WRMP24 Technical Document

Supply forecast

April 2025

Supply Forecast Technical Document

1 WRMP24 Introduction

1.1 About our company

Anglian Water is the largest water and wastewater company in England and Wales geographically, covering 20% of the land area.

We operate in the East of England, the driest region in the UK, receiving two-thirds of the national average rainfall each year; that's approximately 600mm.

Our region has over 3,300km of rivers and is home to the UK's only wetland national park, the Norfolk Broads.

Between 2011 and 2021, our region experienced the highest population increase in England. Despite this, we are still putting less water into our network than we did in 1989.

1.2 Planning for the long term

Our company Purpose is “to bring environmental and social prosperity to the region we serve through our commitment to Love Every Drop”. This purpose is at the heart of our business, having been enshrined in our Articles of Association in 2019.

Central to delivering this purpose is planning for the long term; one of the strategic planning frameworks we use to achieve this is the Water Resources Management Plan (WRMP), which details how we will ensure resilient water supplies to our customers over the next 25 years.

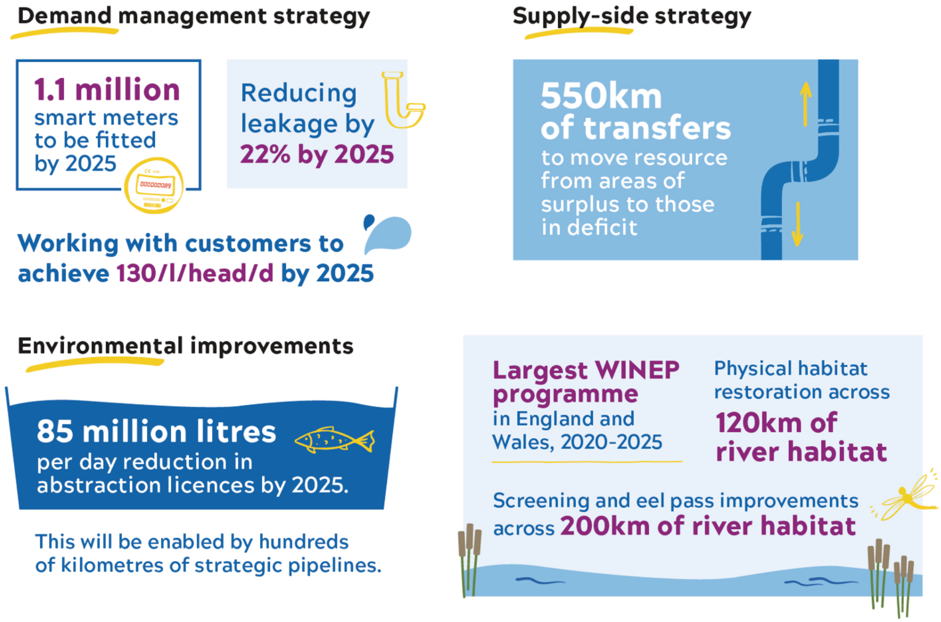
A WRMP looks for low regret investments[1] for our region, giving flexibility to adapt to future challenges and opportunities such as technological advances, climate change, demand variations, and abstraction reductions.

1.3 Water Resources Management Plan

We produce a WRMP every five years. It is a statutory document that sets out how a sustainable and secure supply of clean drinking water will be maintained for our customers. Crucially it takes a long-term view over 25 years, allowing us to plan an affordable, sustainable pathway that provides benefit to our customers, society and the environment.

Our previous WRMP, WRMP19, had an ambitious twin track strategy, combining an industry leading smart meter roll out and leakage ambition with a strategic pipeline across our region, bringing water from areas of surplus to areas of deficit. An overview of the WRMP19 strategy can be seen in Figure 1 below.

Figure 1 Our WRMP19 twin track approach



1 Investments that are likely to deliver outcomes efficiently under a wide range of plausible scenarios

This WRMP focusses on the period 2025 to 2050, and is known as WRMP24. We have developed it by following the Water Resources Planning Guideline (WRPG)[2], as well as other relevant guidance, in order to meet our statutory requirements. This has ensured our WRMP24:

- Provides a sustainable and secure supply of clean drinking water for our customers.
- Demonstrates a long-term vision for reducing the amount of water taken from the environment, and shows how we will protect and improve it.
- Is affordable.
- Maintains flexibility by being able to respond to new challenges.
- Complies with its legal duties.
- Incorporates national and regional planning; and
- Provides best value for the region and its customers.

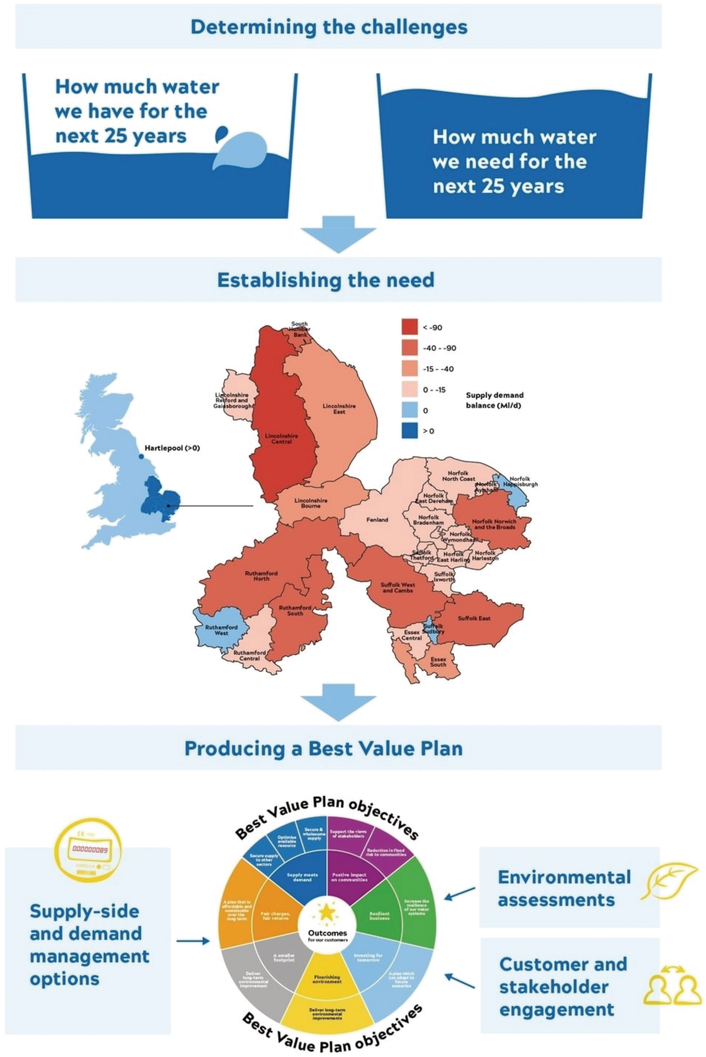
1.4 Developing our WRMP

Our WRMP24 has been progressed following the processes detailed in the WRPG, as shown in Figure 2.

We start by determining the extent of the challenges we face between 2025 and 2050. We achieve this by developing forecasts to establish the amount of water available to use (supply forecast) and the amount of water needed (demand forecast) in our region. When these forecasts are combined, a baseline supply-demand balance is created. This tells us whether we have a surplus of water or a deficit, establishing our water needs for the planning period.

An appraisal for both demand management options and supply-side options is undertaken, starting with an unconstrained list of possible options which progresses through various assessments until a final constrained list is determined.

Figure 2 A high level overview of our WRMP24 planning process



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

Demand management options aim to reduce the amount of water being used by our customers and lost in our water network. Examples of these options include smart metering and the promotion of water efficiency measures, such as reducing shower times. Supply-side options are also developed; these provide additional water to supply to customers. Examples of these options include new raw water storage reservoirs or water reuse treatment works.

We environmentally assess both demand management and supply-side options so we can understand their potential environmental impacts and what could be put in place to mitigate these impacts; in some cases we exclude options from further consideration.

The next step is for the water savings associated with the chosen demand management option to be added into our baseline supply-demand balance to determine if our region's water needs are met. If the demand management options savings do not solve the need, supply-side options are added into the modelling process. This is undertaken in our Economics of Balancing Supply and Demand (EBSD) model which conducts numerous modelling runs, creating a range of plans that meet our objectives. These plans are also environmentally assessed.

We develop a best value plan from these different model runs and environmental assessments, encompassing the views of our customers and stakeholders who have been consulted throughout the plan's development.

1.5 Best value plan

To ensure we develop the right solution for our region's water needs, we have focused on 'best value'. To us, best value is looking beyond cost and seeking to deliver a benefit to customers and society, as well as the environment, whilst listening and acting on the views of our customers and stakeholders.

These views, from our customers and stakeholders, have helped build our best value framework, shown in Figure 3 which has been used as the basis for our decision making.

Figure 3 Our best value planning objectives

1.6 Our WRMP24

Our best value plan, has been produced following a public consultation on our draft WRMP24. This consultation ran from December 2022 to March 2023. Taking into account consultation feedback and our revised forecasts, we:

- Increased our leakage ambition from 24% to 30%.
- Included projected non-household demand for the South Humber Bank, in north Lincolnshire.
- Developed non-household demand management options.
- Recognised further opportunities to utilise the existing resource we have, and
- Removed abstractions from the supply forecast that are likely to be closed due to Habitats Regulations.

1.7 Strategic context of the WRMP24

Our WRMP24 aligns with our Purpose, as well as internal and external strategic plans and initiatives. We have worked collaboratively with internal and external stakeholders, regulators and other water abstractors to achieve this.

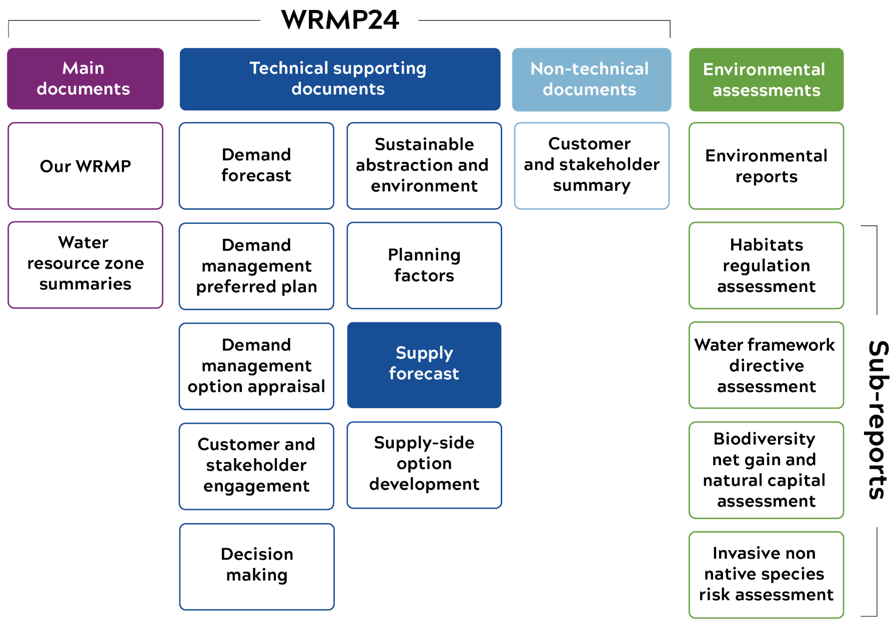
These interactions are highlighted throughout our WRMP24, showing the importance of collaborative planning. For instance, Regional Plans led by Water Resources East (WRE) and Water Resources North (WReN) have been significant in shaping our investment priorities and requirements, with WRE demonstrating the valve of the strategic regional options (SROs) at the regional, multi-sectoral level.

Our WRMP24 has helped to shape our company investment strategy for the Price Review (PR24), as well as our Long Term Delivery Strategy. We have also maintained close links with the Drainage Wastewater Management Plan and our Drought Plan.

1.8 Guide to our WRMP24 submission

Our submission comprises a non-technical customer and stakeholder summary, our main report and nine technical supporting documents, shown in Figure 4 below. These technical documents are supported by a suite of independent environmental assessments.

Figure 4 Our WRMP24 reports



This is the WRMP24 Supply forecast technical s upporting document.

2 Executive Summary

We have developed our supply forecast in line with the relevant guidance and this document details the technical methodologies used.

Our water resource simulation model within the AQUATOR software has been used again to calculate system deployable output. A number of model updates have been made since Water Resource Management Plan 2019 to best represent our supply system across the region. In particular, we have produced new rainfall-runoff models for all of the catchments relating to our raw water supplies. We opted to use the GR6j model for all of our catchments, which have been calibrated to river gauging stations or a distributed model where gauging station data wasn't available.

This supply forecast has a number of additional deployable output impacts compared to previous Water Resource Management Plans (WRMP). The potential impacts for each water resource zone are:

- 1 in 200yr drought resilience (captured in WRMP19)
- 1 in 500yr drought resilience
- Recent actual peak licence caps (captured in WRMP19, but only at individual sources)
- Recent actual average licence caps for time-limited licences
- Recent actual average licence caps for all licences
- Climate change (captured in WRMP19)
- Environmental destination

To avoid double counting of deployable output impacts at the same sources, we have applied an order of impact reflecting licence changes, resilience to drought and climate change.

The use of stochastic information from regional weather generators has also evolved since WRMP19. We have utilised the updated version of the Atkins Weather Generator to produce 19,200 years (400 sequences of 48 years in length) of rainfall and potential evaporation (PET) for both regional planning and WRMP24. This allows us to produce river flows for our catchments to estimate the impact of a given severity drought event (i.e. 1 in 500 year), which is not within our historical river flow catalogue.

The UKCP09 Spatially Coherent Projections projects are no longer in use and are replaced by UKCP18 12 bias-corrected Regional Climate Models for Representative Concentration Pathway 8.5. These can be combined with the stochastic record to allow the impacts of climate change to be assessed in the future, in combination with particular drought events.

We have a base year deployable output for our entire system of 1437 Ml/d, which is 40Ml/d more than the equivelent year (2025/26) within the previous WRMP19.

The potential impacts of the 1 in 500yr drought has been robustly tested through the application of a second weather generator created by the Met Office, known as the Applied Meteorology Explorer (AME). The outputs from the AME have been compared to the outputs from the Atkins weather generator to add confidence to the deployable output impacts within the supply forecast and the level of resilience required for our customers.

Analysis and further modelling has also been undertaken in addition to the deployable output changes through the planning horizon to understand uncertainty and system performance to impacts. This has been assessed to confirm understanding within the supply forecast and also within the target headroom analysis for the current WRMP.

3 Introduction

3.1 Overview

The purpose of the Water Resources Management Plan (WRMP) is to ensure a secure and sustainable supply of water, focusing on efficiently delivering the outcomes that customers want, while reflecting the value that society places on the environment. In our WRMP, we have presented a reliable supply of water in the base year forecasted to 2050, in accordance with the Water Resources Planning Guideline (WRPG). This is how much water is reliably available to supply customers in each of our Water Resource Zones (WRZs) during drought.

This report describes the supply forecast process in support of the WRMP24 to assess our sources' response to current constraints, climate change, sustainable abstraction, licence capping, droughts and environmental destination.

3.2 Developing the supply forecast

The guideline states that water companies should base the supply forecast on the system response. This means the forecast will adequately capture system constraints, conjunctive use capability and operational response.

Our reliable supply of water is assessed within the supply forecast for each WRZ. The WRPG states this needs to comprise:

- the deployable output (DO) for each source (or group of sources)
- future changes to deployable output from sustainability changes, including long term environmental destination, a changing climate and any other changes expected
- existing transfers and schemes where planning permission is already in place
- an allowance for short term losses of supply and source vulnerability, known as outage
- any operational use of water or loss of water through the abstraction-treatment process
- a supply forecast that combines all the elements described into Water Available for Use (WAFU)

The report is structured to detail the approach we have taken to quantify each of these elements. In line with the guideline, we have considered all individual components making up the supply forecast, and taken account of pressures on future supplies. We consider each element in turn:

- Supply forecast approach and DO assessment (Section 4)
- Sustainable abstraction (Section 5)
- Selection of design droughts (Section 6)
- Climate change (Section 7)
- WRMP24 links to Drought Plan 2022 (Section 8)
- Changes in contractual arrangements relating to transfers (Section 9)
- Other supply forecast related items (Section 10)

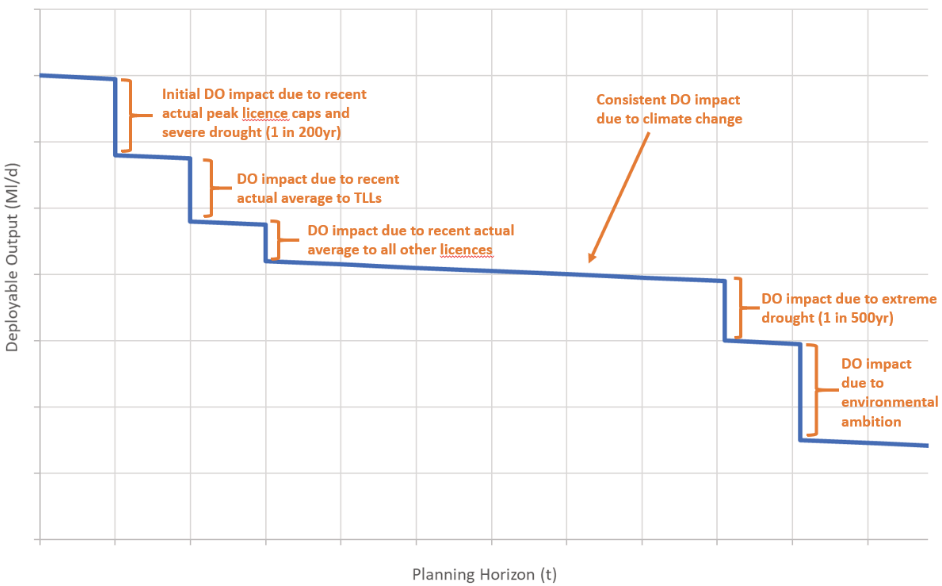
3.3 Future changes to deployable output

The future changes to DO (sustainability reductions, abstraction licence capping, drought, climate change and environmental destination) have been assessed in a fixed order to avoid double counting of impacts at the same sources:

1. 1 in 200 year drought and abstraction licence capping to recent actual peak (also known as Max Peak), including capping by alternative drivers e.g. WINEP
2. Further abstraction licence capping e.g. recent actual average
3. 1 in 500 year drought
4. Climate change
5. Environmental destination

The order of impact reflects the move to 1 in 200 year drought resilience and capping of licences to recent actual peak, including known sustainability reductions as a baseline starting position. From here the impact of the move to recent actual average for time limited licences (TLLs), followed by the impact of recent actual average for all licences can be assessed directly. The impact on DO of increasing resilience to a 1 in 500 year drought event has been assessed, together with climate change impacts for both 1 in 200 year and 1 in 500 year baselines, in order to understand the difference in climatological system response depending on the level of drought resilience adopted. Lastly, environmental destination impacts are modelled, which vastly reduce the allowable abstractions from the environment within the system. These have also been assessed with 1 in 200 and 1 in 500 year baselines, to allow these environmental improvements to be brought in as early as reasonably possible within the plan. Figure 5 demonstrates the cumulative impact of successive DO reductions on the supply forecast through the planning horizon.

Figure 5 Example DO impacts for WRZ(i)



Modelling in this way allows impacts to be individually quantified and avoids double counting at sources vulnerable to more than one impact. In example WRZ(i), there is DO reductions associated with:

1. 1 in 200yr drought and the move to recent actual peak licence caps
2. Move to recent actual average licence caps for TLLs
3. Move to recent actual average licence caps for all other licences
4. Move to 1 in 500yr drought resilience
5. Finally the impact of achieving a particular environmental ambition
6. Climate change impacts consistently run through the period causing reduced DO

These DO impacts result in a cumulative total impact on the deployable output by the end of the planning horizon. Detail on how we have quantified and applied the impact of each change is detailed in the following sections.

3.4 Sustainable abstraction

Where licence change is necessary to prevent deterioration, licences have been grouped into those capped at recent actual average abstraction or at the maximum peak volume of water abstracted in any one year of a representative abstraction period. Within the supply forecast, all of the groundwater abstraction licences within our region are assumed to be capped to at least a recent actual peak, moving to a recent actual average during the planning horizon. This is in addition to any measures driven by the Water Industry National Environment Programme (WINEP) and the National Environment Programme (NEP) or any other environmental or ecological drivers.

Within our environmental ambition, we have modelled further reductions to all abstraction licences to a particular environmental destination scenario based on environmental and flow requirements in our catchments.

3.5 1 in 500 year drought and climate change

We have planned to increase the supply resilience of our WRZs to a 1 in 500 year drought event in accordance with the Water Resources Planning Guideline (WRPG). To define this, stochastic traces have been produced to identify sample droughts that represent an equivalent return period. The same stochastics have also been used to estimate a 1 in 200 year drought event, which forms the baseline of the supply forecast.

Climate change has been incorporated into the stochastics time series providing a number of plausible future climates. The change in supply as a result of climate change can be attributed to a future time slice and scaled back to estimate the impact through time.

4 Supply forecast approach

We define our DO as the annual average output that can be reliably supplied from commissioned sources or group of sources within a WRZ, during a design drought, with current infrastructure. We have assessed DO in accordance with the processes set out in the Handbook of Source Yield Methodologies (UKWIR, 2014).

AWS utilise the AQUATOR water resource simulation modelling software, which was previously used in WRMP19. AQUATOR offers a more accurate and advanced method for calculating DO, compared to the traditional spreadsheet DO method, which we had adopted in the past (i.e. WRMP14). AWS have carried out rigorous data input verification since WRMP19, with many data inputs now audited and replaced with more recent information. These include:

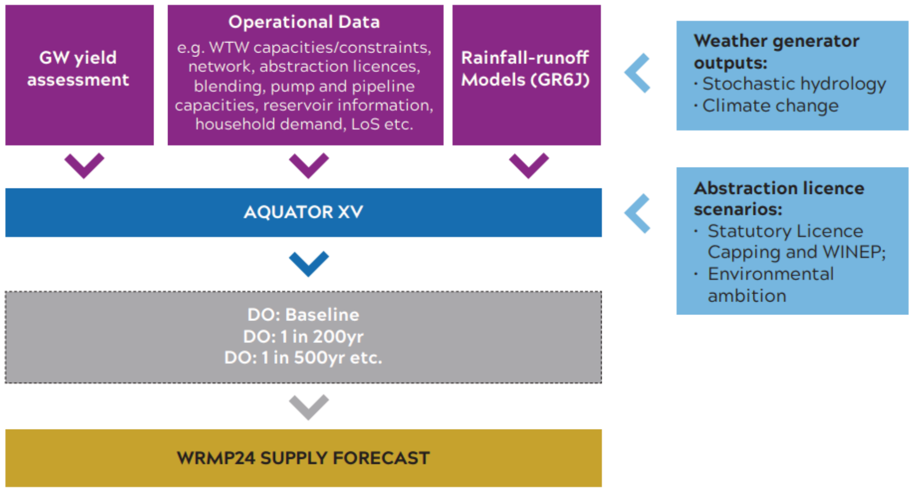
- Simulated catchment flow series (historical and stochastic)
- Total demand at Planning Zone (PZ) level (equal to a demand centre in AQUATOR)
- Demand profile for each demand centre (or WRZ)
- WTW capacities
- Process losses
- Groundwater (GW) source pump capacities
- Abstraction licences
- Network geometry and constraints
- Water Resource Zones (subject to WRZ Integrity)
- Reservoir control curves
- Reservoir dead storage and emergency storage.

The customised WRZ selector tool, which allows associated WRZs to be run in tandem with the WRZ of interest, is utilised so that group licences, which span across multiple WRZs, can be accounted for.

Further developments of note, is the ability to now run Critical Period (CP) DO in AQUATOR, which ensures network and system constraints are represented in the CP calculation.

Figure 6 illustrates the main inputs to AQUATOR and the supply forecast.

Figure 6 Supply Forecast Input Flow



4.1 Rainfall-runoff models

Our rainfall-runoff models required updating ahead of WRMP24 to incorporate the most recent past. In addition, new enhanced weather datasets have been released allowing the extension of simulated flow series back to the 1890s. This, together with the need for a more automated simulation of stochastic scenarios, had prompted the current upgrade of rainfall-runoff models across the region.

As part of our WRMP24 scoping phase, a review was undertaken of potential available datasets and modelling approaches, the results of which were summarised in a Phase 1[3] and Phase 2[4] report. As part of the Phase 1 scoping study different rainfall and potential evapotranspiration (PET) datasets were tested, with the HadUK-Grid 1km rainfall and HadUK-Grid 12km derived PET being chosen given their long temporal coverage, their reliability in the distant past, the fact they are provided

3 Mott MacDonald, November 2019, Rainfall-runoff modelling scoping study. Phase 1
4 Mott MacDonald, December 2019, Rainfall-runoff modelling scoping study. Phase 2

under an Open Government Licence, and their better performance while used in rainfall-runoff modelling. Seven lumped rainfall-runoff models (HYSIM, HBV, PDM, NAM, Catchmod, GR4j and GR6j) were tested in two exemplar catchments, resulting in the shortlisting of the three strongest performing models (HYSIM, HBV and GR6j) for further testing in Phase 2 for a further seven catchments including a larger routed system. As part of Phase 2, further testing a distributed model called TETIS was undertaken to assess if improvements could be made on flow estimation in areas with no or limited flow gauging data.

Our Phase 2 scoping study concluded that GR6j was the preferred lumped model based on its performance, ease of calibration, open source code and ability to be coded in Python. However, it was recognised that lumped modelling approaches can introduce a significant bias when applied to ungauged locations situated far from gauging stations and/or in areas with different hydrological response. This is particularly exacerbated when the contribution of the Chalk to surface flows is relevant. Distributed approaches constitute a better choice in these cases. Even though fits to recorded flows are slightly worse than in lumped approaches, the fact that the calibration is undertaken globally over spatially distributed parameters enables a more reliable estimation of flows at ungauged locations. In light of this, we implemented a combination of lumped and distributed models with the distributed model being used to inform the application of the GR6j lumped models in particular cases.

The main outcomes from this work are:

- HadUK rainfall data has been extracted and reviewed for all catchments. Long-term trends have been identified in the rainfall records, although in many cases there is a certain amount of interannual variation where no clear trends are apparent. The option for detrending rainfall for use in historical simulation was considered. However, it was decided that rainfall data should be left in their original form, because of uncertainties in the way that these trends can affect the modelled hydrology and whether those changes would be reasonable.
- PET series have been derived from HadUK climatic datasets using the modified Penman-Monteith equation. Long-term trends have been identified in the individual climatic parameters which when translated to changes in PET give an average 3.4% increase over the long-term record. The individual climate series have been detrended for use in historical simulation, leading to detrended series of PET that reflect recent (2018) conditions.
- Artificial influence data has been processed for PWS and non-PWS surface water and groundwater abstractions. Dry weather flows have also been derived for Water Recycling Centre discharges within the region.
- The approach to model calibration involved development of distributed models for each basin using TETIS which were used to gain an understanding of how the modelled flows at different gauging stations perform in comparison to each other using a spatially consistent modelling approach. The conclusions from the TETIS modelling have then been used to inform the application of the GR6j models in calibration and for model simulation.
- Automatic calibration of the GR6j models has been adopted using the Shuffled Complex Evolution algorithm applied to a bespoke objective function, which considers the volume error, NSE, Log-NSE and a statistical measure of the FDC fit (Log-NSE FDC) which has resulted in efficient calibration and confidence that the optimum model solution has been found.
- Long-term verification checks have been undertaken at key locations in the Anglian catchments where flow series are available covering historic droughts in the 1970s and 1990s.
- Models have been validated on an alternative period of flow data where possible. This process has highlighted variable performance across the two standard periods adopted (generally 10/2010-09/2018 for calibration and 10/2002-09/2010 for validation) and it has sometimes been necessary to switch periods in order to provide model fits that are more reasonable across both periods and when cascading downstream.
- There is an indication that calibration to the later period sometimes (but by no means always) results in over-simulation in the earlier period. The reasons for this remain unknown though there are some clear examples where this is due to issues with the quality of the observed flow data which in these cases has deteriorated in the recent period. On other occasions, where this over-simulation effect is smaller, it may be due to more subtle changes in flow estimates due to reductions in maintenance resulting in e.g. increased siltation and/or weed growth

at stations. Potential uncertainties in the input rainfall, PET or artificial influence data also cannot be ruled out.

- Despite these issues, and through using the TETIS models to guide the application of GR6j and adopting automatic calibration, good model fits were achieved, both in terms of volume error and FDC fit, along with NSE values in both calibration and validation periods.

Long-term historical simulations for AWS intakes, reservoirs and other locations of interest have been derived for 1891 to 2018 using rainfall, detrended PET and a 5 year recent average profile (2014-2018) of artificial influence. To align with the AQUATOR model the AWS surface water abstractions have been excluded. The flow series themselves show some sign of trend, though this mainly results from a particularly dry period in the early part of the record. Details of the catchments and the calibration and verification within GR6j is detailed in Phase 1[5] and Phase 2[6]reports.

The development of the GR6j models also included local information and recommendations from the EA, such as rating reviews and first-hand information of gauging locations. We have also made further amendments to the GR6J models to accommodate comments and recommendations made by the EA. This includes a flow reduction scenario which adopts lower discharge profiles from water recycling centres during dry weather. We have not been able to correlate these flows to recent dry summers, and has not been used within WRMP24. This is something we will continue to explore.

4.2 Levels of Service

DO modelling was conducted with and without the benefit of demand-side measures. Modelling including demand benefits was related to the company's stated Levels of Service (LoS), which is covered in more detail in Section 6.

Only WRZs with some surface water component (i.e. reservoir) were modelled in AQUATOR with the potential for a demand savings benefit. WRZs with a surface water abstraction, but no reservoir (with LoS curves), were linked to a particular reservoir for demand saving activation. The hydrology was assessed prior to modelling to find the most suitable proxy. GW-only WRZs have not been modelled with demand savings, as the current representation of GW sources as a static yield means that any demand savings in the historical model run period would not produce a benefit in DO.

4.3 Process losses

The percentage of water lost to water treatment has been discussed extensively within the business, and as a result, we have defined an internal methodology for capturing this parameter within AQUATOR. For groundwater treatment works, the type of on-site treatment will dictate the percentage loss attributed to that works as follows:

- Iron Removal / Filters / GAC: 5%
- IX/Nitrate: 2%
- Recirculation: 2%
- UV only: 1%

If more than one treatment exists, these percentages are added together. For example, a WTW with filters and IX would have a process loss of 7%. Historical telemetry data confirms that this definition of process loss is accurate for the groundwater sites, however, due to the unique nature of surface water treatment works across our region, each works is assessed individually for process losses.

Capturing process losses in AQUATOR is important to avoid the risk of over or underestimating simulated deployable output. For example, failure to include losses within the modelling process could lead to reporting a higher deployable output than is possible (without breaching licence conditions). On the other hand, applying set percentage reductions in source outputs post-modelling could underestimate DO, as the model may be able to use additional licence (if under-utilised due to say, network constraints) to fulfil the process loss volume. Furthermore, the model is able (in some situations) to prioritise sources that incur less treatment loss, compared to higher-loss sources.

4.4 WRZ transfers

For WRZ transfers, AQUATOR can determine the flow requirement given the resource state (and potentially cost, subject to the in-built optimiser setting) on the day of the model run. The flexible use of resource can

5 Mott MacDonald, September 2021, Rainfall-runoff modelling main stage. Phase 1
6 Mott MacDonald, September 2021, Rainfall-runoff modelling main stage. Phase 2

create a conjunctive DO benefit, where additional DO can be gained without any additional supply volume. This is turn may create a false supply demand balance (SDB) surplus that later Economics of Balancing Supply & Demand (EBSD) modelling uses to supply regions of the system which have SDB deficits. For this reason, WRZs will be assessed for DO individually, with no WRZ transfers. The only exception to this is our Ruthamford WRZs, which are highly interconnected. As a result, this particular group of WRZs are modelled conjunctively and the DO is split out at a later stage.

EBSD will take the WRZ DO, and provide solutions for future deficits utilising available transfer routes as necessary. Any solutions can then be tested post-EBSD modelling through water resource simulation modelling.

There are a number of funded schemes from WRMP19/PR19 that are included in the baseline DO assessment within AQUATOR, which are listed in the Appendix underTable 14. The majority of these are intra-WRZ schemes, whereas schemes across multiple WRZs are more likely to be captured in EBSD (as a general rule).

4.5 Approaches to assessing deployable output within AQUATOR

Aquator has two in-built methods for deployable output analysis. These are known as the English and Welsh method and the Scottish method.

- The English and Welsh method steps through incremental demand at set intervals until the first failure, which defines the DO. A user can specify whether or not LoS form part of a failure condition, with the user able to specify the maximum number of crossings of LoS curves (the number of crossings is equivalent to a return period when compared against a time series of known length).
- The Scottish method steps through demand at set intervals and records the number of failures. The DO is then stated as a function of the number of failures using an extreme value distribution. For example, the 1 in 500 year DO could be calculated as a run which has no more than 38 failures in a 19,200 year (400 sequences if 48 years in length) simulation.

We consider the English and Welsh method to the most appropriate for DO assessment within the Anglian region. Further justification for this is provided in later sections.

4.6 Application of DO assessment method

AQUATOR is run at a starting base demand, with this demand being distributed across selected demand centres based on their relative contribution to overall demand. This base demand is tested by stepping through increasing demand values to find the maximum demand that can be satisfied from a source/system. The point at which demand can no longer be met is then considered to be the DO of the WRZ. It should be noted the demand in this context becomes theoretical as it is ramped up.

For certain areas, WRZs were considered conjunctively in a joint model to capture the existing interzone connections and drought resilience benefits. The same applies to WRZs that share group abstraction licences. This required adaptation of the above approach where the DO of connected zones could be considered in relation to the WRZ in question.

The English and Welsh DO method within AQUATOR records the first failure to supply and the resulting DO therefore represents the water supplied to a set of specified demand centres (DCs) one demand step below the first failure recorded. This distinction is important at WRZ level, as within AQUATOR the DO represents the demand supplied to a set of DCs rather than the source output. In discrete zones, this is irrelevant as the demand supplied will be the same as the source output. However, in more complex zones with connections between WRZs this may not be true and the demand supplied may not be representative of the source output within a zone.

4.7 Key modelling details

Assumptions of DO modelling for WRMP24 include:

- DO failure when reservoir stocks fall below the pre-defined Levels of Service 4 curve
- DO failure when reservoir stocks fall below the emergency storage volume
- Demand centre and DO failure when water available to meet demand is less than demand requested
- Model exports are static in that they do not have an assigned demand profile, and can cause DO failure
- Abstraction licences run from January to December (unless rolling day)

- DO will be calculated with and without drought permits;
- DO will be calculated with and without company demand savings

4.8 Baseline DO changes since WRMP19

There have been a number of changes to DO since the last WRMP, as a result of updates to river flows, WTW and pump capacities, GW yields and losses, and WRZ delineation. Table 1 shows the reported total DO for our region as forecasted in 2025/26. The difference in total DO for the same year from WRMP19 to WRMP24 is 40 Ml/d. The majority of the difference is attributed to the implementation of the interconnectors, taking locked-in resource, which previously couldn't be counted as deployable output in WRMP19, to other parts of our region where water resources are stretched. The other large difference is a reduced climate change impact using the latest emission scenarios; assessed with and without severe and extreme droughts. As a result, the marginal impacts of climate change are relatively small in comparison to the other supply reductions; drought resilience, licence capping and environmental destination.

Table 1 Comparison of WRMP19 and WRMP24 DO numbers for 2025/26 (rounded up)

Plan	Reported total DO in 2025/26 (Ml/d)
WRMP19	1397
WRMP24	1437

To understand the difference between these numbers at a WRZ level, refer to the Appendix Table 13 and the discussion on the differences that follows.

In terms of changes to sources of water within the DO calculation, the following sources have been added (part of the Alternative North Lincolnshire Option), where previously they were discounted due to long-running operational issues:

- Habrough
- Barton

The following sources have been removed or reduced within the calculation as a result of ongoing problems with raw water quality that cannot be resolved based on the current operation of the treatment works:

- Clapham abstraction removed (water quality causing long periods offline)
- Hall WTW output reduced to 13 Ml/d (water quality limited production)
- Belstead BH output limited to 4 Ml/d (salinity reducing output)

Table 2 Deployable output impacts by WRZ

WRZ	RA TLL Average	RA Average	1:500	Climate Change	BAU+
EXC	√				√
EXS	√		√	√	√
FND	√	√	√	√	√
HPL		√			√
LNB	√	√			√
LNC	√	√	√	√	√
LNE	√	√			√
LNN	√	√			√
NAY		√			√
NBR	√				√
NED	√	√			√
NEH	√				√
NHA	√	√			√
NHL	√	√			√
NNC	√	√			√
NTB	√				√
NWY	√	√			√
RTC	√	√			√
RTN			√	√	√
RTS	√	√	√	√	√
RTW	√	√			√
SUE	√		√	√	√
SUI					√
SUS		√			√

WRZ	RA TLL Average	RA Average	1:500	Climate Change	BAU+
SUT	√	√			√
SWC	√	√	√	√	√

√	1 in 500 year drought only

The impacts associated with each WRZ can be simplified in the table Table 2, where a tick demonstrates that the WRZ deployable output has been impacted as a result of a given future system constraint. Not all WRZs will have an impact under each column, as some may not have time-limited licences (TLLs) for example, while other zones will only have TLLs, or capping may have already taken place during AMP7 through specific drivers.

5 Sustainable abstraction

This section discusses the DO implications of applying sustainable abstraction to our sources of water. Sustainable abstraction is divided up into the following categories:

- Sustainability reductions
- WFD no deterioration licence capping (recent actual peak or average)
- Habitats Directive licence changes (Ant Valley, Broads SAC area licences will be reduced or revoked)
- Environmental destination

5.1 Sustainability reductions

The AMP6 NEP programme specified 28 waterbodies and designated sites where the Environment Agency considered that our current abstractions were causing, or had the potential to cause, environmental harm. An extensive investigation and options appraisal process resulted in the development of solutions designed to deliver environmental benefits and to provide the best value for our customers. Although many of the mitigation measures and sustainability changes that we need to deliver have an agreed implementation date within AMP7, new WINEP obligations could lead to impacts on the supply forecast in AMP8. These are expected to be tweaks to existing conditions, and therefore large supply forecast reductions are not anticipated.

5.2 WFD no deterioration

The Water Framework Directive (WFD) requires us to 'prevent deterioration of the status of all bodies of surface water and groundwater'. We recognise that we have a duty to ensure that deterioration of the environment does not occur as a result of our abstractions for public water supply. In order to address this, and through collaboration with the Environment Agency, we assessed our abstractions and the risk they pose to water-bodies based on future forecast growth. In WRMP19 we committed to maintaining our groundwater abstractions below recent historical peak abstraction rates, to eliminate the risk of deterioration. We have now been asked by the Environment Agency to limit abstraction where there is flow failure at recent actual average rates of abstraction and one of (i) ecological Reason for Not Achieving Good (RNAG) status linked to flow (ii) another known abstraction pressure (iii) growth in abstraction levels above recent actual average.

Note that where we cannot implement licence caps without interruption to supply, we will submit cases of Overriding Public Interest or Imperative Reasons of Overriding Public Interest (Habitats Directive) to the Environment Agency. These cases will demonstrate that we need to delay caps until we have additional sustainable sources of water to replace losses in DO that are a direct result of caps to licensed quantities, in order to leave more water in the environment. As part of this process we are looking at sustainable levels of reductions we can commit to before we can meet the full cap required.

For cases of Overriding Public Interest (OPI) that are currently being considered, we have adopted an interim annual licence volume for the period from April 2025 to March 2030. This interim volume reflects the latest in the OPI discussions to date, on those OPIs that had an expiry date in 2022/23. The interim volumes included within the supply forecast will overwrite the previously assumed RA Peak licence volumes (quoted in the Appendix) for the sources in question (see Table 3).

Table 3 Licence interim volumes as a result of current OPI cases

Licence Number	Interim Volume (Ml/yr)
8/37/21/*G/0064	3700
8/37/31/*G/0133	6132
8/37/31/*G/0214/R02	1274
6/33/48/*G/0021	1700
AN/033/0044/021/R02	1150
6/33/42/*G/0020	1000
AN/034/0014/002/R01	2250
7/34/13/*G/0186	1228
7/34/14/*G/0090	2600
7/34/13/*G/0229	1979
AN/034/0013/011/R01	1500
AN/033/0048/005/R02	794
6/33/45/*G/0016	1850
6/33/56/*G/0096	1500
6/33/56/*G/0055	3800
6/33/37/*G/0343	700
AN/033/0037/001/R02	1500
6/33/39/*G/0008	1408
6/33/37/*G/0205	3318
6/33/37/*G/0428/R02	1500
6/33/37/*G/0032	1200
8/36/11/*G/0070	4000

The approaches to licence capping and appeals depend on the type of licence. With time-limited licences we need to meet the conditions when the licence expires, whereas changes in permanent licences are voluntary unless the Environment Agency invoke Section 52 of the Water Resources Act 1991.

To ensure we can achieve the required demand from our customers within all of our WRZs, there may be a need to abstract above our Peak Max on two of our permenent licences in our Suffolk West and Cambs zone. If this was the case, we would still abstract within our current annual licence limits for those sources of water, and our ability to not meet Peak Max would be temporary (~2 years). The licences identified in this case are:

- 6/33/36/*G/0181
- AN/033/0036/002

Surface water abstractions do not pose a significant deterioration risk due to existing licence constraints such as Hands Off Flow and Minimum Residual Flow conditions, and hence no sustainability changes related to WFD no deterioration are expected.

Abstraction licence capping in the supply forecast could follow one of eight scenarios depending on the which sources are time-limited licences (TLLs) and whether they can be capped without interruption to supply.The selection of scenario could vary by WRZ and will be detailed further in the Decision making technical supporting document. Details of the licence caps used for each scenario can be found in the 11.

Table 4 Licence capping scenarios and dates of implementation

Licence Cap Scenario	Capped at Peak		Capped at Average	
	Time Limited Licences	All other Licences	Time Limited Licences	All other Licences
1	-	-	2022-2024	2025
2	2022-2024	-	2025	2025
3	2022-2024	-	2025	2030
4 - core scenario	2022-2024	2025	2030	2036
5	2022-2024	2025	2036	2036
6	-	-	2022-2024	2030
7	2022-2024	2025	2030	2032
8	2022-2024	2025	2030	2030-2036

It is not accepted that the changes in the amount of water that can be abstracted between scenario 6 and the other feasible scenarios necessarily causes deterioration or presents a risk of that nor that the use of scenarios other than 6 automatically gives rise to the need for OPI. However even if OPI is required in order to amend or alter licences our policy decision modelling shows that OPI would be satisfied.

5.3 Habitats Directive - Abstraction Reform

The Habitats Directive is European legislation (transposed into UK law) to maintain/restore natural habitats and species of European importance. It takes a "precautionary approach" whereby if you cannot rule out there is an impact or an adverse effect then action must be taken (i.e. it does not need to be fully proven by science). However, decisions to revoke or reduce a licence are usually associated with significant scientific evidence and modelling at a localised scale (e.g. the Ant Valley).

Within the Ant Valley area we have been obligated to give up the licences at Ludham (closed March 2021), East Ruston and Witton (due for closure in 2024). Also linked to the Ant Valley investigation, is our Kirby Cane and Thorpe St Andrew / Postwick licences. Although the outcome of these sources is uncertain at this point, our discussions with the Environment Agency to date has led us to assume these licences will be revoked by 2030. As a result, this assumption has been included within the supply forecast.

5.4 Environmental destination

Since the development of WRMP19 there has been a step-change in national ambition with regards the environment, as illustrated by the 25-Year Environment Plan, Environmental Improvement Plan 2023, the Plan for Water 2023, all part of the Government commitment to be the first generation to leave the environment in a better state than we found it[7]. More specifically to delivering sustainable abstraction and the environmental destination, there is an emphasis on defining and agreeing a long-term approach with appropriate short, medium and long-term measures in place to meet the priorities throughout the planning period.

This ambition is reflected in the National Framework[8], which aims to achieve a step-change in the way that we plan for the environment's water needs. This includes:

- Developing a long-term vision (or destination) for sustainable abstraction that accounts for the impacts of climate change on environmental flows. It is hoped that by proactively planning for environmental needs, future pressures can be anticipated so that water supplies can be secured for both abstractors and the environment.
- Working with other sectors to define and understand the problem, as well as collaborating on common solutions that deliver changes to abstraction and reduces reliance on low flows.
- Considering the costs and benefits of reduced abstraction at a regional level, as opposed to an individual site. By trading off the benefits of reduced abstraction with the wider environmental impacts of new sources of supply intended to replace the water, it is hoped we can avoid unintended consequences and maximise opportunities (for example, the development of a strategic option may allow water companies to

7 DEFRA, January 2018, A Green Future: Our 25 Year Plan to Improve the Environment
8 Environment Agency, March 2020, Meeting our future water needs: a national framework for water resources

substantially reduce abstractions in more environmentally sensitive areas).

- Further analysis to explore where there might be more opportunities to access more water without compromising ecology and supporting existing environmental objectives.
- Regional groups are also required to consider opportunities for delivering environmental enhancement by reducing abstraction (over and above reductions that may be required as a result of climate change).

The environmental destination scenarios produced as part of the supply forecast are described in further detail below:

BAU

- Supports "Good" under WFD Environmental Flow Indicator (EFI)
- Screens out waterbodies that were classed as uneconomic in River Basin Management Plans (RBMPs)

BAU+

- Supports "Good" under WFD EFI
- Screens out waterbodies that were classed as uneconomic in RBMPs
- Higher protection for protected sites

ENHANCE

- Supports "Good" under WFD EFI
- Screens in waterbodies that were classed as uneconomic in RBMPs
- Gives additional protection for chalk streams, protected sites and sensitive headwaters

Details of the licence caps used for each scenario can be found in the appendix.

5.5 Modelling approach

In order to assess the impact on DO, alternative parameter sets are created within AQUATOR that include the licence reductions associated with the sustainable abstraction drivers. The timing of the sustainability changes in the supply forecast has been applied.

Environmental Destination has inherent uncertainty associated with it as the methodology is not source specific. Given these uncertainties, we have followed the Ofwat guidance on implementing Common Reference Scenarios to understand some of the future uncertainty around specific components of the WRMP. BAU has been used as the 'low' Common Reference Scenario, whereas ENHANCE has been selected as the 'high' Common Reference Scenario. The system-wide impacts on deployable output can be compared in Table 5 below.

Table 5 Environmental Destination Deployable Output Impacts

Environmental Ambition	Deployable Output Impact (Ml/d)
BAU	-186
BAU+	-241
ENHANCE	-364

6 Drought

The National Framework and the WRMP24 WRPG stipulates that the regions must plan to be resilient to a drought of a 1 in 500 year return period by 2039 at the latest. This is a higher level of resilience than WRMP19, where water companies were required to plan for a 1 in 200 year level of drought resilience. The Supplementary Guidance[9] indicates that this level of resilience should be demonstrated using system response rather than rainfall metrics; if suitable water resources systems models are available it is expected that stochastic datasets will be used to test systems against a wide range of severe droughts, with climate change evidence applied to drought events. The use of stochastic methods can capture random nature of past weather conditions, as well as providing a wider range of drought conditions for testing system resilience. Historical records have too few events to understand the full range of low probability high impact droughts, and stochastic methods can improve the estimation of this type of drought event.

6.1 Stochastic drought methodology

AWS are committed to providing resilient services that can cope with extreme events and future climate change. Multiple methods have been assessed to produce stochastic data for the recent historical period, as well as a stochastic dataset to model future droughts under climate change scenarios. AWS will utilise a portfolio of stochastic datasets, which have been applied in rainfall-runoff and recharge modelling (the latter for Water Resources East (WRE) only, as recharge models are not used for the WRMP) to produce river flow inputs, to allow the assessment of a wide range of drought scenarios, including the interaction with climate change. The stochastic data inputs into the WRE Simulator and WRMP24 models are identical.

There are two weather generators (WGs) that have been procured by AWS to provide the ensemble of synthetic meteorological scenarios in the form of rainfall and potential evaporation (PET) time series that has been used to estimate river flows through modelling:

1. Atkins WG WRSE[10]: the Atkins WG is an update to a previous version used in WRMP19 and was produced as part of an industry collaboration. The updated WG uses a new stochastic model, which uses data from 1950-2000 for calibration, as well as a new set of "climate drivers" alongside the North Atlantic Oscillation (NAO) and (Sea Surface Temperature) (SST) time series. The outputs were provided as 400 independent 48-year long replicates from 1950-1997, giving 19,200 years in total.
2. Met Office Advanced Meteorology Explorer (AME)[11]: a stochastic gridded daily rainfall generator suitable for exploring long-duration drought, created by the Met Office in collaboration with Anglian Water. The AME is developed based on hidden Markov models and copulas and allows for the simulation of physically consistent synthetic daily rainfall data, coherently in space and time, on a high resolution grid. Simulations are shown to accurately capture rainfall occurrence and intensity, as well as long-duration drought behaviour, which can be effectively used for drought and flood risk assessment. The outputs were provided as stochastics replicates of 100 years in length and do not require bias correction.

As shown in Figure 6, the outputs from the WGs were provided as data inputs to our rainfall-runoff models to provide catchment inflow series for use within AQUATOR. All surface water sources within AQUATOR will therefore be impacted by drought extracted from the stochastic record. This may or may not lead to an impact in DO and is dependent on the severity of the impact, licence conditions within the given planning scenario and the resilience of the WRZ.

6.2 Groundwater yield assessment

As part of its Water Resource Management Plan 2019 (WRMP19), we reviewed the impact of droughts more severe than those experienced in the historical record. To understand the impact of such droughts on regional groundwater resources, a yield assessment was undertaken using 200 stochastic 91-year time series of rainfall and temperature developed by the Met Office for the AMP6 (Phase 1) WRE project. These were run

9 Environment Agency, March 2021, Water resources planning guideline supplementary guidance - Stochastics
10 July 2020, Regional Climate Data Tools. Final Report
11 Met Office, March 2021. The Advanced Meteorology Explorer: Creating a Gridded Stochastic Dataset of Future Rainfall

through a lumped parameter model (LPM) for each regional aquifer to output time series of LPM groundwater storage which was then used to estimate stochastic drought groundwater yields.

A total of 64 sources were determined as being at some risk of loss of yield under droughts more severe than historically seen, either directly due to dewatering of key flow horizons, or indirectly through severe water quality failures, requiring reduction in output to maintain functional treatment. The total potential loss of groundwater yield is in excess of 150 Ml/d.

12 stochastic drought events were selected for AQUATOR water resources modelling analysis based on the WRE (Phase 1) simulator "system failure metrics" and meteorological return-period analysis. The LPM groundwater storage results were then used to classify each drought event as either "No worse than historic" or "Potentially at risk under severe drought" for each LPM in turn. For a given drought event, source yields were specified equal to either the historical yield or severe drought yield according to classification of their respective LPM for that event. These groundwater yields were used in AQUATOR, along with the surface water flows for each drought event, to test the water resource system in detail to each drought.

For sources in the most vulnerable WRZs, we reviewed the time series of storage and recharge to provide a more detailed assessment of each selected drought event's impact on LPM storage and therefore the timing/duration of potential losses in yield.

We will continue to adopt the 1 in 200 year and 1 in 500 year stochastic yield assessment of the most vulnerable sources in the water resources system described above. The list of sources impacted by drought can be found in the 11.

6.3 Modelling approach

To ensure consistency with WRE and the inter-regional reconciliation process, we have adopted the Atkins stochastic flow series for estimating 1 in 200 year and 1 in 500 year return period drought events in the supply forecast. Although the large amount of hydrological time series (19,200 years) generated by the Atkins weather generator lends itself to the use of the Scottish DO Method, we have decided, after testing both methods, to retain the use of the English & Welsh Method, as was the case in WRMP19.

A reason against the use of the Scottish Method, is that the Atkins stochastics covers the 1950 - 1997 period, which includes just 1 in 6 (1976/77) of the most severe historic drought events in our region during our 1891 - 2018 historical flow period (analysis performed on our Ruthamford region). This means that a drought event of such severity occurs on average once every 21 years within our historical record, but only once every 48 years in the Atkins stochastic dataset.

As a result, we have selected a 1 in 200yr and 1 in 500yr drought for deployable output assessment. These reference droughts were based on the outputs of ranking methods of drought impacts on each of the eight raw water reservoirs in our water supply system, along with an assessment to the nature of the droughts. For example, a multi-year drought is going to test our system resilience to a greater extent, than a drought which lasts a single year to 18 months, due to the relatively large volume of raw water storage in our system, and the connectivity to zones previously isolated through the investment in our strategic grid network.Furthermore, due to our large geographical area, it was important that the selected droughtevents are regionally coherent within our supply region, meaning that the selected droughts are within the realms of the calculated return periods in all areas of our supply (excluding Hartlepool which is geographically isolated from the Anglian region). Selecting individual droughts per supply area could lead to an unrealistically severe overall drought impact, whereas having a single event to test the system resilience and future options is more realistic.

Another aspect of drought selection is the recommendations from an independent external review of our approach to assessing severe/extreme drought and climate change in the draft WRMP24. A key conclusion of the review is that onlythe most severe events in the weather generator outputs are equivalent to a 1 in 500 year return period drought, due to the highly correlated nature of the weather generator which effectively reduces the sample size.

After careful selection, the 1990-92 drought within Trace 60 was selected as the extreme reference drought. The event ranking varies depending on the duration that is assessed, but is around 10th most extreme event in the Ruthamford region over a multi-year period (36 months) based on reservoir storage as a proxy for system response. This ranking method was used on the remaining reservoirs in our supply system and allowed a shortlisting of drought events that were regionally coherent to test for deployable output. Of those droughts tested for DO, Trace 60 was ranked 4th most severe in Ruthamford, our largest zone, and 2nd most severe when the rest of the supply areas were taken into account (Lincolnshire, Cambridgeshire, Norfolk, Suffolk and Essex).

It became clear from the DO testing, that the most severe drought in the hydrological series, which is 1975-77 within Trace 52, is an extreme outlier. Given how extreme this drought performs in comparison to the other shortlisted events, it was not selected for the reference 1 in 500 year drought, however, the resulting DO has been used by creating a new (to WRMP24) component for 1 in 500 year drought uncertainty within our target headroom assessment. A second additional, slightly less extreme drought was also selected for our target headroom assessment in Trace 208 (1975-77).

To further test the robustness of our reference drought events, we have worked with the Met Office to produce a second weather generator (AME) producinganother set of hydrological series, of 21,105 years. Like the Atkins flow series, we have run this entire series through AQUATOR to assess the system response as a result of these hydrological scenarios, which has enabled further analysis and ranking methods to be applied. More importantly, it provides a cross-comparison to the impact of our selected reference droughts from the Atkins work.

The majority of testing with the AME outputs has been done on the Ruthamford region, being the largest water resource zone and experiencing the most impact due to extreme drought in our supply area. Trace 52 (extreme target headroom drought) ranks higher than the most extreme drought events from the AME in all durations (12 month, 24 month and 36 month).

Figure 7 Grafham Reservoir Minima for 36 month durations

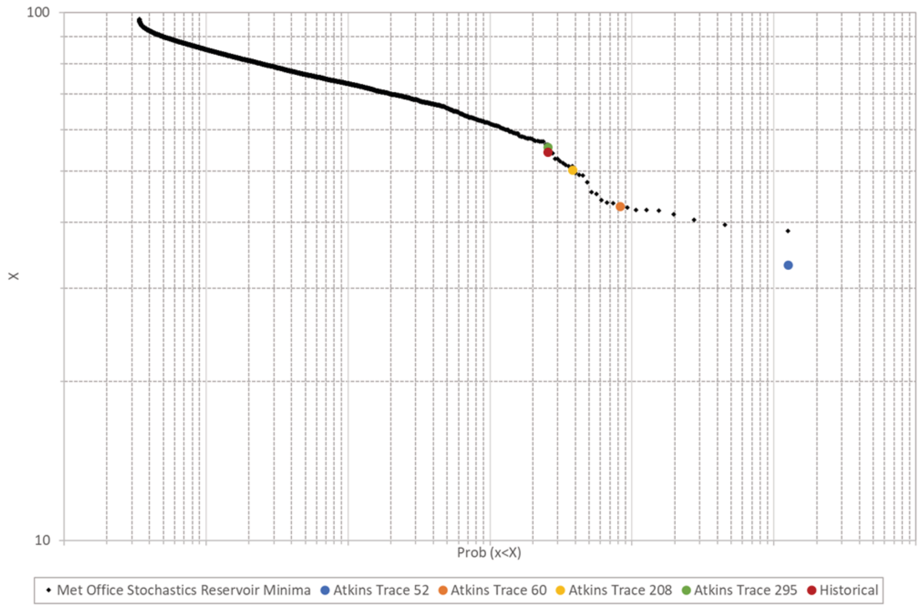
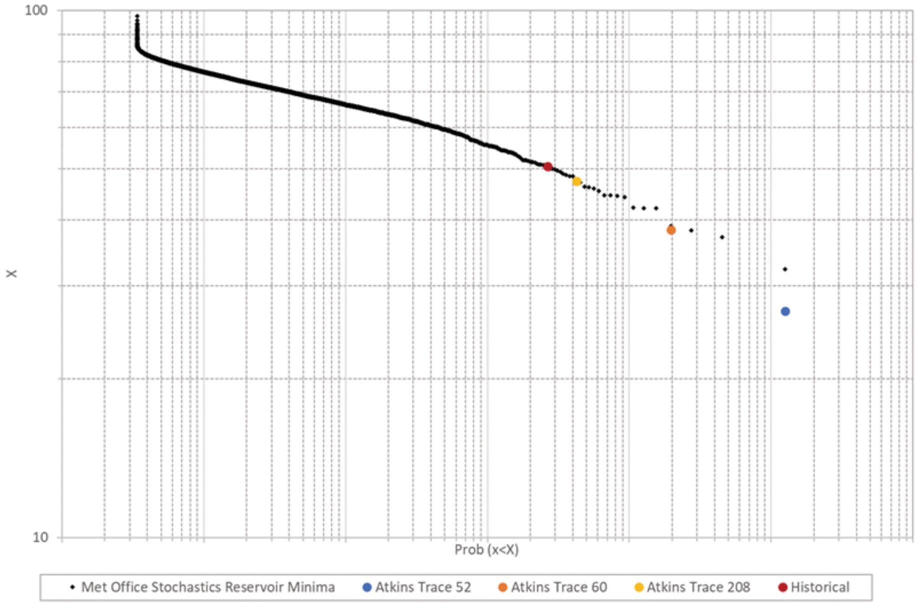


Figure 7 ranks the Met Office stochastics at Grafham Reservoir based on reservoir storage over 36 month durations. Notable events from the Atkins stochastics and historical flow series are also plotted to enable a comparison. The lowest ranked drought in the historical period (red) and Atkins Trace 295 (1 in 200 year reference drought; green) are closely aligned, Atkins Trace 208 (1 in 500 year headroom drought; yellow) is then followed by Atkins Trace 60 (1 in 500 year reference drought; orange) and Atkins Trace 52 (1 in 500 year headroom drought; blue) in increasing drought severity. Atkins Trace 60 ranks among the top 10 most severe droughts if compared to the Met Office stochastic series. This supports the view that this event is in the realms of a 1 in 500 year drought event, particularly as there is a noticeable flattening off of the reservoir response curve at this point in the graph. Atkins Trace 52 is more severe than any drought event in the Met Office stochastics, which could be evidence to suggest it is beyond a 1 in 500 year magnitude event.

Figure 8 Rutland Reservoir Minima for 36 month durations



The Rutland Reservoir 36 month duration plots in Figure 8 shows a similar pattern, only in this case, Atkins Trace 60 is within the top 5 most severe events. Further work will continue on the plausibility of the 1 in 500 year droughts and the system resilience to such events. Atkins Trace 52 provides that extreme outlier, that the Met Office weather generator was unable to replicate for the Ruthamford system. The limitations of the weather generators, as posed in the independent external review, along with comparisons to our historical reference droughts, suggest the Scottish DO or inverse ranking method of droughtselection could underestimate the impact to the system of an extreme drought event.

The adopted reference droughts area pragmatic selection of regionally coherent, long-duration droughts, which rank amongst the most severe events in the weather generator drought libraries we have created with both Atkins and the Met Office datasets. Sensitivity testing of more and less extreme 1 in 500 year events have been included within the plan in the assessment of our target headroom allowance.

7 Climate change

7.1 Baseline Vulnerability Assessment

We have undertaken the most robust level of climate change assessment (Tier 3 in the WRMP SG). In this tier, a new climate change assessment was carried out for each WRZ within the AWS system. This supply forecast demonstrates that the impact of climate change by 2050, is dwarfed by the impact of the impact of licence changes and, to a lesser extent, the 1 in 500 year extreme drought. Climate change-led investment is inevitably going to be relatively low under the forecasted climate change impact of 20 Ml/d (in a 1 in 200 year drought) by 2050 across our region, compared to nearly 400 Ml/d of reduced deployable output as a result of licence changes.

7.2 WRMP19 Climate change methodology

For our previous WRMP19, we used a median of the UKCP09 Spatially Coherent Projections (SCP), which was identified as SCP-8. As we calculate deployable output over geographically large areas, the UKCP09 probabilistic projections were not used due to the lack of spatial coherence.

7.3 Climate change methodology

The Atkins weather generator can be used to provide the ensemble of synthetic meteorological scenarios in the form of rainfall and PET time series that can be used to produce river flows through modelling.

This utilises climate change projections based on UKCP18 through 12 x bias-corrected Regional Climate Model (RCM) factors for RCP8.5. The most recent baseline period was adopted for producing the required climate change factors (1981-2010), with projections running to 2050 (for WRE) mid-point time slices, in order to capture the climate change signal from natural variability. The outputs were provided with the climate change perturbation applied as 400 48-year long replicates.

As shown in Figure 6, the outputs from the WGs are utilised within our rainfall-runoff models to provide catchment inflow series for use within the WRE Simulator and WRMP24 models (i.e. AQUATOR). Therefore all surface water sources represented within AQUATOR will be affected by any climate change impacts simulated by the WG. As is the case with drought, this may or may not lead to an impact in DO. DO assessments have used the English and Welsh Method for absolute DO values. The results of the stochastic replicates have informed the selection of a regionally coherent 1 in 200yr and 1 in 500yr stochastic drought, which has then been run with climate change adjustments.

7.4 Groundwater yield climate change assessment

AQUATOR requires climate change perturbed groundwater yields to complete the DO assessment for non-surface water resource zones. The approach to groundwater yield is unchanged since WRMP19, where the use of Met Office spatial coherent projections (SCPs) for rainfall and temperature, were run through the relevant WRE recharge models. The resulting groundwater storage is used as a proxy for groundwater yield.

The severe drought yield analysis presented in section 6 is based on historical climate conditions (pre-1990), without the influence of anthropogenic climate change. Climate change could interact with severe drought to alter the magnitude, duration or spatial extent of droughts, but the impacts are unlikely to be fully additive. Without any evidence to the contrary, severe drought yield impacts are therefore assumed to include any effects of climate change where they occur. Given that the impact on DO of climate change on groundwater is less than 1 Ml/d across the region, this is a minor assumption. Further assessment of this assumption could be possible once the Met Office AME has been adopted. Sources which also have a 'high climate change yield' are modelled and included within the target headroom allowance.

Upcoming licence capping is reducing the future reliance on groundwater within the Anglian supply system, with a number of sources closing by the end of the next AMP cycle. This places less importance on the assumptions around drought yields as pumping rates will need to be substantially reduced over time. However, work will be undertaken on further understanding the impacts of our key drought vulnerable sources and the process to reflect these most accurately in a water resource simulation run.

7.5 DO calculation and scaling

The climate change perturbed river flows and groundwater yields were run in AQUATOR to calculate deployable output for the 2050s. Water resource regional planning has specific requirements, such as the development of plausible regional drought scenarios that can be used to test proposed regional transfers and other significant supply/demand measures. In the context of climate change, these scenarios need to be 'spatially coherent' or in other words provide a credible representation of the spatial patterns of drought both in the past and under future climate change scenarios. For this reason, the UKCP18 probabilistic scenarios were not used, due to their lack of spatial coherence between catchments.

For our preferred plan, we used a median-impact scenario, which was identified from deployable output calculations of the UKCP18 RCP8.5 Regional Climate Models (RCMs) as RCM-07. RCP8.5 RCMs were the only available regionally coherent product during the development of weather generator-derived stochastic and climate change-impacted rainfall and PET series. This meant that to present plausible median climate change scenarios that are still spatially coherent, the outputs from RCP8.5 RCMs were scaled using values obtained from the Regional Climate Data Tools Report[12] to an impact which represents a level of warming to the probabilistic RCP6.

We have followed the Ofwat guidance on implementing Common Reference Scenarios to understand some of the future uncertainty around specific components of the WRMP. We identified a 'low' and 'high' Common Reference Scenario from our median-impact scenario RCM-07. The deployable output impact for our low scenario is also factored to represent a level of warming to the probabilistic RCP2.6 emissions scenario. The high scenario is not factored.

We have followed the Atkins linear scaling equation[12] (based on the Environment Agency linear scaling equation). This is adjusted for the new baseline (1981 - 2000) and 2050s impact model as follows:

$$Time\ scale\ factor = \frac{Year - 1990}{2050 - 1990}$$

12 WRSE, January 2021, Climate Data Tools Scaling Report

This requires a linear reduction year on year back to 1990, resulting in a recalculated climate change impact, compared to what we forecasted in WRMP19.The system-wide impacts on deployable output can be compared in Table 6 below whereby the impact of climate change is dependent on the reference drought being used (1 in 200 or 1 in 500 year).

Table 6 Climate Change Deployable Output Impacts by 2050

Climate change	Deployable Output Impact in 2050 (1:200) (Ml/d)	Deployable Output Impact in 2050 (1:500) (Ml/d)
RCP 2.6 median (Ofwat Low)	0	-5
RCP 6.0 median (WRMP core plan)	-20	-41
RCP 8.5 median (Ofwat High)	-76	-171

Further work is planned with the Met Office AME hydrological outputs. We plan to run this entire series through AQUATOR to quantify the water supply system impact as a result of these hydrological scenarios, to provide a cross-comparison to the climate change impacts resulting from the Atkins weather generator. Although both WGs use UKCP18 RCP 8.5 projection data, there are contrasting processes for applying these meteorological processes to resulting rainfall and PET used for rainfall-runoff modelling.

8 WRMP24 Links to Drought Plan

8.1 Levels of Service

Our Drought Plan 2022 sets out our operational response to how we will protect public water supplies during a drought in the period 2022-2027. This includes both demand and supply-side interventions to maintain our committed Level of Service provided to our customers.

Our minimum LoS for the WRMP24 are summarised below, along with the assumed demand savings for each LoS as described in our Drought Plan 2022.The demand savings are only applied during the April to September period inclusive within a deployable output model run.

Table 7 Levels of Service (LoS)

LoS	Action	Frequency (years)
LoS 2	Temporary Use Bans	1:10
LoS 3	Non-Essential Use Bans	1:40
LoS 4 (until 2025)	Rota Cuts	1:100
LoS 4 (from 2025)		>1:200

Table 8 Demand side measures applied for Levels of Service

	Level 1 (Demand measures)	Level 2 (Temporary Use Ban)	Level 3 (Non-Essential Use Ban)	Level 4 (Emergency Drought Order)
Anglian Water	1 in 5 years	1 in 10 years	1 in 40 years	1 in >200 years
Demand saving	**0%**	**5%**	**10%**	**42-52%**

Through customer engagement within the WRMP process, our LoS for Temporary Use Bans and Non-Essential Use Bans are deemed appropriate and the frequency of restrictions remains the same.

In WRMP19 we committed to improved levels of service by 2025, to ensure that no customers are exposed to the risk of standpipes and rota-cuts in a severe drought event, equivalent to a return period of approximately 1 in 200 years.

8.2 Impact of drought interventions on demand

As with our water resources management planning, we follow a twin-track approach to managing our supplies during a drought. In the first instance we will seek to manage demand, before instigating any of the available supply-side measures. Demand savings are applied as a percentage of demand, as detailed above in Table 8.

8.2.1 Modelling demand savings

These are included in our baseline DO assessments under the following scenarios:

- No Restrictions: The constant rate of supply that can be maintained by a resource zone throughout the entire period of assessment, with no customer restrictions or other drought actions applied.
- Water Company planned levels of service: The rate of supply that can be maintained by a source or resource zone when the system is operated to meet current Levels of Service. LoS curves are included in the model for each reservoir, and the DO assessment included the application of demand restrictions to the demand profile once a LOS curve is crossed.

The benefits of demand savings have been quantified and included within the EBSD modelling as potential options to meet any supply demand deficits in the future. The EBSD model will select these options as and when required in the planning horizon.

We have modelled the possibility of amending our LoS in order to achieve a greater deployable output in our drought impacted WRZs. Without breaching the Emergency Storage levels however, there is no increase in DO by increasing the frequency of demand restrictions. This is because the benefit of demand savings is already assumed in the reference drought and there isn't a longer cumulative effect by increasing the frequency of the demand side measures prior to the event.

On the effectiveness of the demand savings curves, we have already started a review for all of our reservoirs with pilot studies using genetic algorithms (GA) trialed last year. It is not a simple task of swapping historical reservoir trigger curves based on new modelling outputs. We have found there are other factors to consider, such as the use of stochastics and climate change within the GA analysis, the issue of water quality, which impacts most of our reservoirs, and the day-to-day operation of the reservoirs. We will continue to explore this area for future planning.

8.2.2 Impact of drought interventions on supply

During a drought, a water company can apply for drought permits and drought orders to secure additional water resources or to restrict the use of water. Drought permits are granted by the Environment Agency and modify or suspend conditions on an abstraction licence in order to increase water supply when there has been an exceptional shortage of rain. Drought orders are granted by the Secretary of State and can be used to further modify licence conditions or impose more stringent demand savings.

8.2.3 Drought Plan permits and orders

Our Drought Plan 2022 identifies the possible drought permits and orders we may apply for in a drought to secure additional resources.

Table 9 Summary of potential drought permits

Source	Drought permit application
Ardleigh Reservoir	Increase the groundwater abstraction licence for the augmentation boreholes
River Wensum Intake	Increase the groundwater abstraction for the augmentation boreholes
Grafham Water	Two staged permit to alter the abstraction and MRF conditions at the intake on the River Great Ouse
Pitsford Water	50% MRF reduction at intake on River Nene
Rutland Water	50% MRF reduction at intake on River Nene
River Wissey/Nar Intake	Increased abstraction licence for the supporting groundwater sources
River Trent Intake	Reduction to MRF

We have assessed the drought permits and orders listed in our Drought Plan 2022. For planning purposes, we do not consider that any drought permit can be guaranteed year round, or during a more severe drought, and in accordance with the guidelines we have not included drought permits or orders in our baseline DO.

We have modelled the potential drought permit DO benefit in AQUATOR, both with and without demand savings applied. This showed that, there are drought permit benefits (in terms of DO) to Ruthamford North and Ruthamford South.

9 Water transfers

The baseline supply forecast includes all bulk imports and exports, as summarised in Table 10. The Elsham non-potable bulk export has been extracted from Central Lincs and made into a standalone WRZ, South Humber Bank, so it is not considered as surplus water in the WRZ.

Table 10 Contractual raw water imports and exports

Transfer Type	Associated WRZ	Company	Volume (Ml/d) in 2025		Comment
			Average	Peak	
Bulk Export	Ruthamford North (Rutland - Wing)	Severn Trent Water	18.00	18.00	Average reduces to 15.67 Ml/d in 2050. Peak is fixed throughout planning period.
Bulk Export	Ruthamford South (Grafham)	Affinity Water	89.50	109.00	Average reduces to 73.07 Ml/d in 2050. Peak is fixed throughout planning period.
Bulk Import	South Essex (Tiptree)	Essex and Suffolk Water	3.00	4.50	
Bulk Import	Thetford (Barnham Cross)	Cambridge Water	0.25	0.25	

The bulk export to Severn Trent Water from Rutland and the Affinity Water from Grafham Water has been reviewed to account for the change in Rutland and Grafham yield respectively, due to resilience to a 1 in 500 year drought and future climate change. The climate change impact is scaled as referred to in section 7. Inter-zone transfers are identified through the EBSD model, which optimises the transfers within their constraints to determine the WAFU in each WRZ. These are detailed in the WRMP tables. All existing supplier-recipient and water quality agreements remain in place and are considered to remain valid.

10 WRMP24 Supply forecast

The supply forecast is based on a Dry Year Annual Average (DYAA) scenario, representing an 'average' dry year output during the design drought.

The guidelines state the supply forecast should also be presented as a Critical Period (CP) scenario for each WRZ. CP is defined as the peak daily output on any given day during the design drought. The CP DO has been calculated for all WRZs

CP DO has been calculated using AQUATOR, which is an improvement in the methodology compared to WRMP19, where a spreadsheet method was used. The CP assessment assumes peak licences, peak yields and 24 hour continuous pumping. The only sustainability changes that affect CP DO are where the sources experience a full loss of licence. Drought and climate change impacts on source yields have also been applied.

10.1 Deteriorating water quality

Sources of water that may experience deterioration in water quality during a drought have been modelled through the target headroom assessment. The further reduction to yield above the impact of drought is quantified from the previous groundwater modelling work described in section 6 and is inputted into AQUATOR to understand the additional impact to DO.

10.2 Outage

We have included outage in the supply forecast to calculate WAFU from DO. Outage describes an allowance of water which represents the risk of short term (less than 6 months) supply-side failure. The development of the outage figures is discussed in the Planning factors technical supporting document.

10.3 WRMP24 Options modelling

In some cases, WRMP options have been modelled in AQUATOR, where the DO benefit is unclear from simpler methods of assessment. An example of this is the Strategic Resource Options (SROs) known as the Lincolnshire Reservoir and Fens Reservoir. These options have been assessed with different sized capacities, different combinations of possible sources of supply and under different hydrological scenarios:

- 1 in 500 year drought and median climate change
- 1 in 500 year drought and low median climate change
- 1 in 500 year drought and high climate change

For further information on options, see the Supply-side option development technical supporting document. For further details on the calculation of the SRO yields, see the Lincolnshire Reservoir - Sources of supply assessment (Mott MacDonald, 2023) andFens Reservoir - Sources of supply assessment (Mott MacDonald, 2023) reports.

11 Appendix

Table 11 Licence volumes for our sources of water under different licencing scenarios (Ml/yr)

<table>
<tr><th>Abstraction Source Name</th><th>WRZ</th><th>RA Peak</th><th>RA TLL Average</th><th>RA Average</th><th>BAU</th><th>BAU+</th><th>ADAPT</th><th>BAU++</th><th>ENHANCED</th></tr>
<tr><td>Cadney</td><td>LNC</td><td>27500</td><td>27500</td><td>27500</td><td>27500</td><td>27500</td><td>27500</td><td>27500</td><td>27500</td></tr>
<tr><td>Barnoldby</td><td>LNE</td><td>621</td><td>621</td><td>490</td><td>490</td><td>490</td><td>490</td><td>490</td><td>490</td></tr>
<tr><td>Little Coates</td><td>LNE</td><td>7876</td><td>7876</td><td>4888</td><td>4888</td><td>4888</td><td>4888</td><td>4888</td><td>4888</td></tr>
<tr><td>Weelsby</td><td>LNE</td><td>4062</td><td>4062</td><td>2925</td><td>2925</td><td>2925</td><td>2925</td><td>2925</td><td>2925</td></tr>
<tr><td>Tetney</td><td>LNE</td><td>5070</td><td>5070</td><td>3664</td><td>3664</td><td>3664</td><td>3664</td><td>3664</td><td>3664</td></tr>
<tr><td>Barton</td><td>LNC</td><td>792</td><td>792</td><td>113</td><td>113</td><td>113</td><td>113</td><td>113</td><td>113</td></tr>
<tr><td>Barrow</td><td>LNC</td><td>5906</td><td>5906</td><td>5353</td><td>5353</td><td>5353</td><td>5353</td><td>5353</td><td>5353</td></tr>
<tr><td>Goxhill 1</td><td>LNC</td><td rowspan="2">1449</td><td rowspan="2">1449</td><td rowspan="2">1259</td><td rowspan="2">1259</td><td rowspan="2">1259</td><td rowspan="2">1259</td><td rowspan="2">1259</td><td rowspan="2">1259</td></tr>
<tr><td>Goxhill 2</td><td>LNC</td></tr>
<tr><td>Thornton</td><td>LNC</td><td>3588</td><td>3588</td><td>3025</td><td>1978</td><td>1978</td><td>1978</td><td>1978</td><td>1978</td></tr>
<tr><td>Little London</td><td>LNE</td><td>4978</td><td>4978</td><td>2239</td><td>2239</td><td>2239</td><td>2239</td><td>2239</td><td>2239</td></tr>
<tr><td>Healing</td><td>LNE</td><td>2098</td><td>2098</td><td>1350</td><td>1350</td><td>1350</td><td>1350</td><td>1350</td><td>1350</td></tr>
<tr><td>Ulceby</td><td>LNC</td><td rowspan="2">4380</td><td rowspan="2">4380</td><td>2455</td><td rowspan="2">2658</td><td rowspan="2">2658</td><td rowspan="2">2658</td><td rowspan="2">2658</td><td rowspan="2">2658</td></tr>
<tr><td>Habrough</td><td>LNE</td><td>203</td></tr>
<tr><td>Fulstow</td><td>LNE</td><td>1095</td><td>1095</td><td>950</td><td>950</td><td>950</td><td>950</td><td>950</td><td>950</td></tr>
<tr><td>Waddingham</td><td>LNC</td><td>708</td><td>374</td><td>374</td><td>374</td><td>374</td><td>81</td><td>12</td><td>0</td></tr>
<tr><td>Redbourne</td><td>LNC</td><td>174</td><td>80</td><td>80</td><td>80</td><td>80</td><td>80</td><td>80</td><td>80</td></tr>
<tr><td>Hibaldstow Bridge</td><td>LNC</td><td>334</td><td>334</td><td>225</td><td>225</td><td>225</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Winterton Holmes</td><td>LNC</td><td rowspan="3">2001</td><td rowspan="3">1239</td><td rowspan="3">1239</td><td rowspan="3">1239</td><td rowspan="3">1239</td><td rowspan="3">427</td><td rowspan="3">442</td><td rowspan="3">442</td></tr>
<tr><td>Winterton Carrs</td><td>LNC</td></tr>
<tr><td>Winterton</td><td>LNC</td></tr>
</table>

Abstraction Source Name	WRZ	RA Peak	RA TLL Average	RA Average	BAU	BAU+	ADAPT	BAU++	ENHANCED
Branston Booths	LNC	895	895	784	1232	1232	448	448	784
Moor Farm	LNC	910	910	705	705	705	0	0	0
Dunston	LNC	1116	1116	690	690	690	0	0	0
Welton	LNC	1461	1381	1381	0	0	0	0	0
Spridlington	LNC	269			0	0	0	0	0
Glentham	LNC	553	553	416	416	416	62	62	62
Aswarby	LNC	1353	1144	1144	0	0	0	0	0
Swaton	LNC	850	653	653	653	653	0	0	0
Billingborough	LNC	239	221	221	221	221	0	0	0
Sleaford 1	LNC	1050	1050	889	0	0	0	0	0
Sleaford 2	LNC								
Kirkby La Thorpe	LNC	1677	1588	1588	529	529	529	529	529
Newton Surface Water	LNC	7503	7503	7503	7503	7503	7503	7503	7503
Newton On Trent	LNC	2828	2064	2064	0	0	0	0	0
Grove	LNC	4344	4344	3993	3993	3993	2496	2546	2546
Elkesley	LNC	4719	4719	4719	1348	539	1618	1618	404
Retford 1	LNN	4462	4462	3258	3095	3258	3258	3258	3258
Retford -2	LNN								
Everton	LNN	3431	2657	2657	2657	2657	0	0	0
Gainsborough 1	LNN	1442	1442	1442	1156	1156	1442	1442	1442
Gainsborough 2	LNN								
Gainsborough 3	LNN								
Covenham	LNE	22158	22158	22158	22158	22158	22158	22158	22158

<table>
<tr><th>Abstraction Source Name</th><th>WRZ</th><th>RA Peak</th><th>RA TLL Average</th><th>RA Average</th><th>BAU</th><th>BAU+</th><th>ADAPT</th><th>BAU++</th><th>ENHANCED</th></tr>
<tr><td>Cloves Bridge</td><td>LNE</td><td>9000</td><td>9000</td><td>9000</td><td>9000</td><td>9000</td><td>9000</td><td>9000</td><td>9000</td></tr>
<tr><td>Driby</td><td>LNE</td><td>1358</td><td>1149</td><td>1149</td><td>1149</td><td>1149</td><td>517</td><td>517</td><td>517</td></tr>
<tr><td>Fordington</td><td>LNE</td><td>754</td><td>638</td><td>638</td><td>638</td><td>638</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Well</td><td>LNE</td><td>387</td><td>291</td><td>291</td><td>331</td><td>331</td><td>281</td><td>281</td><td>281</td></tr>
<tr><td>Candlesby</td><td>LNE</td><td>639</td><td>504</td><td>504</td><td>504</td><td>504</td><td>454</td><td>454</td><td>454</td></tr>
<tr><td>Welton Le Marsh</td><td>LNE</td><td>832</td><td>704</td><td>704</td><td>704</td><td>704</td><td>334</td><td>334</td><td>334</td></tr>
<tr><td>Mumby SSt</td><td>LNE</td><td>339</td><td>61</td><td>61</td><td>49</td><td>49</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Maltby Le Marsh SSt</td><td>LNE</td><td>341</td><td>190</td><td>190</td><td>190</td><td>190</td><td>190</td><td>190</td><td>190</td></tr>
<tr><td>Maltby Le Marsh Chlk</td><td>LNE</td><td>811</td><td>694</td><td>694</td><td>46</td><td>23</td><td>23</td><td>23</td><td>23</td></tr>
<tr><td>Bilsby</td><td>LNE</td><td>740</td><td>648</td><td>648</td><td>648</td><td>648</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Thurlby</td><td>LNE</td><td>737</td><td>596</td><td>596</td><td>596</td><td>596</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Mumby Chlk</td><td>LNE</td><td>630</td><td>480</td><td>480</td><td>480</td><td>480</td><td>420</td><td>420</td><td>420</td></tr>
<tr><td>Manby</td><td>LNE</td><td rowspan="2">1527</td><td rowspan="2">1363</td><td rowspan="2">1363</td><td rowspan="2">1227</td><td rowspan="2">1227</td><td rowspan="2">102</td><td rowspan="2">136</td><td rowspan="2">136</td></tr>
<tr><td>Grimoldby</td><td>LNE</td></tr>
<tr><td>Raithby</td><td>LNE</td><td rowspan="2">3850</td><td rowspan="2">3264</td><td rowspan="2">3264</td><td rowspan="2">1170</td><td rowspan="2">870</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td></tr>
<tr><td>Hubbards Hill</td><td>LNE</td></tr>
<tr><td>Aslackby</td><td>LNE</td><td>2985</td><td rowspan="2">4572</td><td rowspan="2">4572</td><td>686</td><td>686</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Rippingale</td><td>LNE</td><td>2650</td><td>914</td><td>914</td><td>229</td><td>0</td><td>0</td></tr>
<tr><td>Pinchbeck (Jockey)</td><td>LNE</td><td>2834</td><td>2294</td><td>2294</td><td>245</td><td>245</td><td>245</td><td>245</td><td>245</td></tr>
<tr><td>Haconby</td><td>LNE</td><td>2570</td><td>2570</td><td>1185</td><td>1185</td><td>1185</td><td>1185</td><td>1185</td><td>1185</td></tr>
<tr><td>West Pinchbeck</td><td>LNE</td><td>807</td><td>245</td><td>245</td><td>245</td><td>245</td><td>245</td><td>245</td><td>245</td></tr>
<tr><td>Wilsthorpe</td><td>LNB</td><td>7337</td><td>6325</td><td>6325</td><td>633</td><td>633</td><td>633</td><td>633</td><td>633</td></tr>
<tr><td>Bourne</td><td>LNB</td><td>5002</td><td>5002</td><td>4841</td><td>2421</td><td>2421</td><td>1775</td><td>1573</td><td>1533</td></tr>
</table>

Abstraction Source Name	WRZ	RA Peak	RA TLL Average	RA Average	BAU	BAU+	ADAPT	BAU++	ENHANCED
Tallington	LNB	4709	3875	3875	3875	3875	395	336	582
Pilsgate	LNB								
Etton	LNB								
Northborough	LNB								
Beachamwell	FND	3837	3837	2442	397	244	0	0	0
Marham GW	FND	3840	3840	3840	0	0	630	630	630
Stoke Ferry (Wissey)	FND	6570	6570	6570	6570	6570	6570	6570	6570
Wellington Wellfield 1	FND	1500	1148	1148	1148	474	0	0	0
Wellington Wellfield 2	FND								
Wellington Wellfield 3	FND								
Wellington Wellfield 4	FND								
Wellington Wellfield 7	FND								
Denton Lodge	FND	1490	1490	1153	1153	1153	0	0	0
Hillington	FND	1775	1235	1235	1173	1173	618	618	0
Congham	FND	616	616	197	187	187	187	187	187
Gayton	FND	1408	1408	1163	814	523	523	523	523
Hillington Group	FND	3222	2687	2687	1940	1940	0	0	0
Sedgeford	FND	900	900	801	0	0	0	0	0
Great Bircham	FND	1200	1200	249	0	0	0	0	0
Fring 1	FND	1000	1000	795	318	199	199	199	199
Fring 2	FND	548	548	75	0	0	0	0	0
Didlington	FND	535	429	429	429	0	0	0	0
Heigham intake PWS	NTB	17000	17000	17000	12092	12092	12092	12092	12092

Abstraction Source Name	WRZ	RA Peak	RA TLL Average	RA Average	BAU	BAU+	ADAPT	BAU++	ENHANCED
Costessey BHs	NTB	1248	1116	1116	936	936	94	125	125
Lyng Forge	NTB	674	514	514	360	360	360	360	360
Sparham	NTB	485	267	267	200	200	200	200	200
Swanton Morley	NED	249	116	116	116	116	116	116	116
Beetley	NED	959	585	585	497	497	497	497	497
East Dereham	NED	1165	1165	887	599	599	599	599	599
Hoe	NED								
Bowthorpe	NTB	1223	1018	1018	1018	1018	1018	459	3
Colney	NTB	1799	1661	1661	1661	1661	1661	1495	1495
Marlingford	NTB	1374	1214	1214	1214	1214	1214	546	15
Barford	NTB								
Mattishall	NTB	388	287	287	273	108	108	108	108
East Tuddenham	NTB								
Runhall	NTB	0	0	0	0	0	0	0	0
Caistor St Edmund	NTB	2414	2081	2081	676	208	208	208	208
Bixley	NTB	1606	1527	1527	1374	1374	1374	1374	1374
Stoke Holy Cross	NTB	700	24	24	24	24	24	24	24
Thorpe St Andrew	NTB	0	0	0	0	0	0	0	0
Postwick	NTB								
Kirby Cane	NTB	0	0	0	0	0	0	0	0
Riddlesworth	NEH	935	284	284	284	0	284	284	284
Harling	NEH	896	637	637	637	64	64	64	64
Quidenham	NEH	550	299	299	299	0	299	299	299

Abstraction Source Name	WRZ	RA Peak	RA TLL Average	RA Average	BAU	BAU+	ADAPT	BAU++	ENHANCED
Rushall	NHL	1574	1574	1392	1243	1243	935	945	945
Billingford	NHL	1365	988	988	919	919	988	988	988
Brockdish	NHL								
Bunwell	NHL	675	630	630	574	574	574	574	574
North Walsham	NAY	964	964	801	310	300	300	300	300
Royston	NAY								
Aylsham 2	NAY	580	580	547	533	533	533	533	533
Aylsham 1	NAY	2143	2143	1945	1386	1252	1106	1106	1106
Metton	NNC								
Matlaske	NNC								
Aldborough	NNC								
Upper Sheringham 1	NNC	1439	1255	1255	406	354	354	354	256
Upper Sheringham 2	NNC								
West Runton	NNC								
Bodham	NNC								
Mundesley	NNC	0	0	0	0	0	0	0	0
Houghton St Giles	NNC	1758	1758	1332	1195	1195	400	428	501
Binham	NNC	503	377	377	377	377	245	214	126
Wighton	NNC	350	350	274	274	274	219	219	219
Glandford	NNC	1495	1193	1193	875	716	716	716	716
Guestwick	NNC	589	527	527	412	412	412	412	397
Wood Norton	NNC								
Cawston	NNC								

Abstraction Source Name	WRZ	RA Peak	RA TLL Average	RA Average	BAU	BAU+	ADAPT	BAU++	ENHANCED
Ludham	NHA	0	0	0	0	0	0	0	0
Witton	NHA	0	0	0	0	0	0	0	0
East Ruston	NHA	0	0	0	0	0	0	0	0
Bradenham	NBR	1460	1354	1354	623	623	0	0	0
Bradenham (NL BH4)	NBR								
Bradenham (NL BH5)	NBR								
North Pickenham	NBR	1459	1084	1084	1084	380	0	0	0
Carbrooke	NBR	560	560	560	560	490	0	0	0
Watton	NWY	1151	1151	995	995	0	0	0	0
East Watton	NWY	632	549	549	490	0	0	0	0
Wicklewood	NWY	1971	1971	1971	813	591	591	591	591
Old Buckenham	NWY	340	307	307	284	0	238	246	246
Tuddenham St Martin	SUE	4000	3732	3732	314	314	634	634	742
Playford	SUE								
Pettistree	SUE								
Winston	SUE								
Belstead	SUE	6840	6435	6435	5607	5607	3418	2250	1626
Claydon	SUE								
Whitton	SUE								
Westerfield	SUE								
Baylham	SUE								
Bramford	SUE	3898	3485	3485	3485	3485	1307	1307	1307
Sproughton	SUE	10783	10783	10783	10783	10783	5931	0	0

Abstraction Source Name	WRZ	RA Peak	RA TLL Average	RA Average	BAU	BAU+	ADAPT	BAU++	ENHANCED
Bucklesham transfer to Alton Water	SUE	2000	2000	2000	2000	2000	300	300	2000
Raydon	SUE	2224	2224	2224	2224	2224	0	0	0
Semer	SUE						0	0	0
Sudbury 1	SUS	1554	1554	1306	1241	1241	0	0	0
Sudbury 2	SUS	2017	2017	1342	1342	1342	0	0	0
Great Wratting	SWC	3504	3127	3127	992	992	0	0	0
Wixoe 1	SWC								
Wixoe 2	SWC								
Kedington	SWC								
Ixworth	SUI	1493	1493	1493	579	467	467	467	467
Stanton	SUI								
Stanton BH6	SUI								
Thetford 1	SUT	1811	1742	1742	1742	1098	1742	1742	1742
Warren Wood	SUT								
Thetford 2	SUT	677	677	612	612	612	612	612	612
Thetford 3	SUT	646	379	379	379	0	379	379	379
Brandon 2	SUT	731	731	344	344	344	344	344	344
Warren Hill	SWC	1349	1349	677	677	0	0	0	0
Long Hill	SWC	1172	1172	880	638	0	0	0	0
Gazeley 1	SWC	605	386	386	0	0	0	0	0
Gazeley 2	SWC								
Gazeley 3	SWC								
Moulton	SWC	717	717	506	0	0	0	0	0

Abstraction Source Name	WRZ	RA Peak	RA TLL Average	RA Average	BAU	BAU+	ADAPT	BAU++	ENHANCED
Newmarket 1	SWC	675	675	525	210	0	0	0	0
Southfields	SWC	1178	1178	788	788	591	0	0	0
Wooditton	SWC	606	606	543	543	0	0	0	0
Newmarket 2	SWC	588	305	305	305	305	305	305	305
Beck Row	SWC	1659	1659	719	719	719	719	719	719
St Helena	SWC	1500	1279	1279	1215	1215	0	0	0
Eriswell 1	SWC	3771	3293	3293	3293	3293	924	924	924
Eriswell 2	SWC								
Twelve Acre Wood	SWC	1500	1273	1273	1273	783	1051	1051	490
Isleham	SWC	806	577	577	0	0	456	466	233
Barrow Heath	SWC	3061	2918	2918	486	195	195	195	195
Risby	SWC	1024	906	906	0	0	0	0	0
Bury St Edmunds	SWC	1964	1199	1199	719	360	719	719	719
Rushbrooke	SWC	1912	1449	1449	1449	0	1063	1063	1063
Nowton	SWC	1010	796	796	0	0	0	0	0
Castle Hedingham	EXC	3677	3325	3325	441	441	0	0	0
Halstead 1	EXC								
Halstead 2	EXC								
Earls Colne	EXC								
Wethersfield	EXS	5385	4968	4968	4322	4322	0	0	0
Shalford	EXS								
Bardfield	EXS								
Hawkspur Green	EXS								

<table>
<tr><th>Abstraction Source Name</th><th>WRZ</th><th>RA Peak</th><th>RA TLL Average</th><th>RA Average</th><th>BAU</th><th>BAU+</th><th>ADAPT</th><th>BAU++</th><th>ENHANCED</th></tr>
<tr><td>Bocking</td><td>EXS</td><td>1083</td><td>838</td><td>838</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Bures</td><td>EXS</td><td>2800</td><td>2695</td><td>2695</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Wormingford</td><td>EXS</td><td rowspan="3">6321</td><td rowspan="3">5602</td><td rowspan="3">5602</td><td rowspan="3">4597</td><td rowspan="3">3389</td><td rowspan="3">4817</td><td rowspan="3">4817</td><td rowspan="3">3405</td></tr>
<tr><td>Nayland</td><td>EXS</td></tr>
<tr><td>Bures</td><td>EXS</td></tr>
<tr><td>Eight Ash Green</td><td>EXS</td><td rowspan="3">692</td><td rowspan="3">569</td><td rowspan="3">569</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">0</td></tr>
<tr><td>Aldham</td><td>EXS</td></tr>
<tr><td>Balkerne</td><td>EXS</td></tr>
<tr><td>Rutland Water</td><td>RHN</td><td>120000</td><td>120000</td><td>120000</td><td>90581</td><td>90581</td><td>90581</td><td>90581</td><td>90581</td></tr>
<tr><td>Wansford to Rutland Water</td><td>RHN</td><td rowspan="2">180000</td><td rowspan="2">180000</td><td rowspan="2">180000</td><td>90000</td><td>90000</td><td>90000</td><td>90000</td><td>90000</td></tr>
<tr><td>Tinwell to Rutland Water</td><td>RHN</td><td>90000</td><td>90000</td><td>90000</td><td>90000</td><td>90000</td></tr>
<tr><td>Duston Intake</td><td>RHN</td><td>38500</td><td>38500</td><td>38500</td><td>38500</td><td>38500</td><td>38500</td><td>38500</td><td>38500</td></tr>
<tr><td>Pitsford Reservoir</td><td>RHN</td><td>19900</td><td>19900</td><td>19900</td><td>15004</td><td>15004</td><td>15004</td><td>15004</td><td>15004</td></tr>
<tr><td>Ravensthorpe and Hollowell Reservoirs</td><td>RHN</td><td>5900</td><td>5900</td><td>5900</td><td>4449</td><td>4449</td><td>4449</td><td>4449</td><td>4449</td></tr>
<tr><td>Grafham</td><td>RHS</td><td>120000</td><td>120000</td><td>120000</td><td>103163</td><td>103163</td><td>103163</td><td>103163</td><td>103163</td></tr>
<tr><td>Clapham Ouse intake</td><td>RHS</td><td>9983</td><td>9983</td><td>9983</td><td>5825</td><td>5825</td><td>5825</td><td>5825</td><td>5825</td></tr>
<tr><td>Offord</td><td>RHS</td><td>150000</td><td>150000</td><td>150000</td><td>150000</td><td>150000</td><td>150000</td><td>150000</td><td>150000</td></tr>
<tr><td>Dunton</td><td>RHS</td><td>1626</td><td>1626</td><td>1252</td><td>1252</td><td>1127</td><td>1127</td><td>1127</td><td>1127</td></tr>
<tr><td>Meppershall</td><td>RHS</td><td>1941</td><td>1941</td><td>1941</td><td>1941</td><td>1941</td><td>1941</td><td>1941</td><td>1941</td></tr>
<tr><td>Newspring</td><td>RHS</td><td>1404</td><td>1404</td><td>1022</td><td>1022</td><td>1022</td><td>1022</td><td>1022</td><td>1022</td></tr>
<tr><td>Pulloxhill</td><td>RHS</td><td>475</td><td>475</td><td>475</td><td>475</td><td>475</td><td>475</td><td>475</td><td>475</td></tr>
<tr><td>Sandhouse</td><td>RHS</td><td>1196</td><td>1196</td><td>1196</td><td>1196</td><td>1196</td><td>1196</td><td>1196</td><td>1196</td></tr>
<tr><td>Battlesden</td><td>RHS</td><td>713</td><td>713</td><td>104</td><td>104</td><td>104</td><td>104</td><td>104</td><td>104</td></tr>
</table>

Abstraction Source Name	WRZ	RA Peak	RA TLL Average	RA Average	BAU	BAU+	ADAPT	BAU++	ENHANCED
Birchmoor	RHS	1941	1941	1941	275	178	178	178	178
Dalton Piercy	HPL	6800	6800	3895	3895	3895	3895	3895	3895
Amerston	HPL	3200	3200	1175	1175	1175	1175	1175	1175
Waterloo	HPL	1900	1900	1419	1419	1419	1419	1419	1419
Hartlepool 1	HPL	1600	1600	278	278	278	278	278	278
Hartlepool 2	HPL	1100	1100	272	272	272	272	272	272
Stillington	HPL	3500	3500	902	902	902	902	902	902
Great Stainton	HPL	2700	2700	1544	1544	1544	1544	1544	1544
Hartlepool 3	HPL	1900	1900	1508	1508	1508	1508	1508	1508
Crookfoot	HPL	500	500	184	184	184	184	184	184
Hartlepool 4	HPL	955	955	731	731	731	731	731	731
Butterwick	HPL	1000	0	0	0	0	0	0	0
Alton Reservoir	SUE	10800	10800	10800	10800	10800	10800	10800	10800
Ardleigh Reservoir	EXS	47730	47730	47730	47730	47730	47730	47730	47730
East Mills	EXS	45460	45460	9092	9092	9092	9092	9092	9092

Table 12 Sources impacted by severe or extreme drought

Source	WRZ	Groundwater Yield		
		Dry year	1 in 200 year	1 in 500 year
Didlington	FND	2	1.6	1.6
Fring	FND	6.2	5	5
Gayton	FND	4	0	0
Hillington (Chalk)	FND	12.3	9	9
Sedgeford	FND	3.4	2.5	2.5
Marham	FND	11	0	0
Amerston Hall	HPL	25		19.5
Dalton Piercy	HPL	25		8.5
Great Stainton	HPL	12		10.5
Hope House	HPL	4.7		2.9
Hopper House	HPL	4.6		4
Red Barns	HPL	2.1		0.5
Stillington	HPL	14.7		13.2
Waterloo	HPL	12.6		12.1
Bourne	LNB	30	24	24
Pilsgate	LNB	7.2	5.5	5.5
Tallington	LNB	15	12	12
Wilsthorpe	LNB	32	16	16
Barrow	LNC	22.7		10
Branston Booths	LNC	8	7.2	7.2
Fosters Bridge	LNC	8	6	6

Source	WRZ	Groundwater Yield		
		Dry year	1 in 200 year	1 in 500 year
Glentham	LNC	2.4	2	2
Goxhill	LNC	5.8		5
Hibaldstow Bridge	LNC	3.5	3	3
Redbourne	LNC	2	1.6	1.6
Spridlington	LNC	3.5	2.8	2.8
Ulceby	LNC	12		5
Waddingham	LNC	3.4	3	3
Dunston	LNC	3.5	1.85	1.85
Welton	LNC	3.3	2.6	2.6
Winterton Carrs 1	LNC	2.3	1.65	1.65
Winterton Holmes	LNC	5.1	2	2
Aswarby	LNC	8.8	5	5
Billingborough	LNC	2	1.6	1.6
Sleaford 1	LNC	10	5	5
Kirkby La Thorpe	LNC	15	11	11
Swaton	LNC	10	8	8
Aslackby	LNE	18	14.4	14.4
Barnoldby	LNE	6		3
Candlesby	LNE	1.6		1
Driby	LNE	5		3.4
Fordington	LNE	0.9		0.8
Pinchbeck (Jockey)	LNE	10	8	8

Source	WRZ	Groundwater Yield		
		Dry year	1 in 200 year	1 in 500 year
Rippingale	LNE	18	14.4	14.4
Welton le Marsh	LNE	2.3		1.5
West Pinchbeck	LNE	6.3	5.04	5.04
Tetney	LNE	12	0	0
North Walsham	NAY	0.7	0	0
Square Plantation	NEH	3.9	2.5	2.5
Matlaske	NNC	2.2	2	2
Metton	NNC	3	1	1
Marlingford	NTB	2.7	2.5	2.5
Battlesden	RHS	5	2.5	2.5
Birchmoor	RHS	7.2	4	4
Pulloxhill	RHS	4.5	4	4
Belstead	SUE	5.6	2	2
Playford	SUE	6.1	6	6
Westerfield	SUE	3.4	2	2
Whitton	SUE	10.5	9	9
Risby	SWC	5.5	1	1
Eriswell 1	SWC	4	3.5	3.5
Isleham	SWC	7.5	4.5	4.5
Ashley Road	SWC	1.7	1.3	1.3
Long Hill	SWC	3.4	2.5	2.5
Lower Links	SWC	2.5	1.5	1.5

Source	WRZ	Groundwater Yield		
		Dry year	1 in 200 year	1 in 500 year
Moulton	SWC	7	0	0
Southfields	SWC	3.1	1.5	1.5

Not all yield impacts will be realised into a DO impact at a WRZ, due to different licence scenarios impacting a sources ability to output.

Table 13 DO in 2025 comparison between WRMP24 and WRMP19

WRMP24		WRMP19		Difference
WRZ24	1 in 200 + Mid CC (DO in 2025)	WRZ19	1 in 200 + Mid CC (DO in 2025)	
Essex Central	9.56	Central Essex	9.60	-0.04
Essex South	63.60	South Essex	67.73	-4.13
Fenland	48.65	North Fenland	34.00	3.65
		South Fenland	11.00	
Hartlepool	38.34	Hartlepool	36.84	1.50
Lincolnshire Bourne	41.67	Bourne	45.00	-3.33
Lincolnshire Central	193.28	Central Lincs	113.00	-27.76
		South Lincs	30.64	
		South Humber Bank	77.40	
Lincolnshire East	154.52	East Lincs	131.00	23.52
Lincolnshire Ret. and Gains	23.35	Nottinghamshire	20.00	3.35
Norfolk Aylsham	4.87	North Norfolk Coast	22.00	0.79
Norfolk North Coast	17.92			
Norfolk Bradenham	8.98	Norfolk Rural North	23.00	2.76
Norfolk East Dereham	5.89			
Norfolk Wymondham	10.89			

<table>
<tr><th colspan="2">WRMP24</th><th colspan="2">WRMP19</th><th rowspan="2">Difference</th></tr>
<tr><th>WRZ24</th><th>1 in 200 + Mid CC (DO in 2025)</th><th>WRZ19</th><th>1 in 200 + Mid CC (DO in 2025)</th></tr>
<tr><td>Norfolk East Harling</td><td>4.88</td><td rowspan="2">Norfolk Rural South</td><td rowspan="2">14.00</td><td rowspan="2">-0.12</td></tr>
<tr><td>Norfolk Harleston</td><td>9.00</td></tr>
<tr><td>Norfolk Happisburgh</td><td>0.00</td><td>Happisburgh</td><td>2.10</td><td>-2.10</td></tr>
<tr><td>Norfolk Norwich & the Broads</td><td>78.45</td><td>Norwich & the Broads</td><td>77.00</td><td>1.45</td></tr>
<tr><td>Ruthamford Central</td><td>0.00</td><td>Ruthamford Central</td><td>0.00</td><td>0.00</td></tr>
<tr><td>Ruthamford North</td><td>316.03</td><td>Ruthamford North</td><td>287.87</td><td>28.16</td></tr>
<tr><td>Ruthamford South</td><td>258.57</td><td>Ruthamford South</td><td>243.25</td><td>15.72</td></tr>
<tr><td>Ruthamford West</td><td>0.00</td><td>Ruthamford West</td><td>0.00</td><td>0.00</td></tr>
<tr><td>Suffolk East</td><td>67.75</td><td>East Suffolk</td><td>72.34</td><td>-4.59</td></tr>
<tr><td>Suffolk Ixworth</td><td>3.99</td><td>Ixworth</td><td>3.20</td><td>0.79</td></tr>
<tr><td>Suffolk Sudbury</td><td>9.66</td><td>Sudbury</td><td>9.40</td><td>0.26</td></tr>
<tr><td>Suffolk Thetford</td><td>10.11</td><td>Thetford</td><td>10.50</td><td>-0.39</td></tr>
<tr><td rowspan="4">Suffolk West & Cambs</td><td rowspan="4">57.00</td><td>Bury-Haverhill</td><td>22.00</td><td rowspan="4">0.70</td></tr>
<tr><td>Cheveley</td><td>1.30</td></tr>
<tr><td>Ely</td><td>21.00</td></tr>
<tr><td>Newmarket</td><td>12.00</td></tr>
<tr><td>Total</td><td>1436.96</td><td>Total</td><td>1396.77</td><td>40.19</td></tr>
</table>

11.1 WRMP24 DO changes and discussion

Essex Central: WRMP24 DO consistent to WRMP19 DO.

Essex South: Reduction in historical river flows as a result of updating the River Colne rainfall-runoff model from SIMFLOW to GR6j, which has in turn reduced the Ardleigh Reservoir yield. River flows used in previously WRMPs were over-estimated.

Fenland: Increased connectivity between WRMP19 North and South Fenland WRZs recognised in the latest model. This has caused an increase in DO in WRMP24 due to the ability to utilise licence headroom and conjunctive benefit.

Hartlepool: DO slightly higher than quoted in WRMP19. Now more accurately represented in AQUATOR XV (previously unmodelled).

Lincolnshire Bourne: Abstraction licence caps in the group licence greater than what was previously expected in WRMP19, resulting in a lower DO for WRMP24.

Lincolnshire Central: South Humber Bank supply reduced due to the maximum capcacity of Cadney being downgraded and Pyewipe being replaced by the North Lincs option (increasing supply in East Lincs WRZ). Hall reduced in output.

Lincolnshire East: Haconby Fen BH and Habrough BH sources back into supply after being excluded in WRMP19 DO assessment.

Lincolnshire Gainsborough & Retford: Abstraction licence capping is slightly less than what was expected in WRMP19, resulting in a higher DO in WRMP24.

Norfolk Aysham, Norfolk North Coast, Norfolk Bradenham, Norfolk East Dereham, Norfolk Wymondham, Norfolk East Harling and Norfolk Harleston: By splitting out a larger WRZ(s) into smaller zones, DO is likely to increase using the English & Welsh Method. This is because smaller WRZs will be less complex, and therefore less likely to constrain source output through any network / connectivity / demand geography issues as can be the case on larger WRZs.

Norfolk Happisburgh: Abstraction licence caps in the group licence greater than what was previously expected in WRMP19, resulting in a lower DO for WRMP24.

Norfolk Norwich & the Broads:WRMP24 DO consistent to WRMP19 DO (increase in WRMP24 of 1.5 Ml/d).

Ruthamford Central, Ruthamford North, Ruthamford South & Ruthamford West: WRMP24 Climate change impact is less than calculated compared to the previous WRMP19. All four Ruthamford zones are now modelled as a whole region, rather than in order which allows for more conjunctive benefit between RHF-N and RHF-S.

Suffolk East: Abstraction licence caps in the group licence greater than what was previously expected in WRMP19, resulting in a lower DO for WRMP24.

Suffolk Ixworth: WRMP24 DO consistent to WRMP19 DO (increase in WRMP24 of 0.79 Ml/d).

Suffolk Sudbury: WRMP24 DO consistent to WRMP19 DO (increase in WRMP24 of 0.26 Ml/d).

Suffolk Thetford: WRMP24 DO consistent to WRMP19 DO (decrease in WRMP24 of 0.39 Ml/d).

Suffolk West & Cambs: There is a DO increase in WRMP24, compared to WMRP19 due to increased connectivity between the Ely, Newmarket, Cheveley and Bury-Haverhill former-WRZs, due to AMP7 investment.

Table 14 WRMP19 Supply-side investments included within WRMP24 DO assessment

Option Reference	WRMP19 Option Name	Scheme captured in AQUATOR (DO)	Scheme captured in EBSD (SDB)
CLN16	East Lincolnshire WRZ to Central Lincolnshire WRZ - transfer only	Yes	No
CLN15	East Lincolnshire WRZ to Central Lincolnshire WRZ treatment for Metaldehyde for existing transfer	No	Yes
NTM1	Central Lincolnshire WRZ to Nottinghamshire WRZ transfer	No	Yes
SLN6	Central Lincolnshire WRZ to South Lincolnshire WRZ Transfer	Yes	No
RTC2	Ruthamford South WRZ to Ruthamford Central WRZ Transfer	Yes	No
RTN27	South Lincolnshire WRZ to Ruthamford North WRZ transfer	No	Yes
RTS Intra 1	Ruthamford South Intra WRZ Transfer 1 (Woburn PZ)	Yes	No
RTS Intra 2	Ruthamford South Intra WRZ Transfer 2 (Meppershall PZ)	Yes	No
NFN4	South Fenland WRZ to North Fenland WRZ Transfer	Yes	No
SFN4	Ruthamford North WRZ to South Fenland WRZ Transfer	No	Yes
HPB1	Norwich & the Boards WRZ to Happisburgh WRZ Transfer	No	Yes
HPB2	Norwich and the Broads WRZ to Happisburgh Transfer (East Ruston/Witton)	No	Yes
NNR8	Norwich & the Boards WRZ to Norfolk Rural North WRZ Transfer (5Ml/d)	No	Yes
NNR Intra1	North Norfolk Rural Intra WRZ Transfer (Didlington PZ)	Yes	No
ESU8	Bury Haverhill WRZ to East Suffolk WRZ transfer	No	Yes
SEX4	East Suffolk WRZ to South Essex WRZ transfer	No	Yes
BHV5	Newmarket WRZ to Bury Haverhill WRZ Transfer (20 Ml/d)	Yes	No
BHV Intra1	Bury Haverhill Intra WRZ Transfer (haverhill PZ)	Yes	No
CVY1	Newmarket WRZ to Cheveley WRZ Transfer	Yes	No
ELY9	North Fenland WRZ to Ely WRZ Transfer	No	Yes
NWM6	Ely WRZ to Newmarket WRZ Transfer	Yes	No
THT1a	Ixworth WRZ to Thetford WRZ Transfer via existing infrastructure	No	Yes
THT1b	Bury Haverhill WRZ to Ixworth WRZ Transfer via existing infrastructure	No	Yes

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THE QUEEN'S AWARDS FOR ENTERPRISE: SUSTAINABLE DEVELOPMENT 2020

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