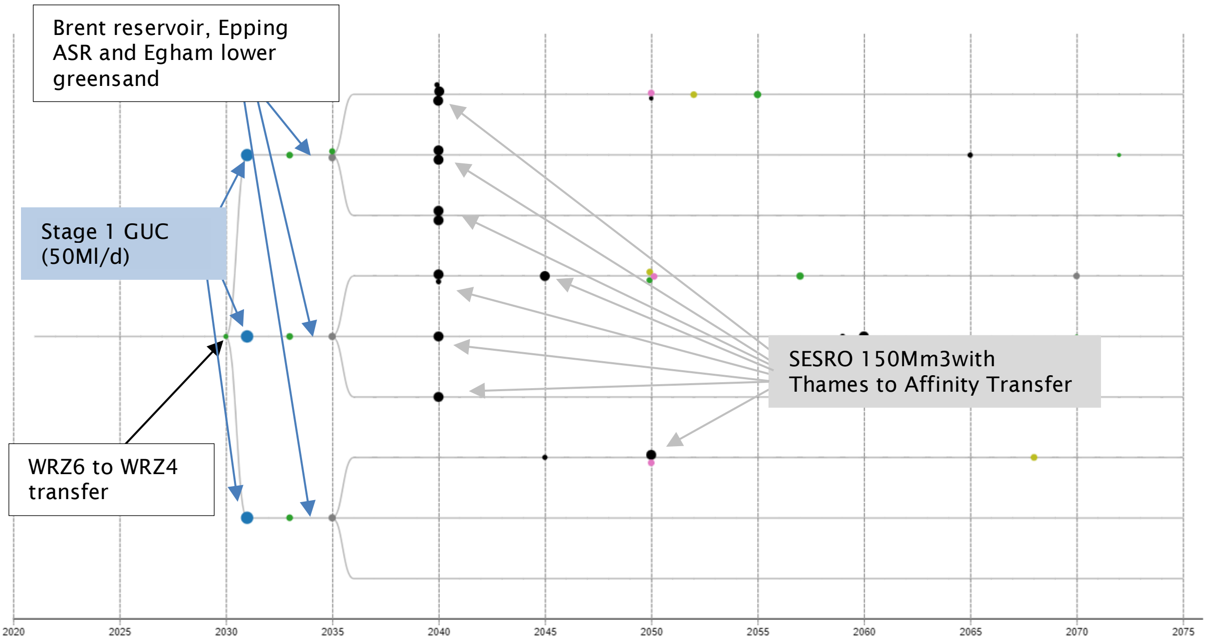


Figure 9.15: 'Bubble plot' of the cost-efficient regional plan with key Affinity schemes (source: WRSE visualisation tool)

Note: This diagram shows the timing of schemes required to be used under the 9 'situations' described in ***Chapter 8****, with situation 1 (the most adverse) at the top and situation 9 (the most benign) at the bottom. The size of the circle reflects the size of the scheme.*

9.34 The key differences between this least cost run and the previous draft WRMP least cost run are summarised below.

- Due to the more challenging demand management targets and associated higher level of government intervention benefits for demand management, the need for a second stage of the GUC transfer is removed. Only the 50Ml/d scheme is required (the implications of not achieving these stretching targets are included in the alternatives assessment below).
- Because of the WRE reverse trade requirement, the re-purposing of Brent Reservoir (an existing Canal and River Trust asset, also referred to as the 'harp' reservoir because of its shape) is brought in 2033. This is just sufficient to meet the supply-demand balance until SESRO and the Thames to Affinity Transfer are built. However, this is only used in the 2030s, as the optimiser calculates that it can construct the Brent Reservoir scheme to avoid having to build the second stage of the GUC under this set of assumptions.

9.35 A summary of the selection and timeline of the Regional Plan elements that are relevant to Affinity Water are described in **Table 9.13.**

Scheme	Timescale			
	2025-2030 (all branches contain the same activities up to 2030)	2030-2040	2040-2050	2050+
Connect 2050 initial stages (WRZ6 to 4 transfer)	Constructed to enable first tranche of environmental destination. Overall transfer increased to 25Ml/d (includes 17Ml/d AMP7 transfer capability).	Continued transfer on all branches	Continued transfer on all branches	Continued transfer on all branches
Grand Union Canal Transfer	Planning permission and construction started (50Ml/d)	Construction finished and used as soon as possible – helps WRE reverse trade and reduces our take from River Thames. The GUC then facilitates our second tranche of environmental destination.	Continued usage	Continued usage
South East Strategic Reservoir	Planning permission	Construction	Used to support Thames to Affinity transfer in 7 out of 9 branches (44 to 73 Ml/d) to facilitate remaining tranches of environmental destination under central and low forecasts	Continued usage (between 40 and 90 Ml/d)
Thames to Affinity Transfer	Planning permission	Construction of Phase 1 (50 Ml/d) completed in 2039/40 alongside SESRO	Construction of Phase2 (50Ml/d) in 5 out of 9 branches	
Brent reservoir, Epping ASR and Egham LGS schemes	Planning permission	Construction and full usage (5Ml/d)	No longer required	

Table 9.13: Main elements of the 'least cost' regional plan for Affinity Water

Other regional implications

Although we have concentrated on the schemes used for Affinity Water, the selection and sizing of schemes that affect our Central region also affect Thames Water and Southern Water. All three companies use SESRO as a key strategic resource under the cost-efficient plan, with the Thames to Southern Transfer affecting the resource position and reliance on schemes such as the Hampshire Water Transfer and Water Recycling Project to Havant Thicket water recycling scheme in Hampshire.

Similarly, the amount of water available to us from SESRO affects our usage of water recycling schemes in the Thames basin (Teddington or Beckton). In the cost-efficient plan, we do not need these schemes to address growth or environmental destination, but these start to form key sources of water for us if WRSE starts to look at alternatives to the SESRO scheme.

We have therefore commented on the strategic implications to other companies as appropriate when we start to consider alternative plans in the next section of this chapter.

9.36. The predominance of demand management within the cost-efficient plan is illustrated through other visualisation tools, as shown in **Figure 9.16** below. This is due to the ambitious levels of reductions reflected in our preferred demand management strategy, and, more widely, within the demand management strategies across the region.

This figure shows the proportion of water provided for the WRSE Region, as a whole, from the different option types selected by the investment model. Each colour shows the proportion of the total provided by that type of option for that situation for that year.

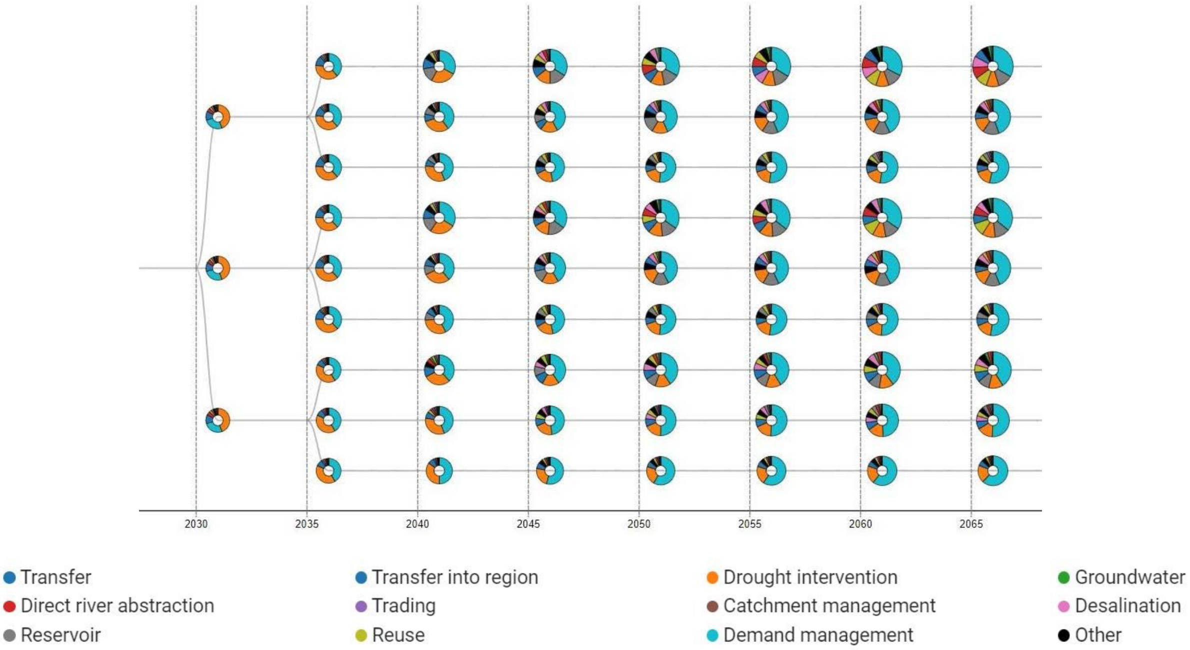


Figure 9.16: Contribution of different interventions to the cost-efficient plan on a regional basis (all situations). Please note: drought interventions are also part of demand management

9.37. Although environmental metrics were not optimised at this stage (i.e., the model reported the metrics associated with the plan, but optimisation was on cost rather than metrics), they were still recorded for the regional plan according to the individual branches. A summary of the total cost metrics across the whole of WRSE over the planning horizon is given in **Table 9.14**. Explanatory notes are provided after the table.

Metrics

Net present value [Cost]									
Metric	Situation 1	Situation 2	Situation 3	Situation 4	Situation 5	Situation 6	Situation 7	Situation 8	Situation 9
Cost w/ deficit [STPR]	15,240	13,062	11,770	15,370	13,060	11,706	13,400	11,572	10,614
Cost w/o deficit [STPR]	16,240	13,062	11,770	15,370	13,060	11,706	13,300	11,572,	10,614
Cost w/ deficit [IGEQ]	26,158	20,183	17,839	24,491	20,145	17,737	21,079	17,688	15,935
Cost w/o deficit [IGEQ]	26,158	20,183	17,839	24,491	20,145	17,737	21,079	17,688	15,935
Cost w/ deficit [LTDR]	18,121	14,431	12,943	17,106	14,424	12,872	14,866	12,751	11,645
Cost w/o deficit [LTDR]	18,121	14,431	12,943	17,106	14,424	12,872	14,866	12,751	11,645

Cost breakdown [STPR]									
Metric	Situation 1	Situation 2	Situation 3	Situation 4	Situation 5	Situation 6	Situation 7	Situation 8	Situation 9
Capex	7,095	5,124	4,253	6,485	5,120	4,192	5,222	3,999	3,421
Fixed open	6,848	6,477	6,379	6,785	6,476	6,377	6,521	6,386	6,311
Fixed operational carbon	233	223	220	230	223	220	218	211	206
Embedded carbon	642	435	369	591	428	364	444	350	311
Variable open	1,272	735	508	1,152	745	511	898	582	345
Variable carbon open	150	67	40	127	68	41	97	44	20

Environmental

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9
SEA environmental benefit	69,276.00	63,943.00	63,099.00	67,149.00	63,619.00	62,710.00	63,882.00	61,608.00	60,552.00
SEA environmental disbenefit	113,350.00	81,960.00	75,599.00	99,769.00	79,604.00	73,499.00	83,904.00	70,527.00	61,680.00
Natural capital	81,558,380.08	77,108,627.79	79,953,048.65	75,242,446.88	77,050,015.70	79,699,194.70	80,870,398.70	81,648,863.21	84,520,785.56
Bio-diversity net gain	-218,825.00	-154,246.00	-127,650.00	-204,324.00	-154,023.00	-128,380.00	-124,133.00	-96,975.00	-67,921.00

Table 9.14: Summary of Cost and Environmental metrics for the ‘Least Cost’ Regional Plan

Notes:

- *The costs in the upper half of Table 9.12 represent total Net Present Value (NPV) costs for the whole WRSE Regional solution for each of the different future situations, incorporating capital and operational costs in a standard NPV calculation. The costs are separated into the three types of discount factor used, with the default HM Treasury 'Green Book' discount rate (social time preference rates, or STPR) at the top. Calculations based on alternative inter-generational equity rates (IGEQ), and long-term discount rates (LTDR) which are lower and hence place more emphasis on longer-term costs are included below. The 'with' and 'without' deficit indicates where a cost penalty has been applied in the model because it has not been able to balance supply against demand in one or more of the future pathways (this did not occur in the cost-efficient run). These costs have increased from the draft Plan on a regional basis due to large increases in mains renewals and demand management costs for other companies in the WRSE region.*

- *The metrics in the lower half of **Table 9.14** apply to supply side solutions only and represent:*
    - *SEA – a summary of the total construction and operational Strategic Environmental Assessment values across all schemes and all years in the relevant pathway (50-year programme).*
    - *The net total impact on Natural Capital, in pound sterling over the 50-year programme.*
    - *The total requirement for biodiversity habitat units (-ve scores indicate habitat creation is required) needed to meet the commitment to biodiversity net gain. Each 'unit' has a cost expectation of around £15,000 according to the latest Natural England methodology[109], but this will vary according to location and the size of our overall habitat creation programme. The model adds the score for each year that the scheme is constructed within the programme, so units should be divided by approximately 25 if the cost impact is being estimated.*

9.38. It is not logical to try and separate out the Affinity-only part of these regional costs, considering there is sharing of water both directly and through existing transfers between water companies. However, an evaluation of the costs, environmental and carbon metrics associated with the main strategic schemes that are utilised by Thames Water and Affinity Water is provided in **Table 9.15**.

Option Name	Year Utilised	Deployable Output (Ml/d)	Capex (m)	Embodied Carbon during construction (Tonnes)	Natural Capital (£/yr)	BNG offset required (units)	SEA Benefit	SEA Disbenefit
GUC phase 1 (50 Ml/d)* [Affinity]	2032	50	£247	67,410	-6,917	-365	9	-30
SESRO 150Mm3 [shared]	2040	271	£2,204	327,435	23,943	+2447	45	-29
Thames to Affinity Transfer Scheme* [Affinity]	2040	50 Ml/d	£124	36,802	-2,682	-47	12	-48
Brent Reservoir Scheme	2035	7.5Ml/d	£46.19	11,020	-2,360	N/A	2	-10
Egham Lower Greensand Scheme	2033	5Ml/d	£4.91	2056	-100	N/A	1	-2
Epping ASR	2035	8Ml/d	£49.68	17158	-350	N/A	2	-4

Table 9.15: Evaluation of the costs, environmental and carbon metrics associated with the main strategic schemes that are utilised by Affinity Water

**This scheme is required to abstract and treat raw water from the Thames, irrespective of whether it comes from SESRO or alternatives such as the Severn to Thames Transfer scheme.*

9.39. This shows that the GUC and SESRO/T2AT combination are similar in terms of cost per Ml/d of DO produced. Similarly, the amount of embedded carbon produced per Ml/d of DO benefit is very similar across GUC and T2AT/SESRO. The smaller three schemes have been selected under this 'cost efficient' plan because it allows the deferral of the second stage of the GUC transfer – i.e. theoretically it saves money on a whole programme basis even though ultimately, they might not be needed in the long term. As discussed later

[109] Biodiversity net gain calculator - GOV.UK

under the alternatives assessment and 'Long-Term Delivery Strategy' sections, there are also significant environmental and cost/benefit risks associated with both the Brent Reservoir and the Epping Artificial Storage and Recovery (ASR) scheme.

9.40. There are several potential alternatives that could have been selected by the IVM. It is also reasonable to compare the costs of the WRZ6 to 4 transfer scheme as a whole, against the 'new' water resource options that were selected. Schemes of different sizes and operational versus capital costs can be reasonably compared through an 'Average Incremental Cost' (AIC) evaluation, which is provided in **Figure 9.17** below. This confirms that GUC and SESRO form two of the lowest cost solutions for Affinity Water.

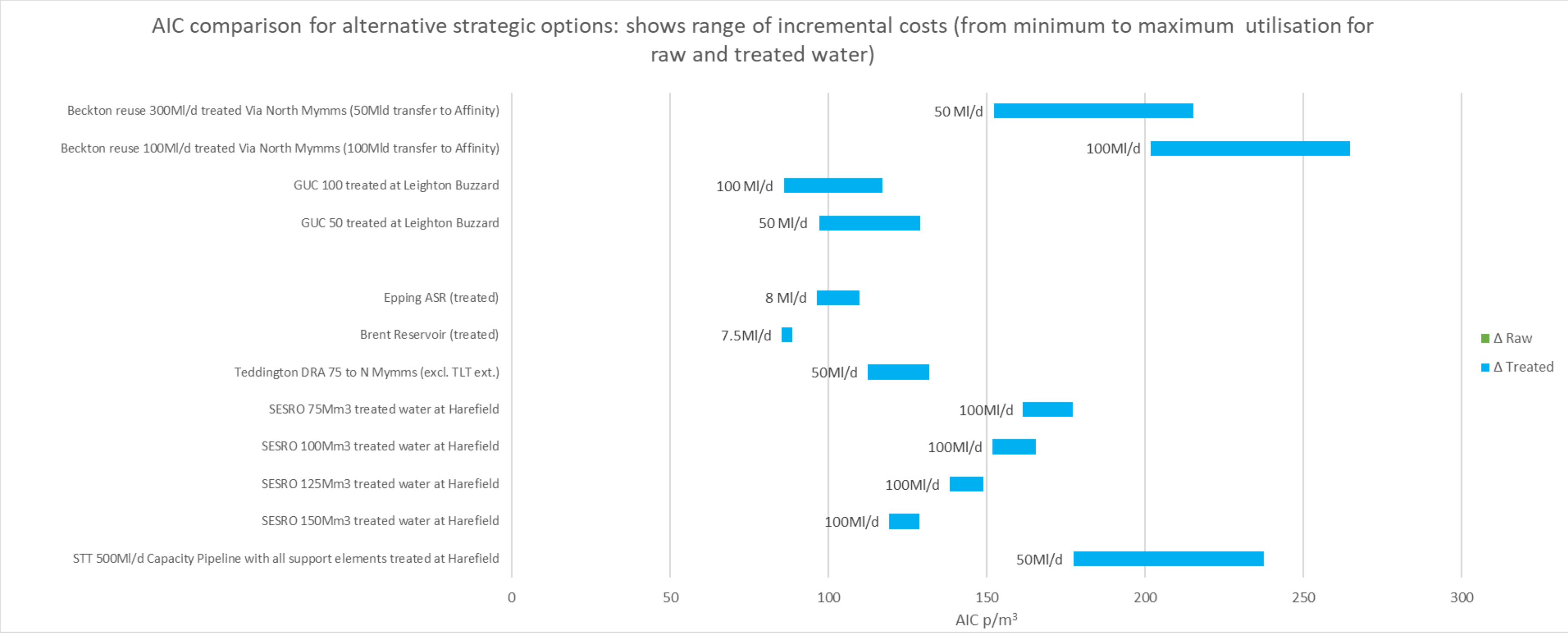


Figure 9.17: Relative costs of strategic options*

*This chart shows the 'average incremental cost' (AIC) of the major strategic options that we can use. The AIC is calculated as the NPV of the total cost/NPV of the total water produced by the scheme (in m^3). Where schemes have been separated into their component parts in the model, the AIC has incorporated the costs of the scheme providing raw water, and the total cost for providing treated water into the network from the scheme. The conjunctive use benefit from SESRO has been incorporated into this estimate. Deployable Outputs for each scheme are shown next to the AICs to indicate their relative size, but the AIC calculation inherently normalises for these size differences.

9.41. Although it provides a starting point for the alternative assessment, there are three aspects of the cost-efficient plan that means it is not necessarily the best solution for either the WRSE region, or Affinity Water as an individual company. These are listed below.

- It assumes that the full demand management ambition will be delivered across all future situations. As noted above, for Affinity Water alone, there are around 103Ml/d of reductions that are classed as 'high risk', with much larger volumes at risk when the region is considered as a whole. This affects the Plan at two key times; the mid-2030s when the 'cost efficient' plan relies on Brent Reservoir, Epping ASR and Egham Lower Greensand (LGS) to only just meet the supply/demand balance. Two of these schemes (Brent Reservoir and Epping ASR) attract a high delivery and Water Framework Directive compliance risk.
- It does not provide an understanding of the costs and environmental metrics for other alternative plans and programmes, which may perform similarly but have advantages when sensitivities (such as demand management risks) are considered.
- It does not consider how 'best value' metrics might be optimised if total costs are allowed to increase beyond this simple, least-cost estimate, and how close other viable strategies are in terms of (net present) cost to this overall plan. Specifically, it does not consider the relative SEA scores of alternative plans, as required by the SEA Directive.

9.42. The next stages of the alternatives analysis for the WRMP therefore concentrated on addressing these three aspects by:

- Evaluating the least cost plans generated under the 'Common Reference Scenarios' required by Ofwat in the PR24 Business plan, as described in **Chapter 8**.
- Sensitivity testing of alternative programmes to understand what might happen to the overall 'least cost' WRSE and Affinity Water plans if key options such as SESRO are changed or excluded, and/or demand management plans cannot deliver the target outcomes. The scope and rationale of this sensitivity testing are described below.
- Best value analysis on the preferred alternative plans identified through the sensitivity-testing process.

Alternatives assessment - sensitivity testing of strategic schemes

9.43. The nature and timing of the supply-demand deficits in comparison to the time taken to develop the larger strategic options, means that there is little flexibility in the programme, which limits the number of feasible alternatives that can be assessed through modelling. This is because of the following reasons.

- The requirement to progress with environmental destination ambition and the need for Thames Water to increase its level of drought resilience to a 1 in 200-year level in the 2030s, means that strategic level schemes are required for Thames, Affinity and Southern Water early in that period. The only options with short enough lead times to satisfy this requirement are either the water recycling schemes or desalination schemes (for Thames and Southern). The three most cost-effective water recycling schemes (GUC for Affinity, Teddington DRA for Thames and the Hampshire Water Transfer and Water Recycling Project for Southern) are already selected in the unconstrained 'cost efficient' plan. From an Affinity Water point of view, the only potential substitutes for the GUC are therefore the Beckton or Mogden South reuse schemes. Of these, Beckton reuse is more cost effective and carries a lower environmental impact than the Mogden South scheme.

- In all but the two least challenging situations (low growth and low to medium environmental destination), there is a need for a second strategic scheme in the 2040-2050 period. The main alternatives to the preferred option (SESRO) that could be used by Affinity Water are the supported elements of the Severn Thames Transfer. A larger GUC scheme (up to 100Ml/d) could also be considered for development without a second scheme, but this would only address the need in two out of the nine situations.

9.44. Up until 2030, we are making best use of existing sources and have identified the best value approach to doing that within the 'Development of our near-term (2025-2030) supply strategy' section earlier in this chapter. Our requirements for strategic resources beyond that fall into two time periods, as discussed above. The alternative strategies that we can consider within that framework are summarised in **Table 9.16** below (note that one of the alternatives for the GUC would be combined with one of the alternatives for SESRO however this would be dependent on the size of the schemes selected).

Alternatives to GUC for the period 2030-2040	*Need to be combined with*	*Alternatives to SESRO for the period 2040+*
Beckton Reuse via the eastern Thames to Affinity Transfer. **Mogden Reuse via the Eastern Thames to Affinity Transfer**		Severn Thames Transfer Anglian to Affinity Transfer from the South Lincolnshire Reservoir Large-scale development of Beckton Reuse

Table 9.16: Alternative strategies

9.45. It should be noted that the modelling itself already carries out the vast majority of alternatives analysis – it optimises on cost and best value across all the combinations of the 1,400 supply-side options available across the South East, each time it is run. Nevertheless, if the optimisation is entirely relied on, then this does not allow us to see what the implications are of moving to other strategies – the costs and best value impacts of alternative programmes may be acceptable and better aligned with non-modelling, qualitative considerations. Several alternative strategies were therefore identified by placing constraints on the model, as described below. These formed part of a wider suite of alternatives testing developed by water companies with WRSE, but the alternatives described below are the only ones that affect Affinity Water directly.

9.46. The first set of alternatives, substituting GUC with Beckton or Mogden reuse, would effectively be a straight swap to a scheme that has higher Capex, higher Opex and higher environmental impacts. The completion of the 'Gate 2' evaluation of GUC/Minworth through the regulatory RAPID programme since the draft WRMP, means that default costs for the GUC now include estimated reasonable worst case treatment requirements for the water recycling element of the scheme. Beckton was not selected in any of the other sensitivity runs and no longer appears in the least cost programme for Thames Water, so this was not forced into the investment model or subject to detailed analysis in the SEA.

The second set of alternatives assessment considered the implications of reducing the size of SESRO, removing it altogether (effectively relying on the Severn Thames Transfer) or building the Severn Thames Transfer pipeline before SESRO. It was found that these sensitivities implicitly included the selection of a larger GUC option in the early 2030s. These alternatives are described in more detail below.

Further scenario analyses were carried out to understand the implications of the key risks that could change the main assumptions contained in the investment modelling that are not inherently addressed through the adaptive branches described in **Chapter 8**. These are outlined below.

- Thames Water has received very high levels of opposition to the Teddington (DRA) scheme within its draft WRMP consultation. If this scheme cannot be delivered then there are potential knock-on implications for Affinity Water, as we can take up to 29Ml/d from Thames through existing bulk imports to support our needs, and if Thames do not develop Teddington DRA, then they may not have enough water to continue supporting those transfers. A run was therefore carried out with Teddington DRA excluded.

- There is a high risk that the ambitious Per Capita Consumption (PCC) targets described in **Chapters 4 and 9** will not be met. To understand the implications of this risk, two sensitivity analyses were undertaken:

    - One with a 'low' company-side demand management benefit as per the WRSE scenario described in **Chapter 4**.
    - One where most of the expected benefits of government interventions are not realised (Government H profile). This effectively tests what would happen if governmental support only went as far as water efficiency labelling, which only achieves our mid-range estimate for that particular intervention.

9.47. The potential for a fully water recycling oriented plan, whereby SESRO and/or the Severn Thames Transfer would be replaced by a very large Beckton scheme was considered, but discounted, because the cost effectiveness (as shown by the AIC comparison in **Figure 9.17**) and environmental performance of the scheme are significantly worse than SESRO, and the unconstrained least cost and best value runs both showed that there is greater flexibility in the STT scheme for Thames Water. The cost to Affinity of trying to develop the Beckton scheme alone (i.e. without Thames Water) would be prohibitive due to the large, fixed costs attached to a smaller 100Ml/d scheme as illustrated in **Figure 9.17**.

The final alternative that was considered was one where the Anglian to Affinity Transfer is used to replace all of Affinity's needs from 2040 onwards. This was discounted as a reasonable alternative because of the costs and impacts this would have on the WRE region, as described under the 'Regional reconciliation' section.

A description of the sensitivity constraints imposed on the model to generate the two modelled sets of alternative programmes for the WRMP24 are provided in **Table 9.17**.

The results presented below are investment model runs that contain a single Deployable Output benefit for options, which are typically simply added to calculate the overall benefit for a WRZ. However, for some schemes the hydrology and nature of the water resource systems mean that there can be in-combination benefits from combining different resources. These benefits have been calculated using the Pywr models referred to in **Chapter 5**, and any 'conjunctive use' benefits have been incorporated through specific rule in the investment modelling. For example, if Affinity Water use SESRO via the T2AT, then because we do not have existing raw water storage, there is a conjunctive use benefit for Thames Water, as described in **Appendix 5.1.** This has been included in the WRSE investment model as a DO benefit for Thames Water if the two schemes are built in-combination.

Scenario Name	Constraints on Supply Schemes
Limited SESRO Storage (125)	SESRO was constrained to 125 Mm3 maximum
Limited SESRO Storage (100)	SESRO was constrained to 100 Mm3 maximum
Limited SESRO Storage (75)	SESRO constrained to 75 Mm3 maximum
No SESRO Storage	SESRO excluded from the analysis.
No Teddington DRA	The Teddington DRA scheme is excluded for selection by Thames
Low company demand management	The demand initiatives implemented by Affinity Water only achieve the lower scenario
Lower government-led demand savings	Government initiatives stop with water labelling and only achieve the central estimate of benefits (6 l/h/d)

Table 9.17: Constraints used in sensitivity testing to support the alternatives analysis

9.48. These sensitivities represented all the strategic changes that might be made that affect the Affinity WRMP24. Alternative plan configurations are limited because the scale of environmental destination means that two strategic reuse schemes are required in the early 2030s, which is before SESRO or STT can be delivered.

It should be noted that each of these alternative scenarios were tested against the same 9-branch situations described for the least cost plan above. An example output that includes all schemes that are relevant to Affinity Water (taken from the cost-efficient plan generated with SESRO excluded) is provided in **Figure 9.18** below.

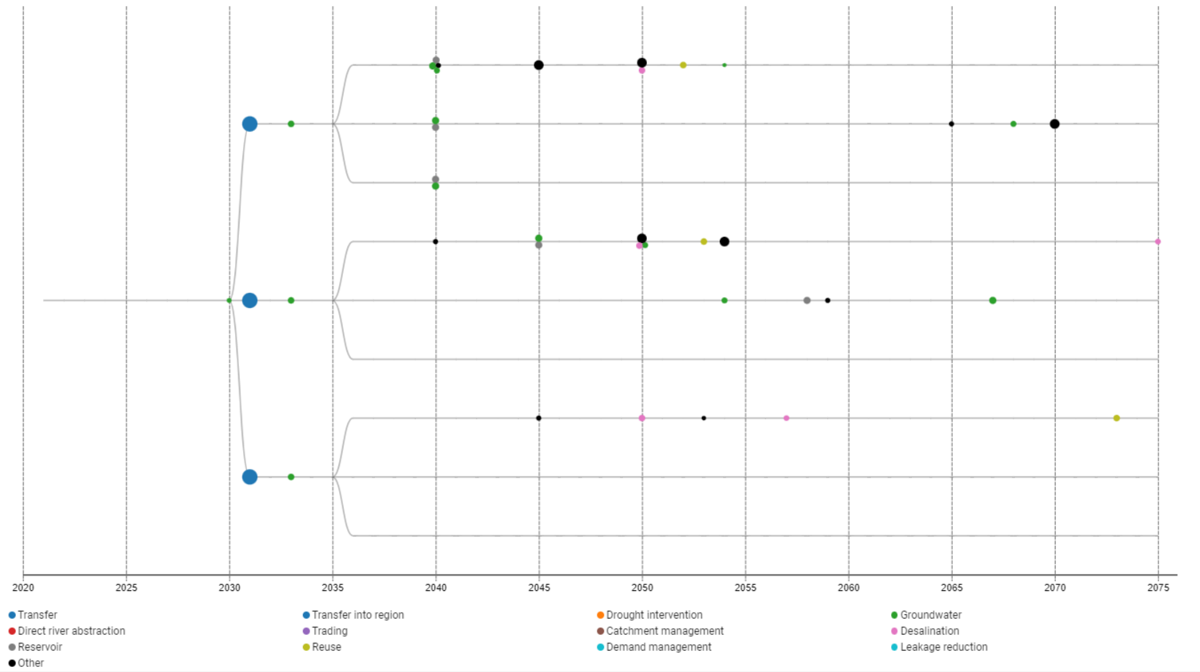


Figure 9.18: Bubble plot for 'No SESRO' option

9.49. The WRSE summary modelling outputs for these 'cost-efficient' runs are provided in **Appendix 9.1**. The results of this alternative analysis are summarised below using the following figures:

- **Figure 9.19**: A summary of the Net Present Cost versus best value performance for each alternative plan across all the best value metrics. For this analysis, the score was calculated by evaluating the highest and lowest score across the alternative plans within each metric and situation and calculating where each alternative plan scores for each metric and each situation as a percentage of that range. The percentage presented is simply an average of the percentages (for each metric and each situation) for each alternative plan. An assessment weighted score according to customer preference is provided later in this section.

- **Figure 9.20**: A 'regrets' analysis of cost against best value plan (BVP) metric performance. This shows the level of cost volatility of each plan against the overall best value metric performance, calculated based on the average difference between the alternative plan cost under each situation, and the minimum cost achieved across all the alternative plans for that situation.

- **Figure 9.21 (a and b)**: The overall carbon emissions associated with each alternative plan, compared against the best value metric performance (as calculated above). It should be noted that the carbon costs include governmental factors for the anticipated reduction in carbon intensity from energy and hence operations, but do not account for potential measures to reduce embedded carbon emissions using 'green' construction techniques. The analysis will therefore tend to favour high operational carbon schemes and schemes involving pipelines and manufactured components[110].

It should be noted that the 'least cost plan' was the only alternative where the model was free to select different sizes of SESRO within the three post 2030 branches. For the other alternatives the size of SESRO was fixed, which means the 'least cost' plan run inherently had a cost advantage compared to the alternatives (it could 'tailor' the size of the scheme to future need to a certain extent). As noted in the draft WRMP, whilst this is theoretically feasible, in practice it may not be feasible, depending on the exact timing and mechanisms involved in the post Development Consent Order procurement process in comparison to the WRMP29 submission.

For further information on the performance of schemes in the Least Cost, Best Environmental and Social Plan, Best Value Plan and No SESRO Plan, please see **Appendix 9.2**.

[110] Cross company research carried out for the SROs indicates that there is likely to be more opportunity for 'green' construction techniques for schemes involving large amounts of on-site mobile plant (e.g. reservoirs), compared with schemes such as reuse where most of the Capex is embedded in prefabricated materials.

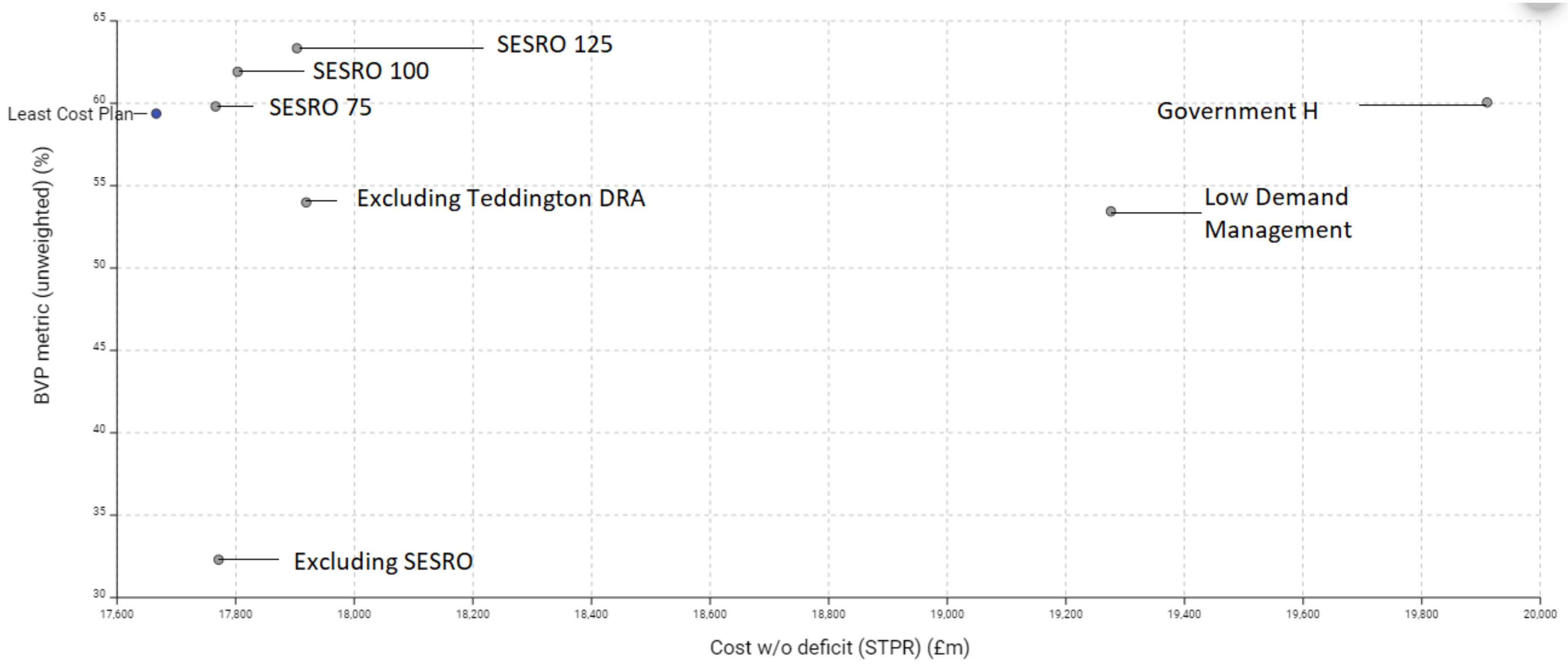


Figure 9.19: Comparison of Net Present Cost and Metric Scoring Across the Alternative Plans

Notes:

- *The costs include the NPC of the whole regional programme*
- *The higher the metric score the better the performance of the programme. The cost/benefit of each programme therefore improves towards the top left-hand side of the chart.*

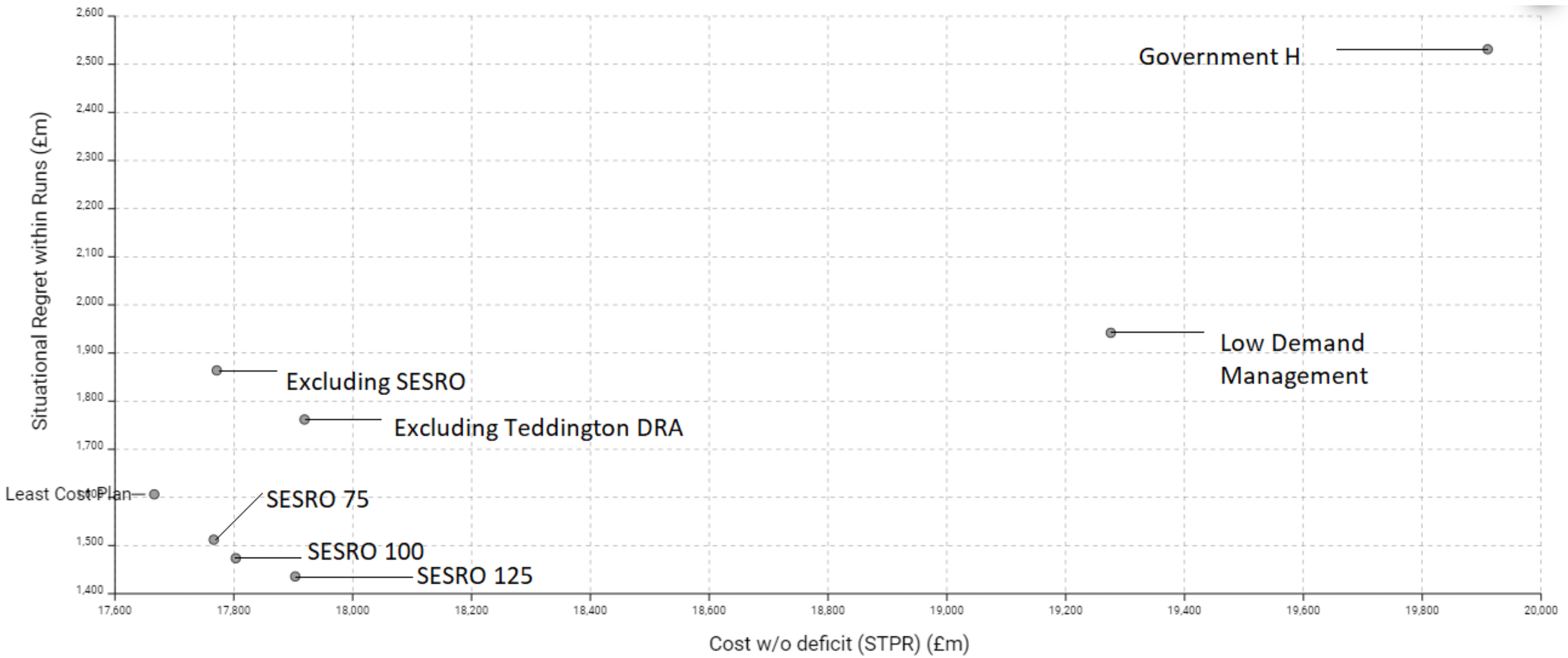


Figure 9.20: 'Regrets' Analysis across the Alternative Plans

Note: The 'situation regret' described in this chart indicates how far from optimal the solution is when considered separately across the 9 situations. Effectively it describes the risks associated with 'getting it wrong' either in the form of under-utilised assets or higher than necessary costs involved when having to build reactively to more adverse situations. In this case the programme is better the further to the bottom left-hand side it scores.

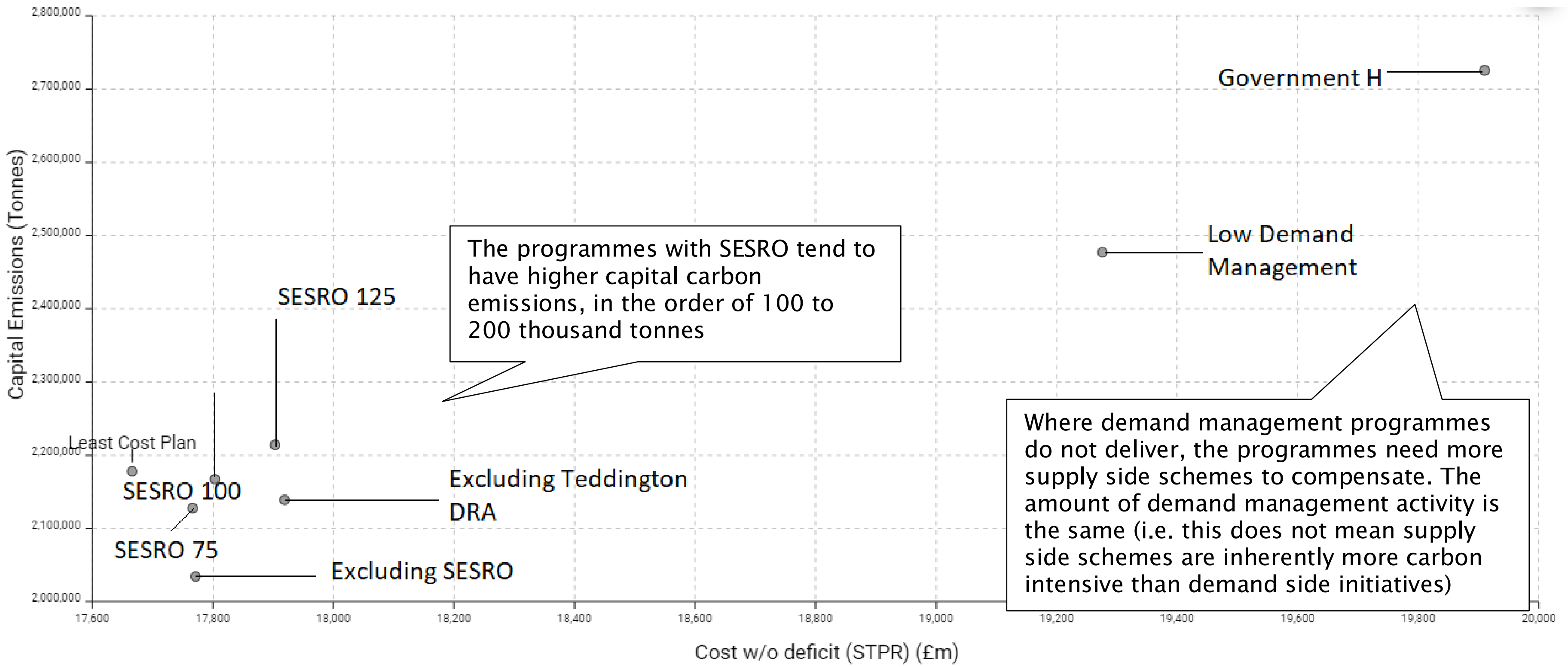


Figure 9.21a: Net Present Cost and Capital Carbon Emissions Across the Alternative Plans

Note: The higher the carbon emissions, the more the programme will require mitigating or offsetting to minimise the carbon impact. 'Capital emissions' relate to the carbon emitted from all Scope 1 and 2 sources (direct and indirect construction activities) during construction.

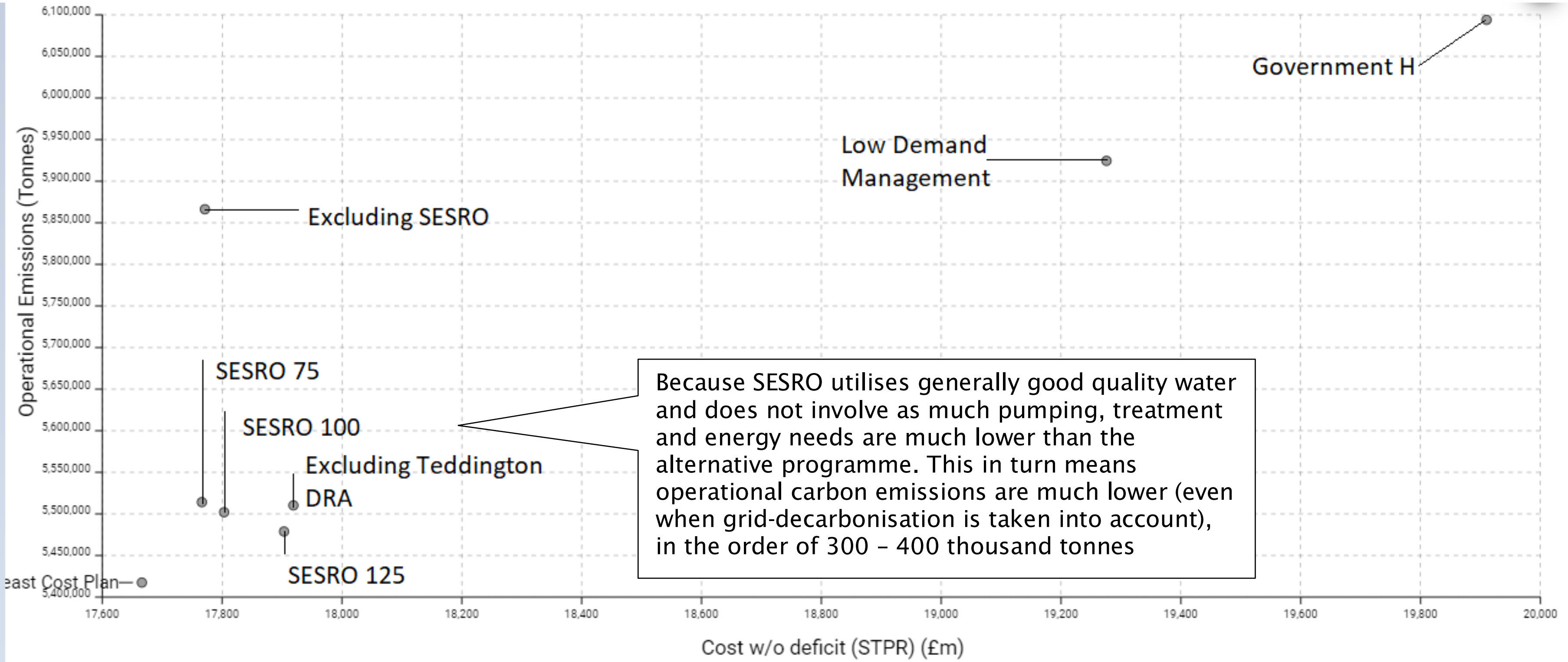


Figure 9.21b: Net Present Cost and Operational Carbon Emissions Across the Alternative Plans

9.50. The interaction and usage of schemes in each of these alternatives is complex but important as it tells us if there is a risk that a large scheme might become under-utilised in some of the future situations that we analysed. It is best explained through graphical analysis of the utilisation of the strategic schemes and transfers over the planning period. This analysis is provided in **Figures 9.22 to 9.27** below. For each alternative plan these show the amounts as follows.

- The amount that the main strategic options (GUC and Thames to Affinity Transfer) are used individually over time under each planning pathway.
- The amount that the main strategic options provide in total over time under each planning pathway.
- The amount of water that is transferred between Affinity Water and Thames Water, in total under each pathway over time (note: this includes the option to temporarily trade water from our Egham licence to Thames Water's Kempton licence).

Key findings from each set of alternatives analysis are presented on the figures as appropriate. A summary of the key findings from the utilisation analysis is provided in **Table 9.17**.

As noted earlier, the utilisation of the schemes in a 'dry' year (1 in 10 event) will be approximately 80% of that under the full design drought.

A relative summary of the strategic implications of in the alternatives tested through the model is provided in **Table 9.18**.

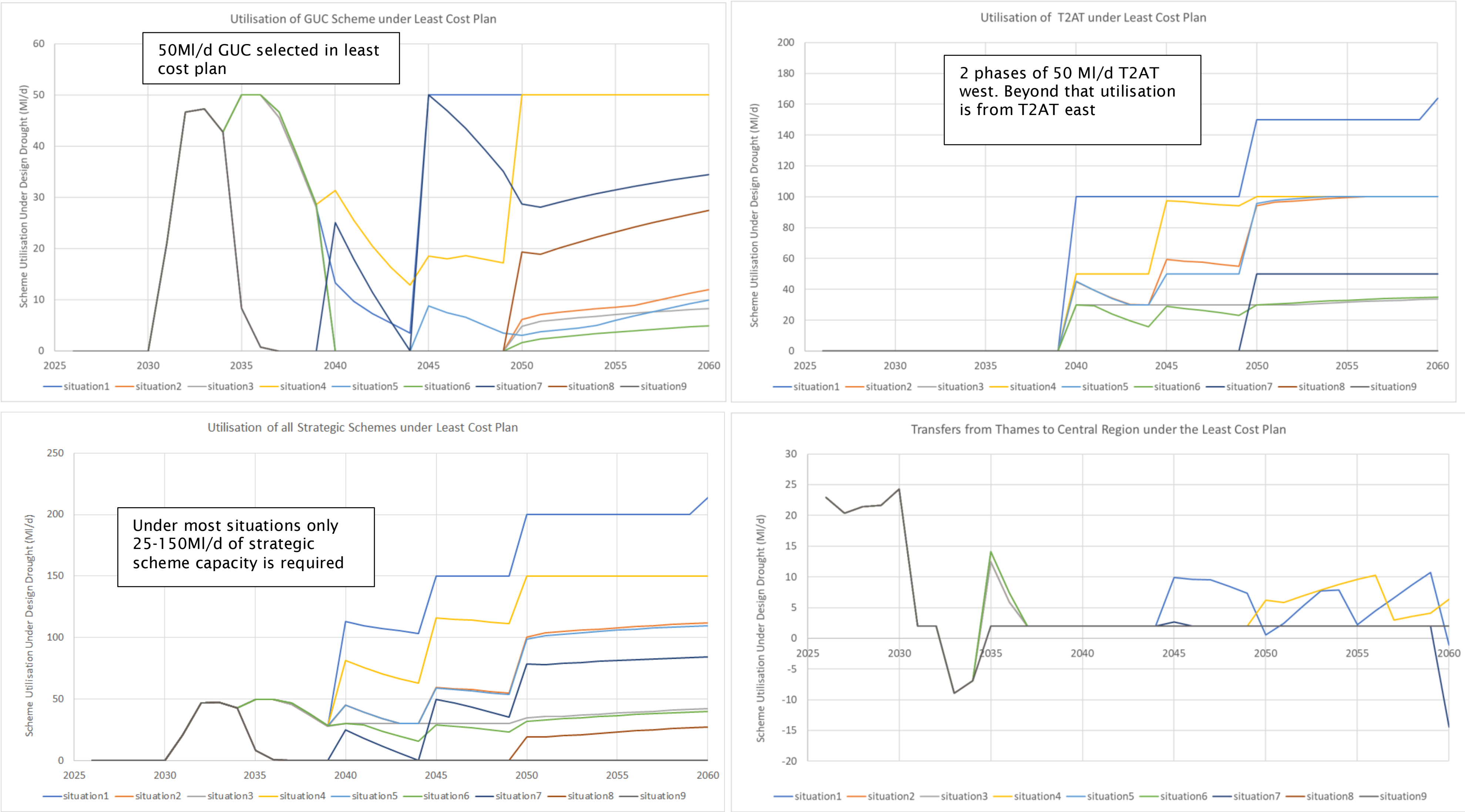


Figure 9.22: Utilisation by Adaptive Pathway Under the Least Cost Plan (Model Selects SESRO at 150Mm3)

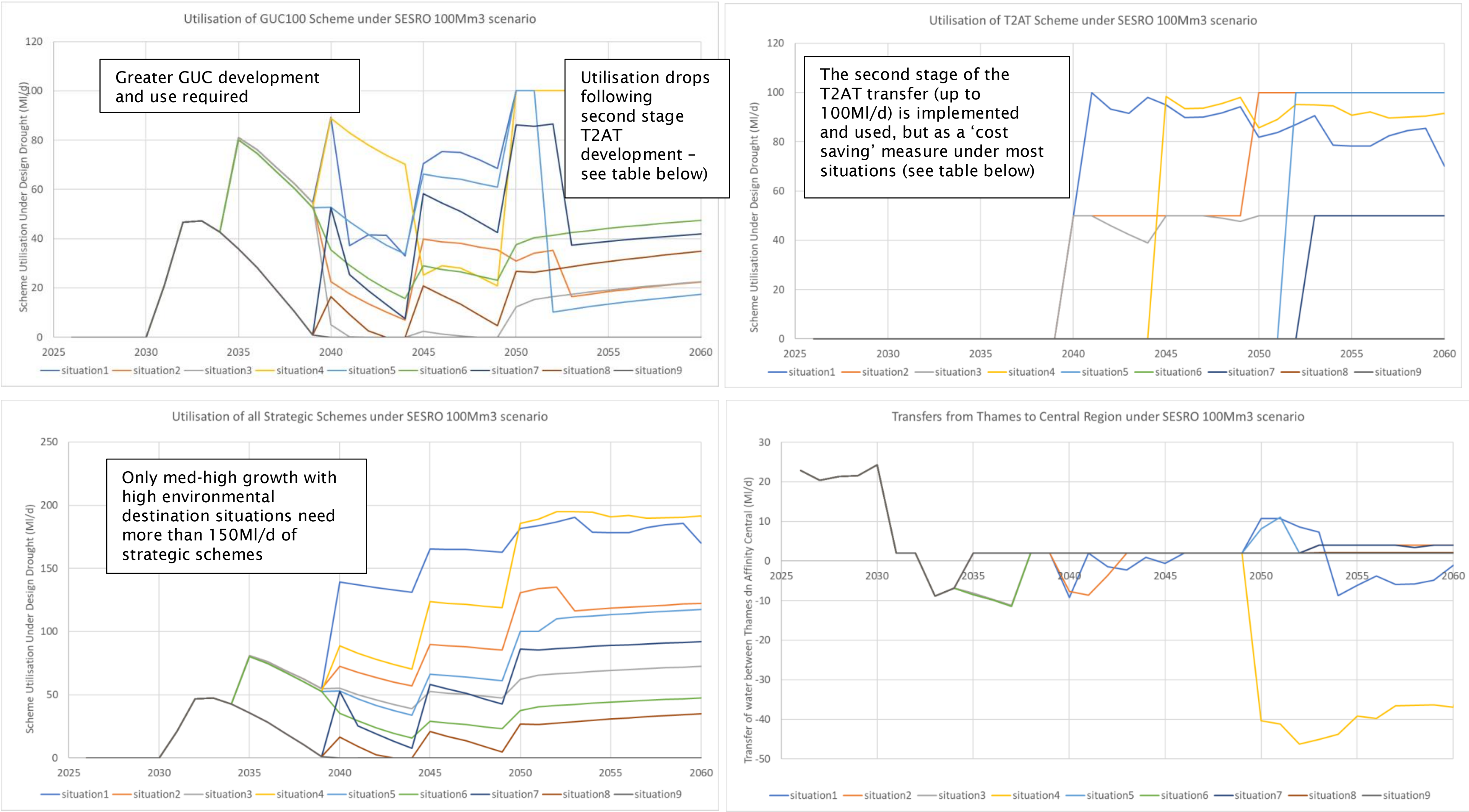


Figure 9.23: Utilisation by Adaptive Pathway Under the Cost-Efficient Plan with SESRO Set to 100 Mm^3

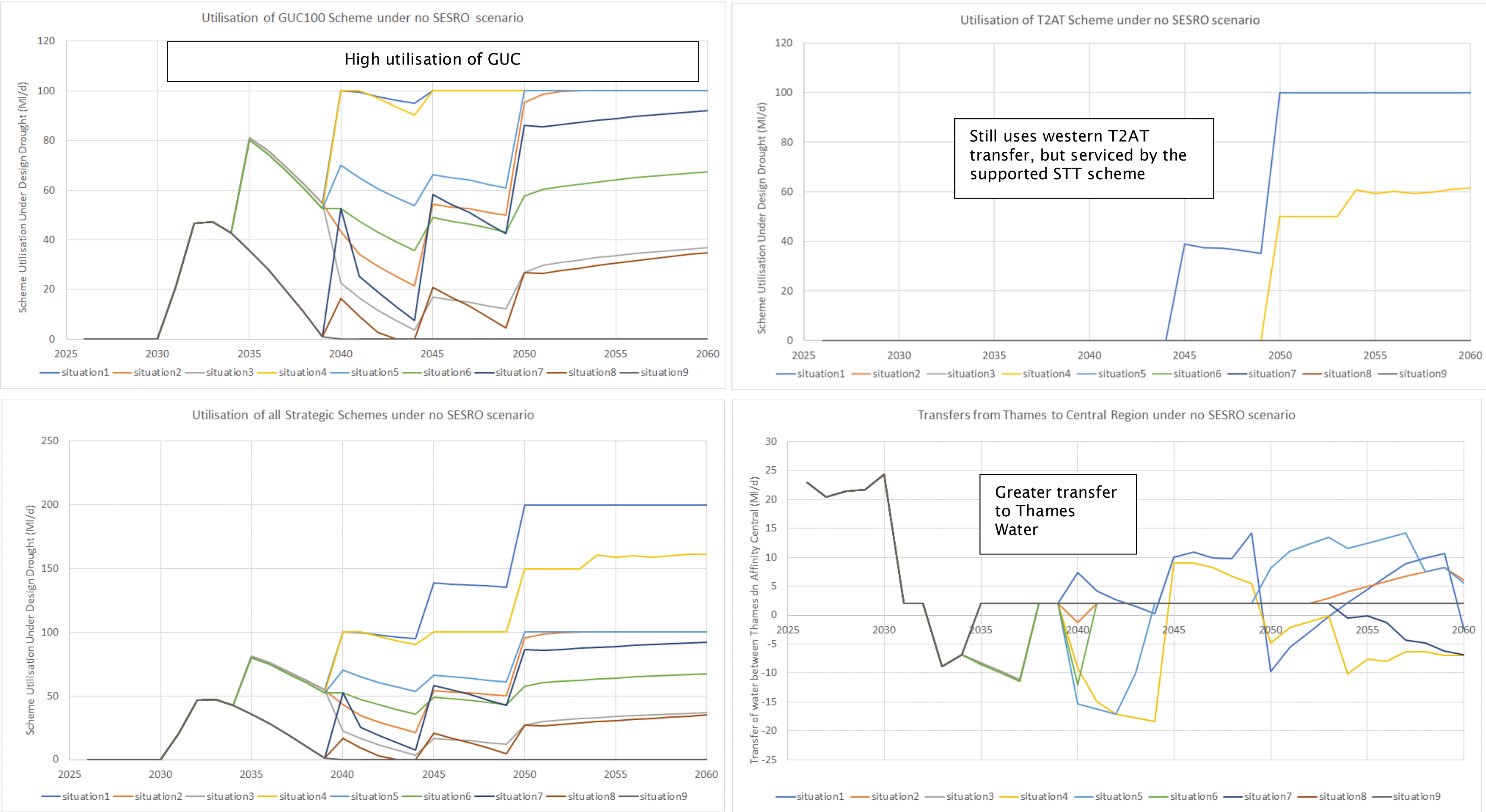


Figure 9.24: Utilisation by Adaptive Pathway Under the Cost-Efficient Plan with No SESRO

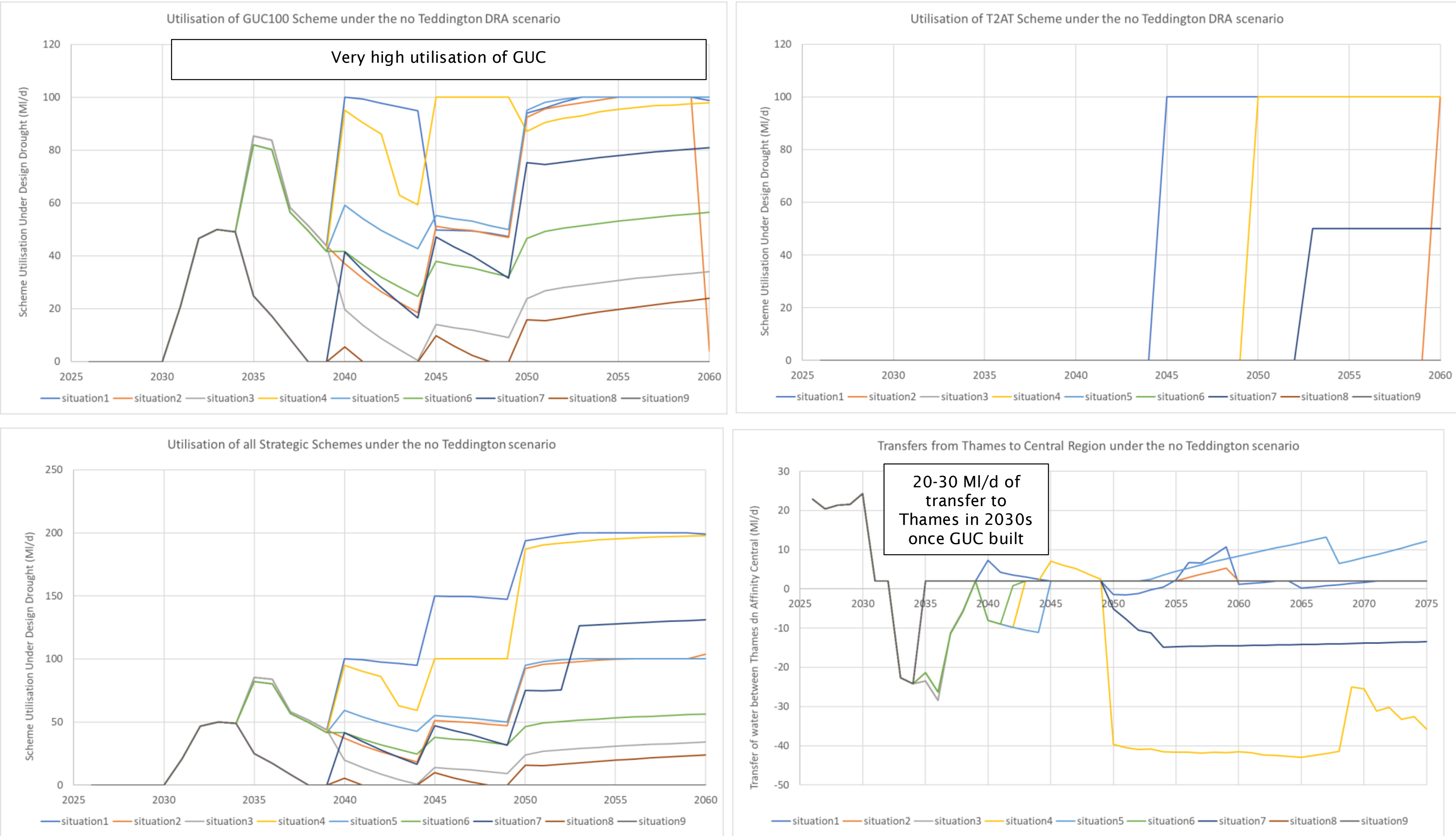


Figure 9.25: Utilisation by Adaptive Pathway Under the Cost-Efficient Plan with No Teddington DRA

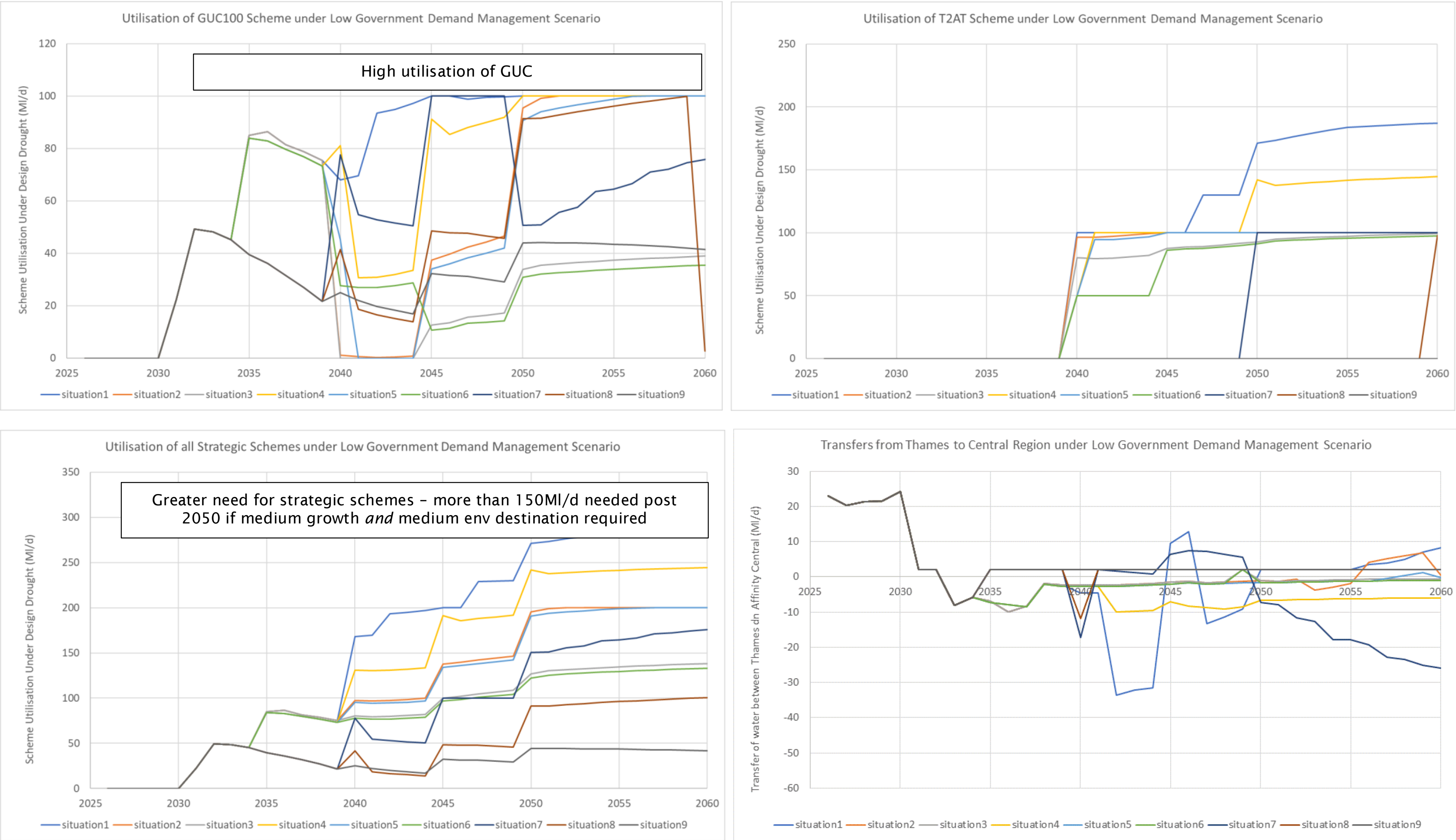


Figure 9.26: Utilisation by Adaptive Pathway Under the Low Government Demand Management Scenario

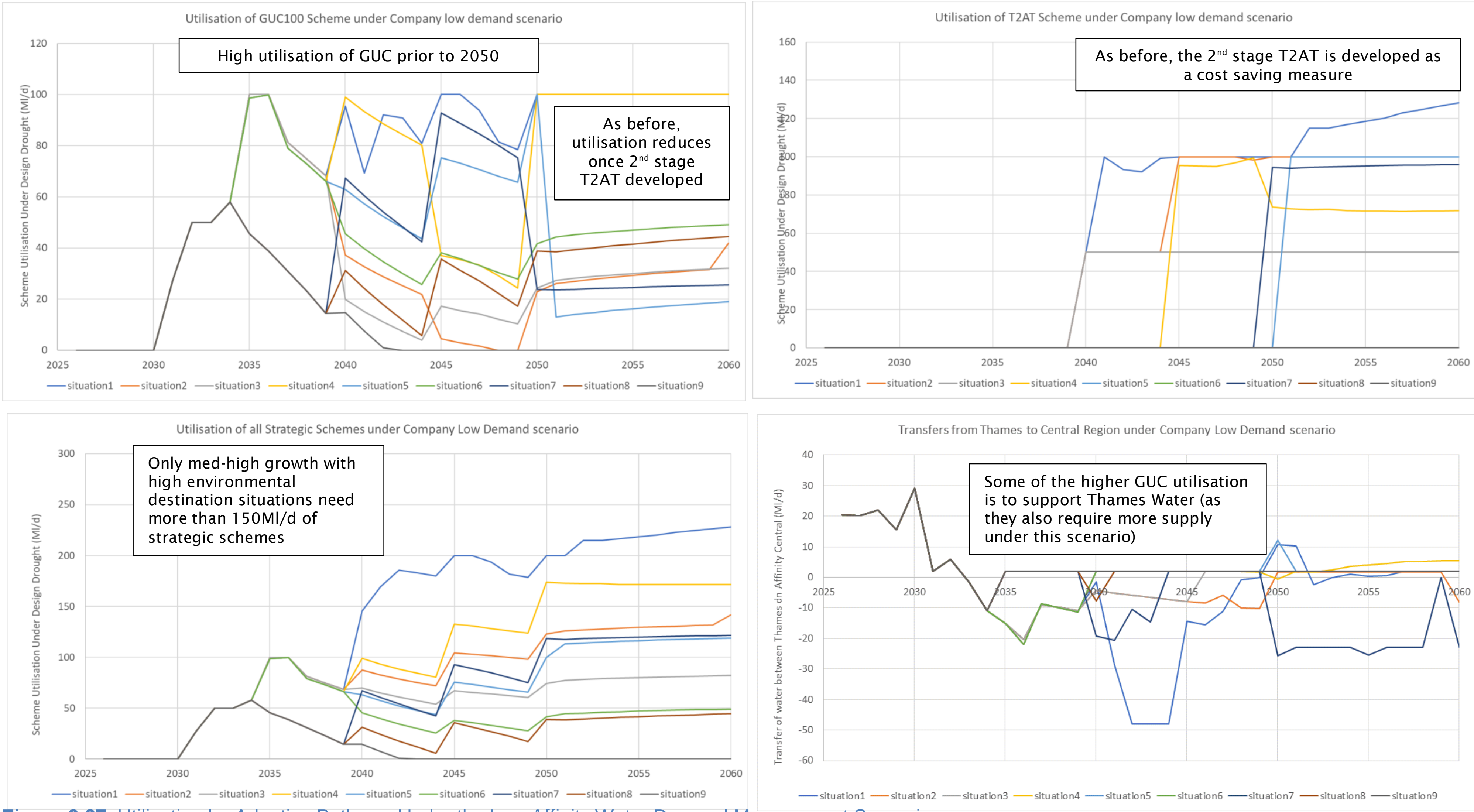


Figure 9.27: Utilisation by Adaptive Pathway Under the Low Affinity Water Demand Management Scenario

Alternative Plan	Strategic Programme Components	Key Points from Utilisation Analysis	Best Value Assessments and Programme Risks
Unconstrained Least Cost Plan	Selects GUC 50Ml/d supported by Brent reservoir repurposing scheme in the 2030s. It then develops two stages of T2AT in the 2040s/50s under Situations 1 to 5, with 1 stage in Situations 6 to 8 (no T2AT in Situation 9). The regional plan contains the SESRO 150Mm3 scheme in the top 6 (most adverse) situations and 75Mm3 in the least adverse three situations (7 to 9).	The T2AT tends to replace the GUC, so GUC is less than 20% utilised in all but the three high Environmental Destination Scenarios. This is because the high spare capacity in SESRO has low operational cost, so the model constructs T2AT as a way of utilising that water as much as and as soon as it can. Transfer to and from Thames Water is limited once GUC is constructed.	Overall, this programme performs well against the no-SESRO and no-Teddington DRA scenarios, butscenarios but is marginally worse under Best Value metrics than the programme where SESRO is limited to 100Mm3, performing better in terms of resilience but less well in terms of environmental metrics. We do have concerns about the repurposing of Brent reservoir this early in the programme, as the EA raised concerns around the historic build-up of contaminated sediment in their consultation response. This will need investigating and it should be noted that the scheme as configured only allows for a pipeline and treatment works, not reconditioning of the reservoir itself.
No SESRO	The model selects the GUC100 rather than the GUC 50 scheme in the early 2030s. It then only uses the GUC under most situations except for high environmental destination when it takes the supported Severn Thames Transfer from the River Thames via the T2AT scheme. Both the Epping ASR and Brent Reservoir re-purposing are relied on in the top 5 situations post 2045, providing 15.5Ml/d of additional resource.	Utilisation of the GUC is high and maximised under the mid-range situations. It is slightly lower under the high environmental destination scenarios due to the use of the T2AT.	This pathway does not result in an NPC programme cost benefit compared to those alternative pathways where the size of SESRO is fixed. This programme performs significantly worse on Best Value metrics than the SESRO based programmes. A comparison of the environmental and resilience metrics performance of the no-SESRO plan in comparison to the least cost plan is provided below, which shows that the programme is worse across all environmental metrics. Significantly it is also the only programme with a notably worse net performance on carbon emissions when balanced across both embedded and operational carbon emissions. This is due to the high energy usage of the schemes (including the Severn Thames Transfer) that replace SESRO, which mean the operational carbon emissions are far higher, even though the WRSE model includes governmental assumptions for decarbonisation of the grid.
Limited SESRO storage (100Mm3)	The model selects the GUC100 rather than the GUC 50 scheme in the early 2030s. This means it no longer relies on the Brent Reservoir repurposing scheme. It tends to defer the T2AT development and only develops two stages (i.e., up to 100Ml/d) in 4 situations. Under two of those situations the need is very marginal.	Utilisation of the GUC is higher than under the Least Cost Plan, but still less than 50% in all but the high environmental destination scenarios. This appears to be because the model is seeking to use the much lower operational cost from SESRO, so constructs the T2AT second stage once spare water becomes available in the reservoir due to demand reductions at Southern and Thames in the longer term. Transfer to and from Thames Water is limited once GUC is constructed.	This programme performs well, with lower resilience metrics but better environmental metrics than the Least Cost Plan. It is more expensive than the Least Cost Plan, although most of the difference is due to the model having to select the 100Mm3 reservoir across all branches (i.e. there is less flexibility for the model to 'right size' the reservoir across different branches).

Very limited SESRO storage (75Mm3)	The model selects the GUC100 rather than the GUC 50 scheme in the early 2030s. This means it no longer relies on the Brent Reservoir repurposing scheme. It tends to defer the T2AT development but is essentially thee same from an Affinity Water perspective as the 100Mm3 based programme.	Similar to the SESRO 100 programme above.	This programme performs worse on Best Value metrics than the SESRO 100 scheme, with a higher 'regrets' risk and significantly worse (around 20% worse) cost/benefit ratio for the scheme itself. The main reason for this is that is marginally lower NPC, but this is less than 0.3% of the programme cost, so not significant.
No Teddington DRA	The model selects the GUC100 rather than the GUC 50 scheme in the early 2030s. Construction of the T2AT tends to be later on, which is because there is less spare reservoir capacity (it is being used more by Thames Water). Thames Water need to either develop multiple groundwater schemes or a small (50Ml/d) Beckton re-use scheme in the 2030s to offset their need.	There is a clear need for transfers to Thames Water in this scenario, with between 25 and 30Ml/d transferring to Thames in AMP9 and 10. Because Thames needs more water from SESRO in the longer term, Affinity utilisation of GUC tends to be higher. In some situations, where Thames does not construct Beckton, there is a large transfer from Affinity to Thames post 2050.	The availability of the larger GUC provides flexibility for Thames Water if Teddington DRA cannot be delivered. It does this through the trading of licence from Affinity WRZ6 to Thames' west London intakes. The lost WRZ6 surplus is replaced by the GUC for Affinity Water, which transfers water down to WRZ1 where it is needed. Both cost and Best Value metrics are worse under this scenario on a regional basis due to the loss of the low cost, low impact Teddington DRA scheme.
Low water company demand management scenario	The model selects the GUC100 rather than the GUC 50 scheme in the early 2030s, which causes the model to then select the smaller (100Mm3) SESRO scheme. Construction of the T2AT is similar, although slightly accelerated (by 0-5 years) in comparison to the high demand management scenario.	The need for the GUC is high in the 2030s, peaking at between 60 and 100Ml/d. Utilisation post 2040 is typically 10-20Mld higher than under the high demand management scenario (with the SESRO 100Mm3 scheme).	The availability of the larger GUC provides flexibility if demand management targets cannot be met in the first half of the programme. This risk cannot be managed without the full GUC 100 scheme. There is no reliance on the Brent Reservoir re-purposing scheme. Costs are inevitably higher than the Least Cost Plan, as there is a need for more supply side development across the region.
Low government demand management scenario	The model selects the GUC100 rather than the GUC 50 scheme in the early 2030s. The need is then greater in the longer term, so it also selects the SESRO 150Mm3 scheme. As the Affinity Water need is much higher in the longer term, both stages of the T2At are required across all but the lowest scenario (9) and in the two most adverse high environmental destination scenarios the eastern T2AT scheme is also triggered to allow Affinity Water to make use of the Beckton desalination development by Thames Water.	Utilisation of the GUC is variable in the 2040s, but medium to high apart from that. This is supported by near maximum utilisation of the T2AT once it is constructed. Overall, the model needs the capacity of the full GUC 100 and more than 50Ml/d of T2AT in 5 out of the 9 situations, including the 'middle' situation 5. If either growth or environmental destination are low, then the Central region only needs a total of 150Ml/d capacity from strategic schemes – i.e., it does not need the second stage of the T2AT transfer to balance supply/demand	Unlike the scenarios above, levels of demand under this scenario mean that 150Ml/d of capacity from strategic schemes is unlikely to be sufficient to balance supply and demand – i.e., in this case the second stage of theT2AT is being constructed because it is needed for drought resilience. This compares to the other scenarios where it can theoretically be constructed purely to save money because it is able to access spare capacity in SESRO that becomes available due to other companies' falling levels of demand. Costs are significantly higher than the Least Cost Plan due to the need for large volumes of supply side schemes to meet the additional demand that results from PCC levels that are around 18 l/h/d higher.

Table 9.18: Initial Findings from the Alternatives Analysis

Metrics

Net present value (Cost)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Cost w/ deficit (STPR)	20,533	17,663	16,988	19,052	17,550	16,797	17,600	16,753	16,060	(£m)
Cost w/o deficit (STPR)	20,533	17,663	16,988	19,052	17,550	16,797	17,600	16,753	16,060	(£m)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Capital emissions	3,162,735	2,156,113	2,004,927	2,589,503	2,118,820	1,929,021	2,107,615	1,846,769	1,685,150	(tonnes)
Operational emissions	6,416,312	5,204,888	5,097,158	6,164,492	5,216,347	5,074,343	5,508,962	5,100,931	4,973,614	(tonnes)

Environmental

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9
SEA environmental benefit	69,276.00	63,943.00	63,099.00	67,149.00	63,619.00	62,710.00	63,882.00	61,608.00	60,552.00
SEA environmental disbenefit	113,350.00	81,960.00	75,599.00	99,769.00	79,604.00	73,499.00	83,904.00	70,527.00	61,680.00
Natural capital	81,558,380.08	77,108,627.79	79,953,048.65	75,242,446.88	77,050,015.70	79,699,194.70	80,870,398.70	81,648,863.21	84,520,785
Bio-diversity net gain	-218,825.00	-154,246.00	-127,650.00	-204,324.00	-154,023.00	-128,380.00	-124,133.00	-96,975.00	-67,921.00

Metrics

Net present value (Cost)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Cost w/ deficit (STPR)	24,308	19,391	18,260	22,659	18,827	17,344	19,615	17,271	16,377	(£m)
Cost w/o deficit (STPR)	24,308	19,391	18,260	22,659	18,827	17,344	19,615	17,271	16,377	(£m)

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9	Units
Capital emissions	4,133,573	2,543,262	2,242,066	3,436,061	2,332,196	1,923,609	2,545,449	1,847,785	1,639,508	(tonnes)
Operational emissions	7,665,719	5,913,392	5,612,786	7,290,025	6,376,054	5,678,443	6,178,152	5,649,831	5,227,755	(tonnes)

Environmental

Metric	situation1	situation2	situation3	situation4	situation5	situation6	situation7	situation8	situation9
SEA environmental benefit	71,568.00	65,049.00	63,438.00	68,595.00	64,556.00	62,054.00	65,164.00	60,728.00	59,622.00
SEA environmental disbenefit	129,521.00	91,717.00	79,758.00	116,335.00	92,593.00	76,677.00	93,825.00	71,992.00	64,015.00
Natural capital	5,763,871.47	2,370,200.55	4,409,095.82	1,369,605.36	5,207,504.77	10,155,152.19	3,150,325.80	7,854,747.62	10,378,394.70
Bio-diversity net gain	-274,807.00	-198,214.00	-182,062.00	-239,532.00	-231,066.00	-191,205.00	-198,693.00	-177,460.00	-165,132.00

Table 9.19 Comparison of the Costs and Best Value Metrics for the Least Cost Plan and the 'No SESRO' Cost Efficient Plan

(figures presented for WRSE as a whole)

9.51. As shown, one of the key sensitivities relates to the risks associated with the delivery of government interventions. The demand management strategy described previously concludes that this introduces a high risk of non-delivery of 64Ml/d of the programme by 2050. As well as testing the least cost plan under this scenario, the programmes that both excluded SESRO and included the different sizes of SESRO were tested to examine how they perform if government support for demand management does not extend beyond water labelling or does not meet the ambition that we have included to meet the EIP targets. The results of this analysis are presented in **Figure 9.28** below.

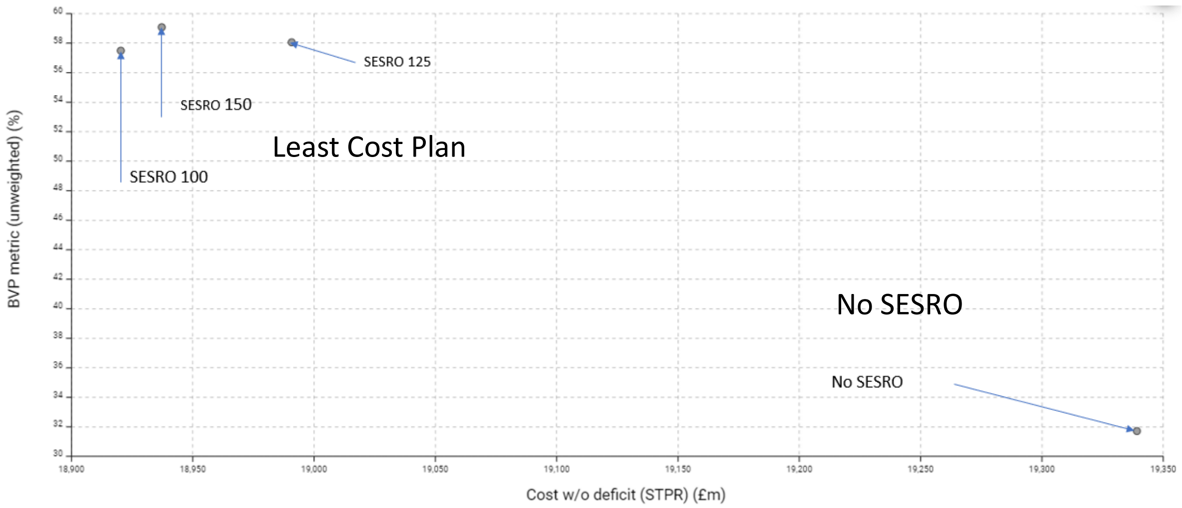


Figure 9.28: Cost and Best Value Metric Analysis for Cost-Efficient Runs under the 'Government H' Scenario

**Note – as discussed under the demand management strategy, the Government H scenario is one where the government only implement the water efficient labelling strategy, although savings from this are still towards the upper end of the potential expectations.*

9.52. This shows that the SESRO based plans still have similar costs and Best Value metrics under the Government H scenario. The plan that excludes SESRO continues to demonstrate poor Best Value metrics, and notably it would cost significantly more (over £300m on average) than programmes that do contain SESRO.

A summary of the overall findings of the alternatives analysis, based on the above analysis, is provided in **Table 9.20**.

Alternative plan	Major programme changes from the least cost plan	Key strategic implications
Somewhat smaller SESRO (125Mm3)	As 100Mm3 below	Very similar to the 100Mm3 based programme. It is slightly more expensive generally due to some excess capacity, but. performs better in terms of resilience scores.
Limited SESRO storage (100Mm3)	Implements the GUC100 Ml/d scheme, which replaces the need for Egham LGS and Brent Reservoir, in 2030s and removes the need for the second stage T2AT in all but the highest environmental destination situations.	Costs and Best Value metrics are very similar to the Least Cost Plan on a regional basis. The NPC is within 1%. It still performs similarly to the plan that includes the 150Mm3 SESRO if government demand management assumptions are not met.
Very limited SESRO storage (75Mm3)	Very similar to the 100Mm3 limited storage programme, with slightly different timings and utilisation.	Worse metric performance than the SESRO150Mm3 based regional Plan, on a regional basis.
No SESRO	Relies heavily on the GUC 100Ml/d scheme and requires Brent reservoir and Roding ASR schemes later on in the programme. The T2AT scheme is triggered, but only under high environmental destination situations, and uses the supported Severn to Thames Transfer scheme.	The revised demand management targets contained in the DEFRA Environmental Improvement Plan mean that Affinity can manage the 'no SESRO' scenario, provided those targets are met, although there is reliance on uncertain, smaller schemes. On a regional basis this alternative has a similar NPC to programmes that include SESRO, provided all planned demand management is achieved. However, has poorer metric scoring than the 'with SESRO' options, which includes higher total carbon emissions, worse environmental performance for natural capital and biodiversity net gain, and worse resilience scoring except in the area of 'evolvability' (the ability to change programme as future risks develop). It is also significantly more expensive than the 'with SESRO' programmes if governmental expectations around demand management are not met.
No Teddington DRA	Implements the GUC 100Ml/d scheme as above. Increases licence trading to Thames in the 2030-2040 period.	The construction of the larger GUC scheme can provide support to Thames Water if Teddington DRA cannot be delivered. Overall, the plan performs significantly worse on both cost and best value metrics than the plans that include Teddington DRA.
Low water company demand management scenario	Implements the GUC 100Ml/d scheme and SESRO 100Mm3 scheme as above. The GUC is heavily relied upon during the 2030-2040 period under both Housing Plan and ONS-21 growth scenarios.	Housing Plan growth cannot be managed without the GUC 100Ml/d scheme, and even ONS-21 growth presents a significant risk if company led demand management does not achieve all the estimated reductions from customers. .
Low government demand management scenario	Requires more than 50Ml/d of T2AT transfer under most of the situations, in addition to the 100Ml/d GUC scheme.	If assumed government led demand management, beyond the 6 l/h/d that can be assumed by the water labelling scheme that has already been announced, is not implemented or does not achieve optimistic estimates, then there is a risk that the GUC 100 scheme and 50Ml/d of T2AT will not be enough to meet medium levels of environmental ambition, unless growth is towards the lower end of the envelop.

Table 9.20: Summary of strategic implications

9.53. Following this analysis, an additional test was carried out whereby the model was forced to initially select the Severn Thames Transfer pipeline at the 2040-time horizon, but then allowed to choose freely from all the options after that point. This was done to understand whether changing the scheduling between SESRO and STT, rather than simply excluding SESRO, might generate a better value plan. This plan performed slightly worse than the 'no-SESRO' alternative.

Availability of raw water storage

As we do not have raw water storage (we only have storage to last a few days, located in the treated water distribution system), we can't directly use the river flow elements of the Severn Thames Transfer. This is because flows that are available for transfer in the River Severn are not reliable in the summer, so flows outside the summer period would need to be stored in a reservoir for several months to generate the required DO benefit. We can use the transfer as a conduit for 'support' schemes involving reservoir release or water recycling that are developed by United Utilities or Severn Trent (the Water Resources West region). The WRSE model also indicates that the treated water transfers implemented under the 'Connect 2050' programme are available and can be used as the situation requires, as these are smaller and can be managed by Thames without having to reserve storage in their reservoirs.

The Thames to Affinity Transfer scheme can take water from Wraysbury Reservoir through the tunnel network, via a new bulk supply agreement. When combined with the additional storage provided to Thames Water by SESRO, this allows us to continue to make best use of the 'Chalk Streams First' concept of catching and using water released by upstream abstraction reduction after 2040. The initial stages of Connect 2050 (prior to 2040) use treated water transfers from Thames Water, which inherently incorporate their storage system. Accessing Wraysbury Reservoir will allow us to continue to do this with raw water transfers without placing unacceptable resilience risks on Thames Water.

Customer preferences and Strategic Scheme Selection

The metrics presented in the figure above are 'unweighted' combinations. WRSE also provided us with an analysis of the cost versus best value performance of the programmes once they are weighted according to the WRSE customer research described in **Appendix 3.4**. This did not change the relative performance ranking of the alternatives, which is not surprising given the fact that the alternatives analysis favoured canal transfers followed by reservoir development, which were the preferred options according to the customer research described in **Chapter 3**.

Sensitivity testing of policy implications

9.54. The population growth and climate change elements of the future 'situations' described in the modelling above relate to external factors that are largely outside of government control, and we have incorporated the range of future possibilities in the development of the supply-demand balances for the situation pathways. However, as discussed in **Chapter 4, Chapter 5** and **Chapter 6**, there are key policies that are within government control that also drive the supply-demand balance. These consist of:

- Environmental destination
- Policies around government initiatives on demand management
- Policies that require enhancements in drought resilience.

Variations around the policy requirements relating to the environmental destination are inherently contained in the adaptive planning (for environmental destination). The risks of further governmental policies not being introduced or having limited impact on demand are described within the alternatives assessment above.

The key remaining policy impact therefore relates to the timing of the change in the timing of the move to a 1 in 500-year level of resilience. All water supply systems are designed to deal with a certain level of drought before they must have recourse to drought measures or in some circumstances refer to more extreme drought restrictions such as rationing water. The level of resilience of the system has overall been improving, but more needs to be done and we need to offer a greater level of protection to both the environment, by not using drought permits as frequently, and customers. This means designing the system to be able to cope with more severe droughts in the future than it has seen in the past.

In line with Government expectations and guidance, we therefore intend to increase resilience of the region's water resources to drought so the need for emergency drought restrictions, such as rota cuts or standpipes, reduces. The Water Resource Planning guidance requires companies and therefore the region, to move the design of the regional systems to be able to cope with a 1:500 year drought, without the need for water rationing by no later than 2040, unless it can be shown that more cost-effective solutions can be achieved by delaying achieving this standard until 2045 or 2050. This marks a change in the current design standard for the system and planning for a more severe drought typically reduces the availability of water from existing and future sources to a greater or lesser extent.

As noted in **Chapter 5**, the nature of our resources means that the impact of changes in resilience is limited for Affinity Water, with only 2Ml/d change from the 1 in 200 level to the 1 in 500 level. However, the change does affect the availability of water from Grafham due to the change in Anglian Water's level of resilience. It also results in Thames Water identifying a need for new resources of over 100Ml/d to meet this policy. We therefore generated two further sensitivity tests to determine the impact of moving the change to 1 in

500-year drought resilience. As with other runs, the results output tables are provided in **Appendix 9.1**. The results of this analysis can be summarised as follows:

- Moving the delivery date of 1in 500 drought resilience forward by five years from 2040 to 2035 has little impact on the preferred plan, but it does tend to maximise the use of the GUC 100Ml/d scheme in order to further support the change in resilience at Grafham.
- Pushing back the policy on meeting 1in 500 drought resilience to 2045 or 2050 does not delay the need for key strategic schemes to be constructed; it merely delays their full utilisation, as a number of these schemes are required to deliver environmental protection. Therefore, the trigger for the infrastructure being developed is either or both to protect customers and the environment and moving the resilience standard back to 2045 or 2050 does not negate the environmental need. Cost implications for the Plan were very small.

Ofwat Common Reference Scenarios

9.55. As noted in **Chapter 8**, the Ofwat Common Reference Scenarios provided a focus on the mid-range of likely future situations, which were run as separate branches using a simple 'cost efficient' objective to examine the theoretical plans that would be required to meet each scenario independently. The scenarios were run as single 'high' scenario changes from the most benign condition (low growth, low climate change, low environmental destination) and as combinations of high scenarios. The seven common reference scenario runs are summarised in **Table 9.21** below.

Scenario	Climate Change*	Growth**	Environmental Destination
1 (the Ofwat 'Core' Pathway)	Low	Low	Low
2 (high climate change common reference scenario)	High	Low	Low
3 (high growth common reference scenario)	Low	High	Low
4 (high Env destination common reference scenario)	Low	Low	High
5 Growth/climate combination	High	High	Low
6 Climate/ environmental combination	High	Low	High
7 Growth/ environment combination	Low	High	High

Table 9.21: Common Reference Scenarios

*Note: The full mapping of Ofwat Common Reference Scenarios to WRSE forecasts is provided in **Appendix 8.2**. The Ofwat common reference scenarios are described by:*

- *Climate change: these are median expectations of low and high representative concentration pathways RCPs)*
- *Environmental destination: 'low' is equal to the EA 'Business as Usual' scenario and 'high' is equal*

to the EA ‘enhanced’ scenario (see ***Chapter 5***).
- *Growth: ‘low’ is the ONS21-P scenario and ‘high’ is Housing Plan growth.*
- *Smart metering: (the Ofwat fast/slow technology common reference scenarios) these were run separately as described below.*

9.56. The implications of slow and fast smart meter rollout (smart metering implemented over 10 and 20 years respectively) were run separately as full adaptive plan scenarios.

Core pathway

9.57. The modelled IVM results for the core pathway are shown below.

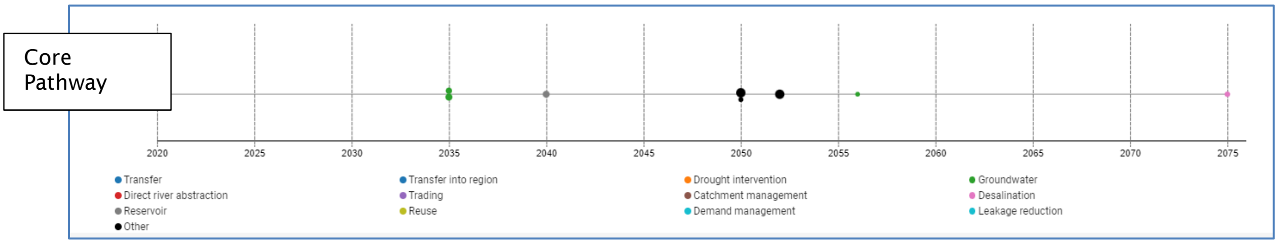


Figure 9.29: IVM core pathway

Under low growth and low environmental destination there is no requirement for the GUC transfer scheme. Instead the investment model selects three smaller schemes to meet demand over the 2030 to 2040 period, which are outlined in Table 9.22

SCHEME	Deployable Output	CAPEX	OPEX (per annum)
Egham LGS	3Ml/d	3,686,340	66,161
Epping ASR	8Ml/d	35,127,428.	291,057
Brent Reservoir	7.5Ml/d	30,204,677	164,721

Table 9.22: Common Reference Scenarios

9.58. Together, these cost £69m for 18.5Ml/d. However, this would represent a very high-risk strategy for customers in the 2030-40 period, even if we do experience low growth climate change and environmental destination needs. This is because ofthe reasons outlined below.

- For the Epping scheme, Aquifer Storage and Recovery (ASR) potential is entirely unproven at this stage and there are no ASR schemes within this part of the Chalk aquifer to draw parallels against. The scheme was also identified as being high risk under the Water Framework Directive assessment (see WFD report), so there are likely to either be significant additional mitigation costs or a risk of non-delivery for the scheme.
- The EA has specifically raised concerns associated with the Brent Reservoir during the dWRMP24 consultation process. The scheme uses the existing Canal and River Trust’s reservoir in Brent and our investigations during AMP7 confirm the EA concerns that there are almost certainly contaminated sediments within the reservoir. The costs for the Brent Reservoir scheme only allow for pipeline and pumping, and the costs of reconditioning the reservoir are likely to be very high, potentially doubling

the stated cost. In addition, the DO is likely to be less than stated for environmental reasons as the reservoir is required to act as flood storage and may need to continue compensation releases to the River Brent. The scheme was also identified as being high risk under the Water Framework Directive assessment (see WFD report), so there are likely to either be significant additional mitigation costs or a risk of non-delivery for the scheme.

- For the Egham scheme, the Lower Greensand aquifer yields are proving lower than expected in recent testing carried out at the Canal and River Trust's (CRT) borehole scheme (selected post 2055 in the programme above), in the order of half of our expectations. There is also no reliable information on water quality in this area and additional treatment beyond the existing Egham treatment works has not been included in the costs.

As we cannot quantify the above risks at this stage, we have not included them in the costs or DO. However, for the schemes listed above, there is a high risk that the costs could be more than double the stated values, whilst the DO could be half the stated values.

These risks mean that the costs and benefits for the four schemes could be as high as £140m and as low as 9-10Ml/d respectively. This would generate an Average Incremental Cost (AIC) of over 200p/m^3 (compared with 110-130p/m3 for GUC and SESRO+T2AT] and would result in a supply-demand imbalance, even under the core scenario. The costs for the GUC scheme already include the necessary mitigation to meet WFD objectives.

We therefore propose that the core scenario should include the 50Ml/d GUC scheme in preference to the three schemes listed above. The risks associated with the GUC are well known and costs contain the appropriate 'optimism bias'[111]. Even with that bias, the AIC is in the order of 115p/m^3.

Adopting this core pathway removes the need for the second stage to the Thames to Affinity Transfer – i.e., only one stage is required, in 2050. WRSE level modelling has shown that a smaller (75Mm^3) reservoir is the only AFW requirement at this level of demand with 50Ml/d GUC in place.

High climate change common reference scenario

9.59. Because of the selection of the 50Ml/d GUC transfer in the core pathway and the limited impact that climate change has on our existing resources, there are no adaptations required for the higher climate change scenario.

High growth common reference scenario

9.60. The results of the high demand scenario are shown in Figure 9.28 below.

[111] See **Chapter 7** for scheme costing methods

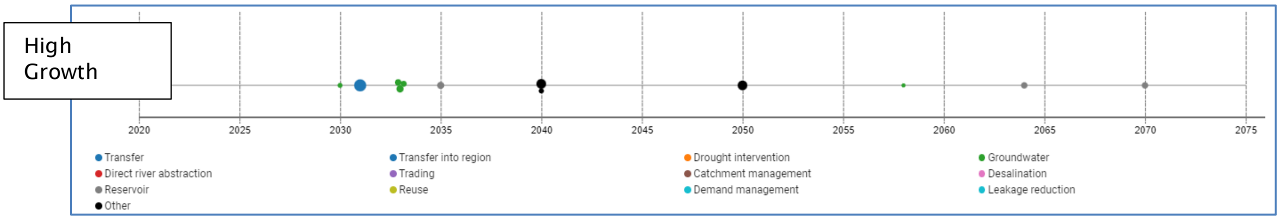


Figure 9.30: IVM results for high demand scenario

Within the cost-efficient modelling the high growth scenario contains the GUC transfer at 50Ml/d. However, it also includes the three high risk smaller schemes described under the core pathway above. Our Best Value assessment therefore concludes that the construction of the full 100Ml/d GUC scheme presents a better approach to managing this scenario, given that the smaller schemes are very uncertain and are likely to have a worse cost/benefit ratio once unquantified risks are considered. The 100Ml/d GUC scheme is £130m more than the 50Ml/d GUC scheme, so in capex terms the difference between that and the smaller schemes is only £61m for a much higher rate of certainty in DO, 31Ml/d of additional supply/demand headroom and a much lower AIC. In practice we could look to 'right size' the GUC scheme as the RAPID Gate 3 evaluations progress (i.e., design and build a scheme somewhere in the order of 70-80Mld), so the differential cost and surplus could reduce.

High environmental destination common reference scenario

9.61. The investment modelling for the high environmental destination scenario is presented below. Because there is little deviation in the Environmental Destination targets until 2040, the main impact is that the first stage of the Thames to Affinity Transfer scheme is brought forward to 2040, replacing the need for the Brent Reservoir re-purposing scheme (when compared to the low growth, low environmental destination core pathway). The T2AT is still bought forward if we swap the three high risk schemes selected by the modelling for the GUC 50 Ml/d scheme, as per the core pathway described above.

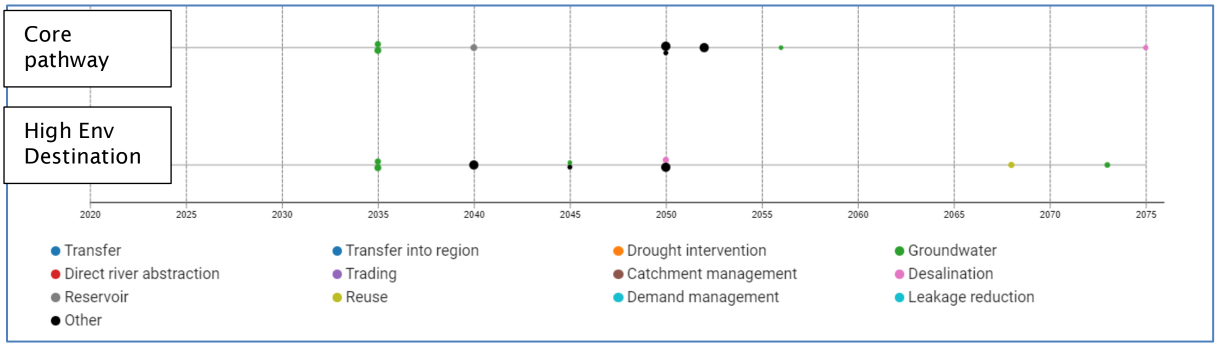


Figure 9.31: IVM results for high environmental destination scenario

In-combination scenarios

9.62. Results for the combined high growth and high environmental destination scenario are shown in **Figure 9.32** below.

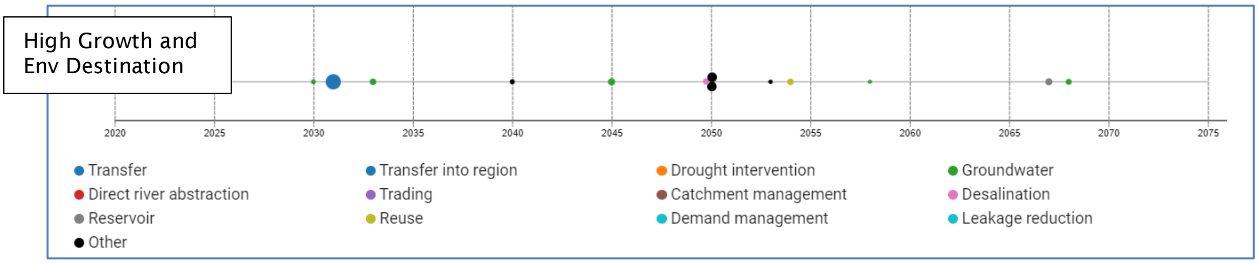


Figure 9.20: IVM results for high growth & environmental destination scenario

Under the in-combination scenario of high growth and high environmental destination the GUC 100Ml/d scheme is required in the cost-efficient modelling in the early 2030s, along with the Egham LGS scheme. Both stages of the Thames to Affinity Transfer scheme are then required in 2050.

The other combinations that include high climate change alongside the growth and environmental common reference scenarios, do not differ materially from the respective common reference scenarios due to the limited impact of climate change on our resources.

Technology - implications of the pace of smart meter delivery

9.63. Accelerating the delivery of smart metering to two AMPs (i.e. with the programme complete by 2035 instead of 2040), does not change the supply side investment programme for Affinity Water, as ultimately the need in the 2030s is dominated by Environmental Destination, housing growth and the need to support Cambridge Water via WRE. It is not enough to defer the timing of need for the GUC, or affect its size given the fact that five out of the eight situations require more than 60Ml/d from the scheme in the 2035 – 40 period (i.e. the difference in profile on the demand side is not enough to reduce this need below 50Ml/d). If the granularity of the GUC options was smaller, then this may reduce the ultimate size of the required scheme, but this cannot be reasonably quantified given the uncertainties that are represented by the range of the future situations.

Similarly, deferring the programme does not affect the selection of supply-side options. Although this accelerates the timing of the maximum points of supply/demand balance need, it does not affect the timing of the strategic scheme selections (which occur at the same time as the relevant tranches of environmental destination impacts). The impacts on the scale of maximum need are relatively small and not enough to change the size of the scheme that is required. Deferring the programme does, however, mean that we are unable to meet the Environmental Improvement Programme interim targets on demand management.

Water quality and resilience factors

9.64. We have evaluated the water quality resilience risks for all the strategic schemes that are covered in our alternatives analysis and confirmed with the Drinking Water Inspectorate that they align with good practice water safety planning.

In addition to the water quality assessments, the WRSE resilience framework has been designed to expand our understanding to other resilience factors (including a lack of resource reliability, complexity of operations and single points of failure). This has allowed us to understand both the inherent resilience of new water resource options and determine whether there are any advantages or disadvantages to a particular plan in relation to the existing operational resilience concerns or 'hotspots' in the current supply system.

As noted above, there was a tendency for the reliability[112] and adaptability metrics to trade-off against the evolvability metrics. The SESRO-based plans tended to result in more reliable and adaptable resources, but the plans themselves were less flexible and, hence, less able to evolve in the face of change. This did not therefore significantly affect the overall findings of the analysis, although it should be noted that water quality resilience risks tend to be lower for the SESRO-based approaches.

9.65. The mapping and evaluation of interaction with existing resilience 'hotspots' (see **Chapter 8**) did, however, identify a significant advantage in the SESRO-based plan in comparison to plans that excluded SESRO. The full regional mapping of resilience 'hotspots' in the existing system is provided in **Figure 9.33** below, with a focus on the issues identified in our Central region.

This figure shows the results of the WRSE 'hotspot' analysis. It identifies the location of known resilience issues within the existing supply systems that may be affected by the WRMP24. The categories shown are according to concerns over system flexibility (A3 – complexity and A5 – connectivity), or reliability (R3 and R5 represent physical and societal shock events such as flooding, etc and R5 reflects water quality risks).

[112] Reliability refers to the ability of the system to maintain intended operation during stress events. Adaptability refers to the ability to change operation but maintain function, and evolvability refers to the ability of development plans to change as longer-term risks change

Figure 9.33: Resilience hotspots

9.66. All the alternative plans address a number of these key resilience risks as a result of the downstream 'Connect 2050' infrastructure proposals, which have been developed to address sub-WRZ supply-demand balance needs in a way that is supportive of our PR24 business plan long-term network proposals. However, our largest resilience risk, which relates to water quality and outage risks at one of our strategic surface water sources, is only addressed by the SESRO Thames to Affinity Transfer scheme. This effectively occurs because we do not have raw water storage at our largest surface treatment works, so there is a risk that we will have to shut the works down if there is an extended period of pollution or other water quality problems in the River Thames. Although schemes such as the GUC incorporate bankside storage as part of their design, this is only sufficient to service the scheme itself. The presence of SESRO means Thames Water can allow us to access the storage at their existing Wraysbury Reservoir, which is much larger than the bankside storage needed for the Thames to Affinity Transfer scheme (which treats the water from the reservoir). This therefore provides us with a large amount of reliable emergency storage for our existing strategic works, which addresses the resilience concern, and represents a notable benefit to those plan alternatives that contain SESRO.

Regional reconciliation

9.67. Regional reconciliation is a process that is run between the regional water resources groups to compare their plans and ensure that the assumptions over availability of water and need are consistent across regions. This process has been requested and facilitated by the EA National Framework. Following the draft WRMP consultation process, Water Resources West (WRW) has provided clarification on the costs and availability of the STT support schemes, which was included in the investment modelling described in this Chapter.

9.68. The regional reconciliation also confirmed that the WRE regional modelling concluded that the WRE region requires all the South Lincolnshire Reservoir (SLR) water. This means that if we were to use the Anglian to Affinity Transfer (A2AT) scheme, the marginal effect would be for WRE to construct more coastal desalination. Originally, it had been assumed that the South Lincolnshire Reservoir would have spare capacity to allow for support of the scheme. The option to supply Affinity Water from the SLR was run through WRE's stated decision making process, which concluded that the costs and dis-benefits to WRE of providing the water, would be worse than the costs and dis-benefits associated with the alternative schemes that are available to Affinity Water within WRSE.

Even though WRE have concluded that using the transfer does not represent a Best Value solution, the Anglian to Affinity Transfer was still included in the WRSE modelling, but with the more favourable assumption that it could be supported at the cost and environmental impacts associated with the South Lincolnshire Reservoir. Even with this more favourable set of assumptions, the scheme was not selected in any of the cost-efficient or best value runs by WRSE, confirming WRE's position.

As noted in **Chapter 5**, the regional reconciliation process did confirm that a 'reverse transfer', whereby Affinity Water develops additional resources within WRSE and stops taking as much water from the existing Grafham Reservoir connection, could help WRE meet some of its statutory environmental targets in the medium term (2030-2040). This position was supported by the EA. This 'reverse trade', at 27Ml/d, has therefore been incorporated into the modelling described above, and is part of the rationale for potentially developing the larger (100Ml/d) GUC scheme.

Final best value assessment and deciding between candidate alternative plans

9.69. We have drawn the following conclusions from the alternatives assessment, common reference scenarios and water quality/resilience analysis in relation to the potential medium to long term strategies that are available to us. These are as follows.

- For the 2030 to 2040 period, the only viable alternative is to construct the Grand Union Canal Transfer. Even under the most benign scenario that we tested (the Ofwat 'core' scenario), the only alternative to this would be to rely on construction of all the three high risk smaller options that we have available to us, which would not represent good value to customers for the reasons described under the Ofwat scenarios above (environmental compliance, plus cost and benefit risks).
- If any of the following scenarios occur, then there is a need for additional

supply beyond the GUC 50Ml/d scheme, and the modelling has identified that the Best Value solution is for the 100Ml/d GUC scheme to be constructed in the early 2030s:
  - Housing Plan growth
  - Demand management not working sufficiently well to meet interim EIP targets
  - Thames Water being unable to deliver their Teddington DRA scheme.
- In addition, the regional modelling concluded that the 100Ml/d GUC scheme was the best solution for Affinity Water, if SESRO is limited to a smaller size (75 to 125Mm^3) or SESRO cannot be delivered.
- In the longer term (2040 plus), the alternatives analysis shows that SESRO with the T2AT scheme is the most cost effective and Best Value solution. The Best Value size of SESRO is not fully clear from the alternatives analysis, so it forms the main focus of the Best Value analysis in the next section.

The utilisation analysis shown above does, however, indicate it is unlikely that Affinity Water would require more than 50Ml/d DO from the SESRO scheme. Although the 100Ml/d T2AT transfer is selected in a number of scenarios, the capacity beyond 50Ml/d is only required under Housing Plan growth with high Environmental Destination, or medium Environmental Destination, if government-led initiatives beyond water labelling, are not implemented or do not work as hoped. Outside of these scenarios, the model is selecting the second stage of the T2AT as a cost saving measure, on the assumption that capacity that is made available in SESRO, would be freely transferred to Affinity Water. Whilst this is theoretically economically optimal, commercially it is not a realistic position. This is because, from an Affinity Water perspective, the development of the second stage of the Thames to Affinity Transfer would require us to pay a capacity charge for SESRO equal to 13.5% of the capital cost of that scheme (this charge is not accounted for by the model). Therefore, whilst the model correctly identifies that there is spare capacity available and that it is cheaper to construct a transfer to use this rather than continue running the more operationally expensive GUC scheme, in reality, doing this would result in a higher cost to our customers.

Based on the considerations outlined above, we therefore included the 100Ml/d GUC option as a default in all of the Best Value optimisation modelling runs that were carried out.

9.70. From this assessment of alternatives, we concluded that the Best Value Plan should contain the maximum capacity GUC scheme in the 2030s, and we used the WRSE IVM automated optimisation process to generate final candidate plans that maximise the Best Value metrics for the 150Mm^3, 125Mm^3 and100Mm^3 SESRO-based strategies. Due to the objections raised against SESRO in the dWRMP consultation, we also included a Best Value optimisation of the strategy excluding SESRO. Although the alternatives analysis indicated this was unlikely to be a Best Value solution, it was considered important to ensure we could compare and understand why the programmes that included SESRO might generate better Best Value metric scores than this alternative. The 75Mm^3 strategy was not included in this final best value analysis, because the cost-efficient sensitivity tests showed that it effectively produced a similar plan, but slightly worse (in terms of Best Value metrics), than the 100Mm^3 SESRO based plan. As shown, the 75Mm^3 reservoir option has a notably worse cost effectiveness (Average Incremental Cost - AIC) in comparison to the larger options, which brings it close to the mid-point of the range of cost effectiveness for the STT.

As with the cost-efficient alternatives analysis, we considered that it was important to understand how each plan performs if the risks associated with the demand management strategy, as described under the strategy within this chapter, materialise. Based on the alternatives analysis the 'Government Led Scenario H' provide the best representation of this, as they result in demand that is 64Ml/d higher than our planned programme by 2050. Each of the four candidate Best Value programmes were therefore also tested under this scenario, however because most of the better value options were already required under this scenario, it was found that no significant increases beyond the cost-efficient runs could be achieved.

The results of the modelling of total programme NPC versus the maximum Best Value metric score achieved, as well as a comparison of environmental and resilience performance, are presented in **Figures 9.34 and 9.35**. The government H runs are a simple replication of the cost-efficient runs already presented.

9.71. The four strategic alternatives are presented in **Table 9.23**, along with our preference and reason carrying out further best value optimisation on two of the alternative options. The overall cost/metric assessment and performance against environmental and resilience metrics, are provided in **Figure 9.34** and **Figure 9.35**. These figures also show runs that attempted to optimise purely on the environmental or resilience metrics.

Along with the BVP runs, the model carried out an investment analysis aimed at optimising the environmental and societal metrics only. This is also included in **Figure 9.35**. This 'free selection' version of the BESP, chose the plan that included the SESRO75Mm^3 scheme, but, as shown, the difference between this and the SESRO100 BVP run was marginal, at significant cost to resilience. More detailed analysis showed that the BESP scored worse than the plans that included the larger SESRO options in terms of SEA disbenefit, but overall generated a positive score, due to the availability of land on the site to reduce the level of biodiversity net gain required by the rest of the programme. Therefore, whilst this programme was carried forward to the SEA Environmental Report as an alternative plan, both the investment analysis and the SEA concluded that this was a less preferable Plan to the candidate strategies identified above.

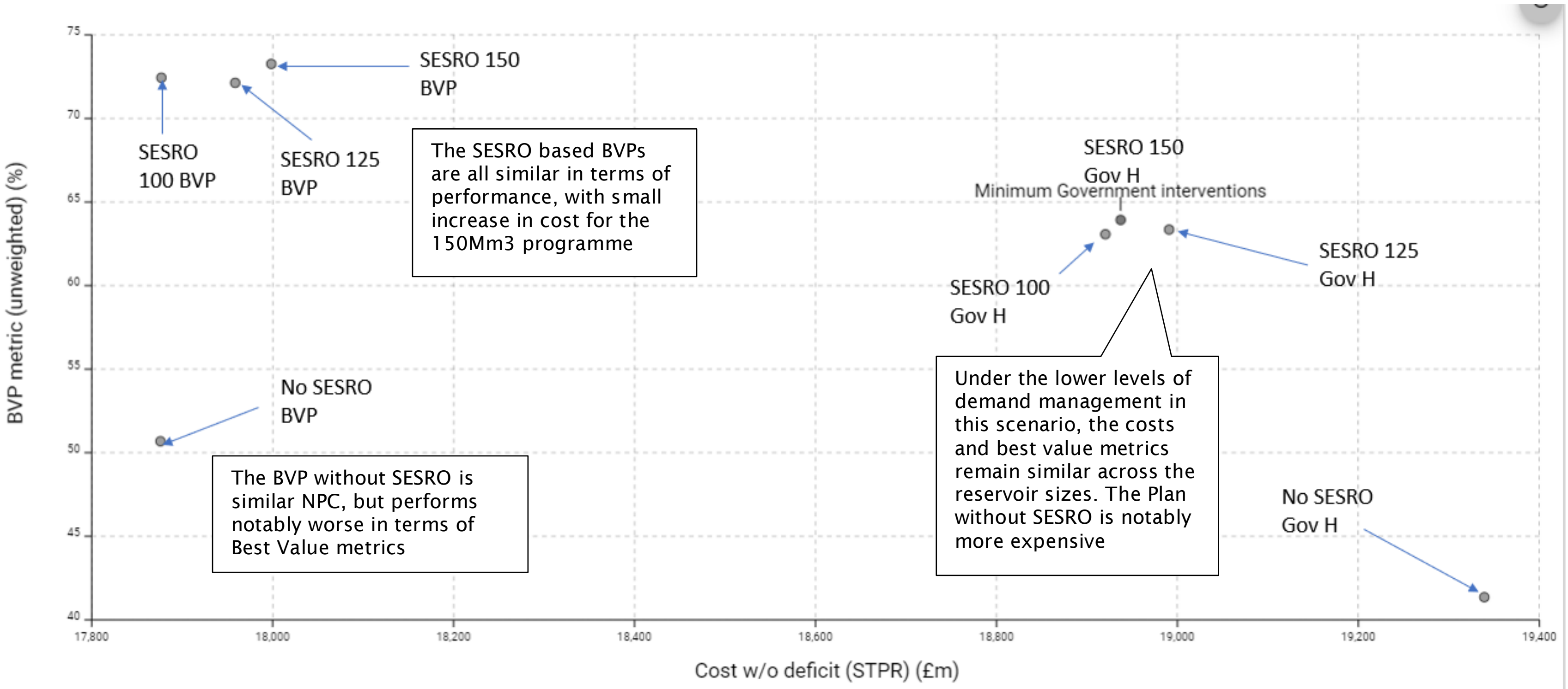
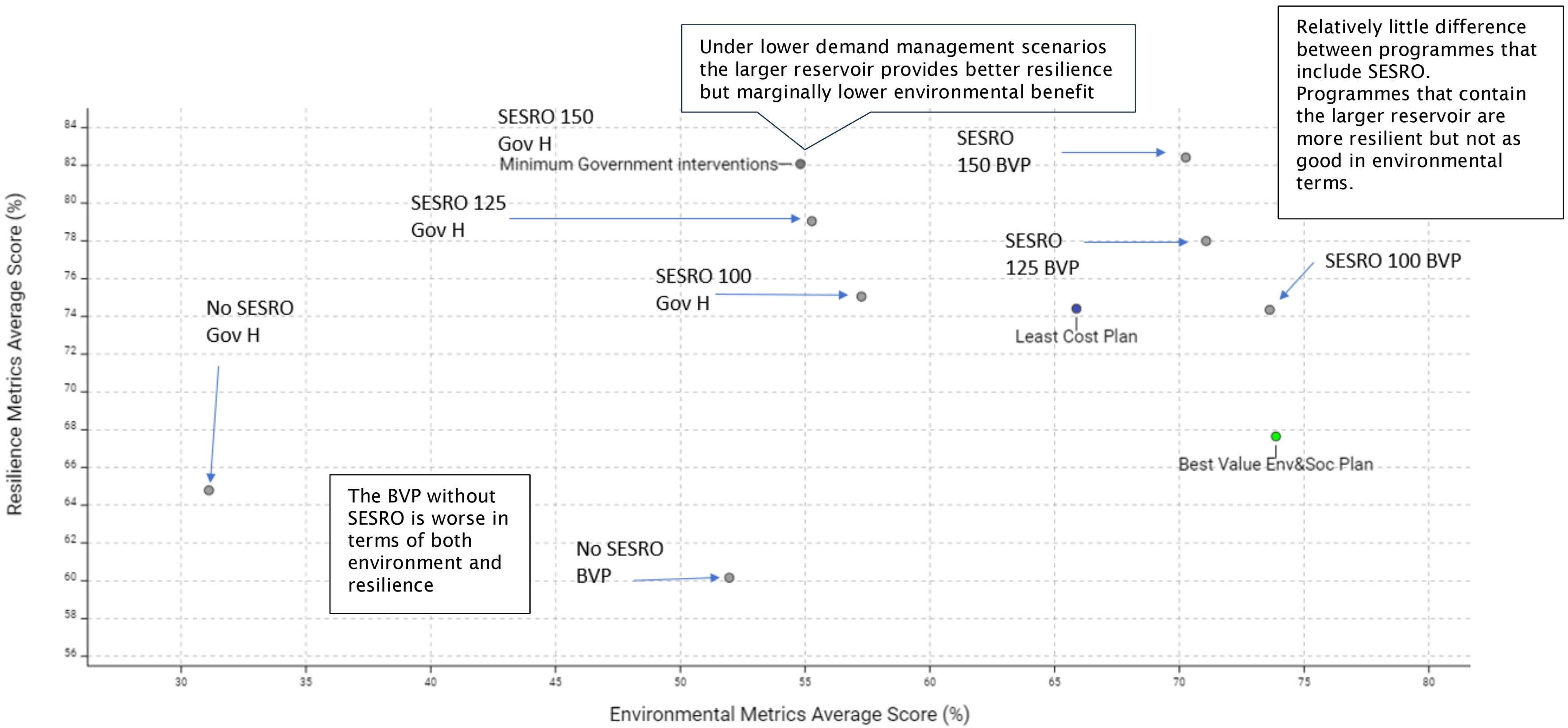


Figure 9.34: Summary of cost and best value metric performance for the four best value candidate model runs

As previously, this chart provides the WRSE regional level costs and metric performance. This incorporates the results from all situations – i.e., it is effectively an average performance across all futures, from low growth, low climate change and low environmental destinations through to the high end of each of those future situations. Plans are more preferable as they plot to the top left of the chart.



This chart shows how the overall Best Value performance for each Plan relates to environment and resilience separately. In this case higher is better in both cases, so investment programmes that plot towards the top right of the chart are best.

Figure 9.35: Comparison of environmental and resilience metric performance for the best value candidate model runs

	Alternative 1 (SESRO 150)	Alternative 2 (SESRO 125)	Alternative 3 (SESRO 100)	Alternative 4 (no SESRO)
Summary of plan - initial stage to 2040	All four alternatives start with new transfers that make use of existing water (from WRZ 6 to 4, and from Thames Water), followed by the promotion of the GUC scheme as soon as possible in the 2030s. None of the sensitivity tests or best value assessments contradicted this approach. For alternatives 2 to 4 the cost-efficient sensitivity testing described above shows that the IVM freely selects the larger (100Mld) GUC transfer scheme.			
Plan beyond 2040	Jointly (with Thames and Southern) deliver the largest SESRO scheme (150Mm³). Construct 50Ml/d or 100Ml/d Thames to Affinity transfer capability in support. Retain the capability to expand GUC to 100Ml/d if required	Jointly deliver the mid-range SESRO scheme (125Mm³) with 50Ml/d transfer to Affinity Water. The remainder of adaptations for Affinity Water are very similar to Alternative 1, but with marginally more reliance on the GUC, particularly if there is a shortfall in demand management	Jointly deliver the smaller SESRO scheme (100Mm³), still with 50Ml/d transfer to Affinity Water. The remainder of adaptations are very similar to Alternative 1, but with more reliance on the GUC, particularly if there is a shortfall in demand management	Rely on the GUC for most of our supply needs, with support from the treated water transfers from Thames Water. Construct 50Ml/d T2AT if we are facing high environmental destination or if demand management is not as successful as planned. This is supported by the Severn Trent Minworth support via the Severn Thames transfer.
Cost and Best Value Performance	This plan has the highest cost if government led demand management interventions deliver at the upper end of expectations, but the second lowest cost if demand management risks materialise (for example, if government led demand management interventions do not deliver). This is because the reservoir tends to provide yields that are higher than utilisation need across many of the adaptive pathways but is the most cost effective when the need	As expected, this cost and Best Value metric performance represents a midpoint between the 150Mm³ and 100Mm³ SESRO based plans. The Programme becomes more expensive and worse value than the other reservoir sizes if the risks that we have identified to the demand management programme materialise.	The plan based on a SESRO 100Mm3 scheme is less expensive and provides mid-range metric performance if demand management performs as required. but provides almost the same overall programme cost and metric performance as the SESRO 150Mm³ based programme.	This Plan is a similar cost to the SESRO based plan if government demand management delivers at the upper end of expectations but continues to perform significantly worse than the SESRO options in terms of Best Value. Both the cost and the Best Value metrics are significantly worse if identified demand management risks materialise.

	increases. It performs best in terms of resilience irrespective of the scenario but follows the same pattern as cost for environmental metrics.			
Reasons for Relative Best Value Metric Performance	Overall, there is a trend for the smaller (100Mm3) scheme-based plans to perform better on environmental metrics and the larger (150Mm3) scheme-based plans to perform better in terms of resilience. On further review it is apparent that the only reason for the better environmental performance of the programme that includes the smaller scheme relates to the opportunities for biodiversity net gain provided by the smaller footprint of the reservoir itself on the land (i.e., there is more land available within the direct scheme footprint for developing environmental enhancement when a smaller reservoir is built). The actual SEA dis-benefit scores for the programmes that contain the smaller reservoir are worse as a result of the need for additional capacity in the re-use and desalination programmes required across the region, particularly under the higher environmental destination futures.			As with the cost-efficient plans the relatively poor Best Value performance occurs across both environmental and resilience objectives and is worse than the 'with SESRO' programmes across most metrics. The only exception relates to the 'evolvability' element of the resilience assessment, reflecting the more modular possibilities for the approach. This relatively poor performance reflects the impact of the transfer itself, the need to develop complex water resource schemes to support the transfer (Minworth and Lake Vyrnwy) and additional desalination and re-use schemes to support Southern, Portsmouth and Thames as a result of the SESRO DO not being available.
Additional risks and consequences	The biggest risk from this plan is one of under-utilisation. However, due to the low operational costs of the scheme this tends to result in low utilisation of other schemes that have been developed prior to scheme implementation – e.g., as shown in the utilisation plots Affinity only needs more than 100Ml/d in total from strategic schemes if	The 125Mm3 does not attract the same risk of STT development as the 100Mm^3 reservoir-based plan, so the additional risks and consequences are similar to those described for the 150Mm^3 based programme (i.e. under-utilisation, although the consequences are lower in this case).	The risks from this plan occur if demand management overall fails to deliver against all assumed targets. Although Best Value metric performance is reasonable and the cost differences appear to be small, under the reported pathway (Pathway 4), the smaller SESRO scheme brings the Severn Thames Transfer into the 2040-50 period for Thames Water This means that they may need to construct both schemes in parallel, resulting in larger costs	Under this plan the investment model selects the Minworth support via the Seven to Thames Transfer for Affinity Water. There is a risk that this scheme may not be compatible with the GUC, as both divert water away from the River Tame and affect hands off Flows in the downstream River Trent. This has the potential to result in significant additional cost for Affinity Water, either in the form of large bankside storage requirements at Minworth, or by having to replace the Minworth scheme with the Lake Vyrnwy option or having to replace the STT water entirely with Beckton re-use/desalination.

	either the 'high' environmental destination scenario occurs, or some of the risks around demand management materialise. Having more than 50Ml/d available from SESRO via the T2AT is therefore unlikely to be required and will tend to leave us with surplus capacity in GUC if it is implemented.		and risks than shown in the modelling.	
Other factors	The storage provided by SESRO is regionally beneficial because it helps support WRZs that currently have no meaningful raw water storage. For Affinity Water in particular, it allows us to share the storage in Thames Water's Wraysbury reservoir, which addresses our biggest resilience concern.			This approach would cause additional reliance on the river Thames abstractions without associated bankside storage, so would increase our resilience risk.

Table 9.23: Best value comparison of strategic alternatives

Conclusions and preferred adaptive plan for our Central region

9.72. As a result of the need to support WRE during the 2030-2040 period, identification of risks associated with our smaller short-term options and following clarification of the costs associated with the GUC scheme in the RAPID Gate 2 reports, our preferred adaptive plan prior to 2040 contains the following elements:

- An initial strategy (up to 2032) based on maximising the transfer of existing resources (although it should be noted that supporting transfer scheme developments continue throughout the plan)
- The construction of the larger GUC scheme in 2032 (up to 100Ml/d from 2033, although further refinement of the exact size will be carried out during the RAPID Gate 3 process and is due to be finalised by the end of 2025).

9.73. Based on the alternatives analysis and best value testing, for the next stage of development (2040 onwards) we do not consider that a plan that excludes the development of the SESRO site or seeks to construct the Severn Thames Transfer main prior to construction of SESRO, represents a suitable preferred strategy. This is for the following four reasons.

1. **Cost:** The STT is notably less cost-effective once constructed than any of the SESRO options within the $100Mm^3$ to $150\ Mm^3$ range. On an NPV basis, the only potential advantage of the STT-led approach is that it is more modular, which allows cost elements to be deferred. However, the WRSE modelling has shown that even this advantage, only results in the STT based programme being as cost effective as a SESRO based programme, and this is only true, if none of the significant demand management risks that we have identified, materialise in the future.
2. **Investment risk:** The variation of costs across the different futures is larger for the 'no SESRO' strategies. There is more difference between the high growth, high environmental destination and low growth, low environmental destination scenarios, which indicates that the strategies that do not include SESRO, do not provide a balanced approach to investment across the range of future situations.
3. **Best Value Performance:** The strategy that excludes SESRO, performs worse across all environmental metrics and most of the resilience metrics. The only metric where it performs better, is on 'evolvability' which relates to the modular nature of the STT elements, as described in the alternatives assessment above. All the best value metrics including carbon, SEA, natural capital and biodiversity net gain, are worse at plan level without SESRO – therefore it is not meeting the guidance on best value planning.
4. **Storage:** The 'no SESRO' strategy means that we do not gain access to significant raw water storage. We know that this means we will continue to be vulnerable to pollution events in the River Thames and will continue to rely heavily on the untested benefits of TUBs and NEUBs in managing our more significant droughts.

9.74. In terms of the sizing of the SESRO scheme, there is little difference at a regional plan level between the strategies that incorporate SESRO in the range of 100 to150Mm^3 storage both in terms of NPV cost or best value performance. From an Affinity Water perspective, we have determined that we are likely to only require 50Ml/d worth of transfer from the scheme via the T2AT, so there is no appreciable difference for our WRMP. However, WRSE, in consultation with Thames and Southern Water, have determined that the development of the largest 150Mm^3 reservoir is the preferred option at a regional level, for the following reasons.

- At a regional level the strategies that include SESRO are demonstrably better value than those that do not, as described above. The regional plan is therefore clear on the need for the scheme.
- Whilst there is little difference between the regional plans and adaptations that include different sizes of SESRO, if all demand management measures are delivered, there are significant differences if government-led demand saving measures do not achieve reductions beyond those included in the water labelling initiatives that have been announced. Under those circumstances, the large (150Mm^3) SESRO avoids expensive adaptations that would otherwise be required under the reported pathway (situation 4), which includes high environmental destination requirements. It also avoids Thames and Southern Water having to develop the Severn to Thames Transfer at the same time as SESRO (it can be developed after SESRO, if more adverse future situations are realised), so represents a more adaptive approach to managing the risk of non-delivery of government-led demand saving measures.
- As described above, the better environmental performance associated with the smaller reservoir is entirely due to higher biodiversity net gain, with poorer SEA performance, the smaller (100Mm^3) based programme, does not actually represent a better environmental plan.
- Overall, the resilience benefits of the 150Mm^3 based programme, its ability to defer construction of the STT until the full extent of the regional need for the STT scheme is understood and the lack of significant difference in environmental performance, are the deciding factors for the final Best Value assessment within the regional plan.

9.75. Details of the rationale for Thames and Southern Water selecting the larger reservoir as the preferred option can be found in their respective WRMPs.

The Thames to Affinity Transfer scheme is the best option for moving water from SESRO into our supply area and will allow us to continue to implement the ‘Chalk Streams First’ concept post 2040, as it relies on taking water from storage out of Wraysbury reservoir. Although it is unlikely that we would require more than 50Ml/d from the T2AT scheme if we are able to successfully implement the GUC transfer at 100Ml/d, we would require additional transfer if we had to deliver against the high environmental destination scenario under housing plan growth. This reflects situation 4 of the WRSE modelling, which is the pathway that we have been advised to report on by our regulators. Utilisation analysis indicates that our need under this adverse situation would be limited to 30Ml/d from the second stage of the transfer (i.e. 80Ml/d or less overall from the T2AT).

There is a risk that we could also need this second 50Ml/d of transfer if the 2050 targets around demand management cannot be fully delivered (particularly if government-led initiatives are not implemented or are successful) under medium environmental destination scenarios with housing plan growth. In that case, the WRSE assessment has shown that additional water could be obtained (from SESRO), albeit at a higher cost for this 50Ml/d than we otherwise would require, if we reserved a higher transfer capacity from SESRO. We therefore consider that this risk is manageable but forms the key adaptation in our adaptive plan.

Our preferred solution

We consider a strategic plan including strategic supply options based on the initial development of the 100Ml/d GUC transfer, is preferable. This, followed by the development of 50Ml/d Thames to Affinity Transfer scheme is our preferred solution, with the potential to extend to an additional 50Ml/d transfer capacity, if we face one of the two most adverse future situations included in our adaptive plan modelling. Combined with our demand management strategies, it is capable of meeting all statutory and policy requirements, can adapt to meet the full range of potential environmental destinations that have been agreed with the EA, and meet customer expectations. It does this through the following ways.

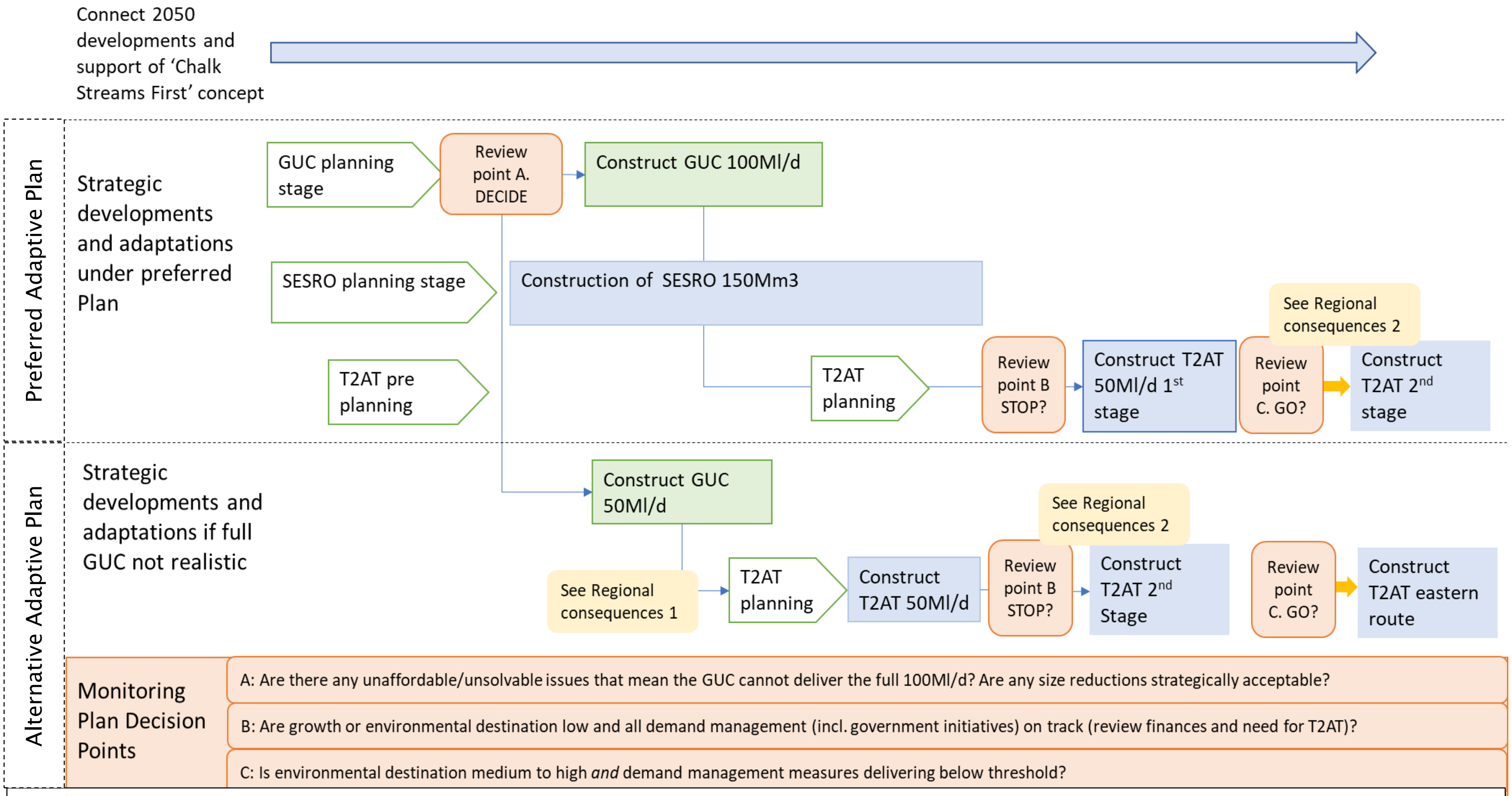
- Incorporating desired ambitions on demand management and leakage, but not over-relying on them to the extent that it threatens affordability and the supply/demand balance if that ambition cannot be achieved.
- Containing adaptive investments that are close to the 'cost-efficient' plan in terms of average expected cost, whilst ensuring that there is no excessive cost risk, if futures turn out better or worse than our central forecasts.
- Proposing supply-side investments that start off with schemes that make use of existing resources and networks (the WRZ6 to WRZ4 transfers and licence relocations) in line with the 'Chalk Streams First' concept and then further utilise existing infrastructure in the form of the GUC transfer. The later strategic scheme then consists of a reservoir, which is marginally preferred by customers to new inter-regional transfers.

The high levels of demand management ambition and acceleration of environmental destination in comparison to our draft WRMP, are aligned with customer preferences and stakeholder feedback. At the same time, we have shown that the risks around future uncertainties and non-delivery can be managed by the proposed investments. The strategic options that we have selected (GUC followed by a SESRO-supported T2AT) are cost efficient, Best Value and aligned with stated customer preferences.

9.76. This strategy seeks to maximise the utilisation of the GUC transfer, keeping it at an average of 43% between 2032 and 2050 across all the adaptive branches. This increases to 60% in the scenario where government-led demand management initiatives do not progress beyond water labelling. There may be an opportunity for further 'right-sizing' of the scheme prior to final design and procurement in 2025, which we have incorporated alongside the potential that the maximum size is limited by environmental or planning constraints, as part of our adaptive pan (**Figure 9.36**).

Under this preferred plan, we can adapt to the full range of future risks by maximising the opportunities afforded by the GUC transfer and developing the second stage of the Thames to Affinity Transfer as required. If we or the region are unable to deliver on our ambitious demand management aspirations and the higher levels of abstraction reduction are required, we can work with Thames Water to develop the eastern Thames to Affinity Transfer route and take water from the Teddington reuse or Beckton desalination schemes.

Figure 9.36: Summary of our best value adaptive plan for Affinity Water



Regional consequences of Adaptations

1) If we cannot deliver the larger GUC scheme then it may not be possible to provide WRE with all the water that they requested (27Ml/d) if growth is higher than ONS or demand management targets cannot be met. We would investigate Brent Reservoir or Epping ASR if this is the case.

2) This Plan means that we are only planning to reserve 50Ml/d worth of Deployable Output capability from SESRO. If we require more then we will have to engage with regional partners about the changes in the solution. The WRSE modelling has confirmed there is flexibility and time to address this as required, although this may involve more expensive schemes unless Southern or Thames are able to release capacity through their actions

There are three key interactions with other water companies on the timing and benefit of options that are covered by our preferred plan that require explanation in relation to the WRMP Tables. These can be summarised as follows:

- For the GUC transfer, the scheme will require a years' worth of commissioning and operational testing due to the complex nature of its operation and interaction with both the Minworth source scheme and the navigation on the canal. That means the benefits provided in the WRMP Tables are for the delivery of the first 50Ml/d Deployable Output in summer 2032 (i.e. 3032/33 in the table), which would be the maximum we would run the scheme to, during this year of commissioning and testing. This then rises to the full 100Ml/d DO by summer 2033 (i.e. 2033/34). This profile is reflected in the Severn Trent tables for Minworth.
- The reverse trade back to Anglian via Grafham Water that allows them to supply Cambridge Water, is contained in 2032/33. In order to facilitate this reverse trade, we require that the first 50Ml/d of the GUC scheme is delivered, but the tables show that the full 100Ml/d is not required in that year to support the trade.
- For the Thames to Affinity Transfer scheme, there is a conjunctive use benefit created, when we utilise the scheme in conjunction with Thames Water. This is simply because we only need to utilise the storage during the summer months, so our volumetric draw on the reservoir required to meet the 50Ml/d of demand, is half of the volume that Thames need to satisfy 50Ml/d of their own demand (effectively we have existing spare water outside of summer, but Thames Water do not). Therefore, although our Tables show that we gain a 50Ml/d benefit from the scheme in 2045, this only appears as a 25Ml/d transfer from Thames Water. This is because we still have (271+25-50) 246Ml/d of DO available to them, once they have satisfied our requirements for meeting 50Ml/d of annual average demand.

Supply strategy for our Southeast region (Dour community - WRZ7)

9.77. The WRSE modelling confirmed that demand management is sufficient to maintain the supply-demand balance in this WRZ, unless we require 'high' environmental destination. As there are no indigenous resource developments available to us within the WRZ, the strategy under the 'high' environmental destination situations comprises a range of continuations of existing transfers from both Southern and South East Water, and additional increases in imports. A summary of the key increases in existing bulk imports is summarised in **Table 9.24.**

It is important to note that additional requirements from neighbouring companies are only in the 'high' environmental destination forecast.

ID/reference	Providing company	Receiving company	Maximum capacity at average (Ml/d)	Maximum capacity at peak (Ml/d)
Aldington to Salt 6 Res	South East Water	Affinity Water WRZ7	6	6
Barham Imp 4 Resource	South East Water	Affinity Water WRZ7	4	4
Deal resource	Southern Water	Affinity Water WRZ7	4	4

Table 9.24: Key increases in bulk transfers

9.78. Following consultation feedback on the dWRMP24 relating to concerns over the Hythe Beach Wells and Hythe Water recycling scheme, we reviewed the location and scale of the 'high' environmental destination scenario with the EA, as described in **Chapter 5**. This allowed us to defer the theoretical need for either of these schemes until at least 2050, even under that scenario. Although the EA requested that we report on Situation 4 as our Reported Pathway (which incorporates the 'high' environmental destination), in practice the fact that we have already concluded WINEP investigations and actions in this WRZ, and some of the proposed abstraction reductions may not actually affect the EFIs in the relevant water bodies, means that we consider it unlikely we will need to deliver against the 'high' environmental destination. The abstraction reductions required under the 'BAU+' National Framework scenario are also proportionally much lower in comparison to the 'high' scenario in this WRZ than they are in the Central Region. Our preferred strategy does not therefore include either scheme, rather we commit to exploring sub-regional alternatives with Southern Water and South East Water and finding an environmentally acceptable option if we need to deliver against the 'high' environmental destination. The deferral of need until 2050 provides sufficient time for us to adopt such a plan if the 'high' environmental destination is required.

Supply strategy and refinement for our East region (Brett community-WRZ8)

9.79. As a result of the more ambitious governmental target on demand management, the WRE RDM investment modelling and associated EBSD scheduling show that no schemes are required in the statutory plan period (2025-2050), even under the 'high' (enhanced) environmental destination scenario. If government-led demand management initiatives are not successful, then additional schemes are only required if 'high' environmental destination is required under that scenario, so the risk that supply side development will be required for this WRZ is very small[113].

[113] As with other WRZs our decision making considers needs that either result from high environmental destination under the full demand management scenario or impacts that affect the Plan under multiple scenarios without government led benefits. When considered in isolation, the risk from high environmental destination in combination with the failure of government led demand management is too specific to be used to formulate our preferred Plan.

Our sub-regional modelling of the conjunctive Affinity/Anglian/Essex and Suffolk systems concluded that the existing supplies are robust to the WINEP and licence capping required in the WRZ during AMP7 and AMP8. We will need to refine operational rules and governance of the Ardleigh reservoir to ensure this is robustly implemented once we revert to the 50/50 sharing arrangement on Ardleigh with Anglian Water, but there is no notable investment required for this solution.

9.80. Following the draft WRMP, Anglian Water has identified that it needs to develop the Colchester effluent reuse scheme as soon as it can, to cover groundwater abstraction reductions. This is a flexible and adaptable scheme, which uses recycled wastewater to help fill Ardleigh Reservoir and utilises the existing treatment capacity. It may therefore be shared between Affinity Water and Anglian Water as required in the future, if the need arises due to unexpected supply/demand balances stresses that occur beyond the range of the adaptive planning analysis.

Sharing water

9.81. We propose to revert back to a 50/50 sharing agreement with Anglian Water for Ardleigh reservoir, post 2025. The yield is calculated on a joint operation basis and will reduce slightly once we move to a 1 in 500-year level of resilience in 2040. Quantification of the transfer is provided in **Table 9.25**.

ID/reference	Providing company	Receiving company	ADO yield prior to 2040 (Ml/d)	ADO yield post 2040 (Ml/d)
Ardleigh Reservoir	Affinity / Anglian Water	Affinity Water WRZ8	10.3	8.7

Table 9.25: Links with Anglian Water

Nature based solutions in our best value plan

9.82. Additional to the inclusion of sustainability reductions in our WRMP, we have included catchment and nature-based solutions which complement the proposed reductions in abstraction and will provide additional environmental resilience in our Chalk catchments. These types of solutions contribute towards natural capital and biodiversity net gain. The following list of nature-based solutions is included within the WRMP24, in alignment with the schemes put forward for the draft business plan. These are therefore subject to the Ofwat determination for PR24 and the WRMP24 will need to align with the outcome of the cost benefit assessments, which are part of the Ofwat determination.

Options/schemes included in WRMP24	Schemes included in PR24 (WINEP)
Upper River Colne holistic catchment management	Colne Operational Catchment – Catchment and Nature-based solutions scheme (08AF100011)
Upper River Lea holistic catchment management	Upper Lee Operational Catchment - Catchment and Nature-based solutions scheme (08AF100010)
Lower River Thames DrWPA	Lower Thames and Wey DrWPA - Catchment and Nature-based solutions scheme (08AF100016)
East Kent Chalk holistic catchment management	Dour, Little Stour and East Kent Chalk - Catchment and Nature-based solutions scheme (08AF100013)
	Ivel and Cam Rhee Granta Operational Catchments - Catchment and Nature-based solutions scheme (08AF100014)
	Karstic Groundwater Sources (North Mymms and Clay Lane groups) - Catchment and Nature-based solutions scheme (08AF100015)
	River Beane Catchment Flagship Chalk Stream Catchment Restoration scheme (08AF100012)

Table 9.26. Summary list of schemes included in PR24 alongside the same schemes (where they exist) in the WRMP24

9.83. The intention is that these are ongoing activities, so will start in 2025-30 with the implementation of the references PR24 schemes. The catchment management activities will then continue with additional, specified schemes after the 2025-30 period, as long as there are demonstrable benefits that pass the relevant regulatory requirements in future 5-yearly review cycles. Where these catchment schemes are shown to have associated flow benefits, then these will be used to either enhance the Environmental Destination targets or replace the abstraction reduction need as appropriate, according to the best environmental outcome.

Strategic Environmental Assessment

9.84. As explained in **Chapter 7**, all the feasible options were assessed through the SEA process. The findings of this were translated into metrics and these were used in the best value analysis to generate the overall SEA benefit and SEA disbenefit metric scores for each reasonable alternative plan.

A cumulative effects assessment was carried out for each reasonable alternative plan, including the 'preferred plan', to determine the likelihood of schemes interacting with each other and/or with other plans, programmes and projects to have significant effects on the environment.

The SEA found that while there is the potential for negative cumulative effects as a result of the 'preferred plan' (schemes interacting with each other and other plans, programmes and projects), these are not likely to be significant once mitigation is taken into account and further project level assessments are carried out. It also found that there is the potential for significant positive cumulative effects on the resilience of water supplies and natural systems to meet changing demand, protect against climate change, flood risk and drought, as well as reduce the presence of contaminants.

Delivering carbon net zero and Biodiversity Net Gain

9.85. The total carbon impacts and requirement for Biodiversity Net Gain (BNG) from the supply side schemes contained in the preferred plan are provided in **Table 9.27** (based on the Situation 4 reported pathway). Where this involves shared schemes, these are based on the agreed apportionment of costs and schemes to Affinity Water for the two regions. Operational and embedded carbon are shown separately. It should be noted that the Water UK net zero commitment currently only applies to the operational carbon element.

Impact	Total BVP Impact for Situation 4 (WSE) and BAU+ (WRE)
Embedded Carbon (tonnes CO_2e)	393,300
Operational Carbon (tonnes CO_2e)	318,900
Biodiversity Net Gain Offset (needed to meet 10% enhancement target)	115 units

Table 9.27: Summary of carbon and BNG impacts

9.86. This will need to be addressed along with our other operational carbon and BNG offset required from new schemes on a business-wide basis, to allow for the development of efficient solutions. The figures will therefore be used as an input to the PR24 business plan and Long-Term Delivery Strategy (LTDS), which will contain our carbon net zero and BNG strategies.

It is the ambition of Affinity Water to deliver operational net zero by 2030 and carbon net zero by 2045. To achieve this, the Net Zero Carbon Strategy has been developed. The strategy is characterised by the following core principles: adopt a Net Zero Culture, applying the carbon management hierarchy, investing in Nature Based Solutions and working with others.

Within our Net Zero Carbon Strategy we have laid out objectives that will allow us to achieve our ambitions. Firstly, we aim to address the amount of energy we consume as a company, by targeting a 10% reduction of energy use by the end of 2034/35. This, together with our aim to have 7.5% of our energy usage from renewable sources by the end of 2024/25, will reduce the amount of carbon generated by this business.

Secondly, as a means of better understanding and controlling emissions from our assets, we are adopting the Public Availability Specification 2080 approach to managing carbon emissions across an asset's whole life. This will allow for earlier intervention and innovation to hit our reduction targets.

We are aiming to have around 20% of our fleet transferred to electric vehicles (EVs) by the end of 2024/25 and the remainder to other low carbon alternative fleet, transferred by the end of 2029/30.

To ensure our employees have the right knowledge and opportunity to support our journey to Net Zero, we are developing and investing in an ongoing programme of training and activities. Using the Carbon Literacy Project as a framework, we have set ourselves the ambition of becoming recognised as a Carbon Literate Organisation before the end of 2024/25.

Further detail on our ambition and action plan to operational net zero by 2030, is laid out in our Net Zero Strategy document.

9.87. There is inherent uncertainty in carbon estimating due to the developing maturity of carbon accounting practices and associated data. There is also additional uncertainty, driven by scope uncertainty associated with level of design information available at given stages within the project lifecycle. There is currently no standardised or established guidance to assess uncertainty in carbon estimates in a consistent way and directly applying the range of uncertainty associated with cost estimates and optimism bias, might overstate the level of uncertainty associated within the WRMP carbon estimates. Further ongoing work is required at a carbon estimating and accounting discipline level and within the infrastructure sector to establish a more formalised approach to assessing carbon uncertainty. Whilst no formal uncertainty range has been presented at this stage, it is suggested it would be best to align this with the Optimism Bias and risk allowance percentages for cost in the absence of a more formalised methodology.

The uncertainty range for carbon would account for:

- Uncertainty in carbon factors related to the quality and representativeness of industry level emissions factors, to the specific activities undertaken and materials used on the scheme.
- Scope uncertainty associated with ensuring the carbon estimate has captured all scope requirements to fully deliver the scheme.

To improve the uncertainty in the carbon factors over time, we expect to use more supplier-specific carbon data for major materials and products, rather than industry-generic emission inventories. For scoping uncertainty, we expect this to reduce as WRMP projects are further scoped and move through project lifecycle stages through to delivery.

Overall plan costs

9.88. The total monetary costs of our reported pathway (situation 4) are provided in **Table 9.28**. These include the unmitigated cost of carbon but do not account for Biodiversity Net Gain costs.

	Component	Delivery period				Notes
		AMP8 (2025-30)	AMP9 (2030-35)	AMP10 (2035-40)	AMP11&12 (2040-50)	
Demand	Capex (000's)	£53,670	£135,299	£136,029	£0	Household and Non-Household Consumption reduction activity
Demand	Opex (000's)	£18,892	£21,492	£22,392	£37,684	
Supply-side improvements	Capex (000's)	£24,018	£2,056	£85,231	£198,358 (c. £50m outside of WRZ7)	AMP11/12 includes £150m of schemes for WRZ7 that are only required under high environmental destination and do not feature in our preferred plan.
Supply-side improvements	Opex (000's)	£11,111	£9,466	£8,027	£27,116	
Leakage improvements	Capex (000's)	£18,561	£16,824	£192,009	£221,262	
Leakage improvements	Opex (000's)	£3,783	£8,157	£20,786	£77,852	
Internal interconnectors	Capex (000's)	£52,969	£82,648	£25,910	£73,483	
Internal interconnectors	Opex (000's)	£0	£2,067	£3,832	£10,269	
Strategic regional water resources	Capex (000's)	£196,387	£518,551	£509,118	£193,429	Based on Capex construction profile, not financing costs
Strategic regional water resources	Opex (000's)	£0	£76,541	£109,281	£218,562	Includes Opex charges from Canal & Rivers Trust and Minworth for the GUC scheme
Total	Capex (000's)	£391,945	£637,268	£710,785	£496,499	
Total	Opex (000's)	£75,823	£150,484	£178,616	£405,480	
Total	Totex (000's)	£411,205	£787,753	£889,401	£901,980	

Table 9.28: Total monetary costs of reported pathway (situation 4)

9.89. Situation 4 represents the upper end of potential costs as it covers the higher levels of environmental destination. At the lower end of our environmental destination forecasts we would expect costs to reduce by around £600m (i.e., reducing the total costs to around £2.4bn).

Monitoring plan

9.90. Adaptive plans require continuous monitoring to ensure that the key activities and their relationships to the decision points, set out within the adaptive plan, are clearly identified and tracked against a proposed metric. That way, timely decisions can be made as we update our WRMP over the coming AMP cycles. This activity is referred to as a 'monitoring plan'.

Our monitoring plan allows us to objectively assess which of the potential futures will be realised and enables us to invest in the right strategic supply option at the right time.

Following our consultation on the draft WRMP, we updated our monitoring programme so that it clearly describes those metrics that will indicate when we have reached a 'tipping point' that means we need to adapt our plan. This has been designed to complement the adaptive plan in **Figure 9.36** and clarify when we may need to adjust our programme. It also takes into account the key elements of monitoring information that stakeholders and customers consider are important to them.

In response to feedback on our rdWRMP24, to further improve the clarity and detail of the monitoring plan, we have updated our rdWRMP24 monitoring plan to include:

- additional thresholds, triggers, and potential actions we would take to manage key risks, particularly in relation to demand management.
- an explanation of the feedback mechanism from company level monitoring into the regional plan

In line with the adaptive plan supplementary guidance, this has been done for stakeholders and regulators to see how key risks are managed within the planning cycle and to show how and when we may need to adjust our programme.

Our monitoring plan is structured around the following elements of monitoring:

- The main drivers of need and strategy for the adaptive plan (levels of demand, environmental destination etc).
- The indicators that we are able to monitor to determine where we are in accordance with those drivers at any given time (*backward looking* indicators) and where we anticipate that we will be in future (*forward looking* indicators).
- The methods that we will use to generate the indicators and the

frequency that we will update them. These form our commitment to regulators and stakeholders in support of the adaptive plan presented in this chapter.

These elements are summarised in **Table 9.29** below.

9.91. These monitoring elements are then used to inform the decision points identified in the adaptive plan contained in **Figure 9.36**. The timing and nature of the key decisions that we will need to make over the course of the plan are provided in **Figure 9.37** below. It should be noted that because our water resource system is relatively resilient to climate change (in comparison to other companies), the assessments we will need to make tend to inform the thresholds and decisions associated with other drivers, rather than driving adaptive change by itself. This is shown in **Figure 9.38**.

Driver of strategy	Measured indicators		How indicators are measured and frequency at which they are reported
Strategic Resource Options (constraints and risks)	Backward looking	Progress against programme	Progress against programme and 'live' issues are reported to the project steering groups on a quarterly basis, and then reported to RAPID.
	Forward looking	Constraints and risks that might limit achievable Deployable Output or threaten scheme viability.	The SROs are developed through the RAPID gated process and reports are produced at intervals that outline the risks and issues as they are perceived at that gate (including engineering, environment and commercial/market risks). The next Gate Reports are due to be produced in late 2024. At that stage final decisions on the size, commercial arrangements and delivery mechanisms will have to be made prior to planning application. Risks will be collated through technical studies and ongoing dialogue with stakeholders through a stakeholder engagement programme (which we will continue to publish on our website). This will include engagement with Local Authorities and other Planning Authorities as appropriate.
Environmental Destination - Abstraction Reductions (need and benefits)	Backward looking (historic)	WINEP scheme delivery outcomes and benefits.	Reported annually via the WRMP annual return. Used to generate monitoring data and support modelling for the forward-looking indicators.
	Forward-looking (forecasts)	Required level of abstraction reduction, by AMP (feeds into the definition of 'sustainable' abstraction). Quantity of flow increase in River Colne, Lee and Ivel and benefit this has on downstream Deployable Output and flood risk.	Input data will come from WINEP investigations, stakeholder inputs and monitoring of groundwater levels at observation boreholes, river flows at EA gauging stations, spot flow gauging, seasonal ecological monitoring. We will share information through extensions to our existing forums and make data available online through our environmental data portal. We will work with the EA to improve the Herts Groundwater Model to the point where it can reliably be used to provide groundwater impact factors and generate 'what if' low flow analyses as required for calibrated catchments. The findings of the measured variables will be fed back into the Regional Groundwater Model to support this process. Outputs from the modelling will be used in CAMs ledgers to generate updates to Environmental Flow

			Indicators (EFIs) and understand the flow increases in rivers. There is an annual report produced to present the updated understanding from this process. We will report on the outcomes of the two indicators as part of the WRMP planning process every 5 years but will hold an update meeting with stakeholders at least once a year to share ongoing findings. We will also use the investigations to periodically review the risk of groundwater emergence and impacts on downstream flood flows caused by abstraction reductions with both the EA and GLA, and ensure that licences and infrastructure are flexible enough to manage that risk.
Demand and Technology (need and opportunities)	Backward looking	PCC, Distribution Input (DI), Leakage, benefits of demand management initiatives.	Historic data (DI, PCC and Leakage) will be reported annually in the APR, and used track how our demand strategy implementation is progressing and how the activities we are conducting perform in practice. Our 'machine learning' analytical models that we have developed to quantify benefits from different activities will be used to quantify the benefits from individual programmes, which will be reported in the WRMP annual return. We will hold an annual demand management forum to share findings with stakeholders.
	Forward-looking	Population forecasts, metering technologies, benefits of metering and demand management, deliverability of leakage targets.	At 5-year intervals for the WRMP we will use the backward-looking data to update our assumptions to include more accurate demand savings in the regional WRMP modelling for future strategies. These will be integrated with market engagement and supply chain information to refine our future demand management strategies. This will include both company-driven and government led demand management activity. Population forecasts and policies will be updated at this stage.
Climate Change (risks)	Backward looking	Published warming and CO_2 emissions trends	Review published data every 5 years to understand the likelihood of the different global emissions RCPs. Data on trends will tend to inform the forecasts

	Forward looking	Updated temperature, rainfall and potential evapotranspiration (PET) forecasts and modelled impacts on Deployable Output and demand.	Climate Change assumptions within the WRMP are based upon rainfall and PET data supplied by the UKCP analyses. These are fed by global and regional climate models that reflect future climate conditions. These are periodically updated and the latest forecasts will be used every 5 years to inform the WRMP. Deployable Output risk will be updated at that time. For WRMP29 we will also use machine leaning tools to re-evaluate the likely impact on the dry year uplift on annual average demand.

Table 9.29: Elements of our monitoring plan

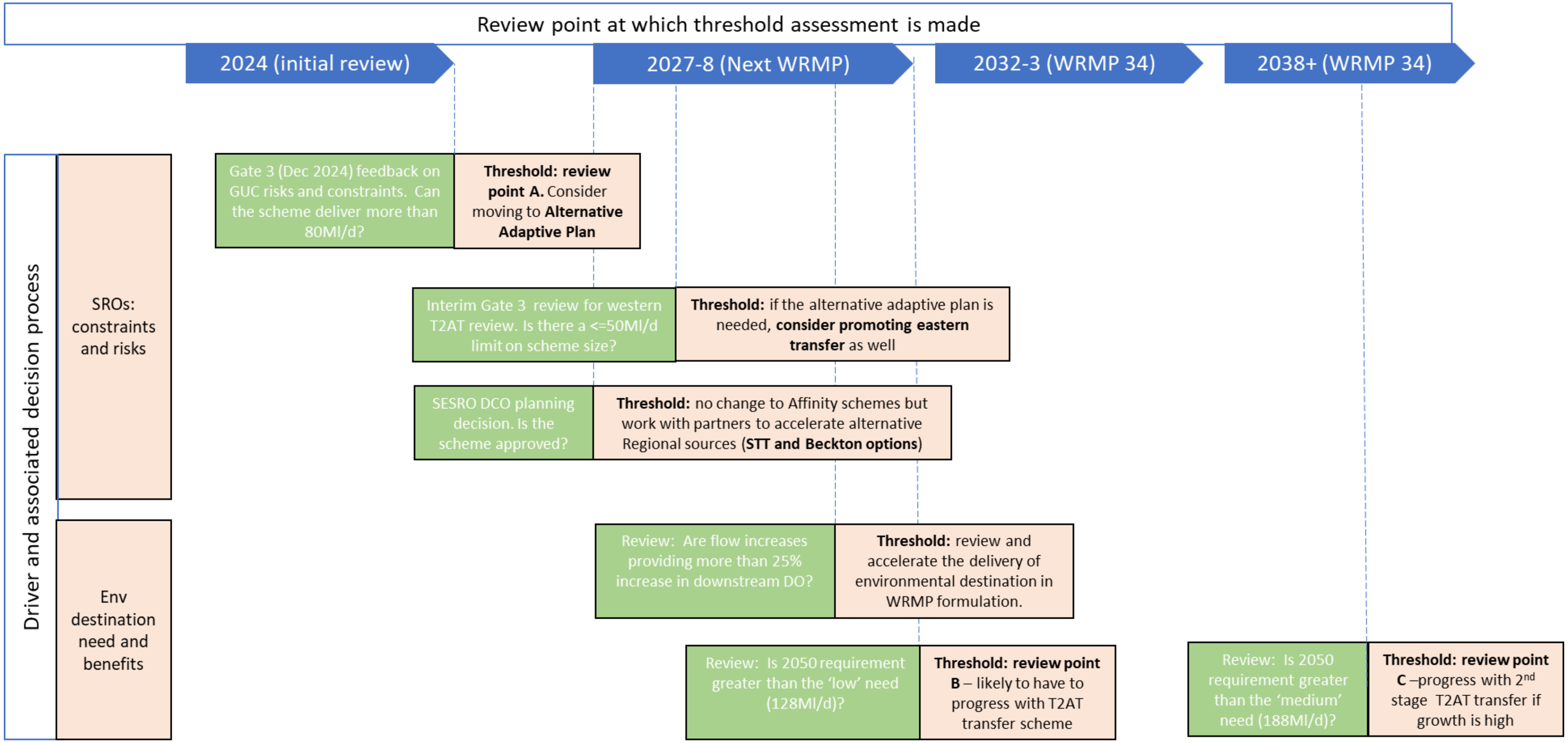


Figure 9.37: Monitoring plan thresholds and decision points (to be read in support of the adaptive plan in **Figure 9.36**)

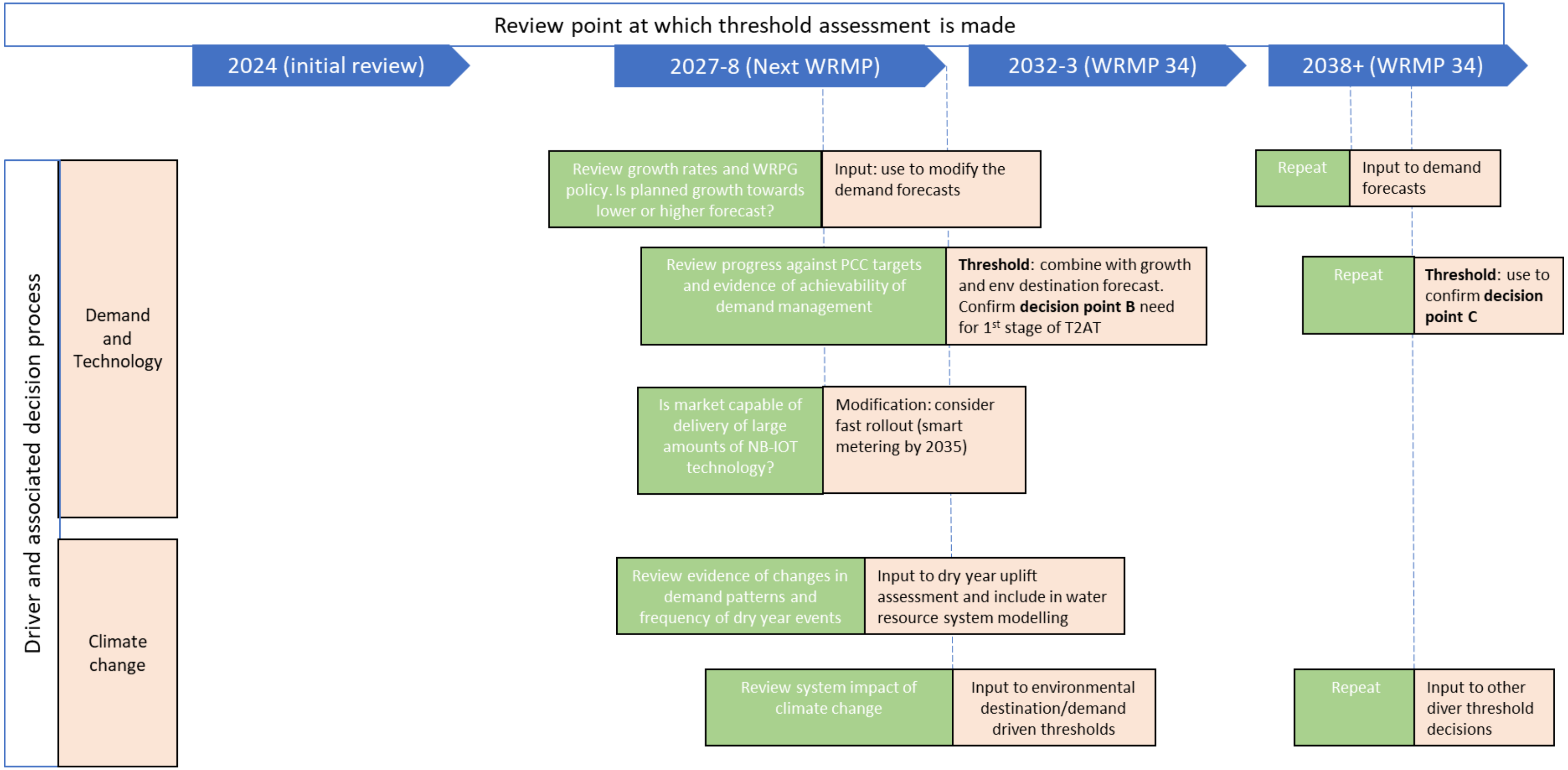


Figure 9.38: Monitoring plan thresholds and decision points (to be read in support of the adaptive plan in **Figure 9.36**)

Monitoring in the shorter term, the next 10 years

9.92. **Figure 9.37** and **figure 9.38** detail our monitoring plan out to 2050. This includes the metrics that we will monitor, the frequency of review for each metric and the source of information. This includes the major thresholds where we expect decisions will have to be made. However, as well as the expected threshold points identified in Figure 9.38, we need to ensure that ongoing monitoring is carried out to track and take remedial action if unexpected issues or change occur between the expected threshold points.

The purpose of the below is to document the specific steps we will undertake in the shorter term to provide that continual monitoring and remedial action, with a focus on the next 10 years, with a particular emphasis on progress against our demand management ambition.

The purpose of the monitoring plan is to ensure that we can meet our supply duty by ensuring sufficient schemes and interventions are delivered to meet their future supply demand challenges. This means understanding if the interventions and forecasts set out for the reported pathway contained in the tables are on track, but more importantly the forecast security of supply is not compromised. Given how long some infrastructure schemes take to deliver it is necessary to continue with their development in parallel with some preferred options.

The metric used to monitor this is headroom, which is the amount of water a company has over the forecast supply demand balance position for each water resource zone (WRZ). We must maintain headroom in each zone, and this should be above a certain threshold, referred to as target headroom. The plan has been derived to ensure that we can meet our target headroom position across all the zones given the level of resilience for each of the zones. Target headroom is a composite measure that brings together the supply and demand forecasts coupled with the program delivery of schemes. When schemes are delivered, they either improve the supply forecast (water recycling, reservoirs, transfers, etc) or decrease the demand (water efficiency and leakage schemes). Outperformance of some schemes can be countered with late delivery of other schemes. Likewise, if population growth does not increase at the forecast rates, this could be countered by an increase in climate change impacts. Therefore, this composite measure better reflects the actual position we are in.

If the actual headroom in a zone falls below target headroom, then action is required to improve the situation. If actual headroom is higher than target headroom, then no immediate action is required but companies should continue to monitor the situation. This is shown in the schematic diagram of **Figure 9.39** below.

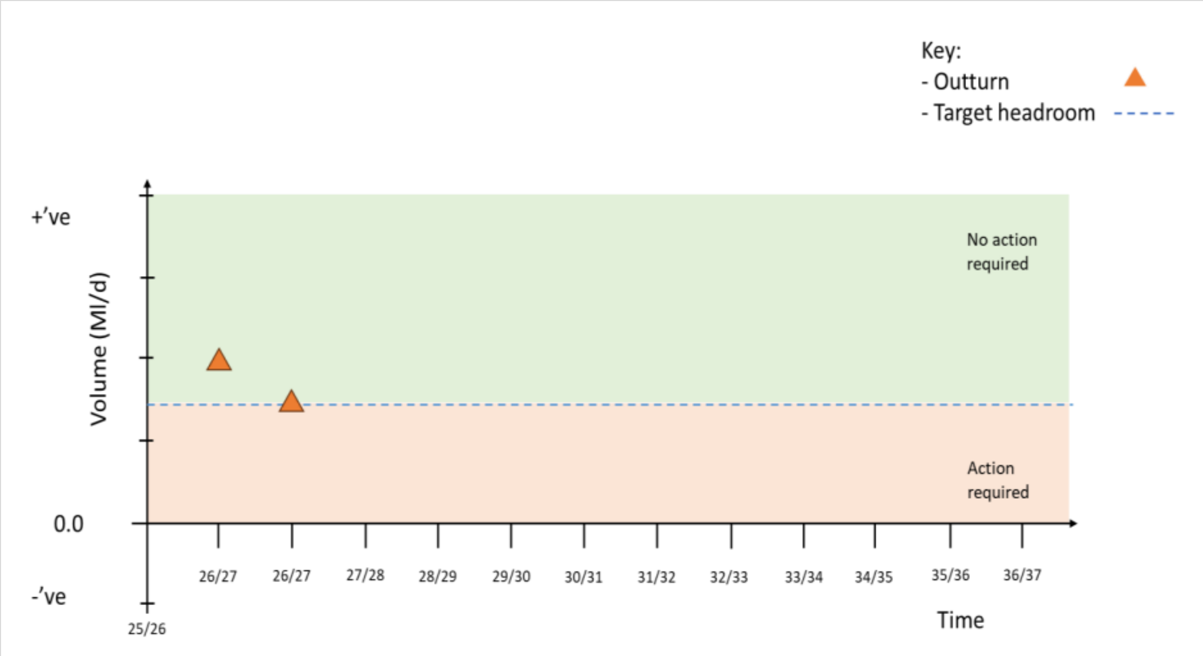


Figure 9.39: Schematic diagram of Target Headroom vs Actual Headroom

We will review both the current and 10-year target headroom forecast position using the outturn 'water balance' and progress on supply side infrastructure schemes on at least an annual basis, as part of the WRMP Annual Return submission. The 'water balance' is the way that we measure and report on the components of our demand, including household demand, non-household demand and leakage, so each review point we can determine how each of those components is tracking against our WRMP. This review will tell us whether any action is required based on the current and forecast Target Headroom position.

Looking at annual return data (or intermediate water balance) is helpful, but the underlying indicators also provide an insight into the future position and therefore we will use the outturn data coupled with the forecast information to estimate future headroom capacity for each of our three regions, as illustrated in **Figure 9.40** below.

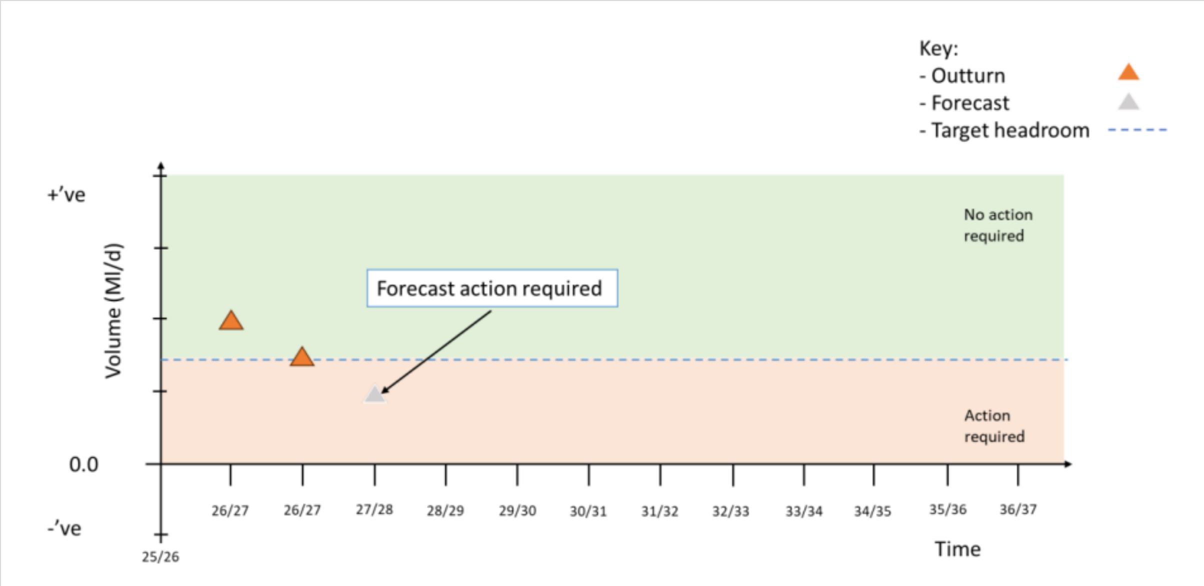


Figure 9.40: Target Headroom vs Actual Headroom and forecast action timelines

The forecast headroom position is calculated by dividing the (hybrid DO profile + resource schemes) by the (Demand forecast adjusted by the DYDI). Where the DYDI is the annual DI uplifted for a dry year.

We will use a 5-step escalation to determine the level of action that is required based on this analysis, as shown in Figure 9.41. As well as the water balance and supply side infrastructure, the forecast will include any relevant updates to climate change impacts, any change in government policy and Water Available for Use (WAFU), as described in our monitoring metrics above.

The climate change projections are unlikely to be updated until 2027. In the interim we will use the Met Office annual "state of the climate" reports and Copernicus information to track how global temperatures are comparing to the 28 Climate Change scenarios we modelled for the regional plan. This temperature proxy will be used to indicate which of the climate change we are tracking against.

Government policy might / could change in the future. We will continue to update the plan where necessary to compare with the known policies in the current plan.

The supply forecast will be updated to take account of the reductions to existing abstraction licences; new schemes coming online and any new information on drought resilience standards. They will also take on board any updates to approaches for generating future droughts.

1: Reporting and Progress	• **In year - 6 monthly review WAFU & DI** • Review actual values against forecast. • If any metric is below forecast, note this for a 'watching brief' and proceed to Step 2. • There is a lag of just over a year with demand components which may improve negating the need for premature action.
2: Enhance our Understanding	• **In year - 6 monthly review WAFU & DI** • For each metric that is below the forecast in Step 1, undertake enhanced data collection and analysis to understand what is not working and why. • Report to the Environment Agency through quarterly meetings to share the outcomes of our enhanced analysis. • Where applicable, use this informaiton to improve performance of the metric.
3: Accelerate the existing plan	• **After 2 years - assess target headroom triggers and accelerate the existing plan** • If after 2 years, we are impacting Target Headroom due to metric underperformance, investigate options to accelerate quickly within the existing plan. • For example, if we are impacting Total DI due to underperformance of household consumption reduction, we could accelerate the leakage or non-household reductions included in the plan for that AMP.
4: Enhance the existing plan	• **After 2 years - target headroom continues to be impacted after Step 3** • If, after the acceleration of the existing plan, we continue to breach Target Headroom, we will look at options to enhance the existing plan. • For example, if we continue to underperform for Total DI, we will increase the total volume of metering or number of leaks repaired within the AMP. Or, if we are impacting WAFU due to excessive outage, we will increase activity to decrease outages.
5: Investigate options outside the plan	• **After 2+ years - target headroom breached after Step 3 and 4** • If, target headroom continues to be impacted, options outside of the existing plan will be considered in conjunction with the Environment Agency • These include* the use of a large proportion of Target Headroom, extension of the Perivale and Cockfosters agreements, the application for Drought Orders and Permits and the delay of Sustainability Reductions.

*Our two potential smaller supply options, Brent Reservoir or Epping ASR have not been included as options in Step 5 as both are unviable and/or unable to be introduced in the short term.

Figure 9.41: Monitoring and Remedial Action Process

Integration of company monitoring with the regional plan

9.93. Affinity Water will work with WRSE to integrate our company monitoring with the regional plan monitoring. Our process has been specifically designed to be similar to the one adopted by WRSE, relying on Target Headroom assessments and forecasts.

WRSE will ensure that it prepares and publishes an Annual Monitoring Report, building upon the content of the company WRMP Annual Reviews (normally published in June of each year). Based on the Headroom trigger level we will indicate to companies which of their WRZ's are at risk. As WRSE is not a delivery organisation, it will rely on the companies and government to undertake any remedial actions required.

WRSE will also ensure that it provides a regular update to its commentary on the factors that could change the regional plan, as summarised in **Table 9.30** below, and explained in more detail through the remainder of this section. These factors and issues will be monitored together with member companies as well as regulators and will also take stakeholder and customer feedback into account where possible.

Factors which could change the regional plan	Key issues to be monitored and resolved where possible
Environmental ambition	WRSE has worked with the EA and Natural England to develop the existing environmental ambition profiles, and to incorporate licence capping. The profiles will need to be reviewed to ensure they meet policy expectations, particularly regarding licence capping and the results of ongoing WINEP and environmental investigations.
Quantifying environmental benefits	WRSE will continue to work with our member companies, regulators and catchment partners to better understand schemes and ecological benefits from environmental ambition.
Demand side options	TUBs and NEUBs have been included in the regional plan as one of the measures to meet the challenges ahead. The default regional position is that this will remain the case unless there is feedback to change this policy position. WRSE have tested several different Government water efficiency policies. Government Policy C+ brings the region to 110 l/p/d by 2050 in a dry year, but this puts a lot of onus on Government to deliver a significant component of the plan. This will require careful monitoring as the plan progresses to review Government commitments.
Supply side options	Uncertainties relating to supply side schemes will be monitored and resolved where possible. Key schemes to monitor include SESRO, GUC, Hampshire Water Transfer and Water Recycling, and Teddington DRA. Drought orders and permits continue to be selected in the regional plan until 2040, however WRSE will monitor regulatory positioning on the continued use of drought orders and permits and adjust our approach accordingly. WRSE has investigated accelerated cessation of the use of drought orders and permits (2035) as well as delayed cessation (2045 and 2050). WRSE will continue to work with the All Company Working Group (ACWG) and the National Advisory Unit (NAU) to look at emerging substances relating to reuse and water recycling schemes and compliance with the Water Framework Directive.
Carbon reduction	We will monitor the cost of carbon and mitigation options.
Future environmental policies	WRSE will continue to work with Government and regulators throughout the regional planning process to inform and support resolution of outstanding environmental policy uncertainties.

Regional reconciliation	There will need to be further regional reconciliation to ensure consistency is maintained between the regions in future.
Multi-sector options	WRSE will continue to engage with stakeholders and multi-sector groups to improve our understanding of non-public water supply demand forecasts, potential multi-sector options, and impacts on non-public water supply sources from droughts and licence capping.
Drought resilience	We have tested several different implementation timescales for 1:500 year drought resilience timing. Unless there is a strong consultation response or regulatory direction, the default WRSE position is 2040 for achieving 1:500 year drought resilience.

Table 9.30: Factors which could change the regional plan and key issues which will be monitored by WRSE

Current and future groundwater resource investigations

9.94. As noted in **Table 9.31**, one of our key monitoring metrics is to understand both the evolving level of future Environmental Destination and the resulting increases in baseflow that are resulting from abstraction reductions. This will feed into the Water Industry National Environment Programme (WINEP), inform Environmental Destination for future WRMPs and provide a better understanding of the Water Available for Use benefits that Thames Water and Anglian Water may achieve trough the increased flows in the lower catchments. Table 3 summarises the current and future groundwater resource investigations that we will be carrying out within the remainder of AMP7 and into AMP8. We will use these outputs to update our understanding of the groundwater-related monitoring metrics. We will track and monitor progress of these investigations as part of our ongoing monitoring plan.

Amp 8 Activities	Expected Outcome	Delivery
Ivel – included within the ED	AMP8 WINEP: investigation into a long term solution for the Ivel US Henlow, with regard to the potential of improving flow conditions in the upper catchment; the study will assess several options and identify costs and risks of each of them, in the context of the WRE schemes and the needs for Affinity Water and the neighbour Water Companies.	31/12/2026
ADO licence relocation scheme	AMP8 WINEP: the investigation will assess effects of planned ADO relocation scheme on three identified SSSI area, carried out in conjunction with EA and NE, through a series of model and field data analysis.	30/04/2027
Secondary effects of SRs	AMP8 WINEP: Investigation to determine the level of risk associated with future planned SRs in terms of increased risk of GW emergence and increase in fluvial flood (Risk A), as well as groundwater quality aspects (Risk B). It will assess all Chalk GW abstractions in the waterbodies planned to be reduced, revoked or altered within AMP8 to AMP12, with particular focus on AMP8, with few selected of historic SR implemented in AMP6-AMP7 to compare model results with observed data.	30/04/2027

AMP 7 SRs	See above Secondary Effects of SR	
EA CBO Groundwater model updates	EAN EA team is currently extending the timeline of the CBO model to Dec 2023. As completed, we will work with EAN and WSP to refine the model in the Upper Cam catchment, based on the outcome of the study we undertook with BGS in 2022-23.	March 2025
Review the EFI requirements (this is an AMP7	Study aiming to determine a local flow constrain (LFC) for the main sub catchments in the Colne and Lee, developing hydro-ecological modelling based on spot gauging and ecological survey datasets; comparison with existing EFI values.	31/12/2026
Longer term tertiary effects on chalk hydrogeology	AMP8 WINEP Installation of a series of GW monitoring OBH and spot gauging of LLT fed springs; focussed on Rib, Ash and Stort catchments, with he intention to quantify their contribution to the baseflow of the streams in comparison with the Chalk aquifer.	31/12/2026
Stanstead Brooke	AMP8 WINEP: Investigation into effect of Affinity Water GW abstractions and failure of the waterbody to achieve good ecological status.	31/12/2026
HCM Groundwater model update	EA HNL released HCM new in July 2023. We are collaboratively working with HNL office and the current consultant (Stantec) for Phase 2, consisting of building up a conceptualisation of the full model area. Subsequent Phase 3 will consist of model migration to Modflow6, experimental conceptual trials and refinement.	Phase 2 May 2024 Phase 3 autumn 2025
WINEP investigations on the Seabrook stream	AMP8 WINEP: investigation into the possible link between Seabrook stream flow conditions and Affinity Water GW abstractions	31/12/2026
WRSE Environmental Destination (ED) Review	Cross regional understanding of technical and policy results of company monitoring programmes and the effect this may have on future ED.	Supporting WRMP29
WRMP lead surface water and groundwater update.	We aim to produce summary reports of outcomes of the AMP7 monitoring works for each relevant catchment, review of the current conceptualisation with regard to the effects of GW abstraction changes and recommendations for future monitoring.	30/06/2025
WR modelling and option appraisal	AMP7 WINEP: the study is looking at the waterbodies within Upper Lee and Colne sub catchments to improve flow conditions towards EFI, starting from the agreed AMP8 implementation baseline scenarios and simulating the increase in flow across the FDC by applying AMP9 and beyond ED scenarios.	31/03/2025
Nailbourne	AMP8 WINEP: investigation into effects of Affinity Water GW abstractions and flow conditions in the Nailbourne, particularly focused on the possible link between dry and flowing reaches.	31/12/2026

Dour	AMP8 WINEP: Investigation into risk of deterioration of the waterbody status due to GW abstractions in the catchment.	31/12/2026
Upper Cam	AMP8 WINEP: Investigation into risk of deterioration of the waterbody status due to GW abstractions in the catchment which are not linked to the river support scheme.	31/12/2026
Oughton Head Common	AMP8 WINEP: Investigation into potential effect of groundwater abstraction from Oughton Head PS on the local wildlife of the Oughton Head Common.	30/04/2027
Hiz	AMP8 WINEP: investigation into effects of groundwater abstractions in the upper Hiz catchment (Hiz through Hitchin) and the effectiveness of the current river support scheme operated by EA and Affinity Water, with the intention to identify solutions to improve flow to EFI or local flow constrain.	31/12/2026

Table 9.31: Current and future groundwater resource investigations

9.95. As described in **Chapter 9** of our Plan, currently we do not anticipate having to carry out any resource development in Dour before 2050, unless it is found to be necessary to follow our 'high' Environmental Destination (ED) forecast. However, in addition to the above, we will engage with South East Water and Southern Water to develop a sub-regional strategy for resource development in Kent and East Sussex that avoids the need for any schemes that have potential impacts on Habitats Directive sites, even if we do have to implement the 'high' ED strategy. This will comprise of two studies in AMP8, which will prepare us to adapt at WRMP29 if required:

1. We will review the potential for reinstating the Lower Greensand boreholes that we have existing licences for at Shearwater. This will cover hydrogeological desk studies, pumping tests and liaison with the Environment Agency on the sustainability of such as scheme.
2. We will work with South East and Southern Water to consider new options for re-use, desalination and other sub-regional scale resource developments to identify a strategy that does not cause any 'likely significant effects' on Habitats Directive sites. We will report on the outcomes of this in WRMP29.

10. Board assurance and governance

The WRMP24 assurance process and regional planning

10.1 Since early 2021, we have engaged with our Board frequently, well in advance of the initiation of the WRMP24 process. We have provided them with presentations focusing on the development and basis of our WRMP24 strategy, in line with our business aims and objectives.

Our Board assurance process comprises of a combined assurance framework for activities carried out at both regional and WRMP level, in line with the WRPG. This clearly states that the WRMP should closely reflect the regional plan unless there are specific and explicable reasons why. The quality and reliability of the regional plans, therefore, has a direct impact on our WRMP24 submission.

The process and outputs used to provide comprehensive assurance to the Board across the regional plans and this WRMP24 are shown in **Figure 10.1**.

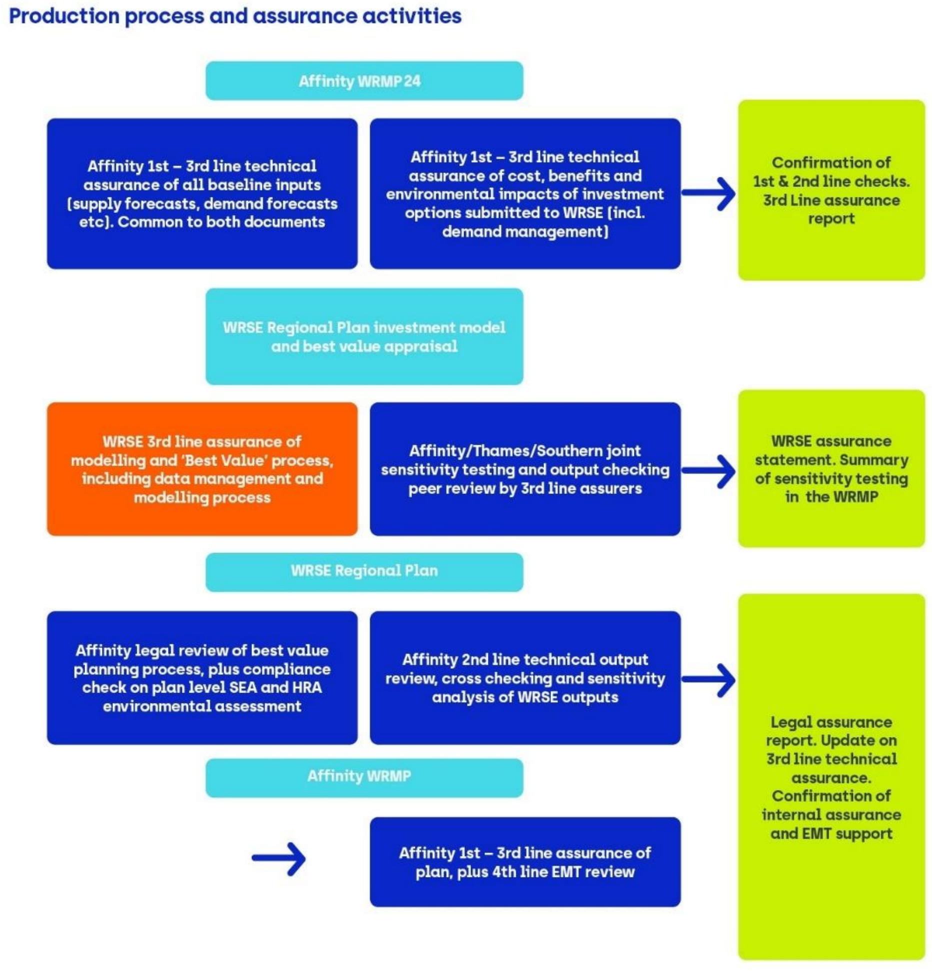


Figure 10.1: The assurance process and outputs summarised for the Board across our WRMP24 and the regional plan

10.2 Alongside the main plan assurance, we have also undertaken technical and legal assurance of our SEA process.

10.3 Our Board statement is set out below:

This Board Statement provides the assurance from our Board to Ofwat and the Environment Agency that we are satisfied that:

- We have met our obligations in developing our plan.
- Our WRMP reflects our element of the WRSE and WRE regional plans, which have been developed in accordance with the National Framework and the relevant guidance and policy. This includes licence capping under Water Framework Directive 'no deterioration' guidance.
- Our WRMP has been developed to provide a best value plan in accordance with the metrics described herein, for managing and developing our water resources, so we can continue to meet our obligations to supply water and protect the environment. We have been provided with appropriate assurance that it is based on sound and robust evidence including relating to costs.
- The Board has challenged the expenditure proposals contained within the WRMP, with a particular emphasis on the 2025 – 2030 period through our engagement with the PR24 Business Plan and Long-Term Delivery Strategy. We are confident that they have been subject to the same level of review and scrutiny as the rest of the Business Plan, which will be commented upon in our PR24 Business Plan assurance statement.

Signed

Keith Haslett
CEO

Glossary of Terms

Term	Description
A2AT	Anglian to Affinity Transfer - a new treated water transfer from Anglian Water to Affinity Water
Abstraction	Taking of water from river, reservoir, or borehole. Abstractions of surface water and groundwater in England and Wales are subject to an Environment Agency licence. Licence holders include water undertakers, general industry (particularly electricity generating companies) and agricultural users
ACORN	Consumer classification tool used to segment the population into 62 different classification types
ADO	Average Deployable Output – the average output of a source of water
AGA	Above Ground Asset
AIC	Average Incremental Cost
AIM	Abstraction Incentive Mechanism - AIM is a means by which water companies can be incentivised to reduce their abstractions from environmentally sensitive water sources when river flows are low (i.e., in a drought)
ALC	Active Leakage Control
AMI	Advanced Metering Infrastructure - the ability for Automatic Meter Read (AMR) meters to automatically transfer data to a central point
AMP	Asset Management Plan - a five-year time period used in the English and Welsh water industry. It is used by the financial water regulator OFWAT to set allowable price increases for water companies and for the assessment of many key performance indicators
AMP6	Asset Management Plan 1st April 2015 - 31st March 2020
AMP7	Asset Management Plan 1st April 2020 - 31st March 2025
AMP8	Asset Management Plan 1st April 2025 - 31st March 2030
AMR	Automatic Meter Reading system. AMR is a way of reading meters electronically without the need for a meter reader to visit the site to take a visual reading
AONB	Area of Outstanding Natural Beauty
Aquifer	A sand, gravel or rock formation capable of storing or conveying water below the surface of the land
AR20	Annual Return 2020

BAF	Bid Assessment Framework
BAU	Business as Usual - this reflects the application of the current policy and excludes catchments where previous investigations have indicated that abstraction reductions are not warranted from a cost/benefit point of view
BAU+	Business as Usual Plus - as above, but with abstraction reductions associated with several of the excluded catchments reimposed
BNG	Biodiversity Net Gain
Brett community	Water resource zone 8 (WRZ8) – also sometimes called the East region of Affinity Water's supply area
BVA	Best Value Assessment
BVP	Best Value Plan
CAfW	Catchment Assets for Water
CAMS	Catchment Abstraction Management Strategy
Capex	Capex (Capital Expenditure) is Water Company money that is used to fund the installation of new water infrastructure. Opex (Operating Expenditure) is company money that is used to fund the day-to-day operation of the water company
Catchment	The whole area that drains into a river. It includes drainage channels, tributaries and floodplains
CCW	Consumer Council for Water
CEP	Cost Efficient Plan
Central region	A general term to describe the water resource zones (WRZs) in the central part of Affinity Waters supply area – it includes Wey (WRZ6), Pinn (WRZ4), Colne (WRZ2), Misbourne (WRZ1), Lee (WRZ3) and Stort (WRSZ5) community areas.
Conjunctive use	The planned use of both surface water and groundwater resources to maximise total water availability in a region in the long-term
CP	Critical Period
CRT	Canal and River Trust
DAPWLs	Deepest Advisable Pumping Water Levels
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
Demand	Demand (for water) is the estimated quantity of water required per unit of time
DI	Distribution Input – the amount of water entering the distribution system at the point of production

Distribution system	Part of the water supply system comprising of pipelines, service reservoirs, pumping stations and other assets by which water is distributed to the consumers. It begins at the outlet from the water treatment works and ends at the point of connection to the consumer's installation
DMA	District Metered Area - A DMA is a collection of water mains in an area that is isolated such that there is only one (or a few restricted) feed(s). This feed is metered, and the volume of water supplied to the area or zone can be regularly monitored to check for leakage
DO	Deployable Output – the output of a commissioned source or group of sources assessed under drought conditions
Dour community	Water resource zone (WRZ) 7 - also known as the Southeast region of Affinity Water's supply area
Drought Management Plan	Operational plan which sets out how the company will deal with a drought situation
DRA	Direct River Abstraction
Drought Order	An authorisation granted by the Secretary of State under drought conditions which imposes restrictions upon the use of water and/or allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis
Drought Permit	An authorisation granted by the Environment Agency under drought conditions which allows for abstraction/impoundment outside the schedule of existing licences on a temporary basis
DrWPA	Drinking Water Protection Area
DTZ	Drought Trigger Zone – a trigger line for groundwater levels at specific points which indicate stages at which different drought actions need to be carried out
DWI	Drinking Water Inspectorate - The DWI regulates public water supplies in England and Wales. DWI is responsible for assessing the quality of drinking water in England and Wales, taking enforcement action if standards are not being met, and appropriate action when water is unfit for human consumption
DWMP	Drainage Water Management Plan
dWRMP	draft Water Resources Management Plan
dWRMP24	draft Water Resources Management Plan 2024
DWSP	Drinking Water Safety Plan
DYAA	Dry Year Annual Average
DYCP	Dry Year Critical Period
EA	Environment Agency - the leading public body for

	protecting and improving the environment in England and Wales. Their role is to make sure that air, land and water are looked after by everyone in today's society, so that tomorrow's generations inherit a cleaner, healthier world
EBSD	Economics of Balancing Supply and Demand - a model used in water resources future planning
FWAG	Farming and Wildlife Advisory Group
WRMP19	Water Resources Management Plan 2019
GLA	Greater London Authority
Groundwater	Water occurring in permeable underground strata, e.g., Chalk or Sandstone.
GUC	Grand Union Canal
Groundwater level	Level of groundwater above Ordnance Datum
Hardness	Characteristic of waters containing dissolved calcium and magnesium salts that makes lathering difficult
HDZ	Hydraulic Demand Zone – zone characterised by having discrete supply and storage arrangements with strategic inter zone transfers
HH	Household
HRA	Habitats Regulations Assessment. HRA is a recognised step by step process which helps determine likely significant effect and (where appropriate) assess adverse impacts on the integrity of sites, examines alternative solutions, and provides justification for imperative reasons of over-riding public interest. HRA is a requirement of the Conservation of Habitats and Species Regulations 2017 for all sites in the National Sites Network
HS2	High Speed 2
HWEC	Home Water Efficiency Check - This is a home visit to customers who are part of the Water Saving Programme, where a technician provides water efficiency guidance and installs free water saving devices. Taps and toilets will be checked for leaks, and the customer is left with a report card indicating how much water in litres and pounds (£) the visit should save them to help with the transition to metered tariffs. An appointment usually takes just under one hour, and is completed by our delivery partner, PN Daly
ICGs	Independent Challenge Groups
IDA	Integrated Demand Analytics
IGEQ	Inter-Generational Equity rates
INNS	Invasive Non-Native Species
IVM	Investment Model

Leakage	Water lost between the treatment works and the customer's home or business
l/h/d	Litres per head per day
LoRaWAN	Long Range Wide Area Network
LTDS	Long-Term Delivery Strategy
Ml/d	Megalitres per day - a measure of consumption. One megalitre is equal to one million litres
MLR	Multiple Linear Regression
MRS	Market Research Society
NB-IoT	Narrow Band – Internet of Things
NbS	Nature based Solutions
NC	Natural Capital
NE	Natural England
NEUB	Non-Essential Use Ban
NFU	National Farmers Union
NGO	Non-Governmental Organisation
NHH	Non-Household
NPV	Net Present Value
NSROs	Non-Strategic Resource Options
NYAA	Normal Year Annual Average
ODI	Outcome Delivery Incentive. Financial rewards and penalties for delivering or failing to deliver the service levels that our customers expect e.g., reduce leakage by 14% or 27Ml/d
Ofwat	The economic regulator of the water sector in England and Wales
OJEU	Official Journal of European Union Notice
OMT	Outage Modelling Tool
Online engagement site	https://affinitywater.uk.engagementhq/wrmp Affinity Water electronic consultation and engagement platform where all documents and materials relating to the WRMP24 are stored for easy access by customers and stakeholders
ONS	Office for National Statistics
Opex	Opex (Operational Expenditure) is Water Company money that is used to fund the day-to-day operation of the water company. Capex (Capital Expenditure) is company money used to fund the installation of new water infrastructure

Outage	A temporary loss of useable water output due to planned or unplanned events. Planned events include maintenance of works; unplanned events can include pollution, turbidity, nitrate, algae, power failure and system failure
Oxcam	Oxford and Cambridge Arc, a significant geographical area of growth between Oxford, Milton Keynes and Cambridgeshire
Performance Commitment	The pledges that we make about service levels in order to make progress towards our customer outcomes e.g., improve our efficiency in supplying water by reducing leakage
PCC	Per Capita Consumption – a measure of water consumption
PDO	Peak Deployable Output – the maximum daily output of a commissioned source, as constrained by (if applicable): • Environment • Licence • Pumping plant and/or aquifer properties • Raw water mains and/or aquifers • Transfer and/or output main • Treatment capabilities • Water Quality
PES	Payment for Ecosystem Services
PET	Potential Evapotranspiration - the amount of evaporation that would occur if a sufficient water source were available
PHC	Per Household Consumption
PR	Periodic Review or Price Review
PR19	Price Review 2019
PR24	Price Review 2024
Pywr	Python water resource model
RA	Recent Actual baseline
RAPID	Regulators’ Alliance for Progressing Infrastructure Development
Raw water	Raw water is water that is NOT safe to drink. Typically, water in streams, rivers and aquifers is not fit to drink until it has been through the purification process at the treatment works. Raw water is sometimes referred to as non-potable water
RBMP	River Basin Management Plans
rCCG	Regional Customer Challenge Group
RDM investment modelling	Robust Decision-Making investment modelling

RPS	Consultancy company supporting Affinity Water with Leakage Assessments
RSS	Regional System Simulator
SAC	Special Area of Conservation – defined in the European Union's Habitats Directive, to protect habitats and species considered to be of European interest
SDS	Strategic Direction Statement
SEA	Strategic Environmental Assessment
SERT	South East Rivers Trust
SESRO	South East Strategic Reservoir Option
SLR	South Lincolnshire Reservoir
SOS	Save Our Streams campaign
SoS	Secretary of State
SPA	Special Protection Area – These are designated under the Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017, and form part of the UK's National Sites Network
SR	Sustainability Reduction - a volume of water agreed between ourselves and the Environment Agency that we must reduce abstraction by, at a site from which we abstract water
SRO	Strategic Resource Option
SSSI	Site of Special Scientific Interest – a conservation designation denoting a protected area in the United Kingdom
Stochastic	A type of modelling uses a random probability distribution or pattern that may be analysed statistically but may not be predicted precisely
STPR	Social Time Preference Rates
STT	Severn to Thames Transfer
STW	Sewage Treatment Works
Supply / demand balance	The extent to which the demand for water and the water resources available are in balance, taking variability of supply and demand into account
Supply pipe	That portion of service pipe which conveys water from the main to the customer's house and which is on the customer's property
T2AT	Thames to Affinity Transfer
Telemetry	Monitoring equipment installed at water treatment works and in the distribution system, which sends signals/alarms to

	a central control room that is remote from the works
TfL	Transport for London
Trunk main	A Trunk Main is a water main which interconnects source(s), treatment works, reservoir(s), and/or supply areas, normally without direct consumer connection(s)
TUB	Temporary Use Ban – demand management action which temporarily restricts non-essential use of water by customers during a drought (formerly a 'hosepipe ban')
Turbidity	Turbidity is cloudiness or opacity in the appearance of a liquid caused by solids, particles and other pollutants. Turbidity measurement provides an indication of the clarity of water and water quality
TW	Thames Water
UKCP18	UK Climate Projections 2018
UKWIR	UK Water Industry Research
WAFU	Water Available for Use - the total volume of all the water that we are able to produce and make available, to supply customers
WFD	Water Framework Directive – a European Union directive which commits EU member states to achieve 'good' qualitative and quantitative status of all water bodies by 2027
WINEP	Water Industry National Environment Programme - a programme of investigations and actions for environmental improvement schemes to ensure that water companies meet their statutory environmental obligations (preceded by NEP)
WRE	Water Resources East - a multi sector regional planning group
WRMP	Water Resources Management Plan – 25-year plan which water companies use to plan ahead and manage their water resources
WRMP19	Water Resources Management Plan 2019 – the WRMP that we are currently delivering
WRMP24	Water Resources Management Plan 2024 (final document)
WRPG	Water Resources Planning Guidelines
WRSE	Water Resources South East - a water company regional planning group
WRW	Water Resources West – a group of abstractors, their representatives and their regulators

WRZ	Water Resource Zone – the largest possible zone in which all resources, including external transfers, can be shared and, hence, the zone in which all customers will experience the same risk of supply failure from a resource shortfall
WSP	Water Saving Programme
WTP	Willingness to Pay
WTW	Water Treatment Works
WwTW	Wastewater Treatment Works

Affinity Water