

COLLABORATING TO SECURE EASTERN ENGLAND'S FUTURE WATER NEEDS

OUR INITIAL WATER RESOURCE POSITION STATEMENT

MARCH 2020

EXECUTIVE SUMMARY

The Water Resources East (WRE) region is characterised by its diversity of water use, including very significant non-public water supply users, particularly for agriculture, food production and energy. The region is under pressure from population growth, climate change and the need to enhance the environment in some of the nations' most iconic landscapes. WRE believe that there is an opportunity to work collaboratively in the region across sectors to tackle the issue of water resources, flood risk management and water quality to enable economic development and environmental improvement. This document sets out our current view of our water resource position and some of the opportunities we have in the region and beyond to tackle this, and states how we will work together with our stakeholders to develop a plan which delivers significant value for our region.

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1. ABOUT WATER RESOURCES EAST

Water Resources East (WRE) was formed in 2014 by Anglian Water, who were keen to learn from international best practice on how to develop a more collaborative approach to water resource management planning in a region under significant pressures. These pressures include high population growth and economic ambition and the need to increase the level of environmental enhancement, all within the context of the need to adapt to and mitigate the impact of climate change.

WRE's focus since 2014 has been on multi-sector water resource planning. Eastern England is characterised by its diversity of water use, including very significant non-public water supply users, particularly for irrigated agriculture, food production and energy.



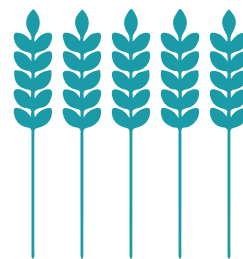
DRIEST REGION IN THE UK



**HIGHEST FORECAST
GROWTH OUTSIDE
LONDON**



**INTERNATIONALLY
IMPORTANT ENVIRONMENTS**



**LEADING AGRICULTURAL
PRODUCER**

In response to these challenges, WRE has developed the following overarching strategy for the region:

- Identifying ways in which all users of water in Eastern England can be as water efficient as possible.
- Promoting the need for additional storage of water within the landscape, increasing resilience and seeking to identify multi-sector opportunities to link water scarcity with flood risk management solutions.
- Seeking to transfer water from areas of surplus to areas of deficit, seeking to increase connectivity whilst maximising the use of open water channels.
- Actively exploring other potential sources of water for our region, for example transfers, desalination and water re-use.



In June 2019, Water Resources East became a separate legal entity (a not for profit Company Limited by Guarantee), and is unique among the five Regional Planning Groups in that it now operates as an independent, inclusive, collaborative membership organisation, focused on the co-creation of the Regional Plan with key national, regional and local stakeholders including regulators.



WATER RESOURCES EAST GOVERNANCE STRUCTURE

OUR BOARD OF DIRECTORS

At the time of writing, the following organisations were WRE's Principal Funding Members, funding the central operating costs of the Company, and had appointed non-Executive Directors to the Board of Directors:

- Anglian Water
- Northumbrian Water (Essex & Suffolk Water)
- South Staffs Water (Cambridge Water)
- Severn Trent
- Affinity Water
- The National Farmers Union (NFU)
- Country, Land, & Business Association (CLA)
- RWE Generation UK
- The Association of Drainage Authorities (ADA)
- Lincolnshire County Council
- Norfolk & Suffolk County Councils (co-funding a single Board seat)
- The Broads Authority
- The Catchment Based Approach (led by the Rivers Trust)

OUR STRATEGIC ADVISORY GROUP

Members of the Strategic Advisory Group are Standard members of the company, having formally applied for membership and providing a guarantee of £1 in the event that the Company is wound up. The role of the Strategic Advisory Group is to support and enable the Board of Directors to make informed decisions. Individual members provide specific advice where WRE activities or outcomes have positive or potentially negative impacts on their specialist activities, and members formally vote on key matters as deemed by the Board of Directors.

All members, whether Principal Funding Members or Standard Members are entitled to a single vote on key matters, irrespective of their financial or other contribution.

OUR CONSULTATION GROUP

The Consultation Group is formed of organisations who do not wish to, or are unable to become members of the company, for example government organisations, regulators, and customer representatives. This group does not have formal voting rights but is integral in bringing a broad view beyond the membership, bringing welcome challenge and specialised knowledge.

WRE is aiming to have over 100 different organisations actively engaged in the co-creation of the Regional Plan, and at the time of publication almost 70 different organisations were involved.

Membership of the Strategic Advisory Group and the Consultation Group is deliberately open and inclusive, and hopefully very diverse, to ensure that the broadest possible set of views are sought and considered early on and throughout the development of the Regional Plan.

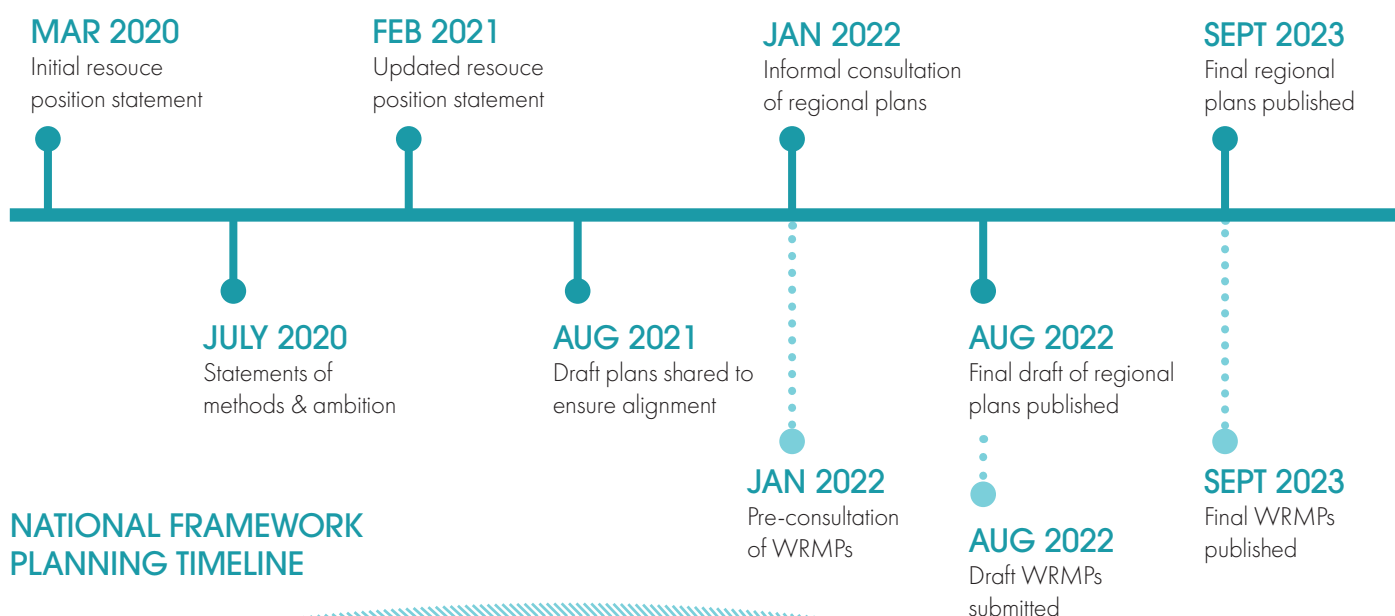
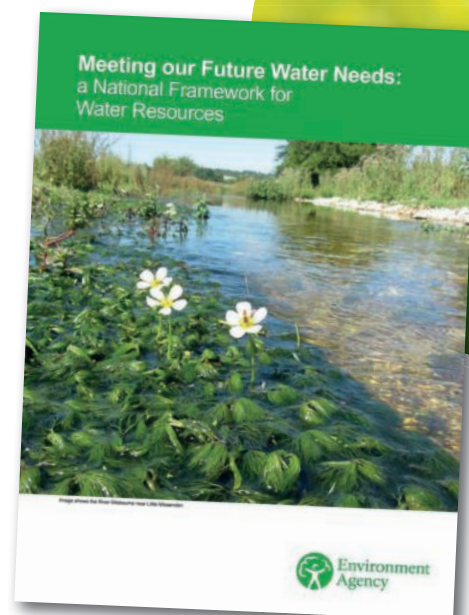
2. BACKGROUND AND PURPOSE OF THIS REPORT

In its 25-year Environment Plan, the UK Government pledged that we would be the first generation to leave the environment in a better condition than we found it. To help meet the pledge to improve resilience to drought and minimise interruption to water supplies, the Environment Agency has led the development of a National Framework for Water Resources in England which was published in March 2020¹. The National Framework evidences the strategic long-term water needs of England, both nationally and within the boundaries of the regional water resources groups. It does this for all sectors that depend on a secure supply of water while also ensuring the environment is improved.

The National Framework, while led by the Environment Agency, has been developed in collaboration with the regulators Ofwat and the Drinking Water Inspectorate (DWI), and the Department for the Environment, Food and Rural Affairs (Defra), as well as a wide range of stakeholders represented by a senior steering group made up of around 40 water industry representatives, other water users, environmental NGOs, government and regulators from England and Wales.

The National Framework is part of the water resources planning cycle. Five regional groups now exist across England, and the National Framework sets the challenge for these regional groups to work collaboratively to develop ambitious regional water resources plans that provide resilient and efficient water supplies into the future and that have environmental enhancement at their core.

Regional groups such as Water Resources East are critical to the development of integrated plans that include the right strategic solutions for the challenges facing the nation, and each regional group has been tasked with pulling together a single multi-sector integrated water resource management plan.



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



WRE is currently developing a regional integrated Water Resources Management Plan (the Regional Plan) covering catchment areas across the East of England and part of the East Midlands (herein after referred to as 'Eastern England'). As a group we aim to co-create and build a long-term, multi-sector adaptive plan that reflects the needs and characteristics of our diverse region. This document represents the first stage in our development of the Regional Plan and sets the scene for our region. It is informed by the National Framework, our water company members' 2019 Water Resource Management Plans (WRMPs) together with new and emerging data and information from other sectors.

For the WRE region, this plan will:

- Seek to increase the level of resilience for water resources for all sectors.
- Identify opportunities to deliver wider benefits in terms of flood risk and water quality.
- Identify ways to ensure that water (either too much or not enough) is not a barrier to economic development in the region.
- Seek to enhance the environment, in line with the 25 Year Environment Plan.
- Explore innovative funding and delivery models for water management solutions.
- Promote schemes which represent the best value for the region, seeking through collaboration to deliver more efficient solutions.
- Co-deliver the water related elements of other key regional strategies and plans,
- Focus on delivery of water-related climate change mitigation and adaptation strategies including net zero carbon ambition.
- Provide academically rigorous evidence to policy makers.

WRE's shared vision is that by working together regionally and nationally across all sectors, we will have a joined-up view of the actions that are needed now, for a sustainable future. Working collaboratively we will seek to increase the resilience of water supplies, ensure clarity of roles and responsibilities, protect and improve the environment and drive efficiency, providing value for our region.

This document explores the challenges we need to address, our ambitions as a region and our methods for producing a plan that meets these needs. The following sections introduce the WRE region, set out our initial resource position, the strategic context and our proposed methodology.

Our ambition is that we will co-create the Regional Plan for Eastern England with as many different stakeholders as we can. This will be enabled by our unique structure as a membership organisation, and throughout the production of our Regional Plan we will hold a series of planning conferences to develop sub-Regional Plans and quarterly Strategic Advisory and Consultation Group meetings, where all members and our regulators will meet to discuss progress.

Throughout this process, we will encourage organisations that can offer options to meet the region's water needs to put those forward for consideration in the Regional Plan.



3. INTRODUCING OUR REGION

Eastern England is home to some of the UK's most exciting businesses, internationally recognised landscapes and habitats, very fertile agricultural land and some of the most prestigious academic institutions – and it is set to grow rapidly over the coming decades. Three of the UK's five fastest-growing cities, the growth corridors centred on the M1, A1, M11 and a significant proportion of the proposed Oxford-Milton Keynes- Cambridge Arc are all in the Eastern region – making a significant contribution to growth nationally.

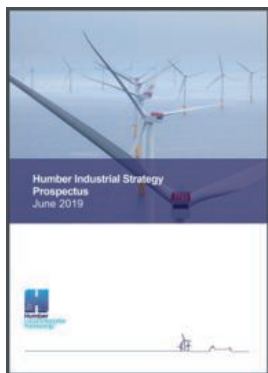
But Eastern England has other attributes that make it uniquely vulnerable to water shortage and severe weather events. Nearly 30% of the land mass is below sea level, a huge proportion of the area is used for agricultural production, it is the driest region in the UK and the East has one of the longest coastlines of any region.

With the increasing risk of drought and the surge in demand for food, energy and services that is likely in future, there is a very real risk that a lack of collaborative water management could limit growth and development in our region. The WRE region is predicted to face a significant gap between supply and demand if the region carries on managing water resources in the same way as it does now.

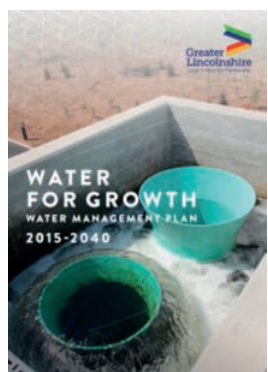


Our region is very diverse in terms of water management issues, and we will be planning along hydrological and political-economic boundaries.





The **South Humber Bank** is characterised by industrial water use by refineries, power stations and manufacturing industry, including British Steel. Much of the area is at risk from flooding, including from the sea, placing it at the forefront, along with other eastern coastal areas, of climate change adaptation. The Humber region has declared itself the 'Energy Estuary' aiming to play a key role in the renewable energy and decarbonisation agenda; here and in other coastal regions, there is an interesting opportunity to think about ways of aligning operations in the energy and water grids. Water in the **Lower Trent** region is used for both public water supply and power generation, but again is an area which has suffered from severe flooding in recent years. The county of **Lincolnshire** is ambitious with regards to water management, viewing water (both scarcity and flood risk) as a constraint to economic development. For this reason, water management forms one of the pillars of the Greater Lincolnshire Local Enterprise Partnership Local Industrial Strategy, and a well-established Water Management Board exists within the county, which WRE planning will align with. There is very strong partnership working with Internal Drainage Boards (IDBs) here and elsewhere within the region; IDBs will be central and key to WRE's strategy.



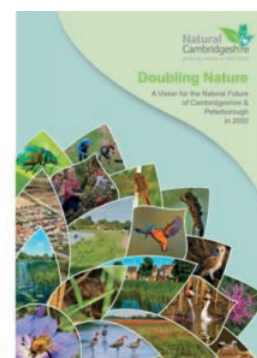
The Fens and counties further to the east are the agricultural heartland of the country, due to the extremely fertile nature of the peat soil. This landscape typifies the balancing of need for intensive agriculture and the requirement to preserve important fen wetland habitats which are extremely effective at carbon sequestration. There is real potential within the fens across Lincolnshire, Cambridgeshire and into Norfolk to manage water in a completely different way, and WRE is actively involved in this thinking. The counties of **Norfolk and Suffolk** are ambitious and innovative in terms of agri-food and other economic development, and water features prominently within New Anglia Local Enterprise Partnership's Local Industrial Strategy. The counties are home to some of our most iconic landscapes, including **The Broads** and many beautiful chalk stream habitats, and there is real tension in parts of the region between the need for water for the environment, public water supply and irrigated agriculture.



The county of **Essex** has a number of important reservoirs and is generally regarded as more resilient to public water supply scarcity due to planning work undertaken several decades ago, including the transfer of water from neighbouring counties. Nevertheless, there is strong housing growth and environmental ambition, but also a strong risk of flooding in certain parts of the county.

The tension between the need to protect precious chalk stream habitats from abstraction pressure and the desire for increased housing in places such as Cambridge are felt strongly in **Cambridgeshire**. There is an inequality in economic terms between the north and south of the county, with the north of the county being vulnerable to flooding associated with a changing climate. Cambridgeshire has joined others in our region in declaring a Climate Emergency, and managing water in a different way across the county could be pivotal in enabling growth and environmental enhancement.

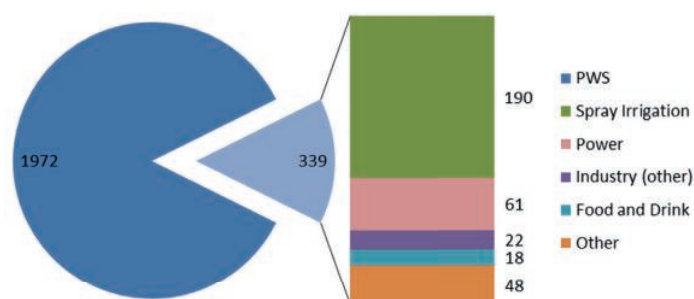
And finally, in its response to the 2017 National Infrastructure Commission (NIC) report, the Government designated the **Oxford-Cambridge Arc** a key economic priority, affirmed its ambition for up to one million high-quality new homes across the Arc by 2050, committed to completing new transport infrastructure, and committed to achieving growth in the Arc while improving the environment for future generations. With approximately 70% of the Arc potentially sitting within the WRE region, enabling a resilient water supply will form a critical element of our planning work.



4. REGIONAL WATER RESOURCES NEEDS

BASELINE (2020/21):

On an average day, in a dry year, the total consumptive demand for water in the WRE region is equivalent to 2,311 million litres (megalitres) per day. Most of this water (85%) is used for public water supply (PWS). Most of the rest is used for spray irrigation (8%), power generation (3%) and in the manufacturing, food and drink sectors (2%). A breakdown in megalitres per day (ML/d) is given below:



Of the water put into supply by water companies, around 59% (1,100 ML/d) is supplied by Anglian Water. Cambridge Water, Severn Trent Water and Essex and Suffolk Water supply 4% (84 ML/d), 13% (250 ML/d) and 23% (450 ML/d) respectively while the remaining 1% (28 ML/d) is supplied by Affinity Water:

Abstraction for spray irrigation occurs across the WRE region but is concentrated (71% in terms of licensed volume) in the Broadland, Cam and Ely Ouse (CamEO), East Suffolk, combined Essex and Witham and Steeping catchments. Spray irrigation is strongly seasonal and in a dry year it peaks in July at levels around 600 ML/d. This is equivalent to approximately 30% of the average daily demand for public water supply.

Abstraction for power generation occurs in the WRE region from the freshwater non-tidal sections of the River Trent and the River Ouse, from several coastal and estuarine locations, as well as from the tidal freshwater sections of the Trent and a number of the fenland rivers. The water is used for cooling and steam generation at coal and gas power stations.

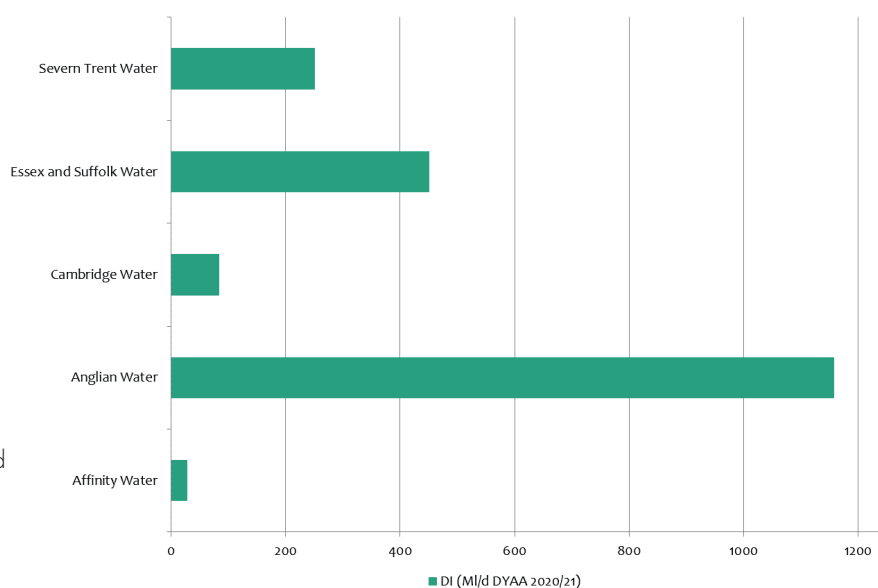
The National Framework clearly summarises our challenge as follows:

WATER RESOURCES EAST

The East faces significant pressure and has little surplus water available. Environment Agency modelling shows that the amount of water needed is equivalent to all the new supply options selected in the company Water Resource Management Plans – in this case Anglian Water, Essex and Suffolk Water, Affinity Water, Severn Trent Water and Cambridge Water – but more ambitious reductions in water use and potentially additional capacity is necessary to meet the higher need estimate. Water Resources East's focus will be on reducing the demand for water by all users and increasing the amount of water available through new water resource options and transfers. Exploring the potential for schemes that benefit other water users is also a priority given the high level of demand from other sectors in this region, particularly agriculture.



Dry year annual average demand (ML/d) in the WRE region (data from water company Water Resource Management Plan (WRMP19) water resource planning (WRP) tables and from the Environment Agency)



Dry year annual average (DYAA) distribution input (ML/d) for 2020/21. Severn Trent data based on Nottinghamshire, Newark and Rutland Resource Zones (RZs) and Affinity data based on Brett RZ. All data from water company WRMP19 WRP tables.

FUTURE NEEDS FOR PUBLIC WATER SUPPLY

Future needs in the public water supply sector are assessed every five years in water company Water Resource Management Plans (WRMPs). WRMPs for the period from 2020 onwards have just been published, and the summary supply-demand data from these is presented below. From this:

- The Affinity Water Brett resource zone (RZ) has an excess of supply over demand ("surplus") to 2050 (note: the published data does not account for significant uncertainty in the short to medium term in relation to the scale of potential future environmental requirements in the Brett RZ)
- All of the RZs in the Essex and Suffolk Water system have surpluses to 2050
- A large deficit is forecast in the Severn Trent Nottinghamshire RZ from 2020 onwards
- Most RZs in the Anglian Water system have a shortfall in supplies ("deficit") by 2050. A significant number of these are large (>10ML/d)
- There is a forecasted deficit in the Cambridge Water supply area of 8ML/d by 2050.

In total, there are RZ level surpluses equivalent to 107 ML/d and RZ level deficits equivalent to -312 ML/d by 2050. Overall there is a net deficit equivalent to just over -200 ML/d.

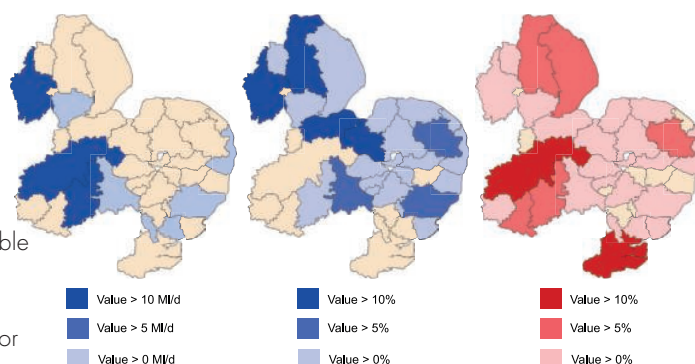
It is important to note that each water company WRMP sets out their plans to close any forecast deficit (see examples later), and the role of the Regional Plan will be to assess whether there is a more optimum way of closing any deficit, compared to the currently published plans.

| Water Company | Resource Zone | 2020-21 | 2029-30 | 2039-40 | 2049-50 |
|-----------------------|----------------------------------|---------|---------|---------|---------|
| Affinity Water | Brett | 7 | 10 | 9 | 8 |
| | Bourne | 5 | -2 | -4 | -4 |
| Anglian Water | Bury Haverhill | 1 | -10 | -10 | -11 |
| | Central Essex | 0 | 0 | -1 | -1 |
| | Central Lincolnshire | 30 | -2 | -7 | -12 |
| | Cheveley | 0 | 0 | 0 | 0 |
| | East Lincolnshire | 24 | 20 | 19 | 19 |
| | East Suffolk | 3 | -5 | -8 | -9 |
| | Ely | 3 | -2 | -3 | -4 |
| | Happisburgh | 1 | -2 | -3 | -3 |
| | Ixworth | 0 | -2 | -2 | -2 |
| | Newmarket | 4 | -1 | -1 | -1 |
| | North Fenland | 6 | 2 | 2 | 2 |
| | North Norfolk Coast | 3 | -1 | -2 | -2 |
| | North Norfolk Rural | 2 | -4 | -5 | -6 |
| | Norwich and the Broads | 10 | 1 | -1 | -1 |
| | Nottinghamshire | 1 | -2 | -3 | -4 |
| | Ruthamford Central | 0 | 0 | 0 | 0 |
| | Ruthamford North | 7 | -19 | -33 | -45 |
| | Ruthamford South | -21 | -37 | -47 | -58 |
| | Ruthamford West | 0 | 0 | 0 | 0 |
| | South Essex | 0 | -9 | -13 | -17 |
| | South Fenland | 4 | -19 | -19 | -20 |
| | South Humber Bank | 11 | 11 | 11 | 11 |
| | South Lincolnshire | 5 | 3 | 2 | 1 |
| | South Norfolk Rural | 3 | 1 | 0 | 0 |
| | Sudbury | 3 | 2 | 1 | 1 |
| | Thetford | 0 | -1 | -2 | -3 |
| Essex & Suffolk Water | Blyth | 3 | 3 | 3 | 3 |
| | Essex | 16 | 21 | 43 | 35 |
| | Hartismere | 1 | 1 | 1 | 1 |
| | Northern Central | 19 | 19 | 18 | 17 |
| Severn Trent Water | Newark | 7 | 7 | 7 | 7 |
| | Nottinghamshire | 1 | -30 | -86 | -99 |
| | Rutland | 2 | 2 | 2 | 1 |
| South Staffs Water | Cambridge supply area | 1 | -5 | -6 | -8 |
| | Sum Surplus | 183 | 103 | 119 | 107 |
| | Sum Deficit | -21 | -154 | -256 | -312 |
| | Net Supply Demand Balance | 163 | -51 | -136 | -204 |

Dry year annual average (DYAA) Resource Zone (RZ) level supply-demand balances for water company's in the WRE region (ML/d). Data from water company WRMP19 WRP tables. Surpluses shaded blue and deficits shaded red

The deficits which are projected to occur over the period to 2050 are driven by a combination of population growth, climate change and a reduction in levels of abstraction in environmentally sensitive areas (also known as “sustainability reductions”). Summary details are given below:

- Climate change impact on the volume of water which is available for abstraction and use from water company sources (WAFU):
-122 MI/d
- Sustainability reduction impacts on the volume of water which is available for abstraction and use from water company sources (WAFU):
-138 MI/d
- Impact of growth and new development on the total level of demand for public water supplies (distribution input – DI):
+159 MI/d



Distribution of climate change (blue - top left) sustainability reduction (blue - middle) and growth (red - right) impacts on water company supply-demand balances. Shading indicates following:

- No shading: no significant impact
- Light shading: 1% of total impact in this RZ
- Medium shading: 1% to 5% of total impact in this RZ
- Heavy shading: >10% of total impact in this RZ

Data from water company WRMP19 WRP tables. Note that the sustainability reductions take no account of the longer term environmental ambition for our region, which are potentially significant, or further statutory reductions which may be required in AMP8 (from 2025-2030)

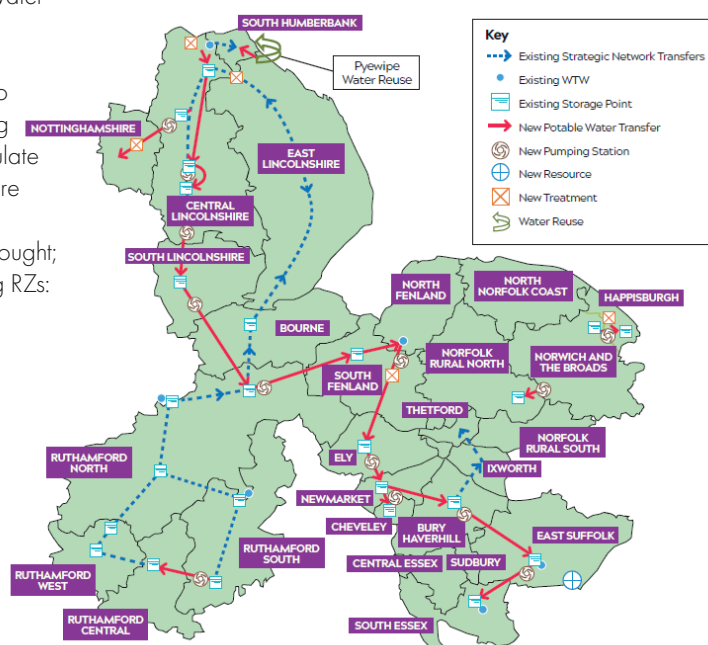
In a regional context, the key schemes are:

- Integration of the Nottinghamshire RZ into the Severn Trent Water strategic grid, and
- The development of a strategic north-south grid within the Anglian Water system.

In supply-demand planning for public water supply systems, measures to increase resilience are assessed by running water resource models using synthetic weather data. Outputs from this process are then used to calculate the water which is available for use (WAFU) in conditions which are more severe than those in the historic record. This approach has been used to assess the need for additional supplies in the WRE region in a severe drought; preliminary results indicate that 88 MI/d will be needed in the following RZs:

- Ruthamford North: **43 MI/d**
- Ruthamford South: **34 MI/d**
- South Essex: **5 MI/d**
- East Suffolk: **1 MI/d**
- Cambridge: **5 MI/d**

Differences with the drought resilience need assessment in the National Framework report (226 MI/d in total) arise from the use of different methodologies. Work to reconcile the two approaches is on-going.



Anglian Water's proposal for a strategic north – south grid

FUTURE NEEDS FOR AGRICULTURE AND POWER

Although subject to significant uncertainty, over the period to 2050 there are likely to be changes in the power and agriculture sectors which could have profound implications for future levels of water demand in the WRE region.

POWER

To achieve UK net zero carbon, decarbonisation of gas and electricity systems in the UK will be needed. Future Energy Scenarios (FES) from National Grid show that this could drive significant growth in carbon capture use and storage (CCUS) and the hydrogen economy, both of which require significant volumes of water. For example, from the FES (2019) and the Committee for Climate Change (CCC) report "Hydrogen in a low carbon economy" (2018) illustrations of the scale of the potential need can be derived from the following:

- Water is needed to produce hydrogen either from electrolysis (0.5l H₂O per Kilowatt Hours (KWh)) or gas-reforming (0.1l to 0.3l H₂O per KWh). This is in addition to any water required for cooling purposes
- In maximum demand scenarios, hydrogen production could be equivalent to between 312 Terawatt Hours (TWh) (FES) and 700 TWh (CCC)
- Equivalent water demands vary between 85 Ml/d (312 TWh by low water demand gas reforming, excluding water for cooling) and 958 Ml/d (700 TWh by high water demand electrolysis)

The 2019 FES notes that rapid decarbonisation is most likely to lead to high levels of demand for hydrogen. The FES and CCC reports also suggest that future CCUS and hydrogen production activity will be concentrated in a small number of "industrial clusters", where suitable infrastructure exists and there are high energy demands. The Humber region, a significant part of which is in Eastern England, is identified as one of five possible cluster locations in the FES.



AGRICULTURE

The potential for future growth in water demands in agriculture was assessed by Cranfield University as part of their work on the initial WRE strategy prior to its publication in 2018. Based on the degree of globalisation in the sector and attitudes to sustainability, a range of different demand scenarios are plausible and each of these has a different growth factor. Details are summarised below:

| Socio-economic Scenario | Growth Factor (2060) | Key features |
|---|----------------------|---|
| Sustainable, Regionalisation (SR) | 1.39 | Low GDP growth (0.5% per annum) with prudent use of water and strong focus on the environment |
| Sustainable, Globalisation (SG) | 2.04 | Moderate GDP scenario (1.7% per annum) with prudent use of water balance between environmental and economic need |
| Uncontrolled demand, Regionalisation (UR) | 2.52 | Moderate GDP scenario (1.5% per annum) with imprudent use of water and strong focus on energy and agriculture |
| Uncontrolled demand, Globalisation (UG) | 1.39 | High GDP scenario (2.0% per annum) with imprudent use of water and public water supply remains main use for available water resources |

Growth factors for agricultural demand in the WRE region. Data from Cranfield University report (2018)

Given base year demand equivalent to 190 Ml/d, dry year annual average (spray irrigation) demand in the 2050's could vary between 264 Ml/d and 478 Ml/d, an increase of between 74 Ml/d and 288 Ml/d. However, since spray irrigation is concentrated in the summer, peak daily demands could increase from around 600 Ml/d to between 800 Ml/d and 1,450 Ml/d.

The 'irrigation water strategy for UK agriculture and horticulture', published in 2020, defines irrigation hotspots and clearly shows that the highest intensity is in Eastern England.

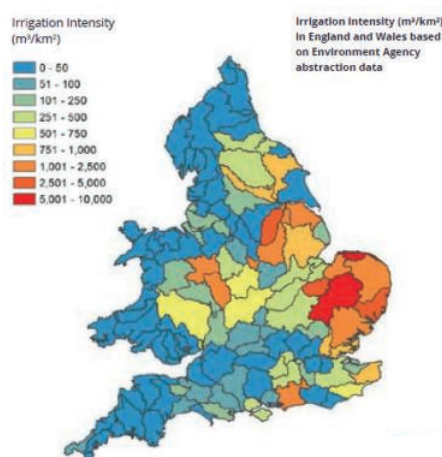


Figure taken from "Irrigation water strategy for UK agriculture and horticulture" by Knox, J.W., Kay, M.G., Holman, I.P., and Hess, T.M. (2020)



FUTURE NEEDS OF THE ENVIRONMENT

The Water Resources East region is the driest in England, receiving less rainfall than parts of Israel. The region is home to some of the most iconic landscapes and habitats, including a number of precious chalk streams, vast fens, the Lincolnshire Wolds and the Norfolk Broads. Many of these are internationally recognised. During droughts and other periods of water stress, rivers and wetlands can suffer damage which is then exacerbated by abstraction or other land and water management activities. In many cases, appropriate measures to protect and enhance the environment have been identified and implemented or are subject to on-going investigations from which schemes will emerge.

In the future, additional environmental needs are likely to arise from a combination of climate change, growth and action to deal with any residual abstraction related issues. The WRE Regional Plan may examine schemes which may previously have been regarded as uneconomic but in the context of the 25-Year Environment Plan and other policy initiatives, such as net zero carbon, become viable. Our overall level of “environmental ambition” will be a key factor in assessing a significant proportion of these needs and will be developed collaboratively with stakeholders across the region as we develop our Regional Plan.

THE IMPACT OF CLIMATE CHANGE

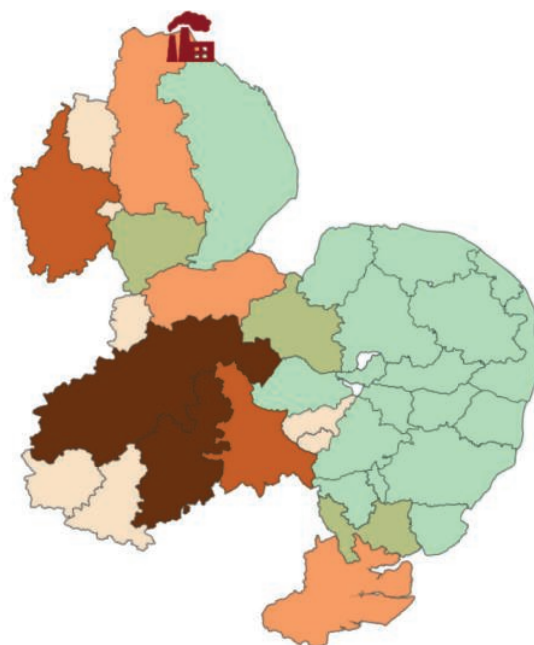
Climate change effects that may drive on-going investment include the following:

- Greater fluctuations in water levels and flows
- Warming temperatures, which may:
 - Threaten the persistence of some species
 - Extend the growing season for nuisance species, such as algae, or
 - Decrease oxygen concentrations in water
- Increase run-off, leading to increased nutrient levels in water bodies and an increase in sediment concentrations
- Drying of shallow water bodies, headwater streams and other marginal habitats, and
- Changes in connectivity of water bodies, which could increase during floods and decrease during droughts

UNCERTAINTY AND THE MANAGEMENT OF RISK

In terms of our current understanding:

- Future needs in the public water supply system are significant and likely to be greatest in the west of the region. Deficits in this area are driven by a combination of growth, climate change and sustainability reductions. These pressures are also be apparent in the south and east of our region, but to a lesser extent
- The agriculture sector is also likely to have significant water related needs in the 2050's, which will be driven by growth in irrigated agriculture mainly in the east of the region, and,
- There may also be significant growth in the water related needs of the power sector, as decarbonisation of gas and electricity systems drive an increase in carbon capture use and storage (CCUS) and hydrogen production. It appears likely that the focus for any such activity It appears likely that the focus for any such activity in our region could include the Humber South Bank and that these demands, if realised, will start to emerge from the early 2030's onwards.



Multi-sector needs in the WRE region in the 2050's.

Key:

Brown shading for PWS (dark brown for >10% total of supply and demand related need;
Mid-brown for >10% of supply or demand related need;
Light brown for 5% of supply or demand related need);
Green shading for spray irrigation needs (dark green where this overlaps with PWS needs) and power station symbol for power sector need related to decarbonisation.

Within this assessment, however, there is a degree of uncertainty about a number of critical planning factors and issues. As well as demand in the power and agriculture sectors, this includes for the future needs of the environment and our level of "environmental ambition", the possible need for exports to other regions, the effectiveness of planned demand management measures, the impact of climate change and severe drought on reservoir yields and deployable output, and future levels of population and property growth in the OxCam Arc. Summary details are given below:

| Sector | Pressure | Dry Year Annual Average Estimated Impact (Ml/d) | | Comment |
|---------------------|---------------------------|---|--------------|---|
| | | Lower | Upper | |
| Public Water Supply | Climate Change | 54 | 180 | Includes range of possible high/low climate change impacts - mostly on reservoir yields |
| | Sustainability Reductions | 139 | 500 | Upper limit accounts for indicative levels of enhanced environmental ambition |
| | Growth (population) | 159 | 408 | Upper limit accounts for maximum possible build-out rates in OxCam Arc and failure to make significant progress with planned demand management measures |
| | Drought resilience | 88 | 88 | Note: methodology uncertainties which are subject to work in progress |
| | Regional exports | (-) | (-) | Unknown at this stage, although 100 Ml/d export is currently assumed for work on the South Lincolnshire Reservoir scheme |
| Power | Decarbonisation | 17 | 192 | Assumes rapid transition to Hydrogen economy with 20% of the national production in WRE region |
| Agriculture | Growth (irrigation) | 74 | 288 | Based on range of plausible growth factors for spray irrigation in the WRE region |
| Total | | 531 | 1,656 | |

Range of uncertainties arising from the initial assessment of need in the WRE region in the 2050's

Arising from this wide range of uncertainty, the potential exists for a series of sub-optimal outcomes. Driven by either under or over investment, these include low levels of affordability, a reduction in security of supply, a reduction in levels of service, increased competition for the available resources and widespread and persistent levels of environmental degradation. To manage these risks, more work is needed to understand the distribution, timing and size of our future needs. In particular, this includes for:

- Decarbonisation and power sector needs
- Drought resilience (the effect of 1/500 droughts)
- Regional exports (and imports)
- Environmental ambition, and
- Agricultural demands

Even upon the completion of this work there will remain a residual level of uncertainty. Given the time-scales over which we are planning and the issues we are planning for, this is likely to be significant. To manage the resulting risk we need to continue to use planning approaches such as Multi-Objective Robust Decision Making (MO-RDM), which are designed to help planners and others make better quality decisions in complex systems subject to significant uncertainty. We will also need to build our capacity for adaptive planning.

MAKING DECISIONS UNDER UNCERTAINTY.

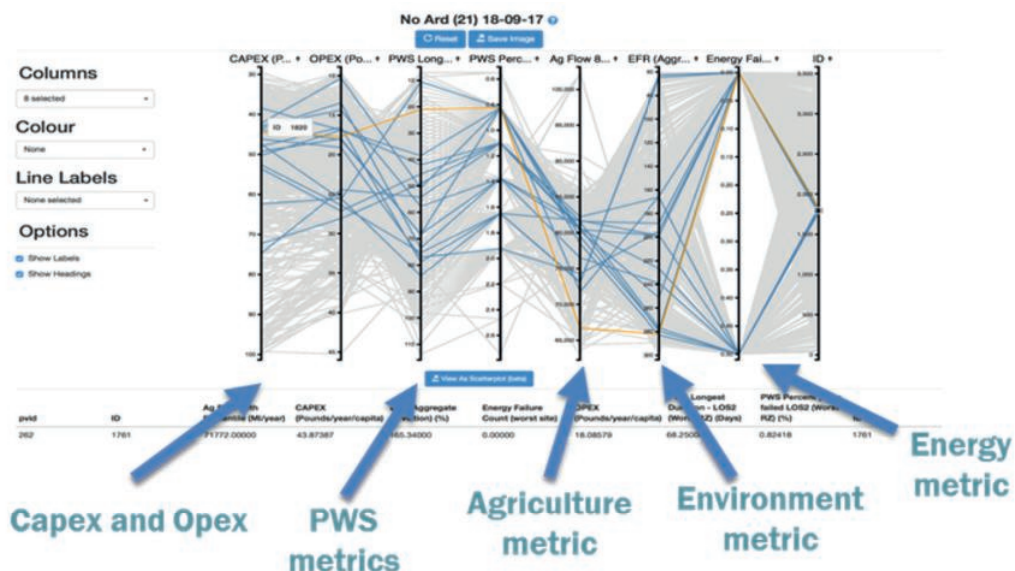
Until recently, water resource planning in England and Wales was dominated by deterministic forecasts of the balance between supply and demand and least cost-optimisation. Used almost exclusively by water companies, the Environment Agency, and Ofwat, this approach identifies the most cost-effective way to maintain levels of service in a single planning scenario that combines environmental need with best estimates of the future impact of drought, climate change and population growth. Within this planning framework, risk and uncertainty are accounted for using a planning allowance known as 'Target Headroom'.

While this approach performs well for single sector planning where the supply-demand investment drivers are well understood, and for regions where the predominant use of water is for public water supply, they are less suitable for multi-sector planning or for planning where there is significant uncertainty about investment drivers and the related risks over the long term. Eastern England is different in terms of the amount of water which is used for other purposes, particularly irrigation and power and in the level of uncertainty moving forward into the 2050s, and so this approach has proved highly beneficial for WRE.

For Integrated Water Resource Management (IWRM) planning that takes account of the uncertainties and risks from many factors including climate change and growth, WRE uses a combination of decision making under uncertainty (DMUU) methods. These include many-objective evolutionary optimisation (MOEO) and robust decision making (RDM).

The MOEO-RDM approach (MO-RDM) allows the vulnerability of water resource systems to be quantified in terms of the impact of growth, climate change, and drought on abstractors from different sectors and the environment. The analysis is simulator based, with uncertainty accounted for using a wide range of plausible future scenarios, and vulnerability defined in terms of metrics and thresholds which are specified by each sector.

Subsequently, MO-RDM identifies 'pareto-optimal' portfolios of schemes that are capable of meeting minimum performance thresholds over a wide range of plausible future scenarios. In these, performance in respect of one metric cannot be improved unless at the expense of another, therefore trade-offs between the portfolios must be used to select the one which best meets the overall needs of the planners. In this way, WRE can produce strategies and plans which simultaneously meet the needs of the public water supply, environment, energy and agri-food sectors.



In the last step of the MO-RDM process, the selected portfolio is rigorously stress tested and the vulnerability analysis updated. It is an adaptive process however, and where additional improvements are needed, alternative portfolios can be selected and tested and, if necessary, the process can be re-run based on new information that becomes available.

5. STRATEGIC CONTEXT AND IMPLICATIONS

The strategic context for WRE's first regional first regional water resource management plan includes the following:

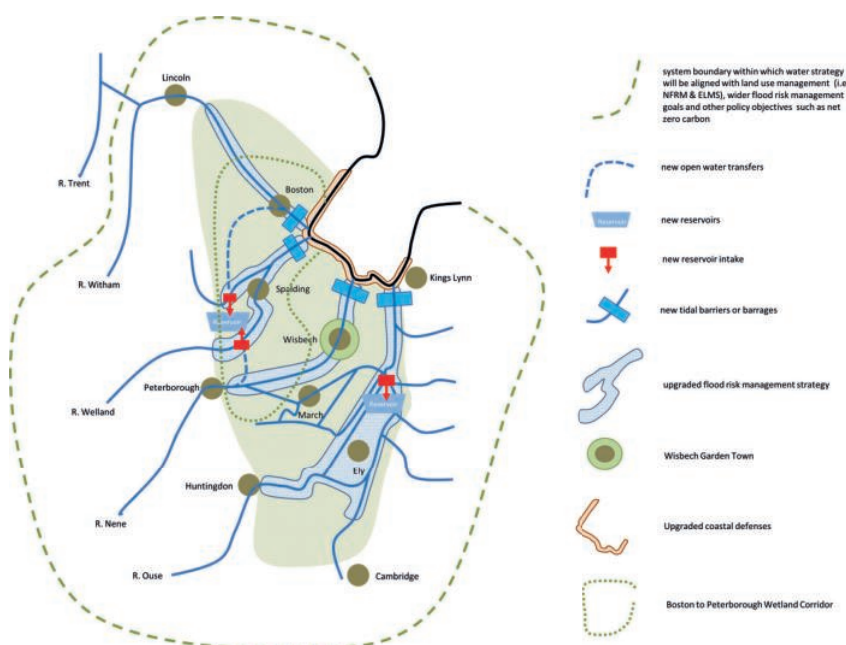
- Expected but uncertain impacts from climate change on drought and flood risk. Arising from a combination of warmer wetter winters and hotter drier summers, these are likely to be significant and to include the threat of coastal inundation in large parts of the WRE region as a consequence of sea-level rise.
- Net zero carbon by 2050, and
- The need to increase levels of growth following our departure from the European Union. This includes delivering on the clean growth agenda which is set out in the Governments Industrial Strategy and "levelling-up" of disadvantaged communities and areas.

Within the WRE region, more effective integrated water management is absolutely pivotal to meeting these challenges. Securing economic growth and the related benefits for our communities and the environment means that we will have to meet growth in demand and increase resilience to flood, coastal inundation and drought. Achieving net zero carbon will require more efficient use of our available resources and may require us to provide a large volume of additional supply to the energy industry for carbon capture use and storage (CCUS) and the hydrogen economy.

With the potential for large investment needs in each sector, cost will become a key driver for decision-makers. To maintain levels of affordability, measures to further strengthen cross-sector collaboration are necessary, specifically in relation to the development and funding of new infrastructure. Some of this will be relevant for regional strategic issues; other for more local sub-regional or catchment-based issues. Developing single sector (or single company) solutions for meeting future water related needs in the WRE region, as well as managing the related uncertainties and risks, is unlikely to be cost-effective. A more integrated, holistic, approach is needed.

CASE STUDY; THE FUTURE FENLAND ADAPTATION STRATEGY

An example of where WRE is strengthening collaboration between sectors is the Future Fenland Adaptation Strategy. This initiative, which is based on the principles of Integrated Water Resource Management (IWRM), seeks to deliver a long-term solution to the drought, coastal inundation and flooding related risks which are posed in our fenland areas by climate change. By coordinating activity and funding in programmes which are traditionally considered to be separate, the overall level of investment which is required can be reduced, and delivery can be made more efficient and the benefits spread more widely. An illustration of the concept is given below:



Key elements of the Future Fenland Adaptation Strategy include:

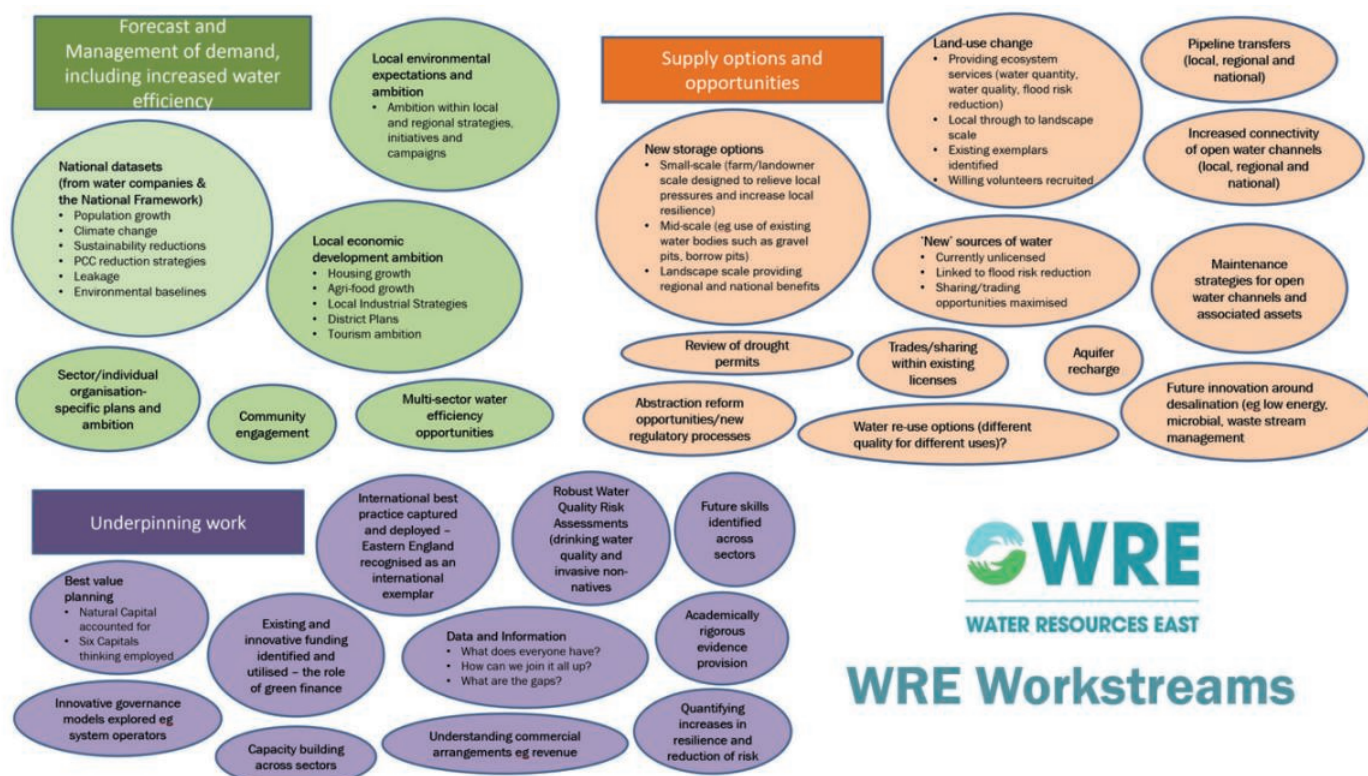
- New multi-sector reservoirs providing additional water supply resilience for water companies, farmers and the food industry.
- Downstream flood barriers or barrages to protect growth areas in the Fens, enabling key local infrastructure projects such as a rail connection from Wisbech to Cambridge and the dualling of the A47 to move forward.
- Open water channels to provide water storage, biodiversity, navigation and tourism, and further flood risk management benefits.
- The opportunity to collaborate to manage land and water across the Fens in a new and integrated way, seeking to secure the future of the peat landscape given its crucial role in carbon sequestration.

6. OUR APPROACH TO REGIONAL PLANNING

At WRE, building on the multi-sector approach which has continued to mature over the last five years, we are pursuing an ambitious regional planning approach focussed on:

- Forecast and management of demand, including increased water efficiency.
- Supply options and opportunities.
- Underpinning work.

The myriad of workstreams and initiatives which sit below each of these headings are summarised below:



Many of these workstreams are outside of 'traditional' water company-only water resource management planning, and as such we are seeking to supplement the funding being provided by our water companies and our Board of Directors with external grants, working in partnership with other organisations in our region.

We have a detailed draft Technical Programme which will run through until the publication of our Regional Plan; this will ensure that the outputs of our work can be directly incorporated into water company Water Resource Management Plans ready for their publication in 2023. We will publish our full Technical Programme and further

details of all of our workstreams in our 3 Year Business Plan in May 2020, and will publish detailed Method Statements in July 2020.

The technical programme will be coordinated via a multi-sector Technical Delivery Group and a series of task and finish groups, supporting more local, sub regional, planning.

It is our intention that the WRE Regional Plan will contain schemes and solutions which will be funded outside of the water company WRMP process, or co-funded via other routes as we develop 'best value' options for the many water users in our region.

7. CO-CREATION OF THE REGIONAL PLAN

The overall 'ethos' of WRE's Regional Plan Development will be one of co-creation and engagement, rather than creation and consultation.

We will co-ordinate the outputs of the sub-Regional Planning processes and the associated working groups via a series of Planning Conferences for stakeholders in each area. This will enable us to discuss the range of proposed solutions for each group, to understand challenges and opportunities and to seek consensus on the portfolio of options which will go forward into the next stage of planning processes.

We will also direct stakeholders with suggestions for options or schemes to each water company Upstream Market process.

In line with the other regional groups, the sort of questions we will ask throughout the process are:

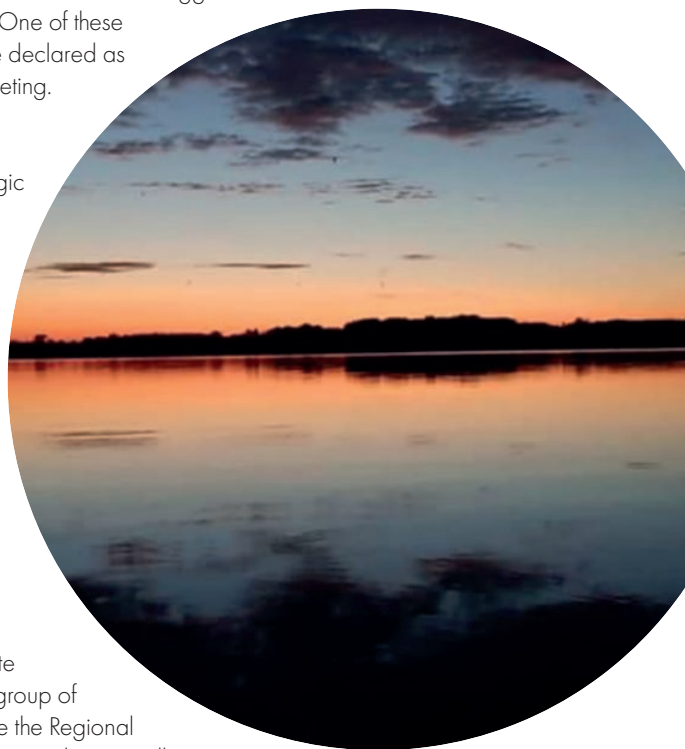
- Do you think we have missed any key water users within the region? If so can you please provide details of these water users and the sectors they may be in?
- Are there any further key challenges and opportunities we face in the region with regard to water resource availability that you believe we should consider?
- We have set out our first thoughts on environmental ambition. Are we focusing on the key opportunities in our region? Are there any other areas of opportunity you think we could benefit from?
- What are your views on how the region could or should use temporary approaches, such as drought permits, to managing continuous water availability in drought events?
- This plan requires engagement across a wide range of stakeholders. What are your views on how best to achieve this and are there any key stakeholders you suggest the plan engages with?
- What are your suggestion on further options we could consider?

We will hold quarterly meetings with our entire membership, our Strategic Advisory Group, together with our Consultation Group (regulators and other government agencies). The purpose of these meetings will be to engage our membership in the emerging plan, to identify any concerns or opportunities as early as possible and to gather feedback and suggestions throughout the process. One of these meetings will formally be declared as our Annual General Meeting.

In between Planning Conferences and Strategic Advisory Group and Consultation Group meetings, we will continue to engage on an individual basis with organisations and will attend and support other organisations' Working Groups, Steering Groups and meetings across the region as required.

Whilst we will collaborate with a diverse, inclusive group of stakeholders to co-create the Regional Plan, we absolutely recognise that we will need to undertake specific targeted engagement with for example water company customers, water company Customer Challenge Groups and individual Company Boards (water company and others). A detailed engagement plan will be developed during 2020 to align with all key milestones within the National Framework.

If you would like to feed into our plan or have any comments on the above, please contact us at contact@wre.org.uk. Stakeholders can also interact with us via our two social media channels. Follow us on Twitter @WaterREast and on our LinkedIn page.



OUR MEMBERS

At the time of writing WRE has almost 70 members across many sectors

Water Companies



Internal Drainage Boards & Other Public Bodies



Energy Companies



Community & Advocacy Groups



Landowners, Farming & Abstractor Groups



University and Education



Business



Environmental Organisations



Local Authorities & Local Enterprise Partnerships



Our Consultation Group





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