This report describes our plan to maintain a secure balance between water supplies and demands in the region served by **anglianwater**

Draft Water Resources Management Plan

Main Report, April 2008

CONTENTS

EXECUTIVE SUMMARY

1. The preparation of a Water Resources Management Plan (WRMP) is a new statutory process. It allows for consultation on this Draft WRMP, our publication of a Statement of Response to representations received later in 2008, prior to the submission of a Final WRMP to Defra in April 2009 for its approval. Defra is advised by the Environment Agency throughout the process. We have worked with the Environment Agency's water resource planners in the preparation of this report.

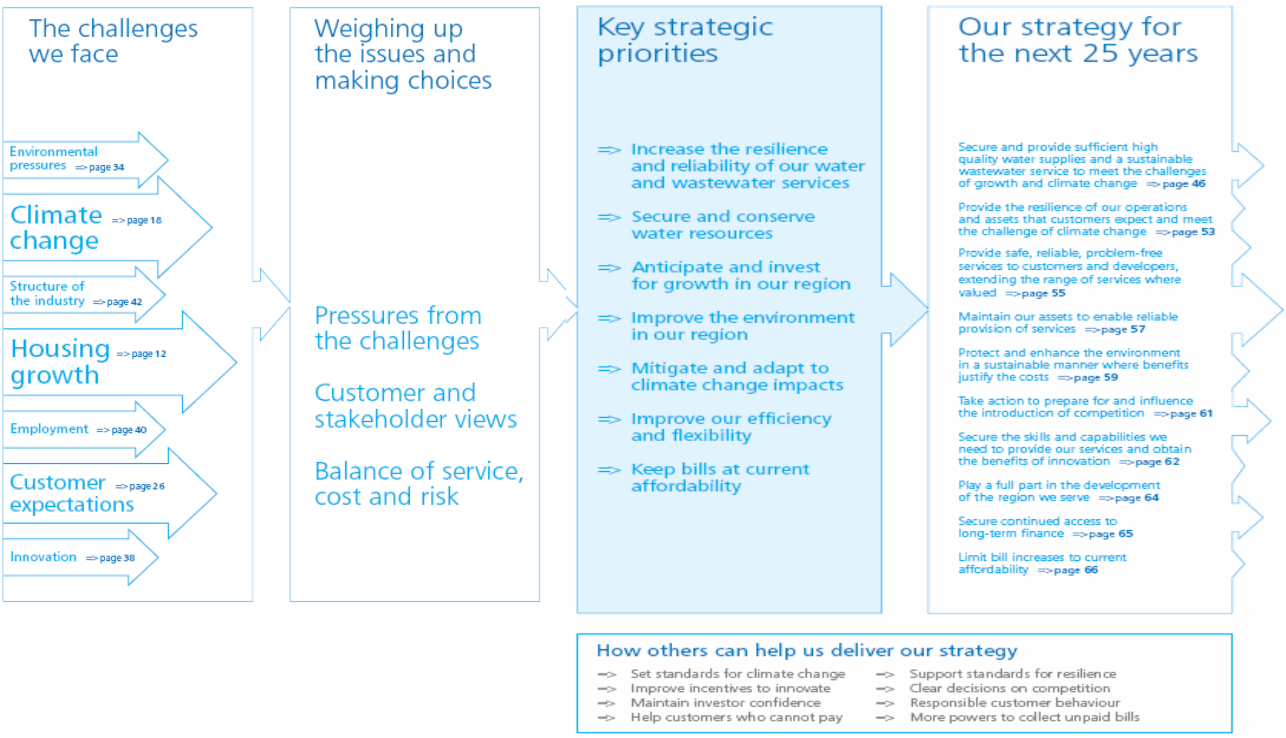
2. The Main Report is accompanied by a Summary Report for readers wanting an overview of the WRMP and the strategy that it describes, without the detail of the analytical tools given in Chapter 3 of this report. The Summary Report provides a regional overview of our strategy for the management of water resources, where Chapter 4 of this report provides a more detailed description of the supply-demand balance in each of the 11 Water Resource Zones that make up our supply area in the Anglian region plus the Hartlepool area.

3. The challenges we face as a company are detailed in our Strategic Direction Statement (SDS) published in December 2007. In particular the impact of housing growth, environmental pressures, climate change and customer expectations have a strong bearing on this plan.

4. Our strategic priorities identified that we will increase the resilience of our water and wastewater services, secure and conserve water resources, anticipate and invest for growth in our region and mitigate and adapt to climate change impacts.

5. Figure 1, taken from our SDS, shows the linkages between the challenges we face, our key priorities and our company strategy for the next 25 years

Figure 1 Strategic direction



6. The WRMP is required to address the challenges to water supplies from growth, climate change and environmental legislation. We operate in one of the fastest growing regions in the country, we operate in the driest region of the country and therefore have vulnerability to drought, and we have more water-dependent, European-designated conservation sites in our supply area than any other water company.

7. We have reviewed and updated the methodologies and processes that we used to develop our Water Resources Plans produced in 1999 and 2004. We concluded that these provide a sound basis for the analysis of the supply-demand balance and the derivation of the assumptions that need to be made when looking forward over 25 years from 2010 to 2025. In particular we have carried out detailed analysis of the impact of climate change on water resources following the guidance provided by the Environment Agency.

8. Our analysis shows that although we have historically developed sufficient water resources to provide supplies to meet the demand for water today we will need to invest to maintain secure supplies in the future. The need for investment will be detailed in our Draft Business Plan submission to Ofwat in August 2008 that will be used to set charges for water services for the period 2010 to 2015. The potential deficit of 246 Ml/d at average and 196 Ml/d at peak demand in 2035 compares with the current quantities of water available for use of 1375 Ml/d at average and 1816 Ml/d at peak demand.

9. An important factor in defining the potential deficit in the availability of water supplies to meet forecast demand is the need for a planning allowance, or target headroom, to address the risks and uncertainties in our calculation of the supply-demand balance. Using the industry standard methodology we require a margin of 5 per cent to maintain the security of supplies in the current year and have allowed for an increase to 15 per cent during the planning period. The extent to which headroom has been used to address an imbalance of water available for use against our demand forecast is reviewed and reset every five years for a new WRMP.

10. The main drivers for headroom are the uncertainties over population growth and the level of water consumption by domestic customers. Our demand forecast assumes that the population served will increase by up to 18 per cent or some 850,000 people between 2010 and 2035. We have also assumed a decline in measured water consumption to 129 l/h/d by 2030. This recognises Government expectations as outlined in its recent strategy ‘Future Water’[1]. We plan to continue to promote water efficiency initiatives, but equally water savings are achieved through customer behaviour and effective regulation, particularly for the construction of water-efficient new homes. A further driver for headroom is the uncertainty associated with the impact of climate change on water resources.

11. In developing the Draft WRMP we have followed the ‘twin-track approach’ of using demand management alongside water resource development. We have already successfully achieved a high level of meter penetration, a low level of leakage from our water mains and our customers’ current level of water consumption compares favourably with the rest of the country. Our demand forecast assumes that water consumption by our metered customers will

[1] ‘Future Water: The Government’s water strategy for England’, Department for Environment Food and Rural Affairs, 2008

decline as a result of the planned continued promotion of water efficiency and that leakage from our water mains will be held at around 210 Ml/d. This represents a significant reduction in terms of losses per kilometre of water mains and per property served.

12. We have included demand management proposals in our supply-demand balance analysis through further targeted leakage control, enhanced metering, pressure reduction schemes, the installation of water-efficiency devices and water audits. These options are normally selected in preference to larger resource development options.

13. We have allowed for an increase in the number of our customers paying water charges by a meter from the current level of 60 per cent to 90 per cent by 2035 in our baseline forecast. The supply-demand balance analysis includes the option for targeted metering to address local supply deficits. We have also integrated enhanced metering in our supply schemes for areas with high growth, such as Colchester and the large towns in the west of our region. This follows the model of our recent project in Ipswich where we installed meters at all homes where installation is practical. Customers can then choose to pay measured water charges by opting to switch and will be subject to paying measured charges by moving to an existing metered home. Both targeted and enhanced metering accelerate the water savings we have included in our baseline forecast, but do not increase them.

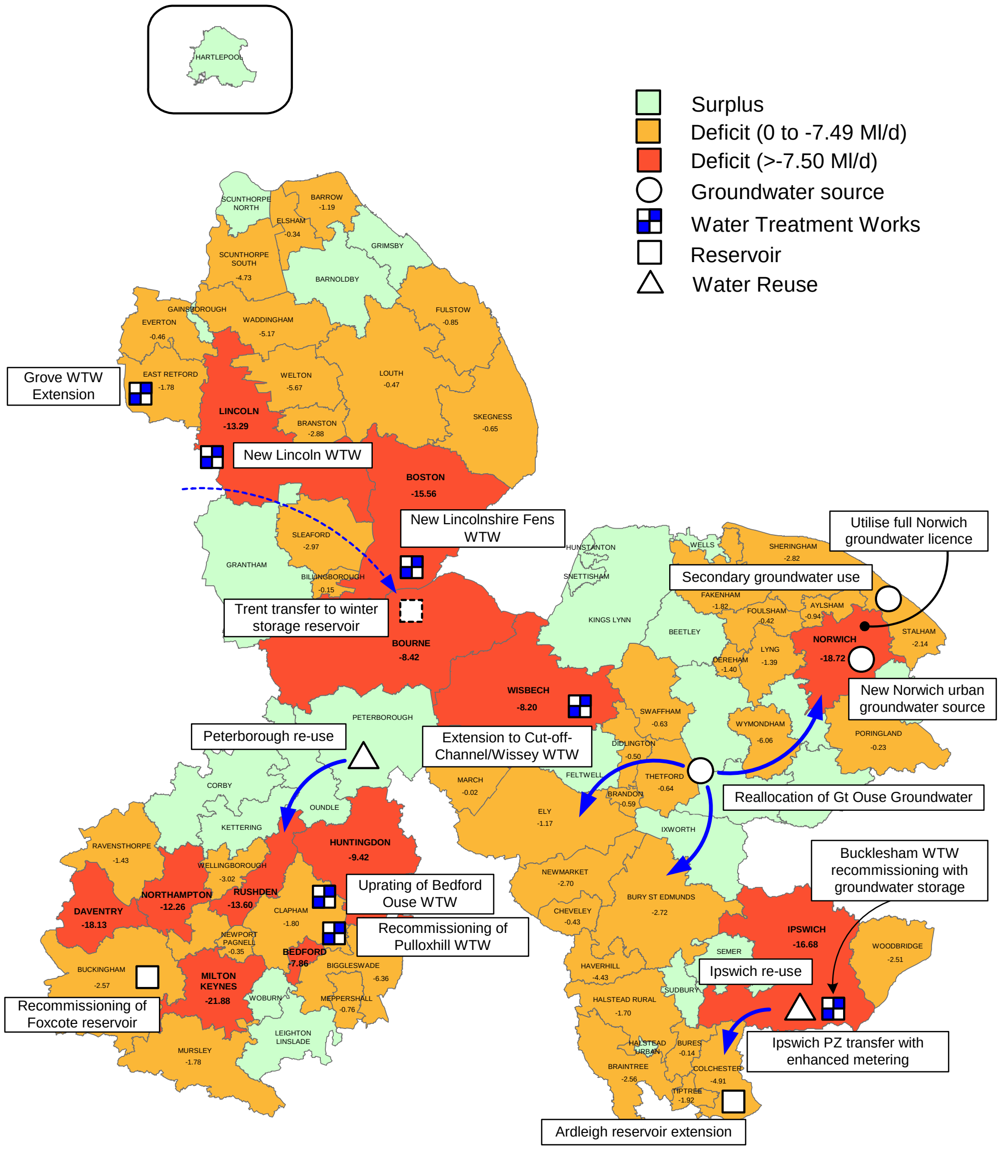
14. In developing the WRMP we have considered the use of compulsory metering as required following the designation by Defra of the Anglian region as an area of serious water stress, using the methodology developed by the Environment Agency. In reviewing our metering policy we have taken into account a range of issues, including its success to date, the cost and benefits of blanket compulsory metering and issues of affordability. We have concluded that compulsory metering of our remaining unmeasured customers is not appropriate at this stage but could be reviewed in 2015. Our 90 per cent penetration on domestic water meters by 2035 will be achieved by the continued metering of all new homes built and proactive customer campaigns.

15. We have committed significant resources over the last two years to evaluate all options available to develop additional water resources, including unconstrained options. These are described in detail in Chapter 4 with those selected following supply-demand balance modelling summarised in Chapter 5. The selected resource development schemes fall into five main categories:

    i. transfer an available surplus to an area of potential deficit
    ii. re-use of water that is currently discharged to tidal waters
    iii. use our currently unused licensed quantities
    iv. development of groundwater resources, where available
    v. transfer or reallocation of abstraction licences

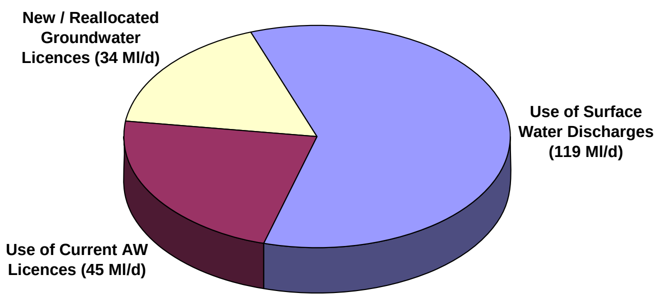
16. Our supply-demand balance model analyses for a surplus or deficit in each of 85 planning zones throughout the 25-year planning period. It identifies where there is a reliable surplus available and will allocate this for transfer to adjacent zones. Similarly the development of a new water resource will be shared between zones using the existing trunk main and distribution network or reinforcement to it. Figure 2 shows the selected resource development options and Figure 3 illustrates where water resource is derived from.

Figure 2 Selected resource development options



Note: Deficit represents the largest average or peak deficit by 2035/36.
Data from FORWARD - Baseline FINAL with Dry Year Uplift with Enhanced Metering

Figure 3 New supplies by resource category



17. The transfer upstream of water currently discharged to tidal waters makes up half of our proposals. The flows in the Rivers Trent, Witham and Bedford Ouse will be augmented by increasing discharges from existing upstream wastewater treatment works. We also propose developing new water re-use schemes to provide the additional treatment needed to return discharges that currently go to coastal waters to discharge upstream to inland waters. In the latter case, the scheme at Ipswich would be for subsequent abstraction further downstream to refill a large storage reservoir. The proposed schemes at Peterborough would allow increased abstraction of surface water at our existing river intake by substitution of flow on the downstream side of our abstraction.

18. We plan to utilise unused quantities on licences currently held by us through recommissioning closed sourceworks or uprating existing sourceworks. This accounts for two thirds of the remaining schemes. The larger schemes are for recommissioning Foxcote reservoir in Buckinghamshire and uprating our existing surface water treatment works in Norfolk to use a licence for abstraction from the Cut-off-Channel.

19. The forecast deficit in the North Norfolk WRZ will be addressed through the development of secondary groundwater where the Environment Agency has stated, through the CAMS process, that water is available for licensing. The groundwater system will be evaluated in the early part of the planning period to confirm its potential. The groundwater quality is likely to be poor and will require advanced treatment processes. This development is preferred to less sustainable options, such as desalination of seawater.

20. The remaining category is our proposal for the reallocation of the use of the Environment Agency's Great Ouse Groundwater Development Scheme (GOGDS) to meet local needs in Norfolk and Suffolk. The scheme was developed for river augmentation and transfer to meet demands in Essex, but its use has been constrained due to concerns on environmental impact, and alternative water resources are currently proposed for the supplies to Essex. The use of the GOGDS would be phased to meet forecast growth in demand in the main growth centres and be limited by the Environment Agency's assessment of its availability. Initially it would be used to supply Bury St Edmunds and Wymondham and then Thetford, Ely and Norwich later in the planning period.

21. We have considered the environmental impact of the plan through an accompanying Environmental Report, as required by the Strategic Environmental Assessment Directive[2]. The SEA has been used to inform the preparation of the WRMP by comparing options against a range of social and environmental criteria prior to and after the identification of feasible options.

22. A significant uncertainty in the Draft WRMP is the need for sustainability reductions as an outcome of the review of consents required by the Habitats Directive of abstraction licences that may adversely affect the integrity of important European Conservation sites. The Environment Agency has informed us of indicative numbers for a small number of sites where their work is sufficiently advanced. In line with the regulatory guidance we have not included an allowance for uncertainty in sustainability reductions as headroom. The Environment Agency has told us that additional information on sustainability reductions will be available in August 2008 for us to take into

[2] Directive 2001/42/EC, European Commission, 2001

account in preparing our Final WRMP and PR09 Business Plan for submission in April 2009.

23. Our water resources strategy requires the redistribution of groundwater licences by the Environment Agency and assumes that the currently proposed level of sustainability reductions is not increased by the Environment Agency. A significant increase in sustainability reductions, and/or a failure to successfully redistribute groundwater resources from the GOGDS would trigger major water resources schemes, such as the development of a major new winter storage reservoir in the Lincolnshire Fens to facilitate the transfer of water resources from the River Trent to Norfolk, Suffolk and Essex. In addition, our Final WRMP may need to vary to reflect changes to the estimates of water resource availability when the outputs from the latest climate change models are published in late 2008 and incorporated into groundwater and surface water resource models.

24. We have already commenced studies to determine suitable locations for a new winter storage reservoir and have confirmed the availability of resources from the River Witham with and without support from the River Trent. We will use the early part of the planning period, from 2010 to 2015, to advance these studies to include site investigations and environmental assessments. This approach will allow us to react quickly to changes to the supply-demand balance should significant sustainability reductions be required or should the reallocation of groundwater resources not be achieved. The lead-in time for developing a new reservoir is estimated as between 15 and 20 years. A new reservoir may form a long-term option for resource sharing with adjacent water companies. We have discussed this and other water resource development options with our neighbouring water companies and will continue to work with them.

1 INTRODUCTION

1. This Draft Water Resources Management Plan 2008 (WRMP) has been produced to comply with the statutory requirements in the Water Resources Management Plan Regulations 2007 issued by the Secretary of State in exercise of the powers conferred by the Water Act 2003. It has been prepared to meet the requirements of the Water Resources Management Plan Direction 2007 and in accordance with the water resource planning (WRP) guideline issued by the Environment Agency in April 2007, and subsequent updates and revisions[3].

2. The process requires that we consulted with Defra, Ofwat and the Environment Agency and any licensed water suppliers using our supply system before preparing our Draft WRMP. We did this in May 2007 and have referred to the comments received during the preparation of the Draft WRMP. There are no licensed water suppliers operating in the area we supply at the time of preparing the draft plan.

3. We have previously prepared Water Resources Plans in 1999 and 2004 at the instruction of government. These were submitted to the Environment Agency who advised ministers on the efficacy of our plans. The plans formed a part of the periodic review process that was used by Ofwat to determine the level of investment required by water companies to maintain services and the charges that are made to finance them.

4. The purpose of the WRMP is to describe how we will manage the supply-demand balance. This will be achieved by a twin-track approach; through investment in the assets that abstract, store, treat and distribute water supplies and through effective management of the demand for water. This Draft WRMP has been prepared in advance of the Draft Business Plan that will be submitted to Ofwat in August 2008 as part of the PR09 periodic review process for determining investment and water charges for the period 2010-15 that is due for completion in 2009. The Draft WRMP and PR09 submissions are both based on the strategy for managing supplies and demands that was outlined in our Strategic Direction Statement submitted to Ofwat and published on our website in December 2007. The Final WRMP will be published at the same time that the Final PR09 Business Plan is submitted to Ofwat in April 2009.

5. The Draft WRMP has been prepared using up-to-date information and guidance. It should be noted that there will be changes to the information available such as revisions to the targets for house building, the requirement to address concerns on the impact of abstraction on the environment and the advice given on climate change scenarios. These will be incorporated as appropriate in the Draft PR09 Business Plan submission and the Final WRMP and Business Plan.

6. The basis for the Plan is the analysis of the balance between supplies defined as the deployable output of sourceworks and the current and forecast demands for domestic and industrial use. The supply-demand balance is built up from analysis at the level of 85 Planning Zones [PZs] using the company's forecasting model, FORWARD, described in Chapter 3. The model compares the difference between supplies and demand as available headroom with the calculated target headroom and selects an optimal solution to maintain secure

[3] 'Water resources planning guideline', Environment Agency, April 2007

supplies throughout the planning period to 2035. The analysis is aggregated to 12 Water Resource Zones that are used to complete the detailed sets of tables submitted to the Environment Agency.

7. The WRMP Regulations require that the Draft WRMP is published in paper form and sent to the statutory consultees, listed in the Appendix. It is also published on the company's website to provide an opportunity for representations to be made to the Secretary of State at Defra. We will consider these representations in moving from the Draft to Final WRMP in accordance with the Regulations and will publish a Statement of Response within the prescribed period.

8. The Environment Agency's WRP guideline recommends a structure for the WRMP based on four separate parts:

Summary Report	Published alongside this report for readers wanting an overview of the WRMP and the strategy that it describes.
Main Report	This document. It provides the detail on the process, issues, analysis and proposed strategy to enable those wishing to submit representations to do so.
WRP Tables	12 sets of nine Tables for average and peak demand scenarios provided in electronic format only to the Environment Agency. The tables are used by the Environment Agency to carry out audit checks on the analysis and calculations used to derive the preferred list of water management options, or final planning components that are described in the Main Report.
Technical Reports	A set of technical reports that support the assumptions made in modelling the supply-demand balance to enable the Environment Agency to carry out their detailed review of the WRMP and to report to ministers on it.

The Summary and Main Reports are published on our website for consultation. We have not published the WRP Tables and Technical Reports, but we would be happy to discuss them on request.

9. Any representations on the Draft WRMP should be sent to Defra at the address below by 4 August 2008. These will then be forwarded to Anglian Water and a statement detailing the consideration given to the representations in finalising the WRMP will be provided by 3 November 2008. The Secretary of State will then consider whether a public hearing is required and whether to issue any Directions for the Final WRMP prior to its publication.

10. Any representations on the draft WRMP should be sent to:

Department for Environment, Food and Rural Affairs
Water Supply and Regulation Division
2nd Floor, Area 2C
Ergon House
Horseferry Road
London SW1P 2AL

11. We have considered whether the preparation of the WRMP comes under the requirements of the European Strategic Environmental Assessment (SEA) [4] Directive 2001/42/EC. We consulted on the need for a SEA with the statutory consultees (Environment Agency, Natural England and English Heritage) through a screening process and all concluded that an SEA was required. This was determined on the basis that the WRMP falls within the scope of Article 3.2(a), where an environmental assessment shall be carried out for any plan or programme where:

    a) it is prepared for, *inter alia*, water management, and

    b) sets the framework for future development consent of projects listed in Annex I and II to Directive 85/337/EEC.

    We then consulted on the scope of the SEA prior to carrying it out in parallel with the preparation of the WRMP. We are publishing an Environmental Report, as required by the SEA Directive, alongside the Draft WRMP and in support of it.

[4] Directive 2001/42/EC

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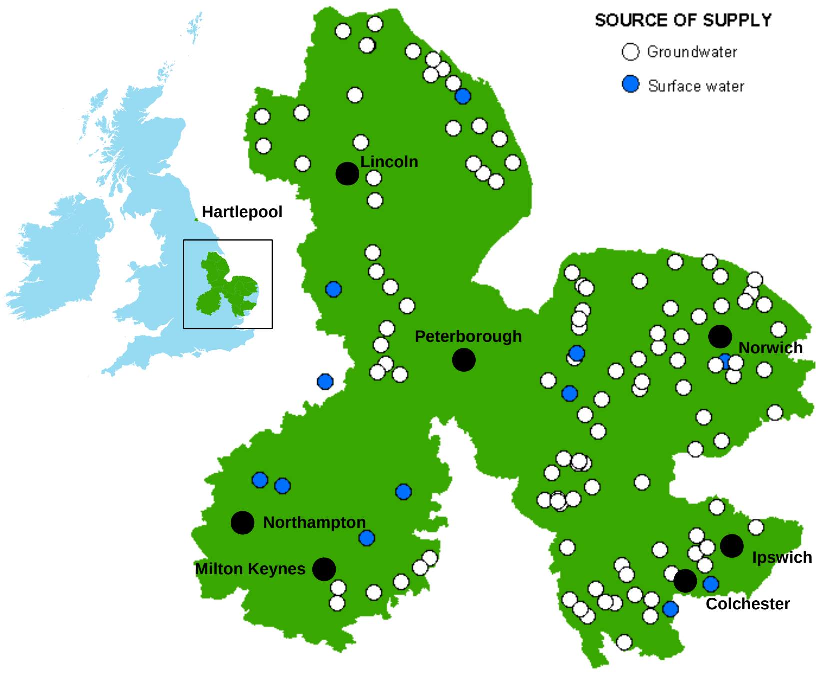
2 REGIONAL OVERVIEW OF WATER RESOURCES

Historical Development of Water Resources

1. The history of public water supplies starts with the development of local groundwater sources in the form of a community natural spring or hand pump. These were progressively replaced from around the mid 19th Century with piped water supplies using larger sources, including treated surface water supplies. It was the middle of the 20th Century before potable mains water supplies reached many small villages, by which time most private water supplies were also replaced with less than 1 per cent of the population now using private water sources. The original driver to improve public health is now taken for granted, being replaced by an expectation of the provision of piped water and wastewater services as the norm for living.

2. The preferred option for water supply has traditionally been controlled by the availability of local groundwater and surface water sources. As the demand for water increased and local supplies were developed to their sustainable level, a network of raw and treated water transfers was developed along with strategic storage reservoirs, resulting in the extensive network that provides water services today. Figure 2.1 shows the location of the water sources that supply the region.

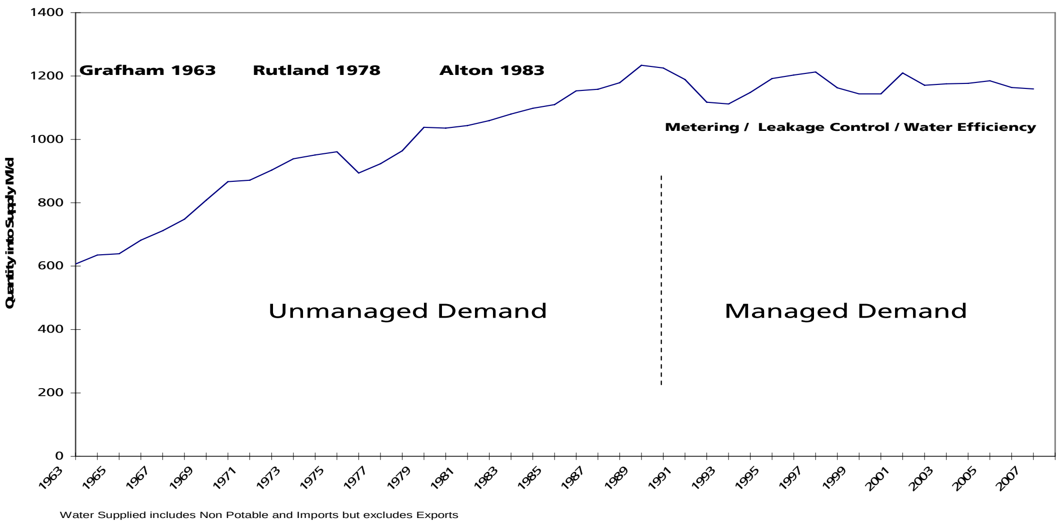
Figure 2.1 Water sources



3. The amount of water supplied increased as a result of economic growth and technological advances, with the demand for water increasing as a result of more washing machines and dishwashers and improved bathrooms and kitchens. Figure 2.2 shows how the amount of water we supply grew steadily from the 1960s through to 1990, but has stabilised over the last 15 years in response to better leakage control, household metering and a decline in water used by industry. Since 1989 the number of properties that we supply has increased by 20 per cent. Looking forward over the new planning period to

2035 we face challenges from plans for regional growth, climate change impacts and environmental legislation. The potential impact of growth in particular has risen markedly since our last quinquennial review and plays a major role in the need to invest in water resource management to maintain the security of public water supplies. Further details of the existing water resources and supply systems and our proposals to develop them are described below.

Figure 2.2 Water supplied 1963-2007



Plan Structure

4. The WRMP is structured on 12 water resource zones (WRZs) that were defined in the previous Water Resources Plan 2004 and in the Drought Plan that was published in April 2008. The WRZs are based on the existing water supply system and represent the largest area in which water resources can be shared. They are defined by the aggregation of smaller areas that are used in the planning and management of our assets. They can therefore change in response to changes in the way in which the water distribution network is developed and operated. The boundaries between WRZs have been reviewed in preparing the Draft WRMP with the result that there have been some minor changes to the areas of the three zones that cover most of Norfolk. The 12 WRZs are:

Number	Name
WRZ1	South Humberside
WRZ2	Lincoln
WRZ3	Lincolnshire Coastal
WRZ4	Lincolnshire Fens
WRZ5	Fenland
WRZ6	North Norfolk Coast
WRZ7	Norfolk Rural
WRZ8	Norwich & The Broads
WRZ9	Cambridgeshire & West Suffolk
WRZ10	East Suffolk & Essex
WRZ11	Ruthamford
WRZ12	Hartlepool

Figure 2.3 shows the areas covered by the WRZs and their component Planning Zones

Chapter 4 describes the characteristics of each WRZ in terms of:

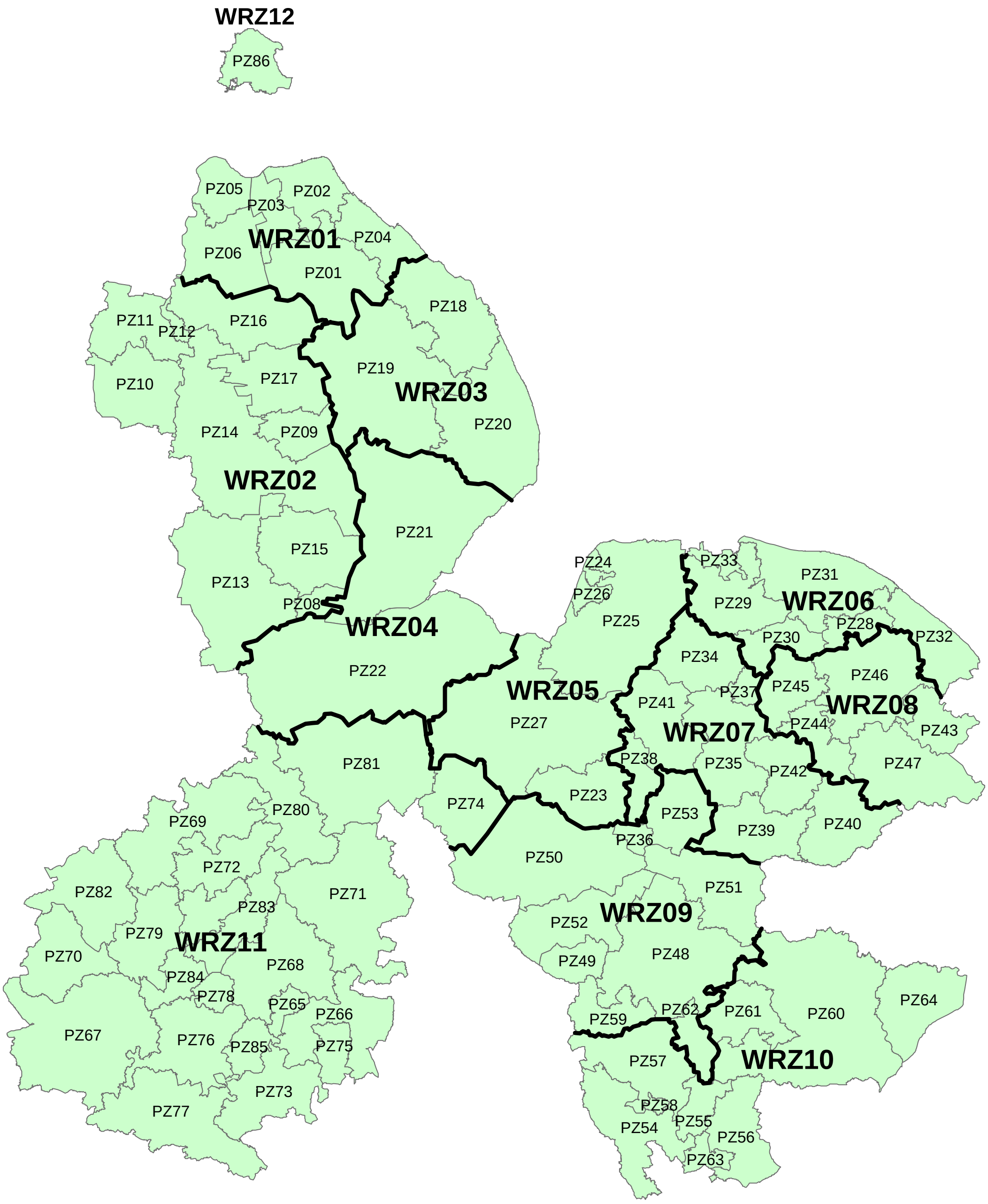
i the historical development of indigenous water resources;

ii the supply-demand balance against both current and forecast demands;

iii the feasible water management options identified; and

iv the preferred list of water management options selected from analysis with the FORWARD model and environmental assessment under the SEA Directive.

Figure 2.3 Planning Zones and Water Resources Zones



WRZ Ref	Water Resource Zones	PZ Ref	Planning Zone
WRZ01	South Humberside	PZ01	Barnoldby
		PZ02	Barrow
		PZ03	Elsham
		PZ04	Grimsby
		PZ05	Scunthorpe North
		PZ06	Scunthorpe South
WRZ02	Lincoln	PZ08	Billingborough
		PZ09	Branston
		PZ10	East Retford
		PZ11	Everton
		PZ12	Gainsborough
		PZ13	Grantham
		PZ14	Lincoln
		PZ15	Sleaford
		PZ16	Waddingham
		PZ17	Welton
WRZ03	Lincolnshire Coastal	PZ18	Fulstow
		PZ19	Louth
		PZ20	Skegness
WRZ04	Lincolnshire Fens	PZ21	Boston
		PZ22	Bourne
WRZ05	Fenland	PZ23	Feltwell
		PZ24	Hunstanton
		PZ25	Kings Lynn
		PZ26	Snettisham
		PZ27	Wisbech
WRZ06	North Norfolk Coast	PZ28	Aylsham
		PZ29	Fakenham
		PZ30	Foulsham
		PZ31	Sheringham
		PZ32	Stalham
		PZ33	Wells
WRZ07	Norfolk Rural	PZ34	Beetley
		PZ35	Bradenham
		PZ37	Dereham
		PZ38	Didlington
		PZ39	East Harling
		PZ40	Harleston
		PZ41	Swaffham
		PZ42	Wymondham
WRZ08	Norwich & The Broads	PZ43	Brundall
		PZ44	Hethersett
		PZ45	Lyng
		PZ46	Norwich
		PZ47	Poringland
WRZ09	Cambridgeshire & West Suffolk	PZ36	Brandon
		PZ48	Bury St Edmunds
		PZ49	Cheveley
		PZ50	Ely
		PZ51	Ixworth
		PZ52	Newmarket
		PZ53	Thetford
		PZ59	Haverhill
		PZ62	Sudbury

WRZ Ref	Water Resource Zones	PZ Ref	Planning Zone
WRZ10	East Suffolk & Essex	PZ54	Braintree
		PZ55	Bures
		PZ56	Colchester
		PZ57	Halstead Rural
		PZ58	Halstead Urban
		PZ60	Ipswich
		PZ61	Semer
		PZ63	Tiptree
		PZ64	Woodbridge
WRZ11	Ruthamford	PZ65	Bedford
		PZ66	Biggleswade
		PZ67	Buckingham
		PZ68	Clapham
		PZ69	Corby
		PZ70	Daventry
		PZ71	Huntingdon
		PZ72	Kettering
		PZ73	Leighton Linslade
		PZ74	March
		PZ75	Meppershall
		PZ76	Milton Keynes
		PZ77	Mursley
		PZ78	Newport Pagnell
		PZ79	Northampton
		PZ80	Oundle
		PZ81	Peterborough
		PZ82	Ravensthorpe
		PZ83	Rushden
		PZ84	Wellingborough
		PZ85	Woburn
WRZ 12	Hartlepool	PZ86	Hartlepool

Strategic Factors

5. The development of the WRMP contributes to the periodic review process that will result in the determination by Ofwat of the financing needed to implement a supply-demand investment programme through charges for water services. In preparation for PR09, we consulted with a wide range of stakeholders and produced our Strategic Direction Statement (SDS) in December 2007 that reflects the views that were received. The SDS included our policy and strategy on factors with particular relevance to the management of water resources of:

- Levels of service
- Approach to climate change through mitigation and adaptation
- Affordability
- Resilience

The Draft WRMP describes how we have taken these into account alongside a host of other factors including the protection of raw water quality and the environment. We have developed our plan methodology to deliver a secure and robust plan to meet the challenges in the form of the key issues described below.

Levels of Service

6. In preparing our WRMP we have to evaluate the level of service that we are to provide to our customers for the security of water supplies. Our customers have told us that it is acceptable to apply restrictions on water supplies during a drought. We have continued to use the level of service that we used for the calculation of surface water reservoir yields in our previous Water Resources Plan 2004 and Drought Plan 2008. These are based on the reference level first defined for the Agenda for Action yield review required by the Government in 1999 of:

- Restriction of the use of hosepipes not more than one in 10 years
- Use of Drought Orders to enforce restriction on non-essential uses and secure raw water resources not more than one in 40 years
- Imposition of the use of standpipes not more than one in 100 years

Effective investment will ensure that no customers are below the level of service, thus providing a better level of service when circumstances allow. We do not envisage a situation when it would be necessary to impose the use of standpipes as a result of drought conditions and we are separately addressing the need to add resilience to our water supply system against the possibility of events that could affect the operation of individual sourceworks.

Approach to Climate Change through Mitigation and Adaptation

7. Our SDS confirmed that climate change is the biggest risk facing Anglian Water over the next 25 years. Our assumptions on climate change are guided by the advice of the UK Climate Impacts Programme (UKCIP). The changes that are most significant for managing water resources are the increase in rainfall in the winter and reduction in the summer with an increase in temperatures that will reduce the length of the winter recharge season and potentially increase the demand for water. The impacts of climate change are included in our calculation of deployable output and forecast demand. At a strategic level it will be important to store more run-off from winter rainfall and to enhance natural groundwater recharge.

Affordability

8. Research for our SDS showed that a substantial proportion of our customers would like current levels of service to be maintained without any increase in prices in real terms and would like further investment to be justified by the benefits. Our strategy is to maintain the overall affordability of water. We believe this will be achieved if annual increases to customers do not exceed the rate of economic growth. However, this will not be possible if customers are required to pay for major investment to adapt to climate change, as well as provide the necessary infrastructure for growth and address major changes required by environmental legislation. These issues will be central to developing a supply-demand programme alongside the investment programmes that make up the Draft PR09 Business Plan submission to Ofwat. The issue of affordability will be central to the determination of the cost of water services in Ofwat's price determination. We believe that it is primarily for

Government to assist customers who cannot afford to pay their water bills, for example by making changes to the benefits system. We will address the issue of affordability in our Draft PR09 Business Plan.

Resilience

9. Our customers expect us to provide a continuous supply of water. The key issues that affect the resilience of our water supply systems are the impact of climate change with severe weather-related events, such as flooding or a major 'outage' incident at a sourceworks supplying one of the major centres of population in the region. We are addressing the impacts of climate change through the need for investment in both mitigation and adaptation to deal with changes to both long-term averages and short-period acute events. In dealing with outage risks we are currently planning to invest in alternative supplies for Peterborough by making the extension of the water treatment works for Rutland Water reservoir independent of the existing works. Elsewhere we are implementing plans to utilise groundwater supplies that were developed for blending when nitrate in surface water is high for contingency use in other circumstances. In developing new sourceworks and strategic water mains we will be considering the case for investment to ensure that all population centres over 50,000 people become resilient to the loss of major water treatment plant by having alternative supplies.

Plan Methodology

Target Headroom

10. There is both risk and uncertainty in the calculation of the availability of water supplies and uncertainty in forecasting the demand for water. As a result, the need to maintain a margin between supplies and demands has been recognised through a planning margin allowance for target headroom. Research work was undertaken for the WRP in 2004 on how to calculate the level of target headroom required through the 25-year planning period. This led to the development of a water industry methodology to consider risks and uncertainties with the factors that affect the security of water supplies and the level of demand. The method is based on probability analysis in a standard statistical package using the Monte Carlo simulation approach. The detail of the application of the methodology using the HOURUS model (Headroom Output Utilising Risk and Uncertainty in a Spreadsheet) is described in Chapter 3.

Economics of Balancing Supply and Demand

11. We have developed models to quantify the supply-demand balance and to evaluate options available to meet forecast demands at each periodic review. The FORWARD model (FORecasting WAter Resources and Demand) has been further developed for the Draft WRMP to meet the requirements of the WRP guideline. These advances include consideration of the Cost of Carbon and to produce outputs to the format required to complete the new WRP Tables. The FORWARD model compares the options available to secure target headroom, defined by the HOURUS model and selects the least cost supply-demand investment plan, with or without taking account of the social and economic costs. FORWARD is also used to determine the economic level of leakage. The analysis is consistent throughout the planning process, is robust and readily auditable by the Environment Agency and is aligned with the

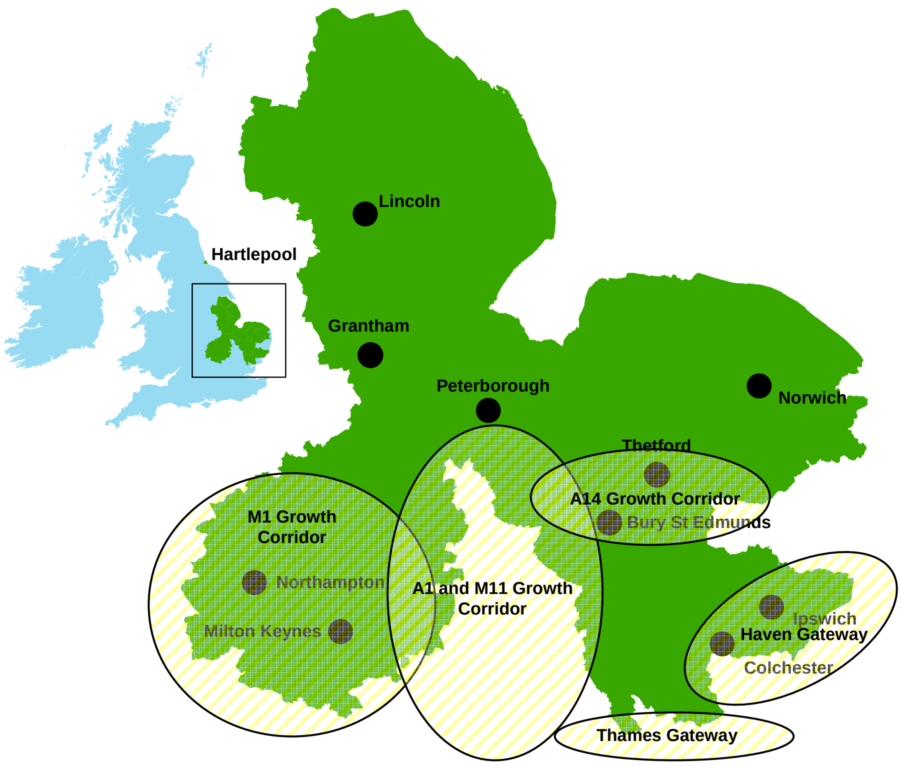
UK Water Industry Research (UKWIR) best practice guideline[5]. The detail of the supply-demand balance modelling is described in Chapter 3.

Key Issues

Growth

12. The former Office of the Deputy Prime Minister announced plans for a number of large, new, sustainable communities in the South East of England in 2003. These include areas within the Anglian region of the Thames Gateway, the M11/Stansted corridor and Milton Keynes. These plans have been further developed by the new Communities and Local Government department and the planning authorities to refine the number of new homes that are needed across the area that we supply. The current plans are to focus development in the larger existing communities, using their existing infrastructure and to develop new townships developing them with the new infrastructure needed for economic growth. Figure 2.4 shows the location of the main centres for growth as they are currently identified within the Anglian region.

Figure 2.4 Impact of sustainable communities growth



13. Information on growth is limited to high-level strategies, with limited information on the timing of development and the associated population changes. We are working closely with the planning authorities through Government Offices and Regional Development Agencies to use the best available information at a regional level. We have taken a lead role in establishing a high-level Regional Strategy Group and are also working with the local authorities who are responsible for the delivery of a local development framework on water cycle

[5] 'Economics of Balancing Supply and Demand', EA and UKWIR, 2002

studies. These enable us to understand the relationship between their work and ours to define strategies for the proper planning of new development and the water services infrastructure that they require.

14. For the region as a whole we have allowed for 27,000 new homes a year at the start of the planning period reducing to 20,000 towards the end and amounting to over 600,00 new properties in total. This represents a higher rate of growth than that experienced historically and we are aware of government policy to promote higher rates of growth. A growth in the number of new homes will result in a growth in the number of customers who live in them and their water consumption. We have used current population figures and forecasts of population growth based on information provided by the Office of National Statistics. We are aware of the uncertainty in these figures due to underestimation of migrant population, particularly from the EU accession countries, and plan to carry out further work to quantify the impacts of migration. The uncertainty in property and population forecasts is allowed for in target headroom and we shall be reviewing the figures used in the light of additional information for our periodic review plans and Final WRMP.

15. The level of demand for new homes is dependent upon the extent to which they are built to high standards of water efficiency and then the water-use behaviour of the customers who will live in them. We will proactively play our part in promoting the efficient use of water, but we need the support of the planning system and all stakeholders in implementing the Government’s growth strategy to ensure that all new homes are constructed to the highest possible standards of water efficiency to help customers to conserve water. We are pleased to note the inclusion of water efficient design in the Code for Sustainable Homes, but remain concerned that it remains voluntary for new homes, with the exception of government-funded social housing. We will actively seek effective control through both the Building Regulations and the Water Supply (Water Fittings) Regulations when they are revised.

16. The Water Resources Plan 2004 identified the need for long-term strategic water resource development based on the import of water during the winter months from the River Trent and the development of raw water storage and transfers within the Anglian region. We have progressed investigations into the engineering and environmental issues related to these developments and other feasible options for use in the option appraisal process to identify an optimal plan. The supply-demand planning process requires a large number of assumptions, affecting almost every part of the plan. While the uncertainty in the process is considered in the allowance for target headroom there is nevertheless a need for a flexible strategy that can be reviewed periodically to reflect actual outcomes in the number of new connections, population figures and the volume of water supplied. The WRP guideline specifies that the WRMP should include a description of the sensitivity of the plan to assumptions made. The assumptions on growth are perhaps the most significant and also the easiest to track. Chapter 5 includes a qualitative sensitivity analysis of the options identified for the final planning solution and how this can be adapted to include alternative solutions, albeit that the main change is likely to be one of the timing of delivery.

Climate Change

Impact on Supplies

17. We have reviewed the potential impact on the yield of surface and groundwater resources using best practice guidelines[6]. This considers the output from six general circulation models (GCMs) developed by international climate change research centres to define a range of scenarios that can be used in water resources models. The results of our analysis have been incorporated into our assessment of deployable outputs from our sourceworks that are used in our supply-demand balance modelling. The impact is made as a linear change through the planning period, centred on 2025-26, although the actual impact of climate change on supplies would be an acute event over a prolonged drought resulting from a period of rainfall below that of the historical sequence. The wettest and driest of the six GCMs have been used to define modelling uncertainty as part of the target headroom calculation. The detail of the climate change modelling is described in Chapter 4.

18. The impact assessment for all sources is based on average deployable outputs although it is recognised that direct river intakes can suffer from a loss of both average and peak deployable output. The overall impact of climate change on water resources over the plan period is calculated as less than 25 Ml/d. This is due to mitigation of the effects by the water resources systems that have been developed to meet frequent summer drought condition in the driest region of the UK. These are based upon the use of large, multiple-season, pumped storage reservoirs and boreholes abstracting from deep major aquifers. We obtain less than 5 per cent of water supplies from direct river abstractions that are more vulnerable to low summer flows. Many of the rivers we abstract from benefit during low flows from the discharge of treated water from our inland wastewater treatment works. We also have few shallow boreholes and adit systems that can be vulnerable to seasonal lowering of the water table.

19. The new UKCIP08 GSM model outputs are expected in late 2008. The impact of any changes to rainfall and runoff scenarios will be modelled as described above and adjustments will be made to the assessment of deployable outputs in time for the Final WRMP.

Impact on Demands

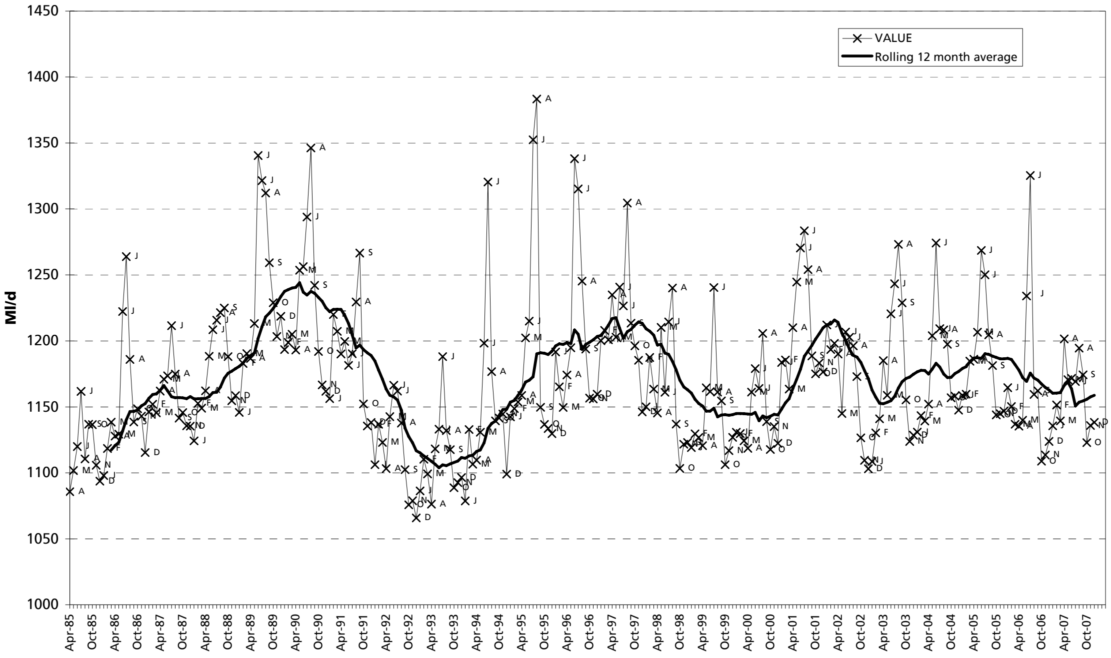
20. The main impact of climate change on demand is related to periods of extremely hot and dry weather that will increase the peak demand for water. The impact on the peak demand and the longer duration effect of a dry year are included in our supply-demand modelling as factors applied to the consumption of water by household and non-household customers. We have used the new work by UKWIR on a Peak Demand Methodology, described in Chapter 3, that relates demand to the climatic factors of temperature and rainfall based on historical records of climate and the current behaviour of our customer base. This enables us to determine figures for per capita consumption (PCC) for peak and average periods. The outcome has been that the factor used in our supply demand model for the dry year has fallen from the factor of 2.5 per cent used in

[6] 'Effects of Climate Change on River Flows and Groundwater Recharge: A practical Methodology - Synthesis Report', UKWIR, 2006; and, 'Climate Change Implications in Estimates of Water Resource Zone Deployable Output', Supplementary Guidance to Water Resources Planning Guideline Chapter 8, Environment Agency, November 2007

the quinquennial reports in 2004 and the annual reviews of them to a figure of 1 per cent. Similarly the effect on demand of a period of hot dry weather has reduced the regional average peak demand factor from an average of 1.34 to 1.32. The effect of peak demands varies between WRZs due to factors such as the location of holiday resorts and heavy industry and socio-economic factors reflected in the type and age of housing stock and customers' behaviour. The effect of hot dry weather on the demand for water by measured and unmeasured household customers and by industry is described for each WRZ in Chapter 4.

21. Our previous estimates of peak demand were based on the historic peaks experienced during the drought of 1995-97. We experienced similar period of hot dry weather in 2003 and again in 2006. The record of monthly sourceworks output from 1985 to 2007 in Figure 2.5 shows that the peak demands in recent years are lower. We attribute this to a change in the customer base as more customers pay measured charges and customers' behaviour in response to the promotion of water efficiency by the water industry, the regulators, government and environmental pressure groups. The peak demand factors used in the Draft WRMP are derived from the PCC model using the current customer base and back calculation of the effect on demand against the recent historic climate conditions. The highest peak demands that are used for forecasting in the FORWARD model still occur in 1996, but are lower than those experienced at the time, due to changes in the customer base. We have considered whether to use climate change forecast in the PCC model to forecast the impact of climate change on peak demand. However we consider that the uncertainty over future customer behaviour and the scale of extreme events is too large to produce a robust model. The uncertainty is allowed for within the figures derived for target headroom by the HOURUS model.

Figure 2.5 Monthly sourceworks output 1985 to 2007



Sustainability Reductions

22. The WRP guideline explains what water companies are expected to do where the Environment Agency considers that water abstraction is having a detrimental effect on the environment. Where an effect has been investigated and identified, the Environment Agency will require Anglian Water to implement solutions to reduce the impact to an acceptable level. These are known as sustainability reductions. We are working with the Environment Agency on many of these investigations during the period of 2005-10 through the Water Resources Environment Programme. During the preparation of the Draft WRMP, the Environment Agency has provided us with a list of those conservation sites that it considers may be affected by our licensed abstractions.

23. The Environment Agency is determining the need for sustainability reductions as a requirement of the Habitats Directive to review all licences and consents that may affect the integrity of designated European sites. It is also considering the need to protect other sites as part of its restoring sustainable abstractions (RSA) programme. However, with the exception of a small number of sites, it has not been possible at the time of preparing the Draft WRMP to identify actual or indicative numbers, or changes to licensed quantities, that would enable us to determine changes to deployable outputs. The Environment Agency has told us that it hopes to provide more detailed information as the review of consents and RSA programme are progressed. We are actively seeking better information from the Environment Agency in time to inform our Draft PR09 Business Plan and failing that for the Final WRMP and Business Plan. We consider that it is the Environment Agency's role to identify where sustainability reductions are required, taking account of in-combination effects, and then to implement the changes necessary to modify or revoke abstraction licences through the formal regulatory process.

24. We have discussed the need to represent sustainability reductions in our supply-demand balance modelling with the Environment Agency and have agreed which sourceworks should have sustainability reductions applied. The numbers agreed for sustainability reductions (SR) to be included as a reduction of average day deployable output in the Draft WRMP are:

Sourceworks	WRZ	SR Ml/d
Beachamwell	5	0.5
Sheringham	6	1.6
Dereham	7	0.7
North Pickenham	7	0.1
East Watton	7	0.1
Heigham	8	0.9
Twelve Acre Wood	9	0.03
Rushbrooke	9	1.5
Total		**5.43**

Details are given in Chapter 4 for those WRZs where indicative or definite sustainability reductions are applied at this stage. These represent a small number of the 61 conservation sites that have been identified as at risk for changes to abstraction licences through sustainability reduction. The WRP guideline excludes the inclusion of sustainability reductions in target headroom and confirms that further information will be provided before the preparation of the Final WRMP. The WRP guideline also confirms that water companies will be given enough time to adequately plan and implement solutions to deal with licence changes to ensure they do not in any way undermine the security of the public water supply system. We will include any additional information on sustainability reductions provided in time for inclusion in our Draft Business Plan in August 2008.

25. For the past 15 years the Environment Agency's Anglian region has implemented a policy of time limiting all new abstraction licences and licence variations. As a result time limits apply in whole or in part to approximately a third of our abstraction licences. Where these licences are being reviewed under the Habitats Directive, the end date has been set to the completion of the process by March 2010. In the absence of specific advice from the Environment Agency we assume that all licences will be renewed until any sustainability reductions can be imposed without jeopardising our ability to maintain secure water supplies. We have followed the WRP guidance and not made any allowance in target headroom for the non-renewal of time limited licences.

26. The Environment Agency is also responsible for the implementation of the Water Framework Directive through River Basin Management Plans and the Programmes of Measures. At the time of preparing the Draft WRMP the Environment Agency regions are consulting on the significant water management issues, prior to publishing the Draft Water Management Plan in December 2008. We will review the development of this process when preparing the Final WRMP.

27. We have carried out investigations into the impact of our abstractions on the water dependent environment through the National Environment Programme during the AMP3 period and the Water Resources Environment Programme during the AMP4 period. These have been funded as part of the Water Quality capital investment programme. The Environment Agency has advised us that they would expect to see further work carried out during the AMP5 period on investigations to support the Water Framework Directive and to implement any agreed environmental enhancements.

Water Quality Programme in PR09

28. Whilst the WRMP deals with maintaining the security of supplies it also has to include the need to meet drinking water quality standards. An increase in nitrate concentrations in groundwater due to the use of agricultural fertilisers has been observed since the 1950s. The need to ensure compliance with drinking water standards has required investment at 25 groundwater sourceworks during the AMP4 period (2005-10). Our monitoring of the trends in groundwater nitrate concentrations and predictions for future rises indicate that further sites will require investment to reduce the nitrate level in drinking water during the AMP5 period (2010-15). Some existing sites will also require further investment to manage the rising trend. We are reviewing the options for nitrate reduction and will seek to use blending with low nitrate groundwater as a more sustainable solution, where possible. Our existing nitrate removal treatment plants will require refurbishment in the future. We will review options for replacing the treatment process with blending schemes, where it is practical to do so, as well as evaluating the costs and benefits associated with catchment management and combining water quality and supply-demand schemes to provide holistic and cost effective solutions.

29. We intend to seek support from the Drinking Water Inspectorate for trials with catchment management solutions as a more sustainable long-term option alongside our PR09 schemes to maintain compliance with water quality standards during the AMP5 and AMP6 periods. We are also considering the potential for catchment management schemes for sources at risk of parameters other than nitrate, namely pesticides and pathogens, where the benefits may be realised in a shorter timescale.

30. No allowance has been made for the impact of increased nitrate in groundwater in target headroom. This presumes that a long-term trend of increasing nitrate will continue to be met by timely investment in the water quality programme. It is anticipated that in the longer term the risk from the poor protection of groundwater quality from diffuse nitrate and pesticide pollution will be addressed through the Water Framework Directive targets to achieve good groundwater status and management initiatives such as the catchment sensitive farming programme. We are proposing to develop advanced mathematical groundwater models to help us do this by better understanding nitrate and pesticide migration in different aquifers.

31. The trend of increasing nitrate in surface water as well as groundwater is also forecast to increase despite efforts to limit it through the management of nitrate sensitive areas. The impact on direct surface water abstractions from rivers in the winter is managed by local treatment or blending schemes to manage the peak of nitrate in river water during the winter months. The impact of nitrate on our surface water sourceworks supplied from our large raw-water storage reservoirs requires the management of reservoir refill during the winter following drawdown in a severe drought. Reservoir simulation modelling has shown that the limitation on the dilution within the reservoir for the high nitrate refill water can affect the rate of refill and hence the yield of the reservoir for an ensuing period. This can be addressed by limiting the extended drawdown through reducing the reservoir yield before a drought with the effect of reducing average deployable output of the sourceworks, or by providing nitrate removal plant for very occasional use. We have not included an allowance for managing nitrate in our reservoirs during drought in the supply-demand modelling, assuming that operational arrangements that were applied during previous droughts will be sufficient for us to maintain compliance.

The Twin-Track Approach

32. We have always implemented a twin-track policy for the management of water resources through investing in demand management alongside water resources development. As a result we have achieved a high level of meter penetration, a low level of leakage from our water mains and our customers' level of consumption compares favourably with the rest of the country, particularly when considering that we are the driest region. In reviewing the options for maintaining a secure balance against the challenges of growth and climate change and sustainability reductions, we have considered the available options for demand management alongside water resource development. It is important to note the differences between demand management and resource development options in terms of the certainty of quantification of water saved or provided. Whilst the output of a new reservoir or borehole scheme can be relied upon with some certainty throughout its design life the savings from demand management are subject to changes in the water usage of products, for example the installation of new higher flow rate electric showers or growth in the number of kitchen waste disposal units, and with customers' behaviour in

using them. The success of demand management also relies upon customer behaviour which, although we can influence it, is to a large extent outside our direct control. The risks with demand management options can be managed provided that sufficient available headroom has been provided to allow for the uncertainty that they carry. The key issues in delivering effective demand management and resource development include:

Demand Management

Household Metering

33. Since the privatisation of the water industry in 1989 the percentage of our customers with a water meter has grown steadily from less than 10 per cent to currently over 60 per cent, which is twice the national average. The increase was highest in the mid 1990s when we were able to promote water metering and progress universal metering in the towns of Bury St Edmunds and Braintree. In 1999 our ability to progress universal metering was curtailed by Government, but nevertheless during the first three years of the AMP4 period from 05/06 to 07/08 we have seen over 60,000 customers choose to pay measured charges for water by ‘opting’ to use a water meter. This together with approximately 20,000 new metered connections each year results in the growth in metered households by 2 per cent each year. Our baseline demand forecast is to assume that this will continue and to meter 90 per cent of our customers by 2035. We recognise that maintaining growth in meter penetration may be difficult and we plan to actively encourage our customers to continue to take up voluntary metering. Where necessary to secure the supply-demand balance we will implement cost-effective options of targeted and enhanced metering.

34. The basis of our current metering strategy is to highlight to customers the benefits of water metering in terms of saving both water and money, and to provide an efficient and effective service to opt for switch to a water meter. In developing our future metering programme we have sought to meet the requirements of the new Direction from Defra on the determination of the Anglian region as an area of serious water stress. This requires us to on consider the option to use compulsory metering within the WRMP. We have considered the costs-benefits of water metering and the importance of continuing to give our customers choice. The outcome is a strategy for enhanced metering in selective areas where planned growth and climate change pressures on water availability are greatest, as described below. Details of areas where we propose to promote household metering are given in the description of works in each WRZ in Chapter 4. This will advance the rate of metering in the baseline forecast. We will maintain the principle of voluntary metering through the 2010-15 AMP5 period and will review the position before our next WRMP in 2014. We will continue and extend our offers of incentives for customers to opt for measured charges by encouraging waterwise behaviour and providing assistance in conserving water. The change from measured to unmeasured charges is underpinned by our ‘switchback promise’ to enable a customer to revert to an unmeasured charge within one year of choosing measured charges. In practice less than 2 per cent of those who have opted for a meter have chosen to go back to paying unmeasured charges. We have reviewed the costs and benefits of installing a meter prior to the first bill on change of occupancy, but consider this to be an uneconomic and inefficient way to extend metering. Customers moving into a house where a meter is already installed will receive measured charges for water and

wastewater services.

Enhanced Metering Project

35. During 2007-08 we implemented an enhanced metering project in the Ipswich area to provide up-to-date information on the costs of a blanket approach to metering and the rate of uptake under voluntary switching and on change of occupancy. The project includes engaging with customers by providing them with comparison of unmeasured and measured bills and a trial offering free household water efficiency assessments with the installation of water efficiency devices where appropriate to secure financial and water savings. The project will provide us with additional information on the demand effect of metering. At the time of preparing the Draft WRMP the project is still in progress. The information that it provides will be used to refine the supply-demand analysis for the submission of the Draft and Final PR09 Business Plan submissions.

Water Efficiency

36. We promote a consistent message to be 'Waterwise' to all our customers and offer advice through our website and billing literature. We also distribute over 10,000 leaflets direct to customers and at events across the region each year. We include information in our annual June Return to Ofwat each year through reporting on the activities carried out. Ofwat publishes its report on Security of Supplies, Leakage and Water Efficiency each autumn. This confirms that our most effective initiatives in reducing the demand for water are through our 'Watertight' promise to repair or replace customers' supply pipes, at no or reduced cost. Along with a number of other water companies we are exploring the feasibility of assuming the ownership of our customers' supply pipes. We also carry out water efficiency audits for some 180 non-household customers each year. Our Business Customer Services Team offers a service to our larger water users through our 'Optimiser' scheme for on-site leakage detection and advice on process engineering. In addition we supply over 15,000 cistern displacement devices to customers each year and promote the sale of water butts. The savings that accrue from these initiatives are important but relatively modest.

37. We have carried out a number of local trials in fitting variable flush devices to WCs and in controlling flows using flow restrictors and aerator heads. We are currently carrying out trials in retrofitting of water-efficient devices as part of our enhanced metering project in the Ipswich area to enable customers to save both water and money. We are active sponsors of Peterborough Environment City Trust's 'Sustainable Communities Project' that has linked the 'Waterwise' message to those of saving energy and recycling and will continue to promote these messages.

38. We work closely with our neighbouring water companies in the Anglian region to present a clear and consistent message on the need for homes to be built to water-efficient standards and for our customers to adopt water efficient behaviour. This is achieved though the co-ordination of publicity and trials at regional and national level and lobbying for a regulatory framework through which the consumption of water can be managed. We actively support and are working closely with stakeholders on the new 'Waterwise' East centre of excellence at Inspire East in Thetford to fulfil its aims to improve water efficiency across the East of England through working with developers and planners.

39. During the 2004-06 period of low rainfall we implemented our Drought Plan and increased publicity in the south of the region where the rainfall deficit was most intense and the need to save water was greatest. Both local press coverage and our own market research showed that the campaign was well received with half of customers questioned saying that they recalled it and 18 per cent claimed they had made changes to the way they use water. The campaign was effective and also well perceived by the media industry and was short listed in 2006 for the prestigious Utility Industry Achievement awards.

40. In preparing the WRMP we have considered the level of saving that can be achieved through investment in large scale projects for retrofitting water saving devices that control tap and shower flows and reduce the volume of a WC flush. There have been many small scale trials both in the UK and abroad and we have commissioned expert consultants to draw on these to determine the most appropriate figures to be used for cost-effectiveness analysis. Details of the outcome of this work are described Chapter 3. We have used the results of this work in the FORWARD model to identify those areas where investment in water efficiency initiatives for customers to conserve water is a cost-effective solution. We look forward to and will assess future water efficiency evidence-based data to assess the scope of further water efficiency initiatives.

Regulation for Water Efficiency

41. The need to make new homes water efficient was recognised by Government in the proposal for sustainable housing in 2003 and the introduction of a Code for Sustainable Homes in 2006. We are disappointed that there remains reliance upon voluntary adoption of water efficiency standards by private developers and builders and we will continue to promote the adoption of mandatory standards. We see little evidence of a step change in building construction specification and in particular are concerned at the increased use of direct mains pressure-fed hot water systems. These provide higher flow rates that not only result in more water usage but also in higher energy usage in heating more water. We fully support the progress of water-efficient design of homes through the adoption of the standard of the Code for Sustainable Homes level 3 of 105 l/h/d for all new social housing from April 2008. Similarly minimum water efficiency standards for all new homes are now in prospect through changes to the Building Regulations and the Water Supply (Water Fittings) Regulations. We support these changes being made at the earliest possible opportunity and have assumed a decline in measured water consumption from 138 to 127 l/h/d over the plan period to 2035. We are unable to assume higher reductions without information on the standards in the new regulations and some evidence of the effectiveness of their enforcement.

Rainwater Harvesting and Grey Water Re-use

42. We are monitoring the development of rainwater harvesting and grey water systems. Both of these have potential to make a significant contribution to water conservation. We are working to ensure that the limitation of storage and collection area on the reliability of rainwater systems is properly understood and will seek to use the proposed British Standard to account for the additional demand that these systems will have for mains water supplies during periods of low rainfall. We will continue to need to plan for peak demands without the availability of rainwater collection systems until we can be assured of their reliability during drought. It is important that they comply with the Water Supply (Water Fittings) Regulations and do not pose a risk of contamination to either

household plumbing or water main distribution systems. Similarly, grey water wastewater re-use systems need to be properly designed and installed to function reliably and without risk to public health. Where necessary we will use our powers under the Water Supply Regulations to ensure that this is the case. Installations in individual homes would place the responsibility for the operation and maintenance of what is effectively a small treatment plant on the individual household. Failure to do this properly could prejudice drinking water quality in the home.

Water Efficiency Targets

43. Operating in the driest region of the UK, we recognise the importance of using water resources efficiently and hence have promoted and encouraged our customers to use water wisely. The proposal for setting of a mandatory water efficiency target (WET) has received broad support from the Water Savings Group, chaired by the Secretary of State at Defra. Ofwat requires companies to identify a WET based on a percentage of water delivered that will be monitored through the June Return process for 2008-09 and 2009-10 with a view to introducing a mandatory WET for the AMP5 period. The WET is intended to be proportional to the degree of water stress as identified by the Environment Agency for the granting of powers for compulsory metering. The form that the WET will take is still subject to consideration by both regulators and water companies. It is, however, broadly accepted as necessary to monitor water companies' legal duties to promote water efficiency and to conserve water. Our view is that these duties are represented in different

Water efficiency activities:	Water conservation interventions:
- Available to all customers	- Targeted on areas of supply deficit
- Allowed for in price limits	- Funded as an S-D investment
- No consideration of economic case	- Selected by the EBSD analysis
- Enhanced through the Drought Plan	- Timed within the S-D programme

44. The promotion of water efficiency is included in the Draft WRMP as a baseline activity and reported through Table 1 of the June Return to Ofwat as a mixture of activities and auditable water savings. The outcome of the 'Waterwise' message is included in our baseline forecast of per capita consumption, and enhanced savings are included in our Drought Plan. Schemes to conserve water are included as options, or interventions, in the analysis of the economics of balancing supplies and demand (EBSD) and selected as appropriate for investment with other supply and demand (S-D) options. The use of water conservation schemes in the supply-demand investment programme requires assumptions on the water savings that will be achieved. These savings could be used as a WET, but quantification is subject to the same uncertainty that requires target headroom for water efficiency programmes.

Using Pricing to Affect Customer Behaviour

45. Using pricing to influence customer behaviour and thereby contribute to the successful management of the supply-demand balance is a legitimate objective. Twenty years ago the vast majority of household customers paid for water and wastewater services by reference to the rateable value of their property and still do in many water companies' areas. This form of unmeasured charging delivers a marginal price signal of zero and customer behaviour in using water is unaffected. If we are to present customers with a price signal, we must ensure that they are metered. We were the first water

and wastewater company to give full support to household metering in the early 1990s and more than 60 per cent of households in our region are now metered. This high penetration of metering is double the national average and has given an opportunity to develop a number of tariff options and to consider whether further development might reduce the demand for water.

46. Many tariff proposals have been considered particularly regarding the way measured household customers are charged, with a view to influencing customers' behaviour. The rationale for any proposal depends on behaviour being sensitive to price, what economists call the 'price elasticity of demand'. If demand is elastic, customers will respond to price changes by altering the demand, whereas if demand is inelastic, price changes will have little or no effect.

47. Tariff proposals will only work if customer behaviour and demand is elastic. We carried out research as part of the last Periodic Review to draw together evidence of price elasticity from around the world. The results gave us some clear messages. First, demand tends to be elastic for the large industrial customers, but much less elastic for the small household customers. Second, demand tends to be elastic in countries such as Australia, where the discretionary use of water is high, but is low in the UK where discretionary use is a relatively small proportion of total water use. This leads us to conclude that increasing the marginal price of water and wastewater services would have some impact on our largest customers, but would tend to have a limited effect on household water consumption either by affecting total demand or by influencing peak profiles. We consider that customer behaviour can be influenced more effectively by advertising and promoting 'Waterwise' behaviour rather than by changing the way customer charges are applied.

48. A number of small-scale trials of alternative tariff structures have been commissioned by other companies and we will monitor results closely and explore how water conservation might be encouraged using tariffs. We are implementing our own trials with intelligent meters and automated meter reading systems to assess the use of these technologies. However, we consider that there is insufficient information available for us to affect our approach to the supply-demand balance for this Draft WRMP. We will consider the results of these trials and the conclusions of the independent review of charging for water and wastewater services proposed by Defra which are expected to be published later this year.

Addressing Affordability

49. We were the first company to introduce a tariff that was intended to offer assistance to low-income, household-measured customers with high water use in the late 1990s. The tariff, Aquacare Plus, is still available and it offers assistance to low income households whilst retaining a marginal price signal. The Government used this tariff in a modified form to create its own proposals for use by the rest of the industry in 2000. This has become the current Watersure tariff. Taking the two tariffs together we have a greater penetration rate than other companies. Nonetheless, we have recognised that the current arrangements are targeted at a very small group of customers with large families, high water use and low income, but that they ignore all other low-income customers. So we have developed a more far-reaching tariff proposal to address affordability. This has not been approved by Ofwat, but we intend to review our proposals with a view to resubmitting them in the future.

Leakage Control

50. Anglian Water has one of the best leakage records in the industry with leakage performance at 5 m^3/Km of main per day, half the industry average and we plan to continue to give leakage a high priority. We manage leakage by the detailed evaluation of continuously telemetered flow data from over 3,500 distribution zones and district area meters. The quantity of water that is attributed to leakage is then assessed by the night flow analysis method, commonly known as the bottom-up leakage estimate. The leakage estimate is corroborated by determination of the water balance, otherwise known as the top-down leakage estimate.

51. Although some leaks are identified by acute bursts and the visible flow of water to the ground surface, a large proportion of leaks are unseen and can only be detected by detailed investigation following monitoring for increased night time flows. Detailed investigations almost invariably involve the use of acoustic devices which carry out a 'correlation' to determine the existence of a leak. If confirmed, further surface listening techniques utilising ground microphones are employed to pinpoint their location.

52. The economic level of leakage (ELL) is a function of many factors, including the age and condition of the water mains, the network operating pressure, the cost of detecting them, the availability of surplus water and the cost of developing new supplies. The level of leakage can be reduced through measures such as lowering the water network pressure, further improvement to techniques for detection and repair and through investing in additional resources to detect and repair leaks where it is not economic to do so. However, a step change in the ELL can only be achieved by the wholesale replacement of the distribution system from trunk mains to private customer supply pipes. Current research in this area suggests that this level of investment is neither economically justified nor affordable.

53. The new Traffic Management Act (TMA) which comes into effect on 1st April 2008 will have an effect on our leakage performance. It is envisaged that most of our proactive leak detection surveys and associated repairs will have to be conducted at night, with increased costs and constraints on the availability of competent technicians. The need to administer the issuing of notices to work in the highway and the shorter working window are likely to increase leak repair times. Therefore, and in common with other service providers, the TMA threatens our leakage control performance. We are running pilot trials of working under the TMA in order to minimise the effect on leakage.

54. In response to the latest guidance to the ELL determination published in November 2007, we are examining the effect of accounting for the social, environmental and carbon costs on our ELL. The work will be complete in time for the Draft PR09 Business Plan in August 2008. We await the outcome of the proposed "frontier" methodology to setting ELL targets to determine the effect this will have on our ELL target.

55. For the purposes of the Draft WRMP, we have forecast the level of leakage through the plan period by considering not only the economic level of leakage but also the importance given to demonstrating our commitment to conserving water. We therefore plan to maintain leakage at around the current level of 210 Ml/d as part of our twin-track approach to managing the balance between supplies and demands. This represents a gradual fall in the rates of leakage

over the plan period given the potential increase in leakage as a result of network expansion to accommodate growth of up to 18 per cent in the domestic customer base.

56. The effective reduction in leakage throughout the plan is an outcome of our supply-demand optimisation process. Where our analysis shows a zonal deficit in the supply-demand balance we will determine if there are options to further reduce leakage through increased detection resources to respond to smaller leaks or further pressure management to reduce network operating pressure where feasible. These are compared with other demand and supply side options using the FORWARD model to select the most effective solution. In due course, we will take account of future changes in the methodology for determining the level of leakage as a result of ongoing research and regulatory policy within our water resource planning process.

Resource Development

57. As part of our preparation for the WRMP and PR09 submissions, we undertook a detailed scoping study of feasible options for the development of additional water resources. The scoping phase reviewed all potential options and identified them in terms of generic types of scheme that could be available in different parts of the Anglian region. The main categories of potential options can be summarised as:

- intercatchment transfers
- reservoir storage
- groundwater development
- managed aquifer recharge
- desalination
- indirect wastewater use
- recommissioning unused licensed sources
- bulk supplies
- enhancing existing reservoir storage

58. We then commissioned a series of more detailed workstreams that provided the technical and financial information needed to evaluate feasible options for use in economic modelling of the 12 WRZs. The main options considered for development are:

- increased transfers from the River Trent to the River Witham through the Fossdyke canal
- storage of winter runoff and transfers near the lower River Witham
- transfers from storage or the River Witham to the Ely-Ouse catchment using pipelines
- transfers from the Ely-Ouse catchment to Essex using the Environment Agency's existing transfer scheme in association with Essex and Suffolk Water
- transfers from the River Trent to Rutland Water or direct to a water treatment works by pipeline
- additional groundwater development, including reallocation of the use of the Environment Agency's Great Ouse Groundwater Development Scheme

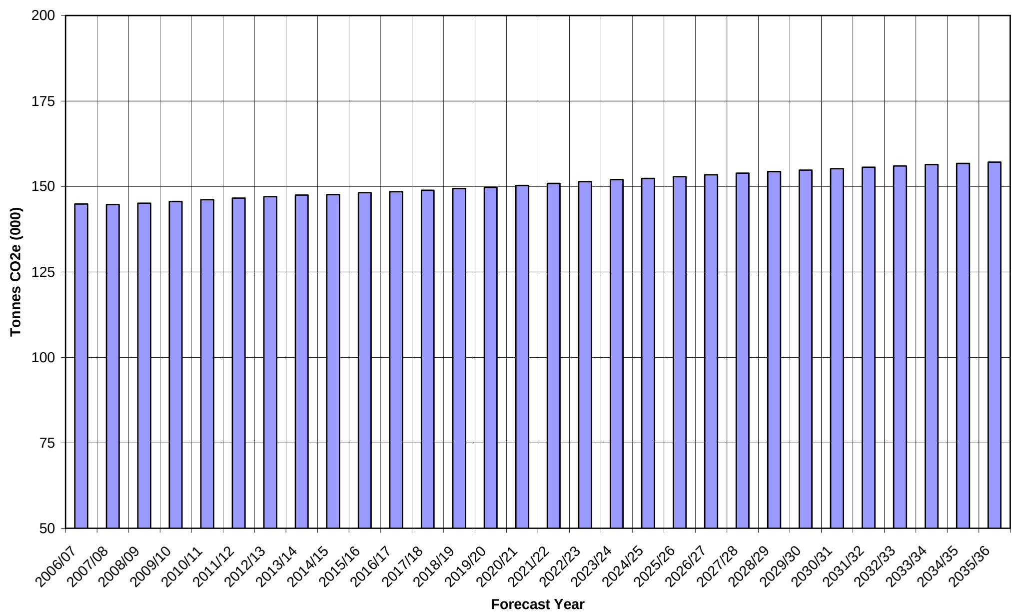
- managed aquifer recharge / aquifer storage recovery where hydrogeological conditions are suitable
- desalination of seawater
- indirect water re-use where the existing discharges are to coastal or estuarine waters

59. Details of the methodology used in evaluating the demand and supply options and the criteria used in selecting the feasible and preferred list of water management options are described in Chapter 3. The feasible and preferred options that make up the final planning supply-demand components for the Draft WRMP are described in Chapter 4. Chapter 5 summarises the proposed regional planning and refers to the alternatives that are available in the context of the sensitivity of the plan to assumptions.

Greenhouse Gas Emissions

60. The WRMP Direction 2007 requires details of the greenhouse gas emissions that are likely to arise through the delivery of our proposed Water Resources Plan described in Chapter 5. We have estimated these from our calculation of greenhouse gas emissions as tonnes of carbon dioxide equivalent (tCO_2e) for the base year 2006-07 of 144,873 tCO_2e for drinking water treatment and distribution. For subsequent years the value of 0.34 tCO_2e/Ml has been used with the forecast demand to give the mass of CO_2e likely to be emitted on the basis of current technologies. Figure 2.6 gives the result based on demand in a normal year. It excludes any assessment of embodied carbon and assumes that electricity from renewable sources will be available at the current level. Similarly we have not included any allowance for improvements in the efficiency of plant that will come through the development of new technologies. We will address our use of energy as part of our business planning process.

Figure 2.6 Greenhouse gas emissions



3 METHODOLOGY AND MODELS

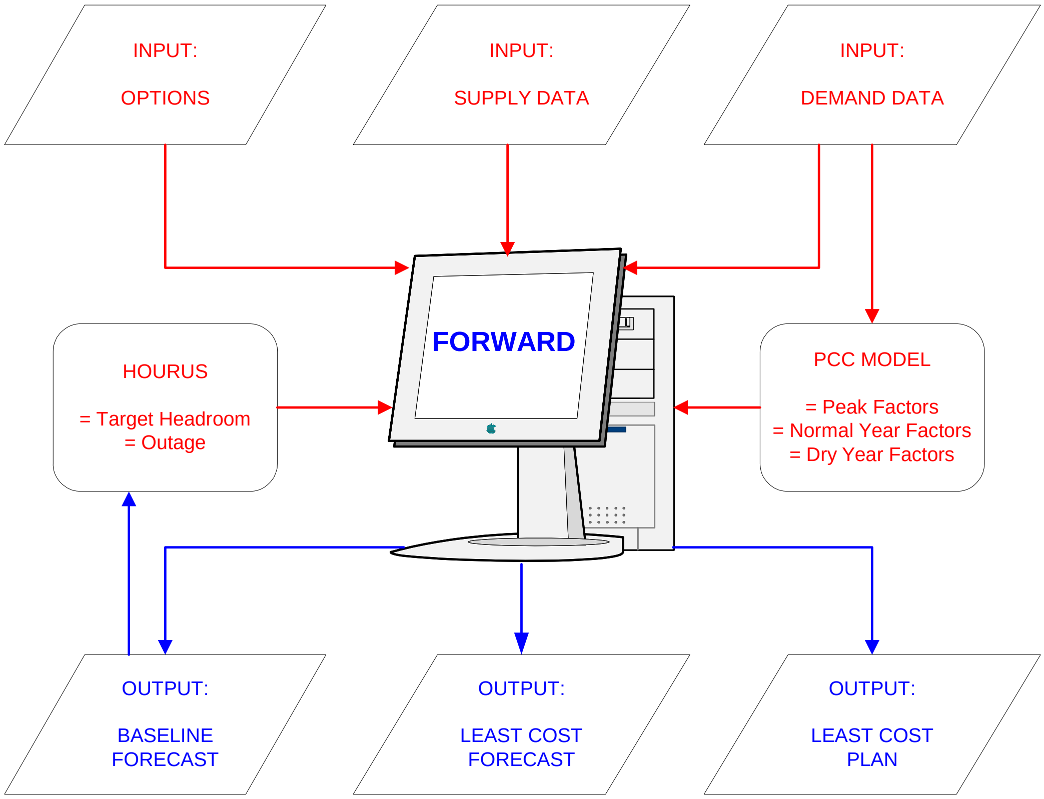
Introduction

1. To process data and generate outputs required for the Draft WRMP we have used three computer-based models:

   - FORWARD
   - PCC Model
   - HOURUS

   The aim of this Chapter is to describe the use of these models in the supply-demand forecasting process. Each model and its main features are explained in the following sub-chapters.

Figure 3.1 Supply-Demand forecasting models



2. The models use a range of different data inputs, and contain many calculations. They may seem complex, but their function and relationship is simple, as illustrated in Figure 3.1. The final output of the entire process is a supply-demand forecast and an investment plan intended to ensure a secure water supply into the future.

The FORWARD Supply-Demand Balance Model

Overview

3. FORWARD (FORecasting of WAter Resources and Demand) is a water resources supply-demand forecasting model developed by consultants under licence from Anglian Water Services. The model stores and writes data to a Microsoft Access database, but the core function of FORWARD is contained in a Visual Basic Application (VBA) computer program. The calculations in the program produce supply-demand forecasts at a sub-regional planning zone (PZ) level. PZs can be added to or removed from a project by the user. The use of PZs is explained later in this chapter.

4. FORWARD uses a vast array of input variables. These inputs may contain parameters such as the length of trunk mains, head of population, the marginal cost of water, and unmeasured household occupancy growth. These inputs can vary from year to year and PZ to PZ. They are needed to produce the following baseline outputs:

    - domestic consumption forecast
    - commercial consumption forecast
    - leakage forecast
    - supply forecast
    - target headroom

    The model is used to determine a baseline forecast that assumes no additional investment in options to reduce demand or increase supply beyond our existing base level of activity. Where the baseline forecast identifies PZs with current or emerging supply deficits, the FORWARD program runs an economic optimisation routine to find the most cost-effective solution available. This results in what is called a least cost investment plan and a revised supply-demand forecast (also known as the least cost forecast, or LCF).

5. The LCF investment plan is calculated based on an average incremental cost (AIC) or average incremental social cost (AISC). This is a division of the net present value (NPV) of an investment option by its volumetric water yield, discounted over a 30-year period. This gives a value in £/Ml for each option, and a means of comparing economic efficiency for each option. The AISC valuation includes the environmental and social costs and benefits of an option. The AICs capture the internal or private costs of a scheme, for example, the capital and operational costs of a new water treatment works, while the AISCs include the external or public costs of the option, such as the carbon footprint of operating a new water treatment works.

6. In both baseline and least cost forecasts, FORWARD produces outputs for average and peak demand periods. Demand for water is not at a constant rate; it varies throughout the day and the year. Our aim is to invest in options that will help us to maintain a healthy supply-demand balance when demand is at its highest, such as during a hot and dry summer, as well as the rest of the year. The availability of water resources is defined for average and peak periods, which means the need for investment in options is not simply driven by planning for peaks in demand.

7. We refer to the potential output from our water treatment works as deployable output (DO). This is subject to a number of constraints such as:

- abstraction licence quantities
- water treatment plant capacity
- pumping plant capacity
- source yield
- water quality constraints

Average and maximum DOs provide the basis for the supply element of the baseline forecast in the FORWARD model. The DOs are reduced by an allowance for the unplanned loss of sourceworks output, known as outage, to produce a measure referred to as water available for use (WAFU).

8. Uncertainty in demands and possible risks to supplies are represented in the target headroom element of the forecast. Target headroom acts as a residual component of the supply-demand balance where all the uncertainties are grouped as one and expressed in terms of Ml/d. The risks may include loss of water sources due to pollution, or greater than expected rates of population growth. Analysis of the various risks and uncertainties and the calculation of target headroom is handled by the HOURUS model, described later in this chapter.

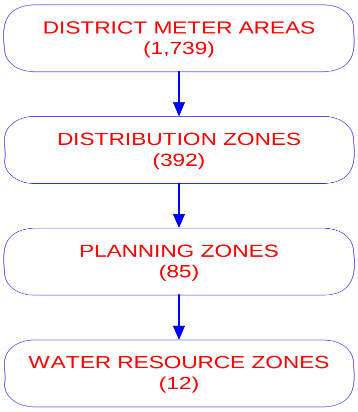
9. The detail of the main inputs to the FORWARD model is described under the headings that follow of:

- Planning zones
- Supply inputs
- Demand inputs
- Target headroom
- Forecast scenarios
- The baseline forecast
- Options
- The least cost forecast

Planning Zones

10. The PZs describe the geographical areas for which FORWARD produces a supply-demand forecast. Groups of PZs are aggregated to form a WRZ. PZs cover discrete areas of the water distribution network and are based on collections of district meter areas (DMAs) and distribution zones (DZs). DMAs and DZ are small areas of the distribution system used for operational planning, into which flows of water are constantly monitored via our telemetry meter system. The hierarchy of planning areas is illustrated in Figure 3.2.

Figure 3.2 Hierarchy of water resources planning zones



The current number of zones in each group is shown in brackets.

11. The link between DZs and PZs is important to the supply-demand modelling process, because the base year PZ water balances are built-up from metered flow data at a DZ level. At a regional level this reconciles with the supply-demand balance reported each year in our June Return submission to Ofwat.

12. The PZs enable us to identify specific areas where intervention or investment may be needed now or in the future to resolve current or emerging supply-demand deficits, referred to as ‘hotspots’. A supply-demand deficit in a PZ can drive the requirement for sub-WRZ strategic resource, transfer, or demand management options.

13. We have used PZs for water resources planning since the 1999 periodic review. Reviews of the PZs for subsequent plans have resulted in changes to their size, shape and number over time. This reflects operational changes in the supply network. For instance, opening or closing a valve to redirect water at a DMA level, for operational purposes, may have an effect on the larger planning boundaries.

14. The latest review, concluded in October 2007, identified the need for 86 PZs, including our Hartlepool area, aligned with a snap-shot survey of DMAs and DZs in August 2007. Figure 2.3 in Chapter 2 illustrates the alignment of the PZs to the WRZs. Table 3.1 lists the changes to the PZs from the Water Resources Plan 2004 (WRP04) report; and Table 3.2 lists the changes to the WRZs.

Table 3.1 Changes to PZs since WRP04

PZ WRP04	Draft WRMP	Comments
Bourne	Bourne Boston Billingborough	WRP04 Bourne PZ split into 3 PZs to better describe discrete areas of demand
Rushden Thrapston	Rushden	WRP04 PZs merged in order to align with a discrete area of the supply network
Harpswell Waddingham	Waddingham	WRP04 PZs merged in order to align with a discrete area of the supply network
Buckingham Towcester	Buckingham	WRP04 PZs merged in order to align with a discrete area of the supply network
Flitwick	Leighton Linslade	WRP04 PZs merged in order to align with a

PZ WRP04	Draft WRMP	Comments
Leighton Linslade		discrete area of the supply network
Corby Desborough	Corby	WRP04 PZs merged in order to align with a discrete area of the supply network
Grimsby Weelsby	Grimsby	WRP04 PZs merged in order to align with a discrete area of the supply network

Table 3.2 Changes to WRZs since WRP04

WRZ	Comments
East Suffolk & Essex	Reallocation of the Sudbury DZ from Semer PZ to Bury St Edmunds PZ means a slight change in the northern border of this WRZ
North Norfolk Coast	Reallocation of the Aylsham, Foulsham and Stalham PZs from the Norfolk Rural and Norwich & The Broads WRZs
Norwich & The Broads	Reallocation of Lyng PZ from the Norfolk Rural WRZ
Lincoln	Now includes the newly created Billingborough PZ, and area previously covered by the Bourne PZ in the Lincolnshire Fens WRZ

15. The changes to the WRZs are marginal in effect, and meet the regulatory definition set by the Environment Agency as:

'*The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall*'[7]..

The total number of WRZs remains 12, including Hartlepool areas, which has not changed from WRP04.

Supply Inputs

16. This section describes the key data inputs to FORWARD related to the evaluation of DO. This is annually reviewed for each sourceworks. Principal constraints on DO are the raw water abstraction licence quantities and the operational capacity of our water treatment works. In estimating the DO inputs into FORWARD, allowances have also been made for:

- bulk exports and imports of potable water
- sustainability reductions
- climate change impact
- investments in new sourceworks
- sourceworks closures

17. We have statutory agreements for bulk exports with Three Valleys Water Services and Severn Trent Water. There is also a bulk import from Essex and Suffolk Water. These are assumed to continue throughout the forecast period at the volumes currently agreed at average and peak demand periods.

[7] 'Water Resource Plan Guidelines', Chapter 24, Section 3, EA, 2007

18. We also have a shared water resource with Tendring Hundred Water Services in the East Suffolk & Essex WRZ. This will increase from a current 60:40 to a 70:30 share of DO in our favour from 2010. The agreement will be reviewed in 2015. We have assumed for the purposes of supply-demand modelling that this agreement will continue beyond 2015.

19. The Environment Agency has informed us of the allowance to be made in the Draft WRMP for sustainability reductions (SRs) on the DOs at eight of our sourceworks. The SRs are intended to address the risk of an adverse effect on the ecology of important conservation sites from water abstractions. We have assumed that the SRs take effect in the base year and continue at the same level throughout the forecast period. The date of implementation will be adjusted in the final model runs to coincide with the earliest date that an alternative water supply can be made available in order not to jeopardise water supplies.

20. The impact of climate change is an important consideration in making an estimate of the future availability of water resources. We commissioned specialist consultants to assess the impact of climate change on our ground and surface water sources. The analysis followed the methodological guidelines published by UKWIR and the EA[8]. The results of the analysis have been incorporated into our assessment of DO used in the FORWARD model

21. The analysis involved processing median, best and worst case scenarios through a number of recognised climate change models. This process was repeated for 25 groundwater and 10 surface water sources considered vulnerable to the potential impacts of climate change on source yield. The results identified a more significant impact on surface water source yield than for groundwater. The modelling results also indicated that in some cases potential groundwater yield could increase, as the climate change scenarios not only predict higher temperatures but increased periods of prolonged and heavy rainfall. The climate change modelling calculated impacts on source yields in the year 2025. The impacts have been interpolated over the forecast period. This means zero impact in the base year DO (2006-07) rising to the modeled impacts in 2025-26, and then continuing to grow at the same trend to the end of the forecast (2035-36). The overall results of modelling climate change impacts on DO amount to 24.81 Ml/d. Small reductions in DO at sourceworks level may affect local areas of the supply network.

22. Adjustments to our DOs not only involve reductions. We are currently working on our AMP4 2005 to 2010 investment programme, agreed with Ofwat in 2004, which includes options to increase DO. Many of these are to transfer water from areas of forecast surplus DO to those that may otherwise experience a deficit in supply. Investments already made in new resources and transfers are reflected in our base year assessment of DO. There are some schemes yet to be commissioned that will increase the overall availability of potable water.

23. Having assessed the factors influencing decreases and increases in DO at a sourceworks level over the planning period, DO is then allocated to the appropriate PZs. This may involve dividing the DO from a large sourceworks to

[8] 'Effects of Climate Change on River Flows and Groundwater Recharge: A practical Methodology - Synthesis Report', UKWIR, 2006; and, 'Climate Change Implications in Estimates of Water Resource Zone Deployable Output', Supplementary Guidance to Water Resources Planning Guideline Chapter 8, Environment Agency, November 2007

a number of PZs; or summing the DOs from a number of small sourceworks to a single PZ. The allocation of DOs to PZs for the FORWARD baseline forecast is based on the split of sourceworks output reported in the base year PZ water balances. In turn, this is based on observed telemetry recorded data reported from flow meters located across our distribution network, for the base year.

24. For the baseline forecast it is assumed that this split of DO to the PZs remains constant. Reallocation of DO from a PZ in surplus to one in deficit may involve the need to invest in new infrastructure. In other cases it may simply require a transfer of water using the existing supply network at no investment cost. Where feasible such options would be included as a possible option available to the least cost plan.

25. The DO forecast in FORWARD excludes any allowance for outage, as this is accounted for in the target headroom calculation. For further explanation see the section about the HOURUS model later in this chapter.

Demand Inputs

26. The five main components that drive the demand forecast in FORWARD are:

- population and properties
- household and non-household water consumption
- leakage and the water balance allowance
- peak demand factors
- target headroom

The base year PZ water balances are based on observed data for the year 2006-07. This is used as the basis for dis-aggregation of the regional supply-demand forecast into the various PZs in the base year.

<u>Population and Properties</u>

27. The model uses a forecast of growth across the Anglian region that is geographically aligned with central and local government growth projections. This data allows us to allocate population and property growth at a PZ level based on Office of National Statistics (ONS) population projections, and Regional Spatial Strategy (RSS) and Local Development Framework (LDF) projections of new build targets. Our approach has been based on the best practice guidelines published by the Environment Agency[9]. The results of this approach are two growth projections versions:

Trend - An ONS prediction of population growth based on patterns over the last five years in fertility, mortality, and national and international migration rates.

Policy - A combination of the ONS population trend predictions redistributed geographically by the new build property targets published in the RSSs and LDFs.

28. The process of disaggregating the regional forecast data into PZs provides the required inputs needed for FORWARD to produce a baseline supply-demand

[9] 'Methods of Estimating Population and Household Projections', Science Report: SC030238, Environment Agency, 2007

forecast. Based on this dis-aggregation, we can make estimates of how many people and properties there are in each PZ. We then make estimates of how much water a person uses on average each day and how this may change over time, reported as per capita consumption (PCC).

Water Consumption

29. PCCs differ between measured (metered) and unmeasured (non-metered) households, for new and existing properties, and between PZs. By multiplying PCCs by occupancy rates and property numbers, FORWARD is able to project an estimate of baseline demand, factoring in rates of change in consumption, population and property numbers over time. The model also makes an allowance for people switching from unmeasured to measured water charges, which typically results in a lower PCC.

30. Non-household water consumption is also forecast at a PZ level by FORWARD. The required inputs are generated by proportionally disaggregating data from the regional forecast to the splits in non-household consumption reported in the base year PZ water balances. We have assumed that the allocation of change in non-household consumption remains proportional to the base year PZ water balances throughout the forecast period.

Leakage and the Water Balance

31. FORWARD calculates the economic level of leakage (ELL) and includes this in the supply-demand forecast. The assessment of ELL in FORWARD was described in Chapter 2 in the context of Leakage Control. The ELL is calculated using separate runs of the FORWARD model in order to determine the company's leakage target. The calculated ELL is then used as an input component to FORWARD for modelling the supply-demand balance.

32. The base year water balance is calculated from the summation of demand in measured and unmeasured use, and leakage. When compared with the measured volume of water supplied from our sourceworks there is an imbalance. This imbalance can be positive or negative and the difference between water supplies and demands is reconciled by a method known as the maximum likelihood estimation (MLE). This allocates any imbalance according to the accuracy in the measurement or estimate of the water balance components. The WRP Guideline states that (MLE) should be used to reconcile the base year water balance estimate to distribution input, at a WRZ level. In order to achieve consistency with our annual regulatory reporting requirements, the base year water balance for the Draft WRMP reconciles to Table 10b of the June Return 2007. Table 10b sets out the water balance for each WRZ in the reporting year 2006-07. However, this data is presented without MLE.

33. Table 10 of the June Return 2007 provides a post-MLE summary of the base year water balance at a company level. The approach to assessing this imbalance was in accordance with the best practice guidelines[10]. We reported a water balance of -33.94 Ml/d for 2006-07, with demand being more than water supplied. This is less than 3 per cent of the volume of water supplied. Of this, 9.96 Ml/d was attributed to distribution input. The remaining imbalance of 23.98 Ml/d was allocated to components of demand in the water balance. For

[10] 'Demand Forecasting Methodology Main Report', NRA and UKWIR, 1995

the purposes of the Draft WRMP we proportionally disaggregated this imbalance across the PZs, split by the estimate of distribution input reported in the base year PZ water balances. We have assumed that this post-MLE imbalance remains constant throughout the forecast period.

Peak Demands

34. The final key demand inputs required by FORWARD are the peak factors. The calculation of these factors for water consumption is based on records of peaks in historical distribution input, and meteorological data. For the Draft WRMP consultants applied the latest best practice guidelines to estimating peak factors for customers' water consumption, to generate inputs for FORWARD. For more detail see the section describing the PCC model later in this chapter.

35. The outputs of the PCC model are factors that are applied to the average rates of consumption to reflect the observed effect of weather conditions on the demand for water. The peak factors are not uniform across the water supply region, but vary between geographical areas due to differences in demographic, sociological, economic and climatic influences.

Target Headroom

36. Target headroom is calculated by the HOURUS model, prior to input to FORWARD. The HOURUS model simultaneously calculates the target headroom needed to manage risk and uncertainty associated with supplies and demands; and the outage allowance for the risk of unplanned interruptions to the output of a sourceworks. FORWARD uses a combined planning allowance for target headroom and outage that, for simplicity, we refer to simply as target headroom, see the section about HOURUS, further on in this chapter.

37. The HOURUS outputs are factors that increase with time as uncertainties grow and vary between WRZs over time. This is due to regional differences in the drivers that influence both risk and uncertainty depending on the local sources of supply and the factors affecting the forecast of demands.

Forecast Scenarios

38. The FORWARD model is first run to produce a base year baseline forecast. This is the first of a number of scenarios that require separate versions of the model to be run. FORWARD initially produces average and peak period supply-demand forecasts using the base year water balance reported in Table 10 of the June Return. This may not provide a sound basis for planning investments to ensure a secure supply of water into the future as the base year demand may be lower or higher than average demand. We therefore produce two further scenarios that involve adjustments to the base year demand inputs for the 'normal year' and the 'dry year'. The Environment Agency guideline requires that we consider the supply-demand balance in the dry year scenario so that our plans are secure under drought conditions; whereas Ofwat needs data on the normal year for long-term economic planning. The PCC model is used to define the factors needed to adjust the base year data for normal and dry years, as described in the section below.

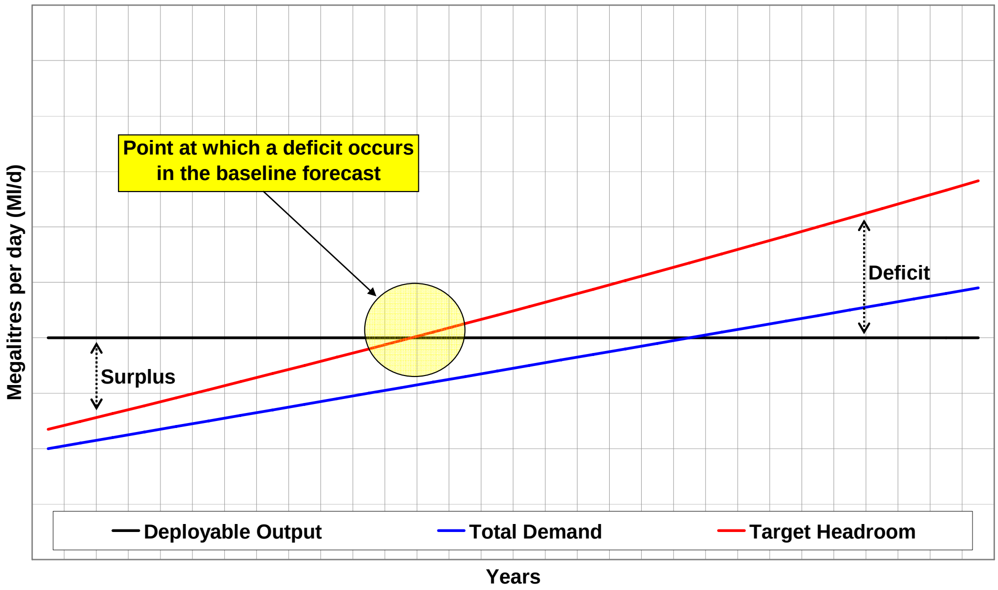
39. In addition to the climatic scenarios, we are also able to produce versions of FORWARD based on distributions of population and properties driven by growth trends as influenced by new central and local government policies, the

'trend' and 'policy' growth projections as described above. Whilst this approach allows a range of possible scenarios to be modelled and compared, the one that drives our investment programme is the dry year baseline forecast based on the 'policy' growth projections.

The Baseline Forecast

40. Figure 3.3 illustrates a typical baseline supply-demand forecast for a PZ that may run into deficit.

Figure 3.3 Baseline forecast



The black line shows the forecast level of DO in the PZ; the blue line is total demand (consumption plus leakage); and the red line is the target headroom requirement. As long as the red line (target headroom) remains at or below the black line (DO), we have a healthy supply-demand balance: There is enough DO available to meet forecast demand and target headroom (including outage). When target headroom exceeds DO a supply-demand deficit occurs. In such a case investment options are needed to reduce demand and/or increase DO in order to maintain security of supply.

Options

41. Options to resolve forecast supply-demand deficits that are be made available to FORWARD are:

- strategic resource and transfer options
- demand management options

42. Strategic resource and transfer options have the effect of increasing DO in one or more PZs. This may be achieved by building a water treatment plant; laying a new trunk mains to redistribute water from an area in surplus to one in deficit; or a combination of both. For such options FORWARD needs to know the average and peak yields (increases in DO), the capital and operational costs,

and the timing or availability of the scheme over the forecast period. A major resource development may take many years to build and commission.

43. Demand management options are those that have the effect of reducing the use of water. This can be achieved through options such as:

- metering
- further targeted leakage control
- pressure reduction
- household water efficiency audits
- installation of water efficiency devices

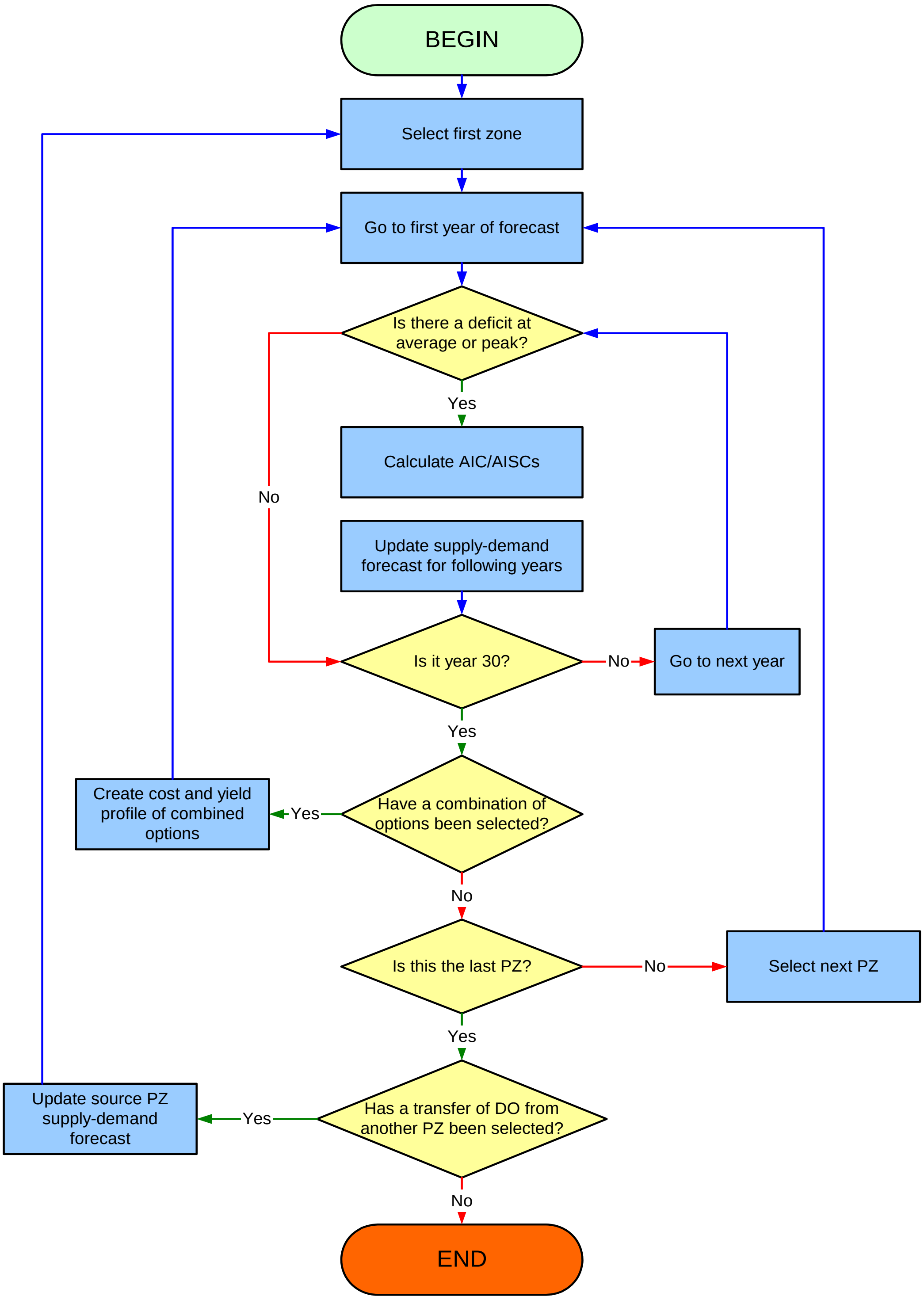
For these options we need to make an assessment of their demand impacts as well as their costs. An assessment has been undertaken for us by consultants, who carried out a literature review on the effectiveness of water efficiency options. This has helped to inform the water efficiency option inputs used in FORWARD. Demand management options are generally quicker to implement, but they are also subject to greater uncertainty over their volumetric effect and the length of time this may last. They are of most benefit where deficits are marginal.

44. We have included the social and environmental costs and benefits that may be associated with the options. We commissioned consultants to develop an approach to environmental valuation of options that is consistent with the EA Benefit Assessment Guidance (BAG). The approach we have adopted considers a wide range of impacts: from the carbon footprint created by operating a new treatment works; to the possible negative effects on recreational amenity created by increasing raw water abstractions from rivers. These impacts are translated into monetary values against the yield or demand impact of an option expressed as pounds per megalitre per day (£/Ml/d). The intention of this approach is to ensure the economic value of each option reflects the wider costs and benefits it may bring to bear on society and the natural environment.

The Least Cost Forecast

45. The baseline forecast and options to resolve any supply-demand deficit inputs are used to generate a least cost forecast (LCF). This forecast is calculated as a result of FORWARD's least cost planning option selection process, illustrated in Figure 3.4.

Figure 3.4 Option selection process

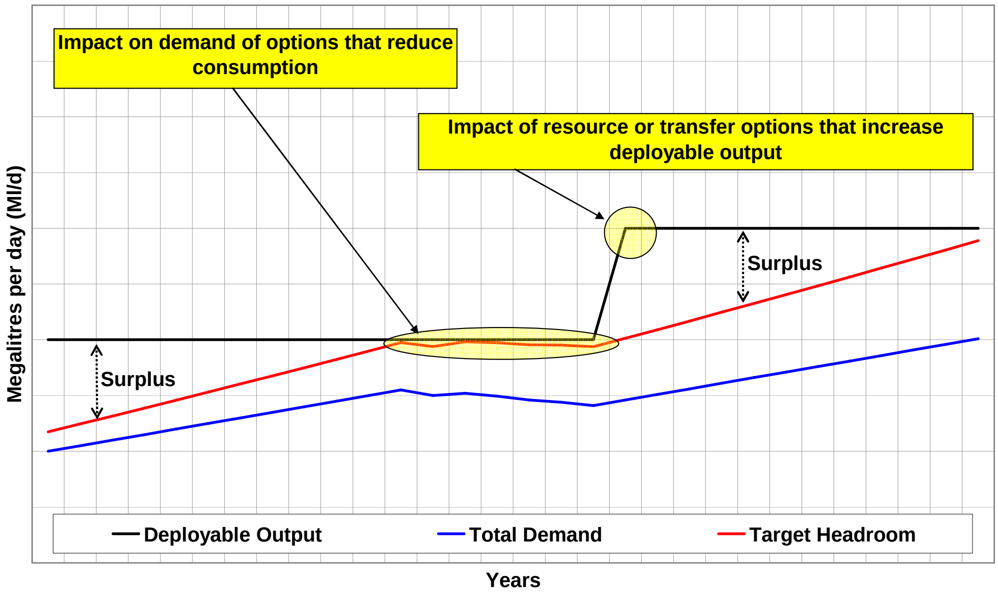


46. FORWARD can produce two least cost plans: one based on the average incremental cost (AIC) of the options; the other based on the average incremental social cost (AISC) of the options. The difference is that the AIC excludes the environmental and social costs and benefits of an option, but the AISC includes them. In either case, the cost of each option is discounted over a 30-year period to return a net present value, and divided by its similarly discounted yield or demand impact. This produces a £/Ml/d common unit of value for all options, allowing FORWARD to run through multiple iterations to find the most cost effective single option or combination of options to resolve a

forecast deficit. This process follows standard economic cost effectiveness methodologies, and is consistent with the best practice guidelines[11].

47. Having identified the most cost-effective solutions, the LCF is produced as an output of the FORWARD model. Figure 3.5 shows a typical LCF outcome for a PZ.

Figure 3.5 Least cost forecast



In this illustration growth in demand is reduced by metering, water efficiency and leakage control options, and further into the forecast a strategic resource or transfer scheme that increases the level of DO in the PZ.

48. In summary, FORWARD plays several roles in delivering baseline and least cost forecasts; delivering an optimised set of preferred water management options; and calculating the ELL. To do this it requires data inputs generated from the base year PZ water balances, consumption forecasts, and predictions of population and property growth from central and local government. The model also needs inputs based on estimates of future peak demand, normal and dry year factors; calculated by the PCC model. Finally, inputs from HOURUS provide a target headroom allowance for uncertainty and risk in the assumptions made in the forecast.

The PCC Peak Demand Model

Overview

49. The per capita consumption (PCC) model plays two roles in processing input data used by FORWARD. It is used to calculate peak factors and to calculate the normal and dry year factors. The PCC model has been developed and is

[11] 'Economics of Balancing Supply and Demand', EA and UKWIR, 2002

maintained for us by consultants. The approach is consistent with the best practice guidelines[12].

50. The PCC model estimates PCCs for measured and unmeasured households based on a range of data sets. This includes historical data from our survey of domestic consumption (SoDCon), which monitored demand at over 2,000 properties for over 10 years. Socio-economic and demographic information on the SoDCon participants was also gathered through an annual survey. This sample population of our customer base provided a statistically robust means of reporting estimates of measured and unmeasured household PCCs until the survey was curtailed in 2006. This step was only taken on the basis that the newly developed PCC model would provide an equally reliable alternative.

51. Based on historical SoDCon data paired with meteorological records of rainfall, maximum temperatures and sunshine hours, it was found that the PCC model was able to predict PCCs within 2 per cent of observed data. This level of variance is considered statistically insignificant, and the model is now used in reporting PCCs in Table 10 of the annual June Return submission to Ofwat.

52. The PCC model can predict daily variations in PCC, as well as weekly, monthly and annual averages and peaks in demand. For the purposes of the Draft WRMP, the peak and dry year factors have been calculated at a WRZ level and applied evenly to PCCs across all the PZs within them.

Peak Factors

53. In order to calculate the peak factors for measured and unmeasured PCCs, the following data inputs to the model is required for each WRZ:

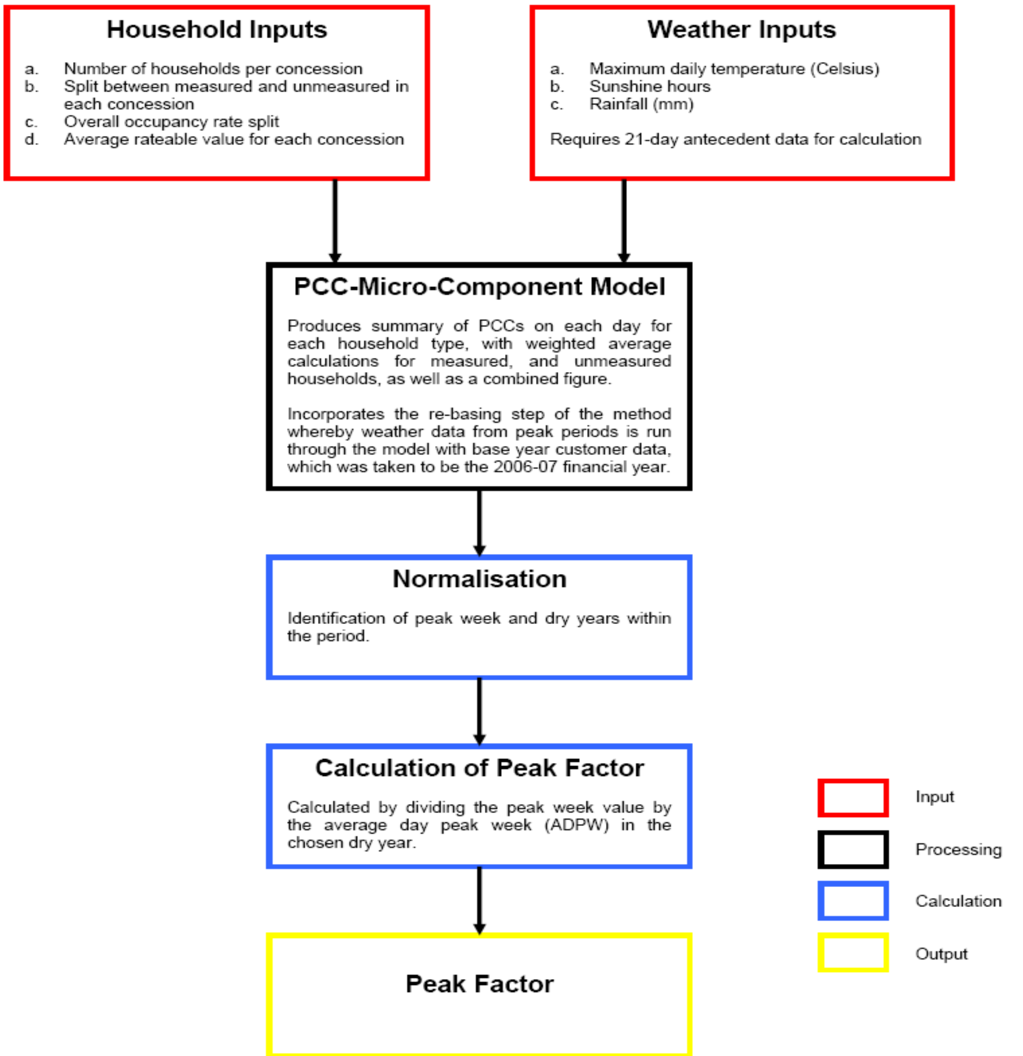
- number and proportion of measured and unmeasured households
- measured and unmeasured household occupancy rates
- maximum daily temperatures
- daily rainfall
- sunshine hours per day

The meteorological data was gathered from all the Met Office weather stations in our water supply area and matched to the nearest corresponding WRZ. The methodology used by the PCC model is illustrated in Figure 3.6

54. Peaks in PCC tended to occur in the summer months of June, July and August. We reviewed the duration of the critical period of demand as one, three and seven-day rolling period and determined that the three-day period best suited the conditions in our region. This is because peak demand is normally associated with the increased domestic use of water over long weekends and the balancing effect of treated water storage needed to be used, but not relied upon to met peak demands.

[12] 'Peak Demand Methodology', UKWIR, 2006

Figure 3.6 Peak factor methodology



55. The analysis of the three-day rolling mean of PCC identified that the largest historical peaks were concentrated in the years 1995, 1996 and 2006. The long-term average PCC, or normalised PCC, was also assessed excluding data for the identified peak periods of demand and a comparison provided the factors at a WRZ level used in FORWARD. Table 3.3 provides a company level summary of the peak factors.

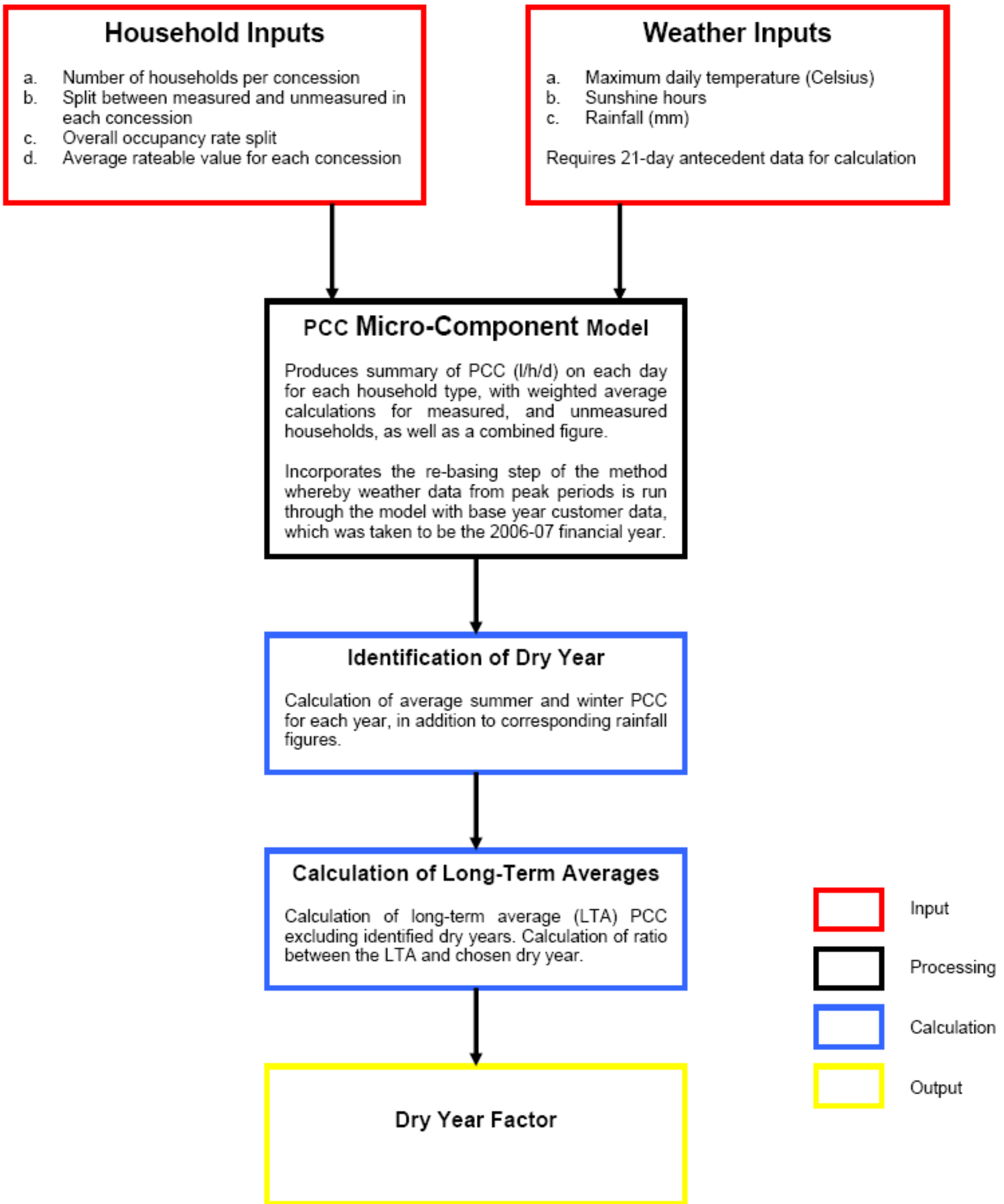
Table 3.3 Company level peak factors

Household Type	Peak Factor
Measured	1.277
Unmeasured	1.342
Combined	1.32

Dry Year Factor

56. Use of the PCC model for the Draft WRMP provides a more sophisticated assessment of dry year household demand than previous methodologies based only on changes in distribution input (DI). The dry year methodology is illustrated in Figure 3.7. The model uses the same data inputs as needed for calculating the peak factors, and provides outputs at a WRZ level.

Figure 3.7 Dry year methodology



57. The first step is to identify a normal year demand based on an estimate of average PCC. This was done by comparing annual and seasonal demand variations in PCC generated by the model, using the 2006-07 base year customer population, property numbers and property type information. As with the peak factor methodology, refinements are made in the modelling process to adjust (rebase) the customer data for sensible comparison of historical PCC and DI data in other years. A factor representing the seasonal difference in

demand between the summer and winter averages was calculated for each year in our historical data set. Based on this analysis, dry years were identified as 1995, 1996, 2003 and 2006, and excluded from assessment of the long-term average normal year factor. Table 3.4 summarises at a company level the dry year factors calculated by the model.

Table 3.4 Company level summer : winter demand ratios

Year	Summer : Winter ratio
1995	1.097
1996	1.082
1997	1.071
1998	1.054
1999	1.069
2000	1.054
2001	1.065
2002	1.063
2003	1.083
2004	1.062
2005	1.057
2006	1.084

58. This assessment meant that the seasonal winter to summer ratio in demand for 2006 was not significantly different from the largest historical dry year factor in 1995. As such, the dry factor adjustment to the base year demand data in FORWARD is small, because it is a dry year, and a downward adjustment was applied to produce the normal year demand.

59. In summary, the PCC model has provided a new approach consistent with latest best practice guidelines for calculating peak and dry year factors. The results of the analysis provided FORWARD input data at a WRZ level which have been applied at a constant rate throughout the forecast period. Whilst the peak factors show a significant increase in demand during the critical period, the dry year factor analysis and resulting adjustment to the base year PCCs are small. This is because in water balance terms 2006 was a relatively dry year.

The HOURUS Headroom and Outage Model

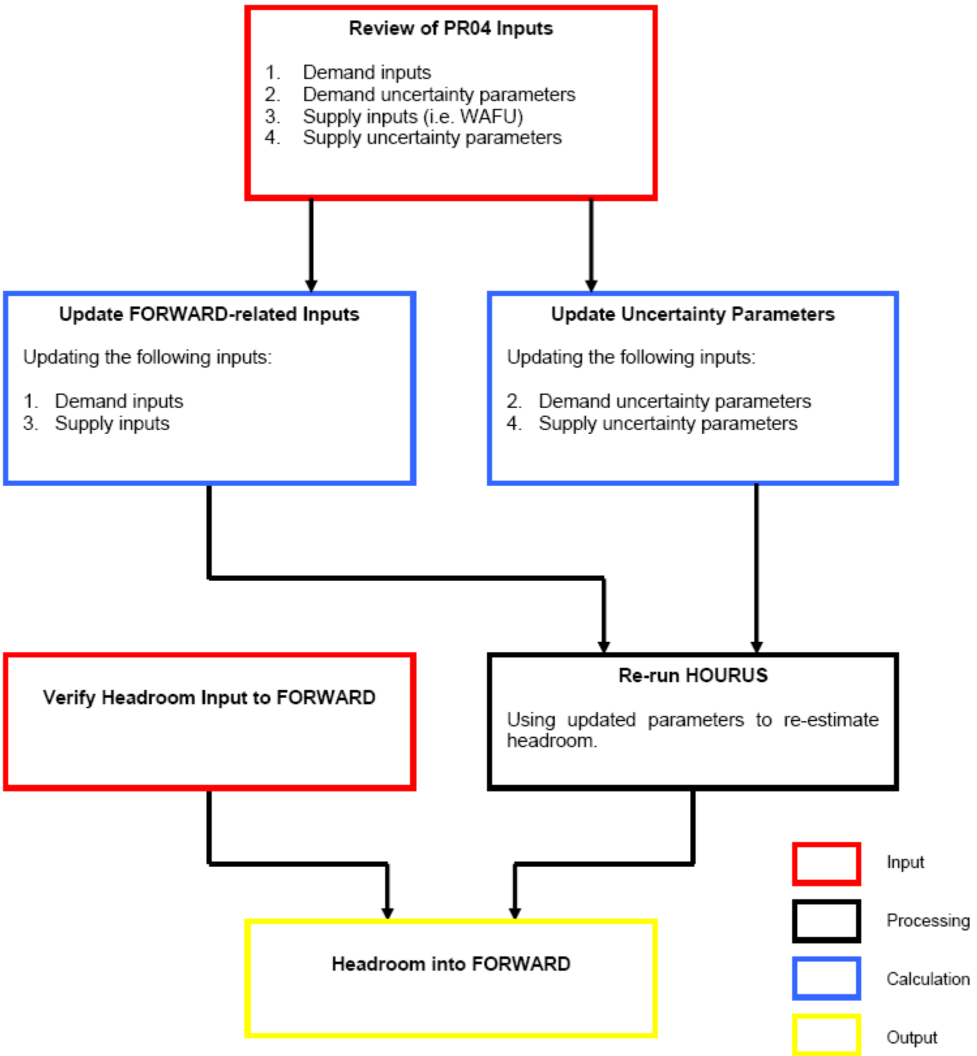
Overview

60. Target headroom is calculated in FORWARD as a percentage of demand. This percentage is generated as an output of HOURUS. This is a Microsoft Excel-based spreadsheet model developed for us and maintained by consultants. It uses the Crystal Ball™ software application for probability analysis, also known as stochastic modelling and Monte Carlo analysis. Such analysis tells us the likely occurrence of different outcomes. This can be applied to different

components of the water balance to express the level of risk and uncertainty associated with them over the forecast period[13].

61. HOURUS was first used by us to assess target headroom for the 2004 Water Resources Plan and Periodic Review submissions. The model has not been changed for the Draft WRMP 2008, but the input data is being reviewed and updated. Figure 3.8 illustrates the process used by HOURUS.

Figure 3.8 HOURUS methodology



62. Calculating target headroom outside of FORWARD allows us the flexibility to adjust the calculation of this critical forecast element as best practice guidelines evolve. The alternative would be a specialist task of embedding and amending complex calculations in the FORWARD program. We consider that the statistical functions required to model the risks and uncertainties in the supply-demand forecast are better handled in a spreadsheet application.

[13] HOURUS has been developed to be consistent with best practice guidelines. 'Uncertainty and Risk in Demand Forecasting', UKWIR, 2003; 'An Improved Methodology for Converting Uncertainty into Headroom', UKWIR, 2002; and, 'The Economics of Balancing Supply and Demand', UKWIR, 2002

Model Inputs

63. The inputs to HOURUS are the same as those used in the FORWARD baseline forecast supply and demand data sets. HOURUS requires additional information on confidence ranges assessed for the uncertainties associated with the various elements of the base year and forecast water balance components. The model then mimics the FORWARD baseline forecast but calculates a distribution of likely outcomes around the water balance components, dependent on the confidence ranges.

64. As our water balance reporting and supply-demand forecasting processes are largely unchanged since WRP04, the majority of confidence ranges are also unchanged. The impact of climate change on DO and sustainability reductions are now explicitly included in the supply-demand balance analysis, but the uncertainties associated are included in the calculation of target headroom. Confidence ranges associated with components of the base year water balance are consistent with the MLE applied to the figures reported in the June Return.

65. Outage is included in the target headroom calculation. Outage allows for the unplanned loss of output from a sourceworks for a short period. For instance, a pollution of the raw water source may mean we have to close the sourceworks. The term water available for use (WAFU) is applied to DO minus outage. FORWARD accounts for outage within headroom rather than an explicit reduction of DO. The net effect is the same, in that outage is included in the supply-demand balance analysis to ensure that there is enough water available for use from our sourceworks to meet forecast demand and target headroom requirements.

Model Outputs

66. HOURUS outputs provide the headroom and outage percentages for each year of the forecast at a WRZ level. This is applied in the baseline and least cost forecasts as a factor on total demand. The outputs of the model are summarised at a WRZ level in Table 3.5, which shows the headroom and outage elements. Added together, these provide the target headroom percentages used in FORWARD.

Table 3.5 WRZ HOURUS outputs (%) for headroom (H) and outage (O)

WRZ			06-07	10-11	15-16	20-21	25-26	30-31	35-36
1	South Humberside	H	4	6	8	11	13	15	17
		O	8	8	8	8	8	8	8
2	Lincoln	H	4	6	7	9	11	13	16
		O	5	5	5	5	5	5	5
3	Lincolnshire Coastal	H	3	5	6	7	9	11	13
		O	6	5	5	5	5	5	5
4	Lincolnshire Fens	H	4	6	10	13	15	17	20
		O	6	5	5	5	5	5	5
5	Fenland	H	3	4	5	7	8	10	12
		O	7	7	7	7	7	7	6

WRZ			06-07	10-11	15-16	20-21	25-26	30-31	35-36
6	North Norfolk Coast	H	4	5	6	8	10	13	15
		O	5	5	5	5	5	5	5
7	Norfolk Rural	H	4	6	7	8	11	13	15
		O	5	5	5	5	5	5	4
8	Norwich & The Broads	H	4	6	7	9	11	13	16
		O	10	10	10	10	10	9	9
9	Cambridgeshire & West Suffolk	H	4	7	9	12	14	17	20
		O	5	5	5	5	5	5	5
10	East Suffolk & Essex	H	4	6	8	10	12	14	17
		O	4	5	4	4	4	4	4
11	Ruthamford	H	4	6	7	9	12	13	16
		O	5	5	5	5	5	4	4
12	Hartlepool	H	4	6	7	8	10	11	13
		O	6	6	6	6	6	6	6

67. Supply-demand forecasting is not a deterministic process but rather one full of uncertainties. The assessment of target headroom adds a significant element in the supply-demand balance, growing from around 10 to 20 per cent over the forecast period. This reflects the significance of the cumulative impact of the range of risks and uncertainties associated with the various supply-demand forecast components and of outage at sourceworks. If we do not account for such uncertainties we would be exposing our customers to a growing risk of insecure water supplies through the 25-year planning period.

Chapter Summary

68. Chapter 3 has provided a brief overview and summary of the principal models used to calculate the supply-demand balance for the Draft WRMP. As best practice guidelines change, it is likely that these models will also continue to evolve, be replaced, or be complimented by additional ones. However, our objective remains simple: to deliver a robust plan for managing water resources, supporting an investment programme in the coming periodic review, to maintain a secure water supply to our customers and to protect the environment now and into the future.

69. The outputs of these models have been used to populate the WRP Tables that are submitted to the EA and Ofwat for detailed consideration. The outcome of the supply-demand analysis is summarised for each WRZ in Chapter 4. Chapter 5 describes how the individual schemes combine to define our water resources management strategy for the region as a whole.

4 DETAILS OF THE WATER RESOURCES ZONES

Introduction

1. The aim of this chapter is to describe the historical development of water resources and our plans for its future management in each of the 12 WRZs. We used the FORWARD model to forecast where PZs will have a deficit of supplies against demand, including planning allowances of target headroom and outage over the 25-year planning period of 2010-35. The model was then used to identify the optimal solution from the options of demand management and resource development schemes to satisfy the deficit using the principles of the economic balance of supplies and demands, taking account of social and environmental costs.

2. We have worked with consultants during the preparation of the Draft WRMP to subject the plan to the process of strategic environmental assessment (SEA), as required by the SEA Directive. We believe that the preparation of the WRMP is the first time that an SEA has been applied to a planning process by non-public bodies, namely the statutory water undertakers. In producing the environmental report in support of the WRMP, we have tested the feasible options against the criteria for SEA. In doing so, we have noted that the feasible options identified do not present significant differences. Thus the environmental report provides a detailed commentary on the relative impacts of schemes. The outcome is to influence the timing, with preference given to demand management schemes where they can provide savings to be effective. This outcome is confirmed by the economic modelling.

3. The timing of the demand and supply side schemes is given in terms of the five-year asset management planning period in which they would be required. These are:

Asset Management Plan period	Dates (April to March)
AMP5	2010 to 2015
AMP6	2015 to 2020
AMP7	2020 to 2025
AMP8	2025 to 2030
AMP9	2030 to 2035

The timing of schemes will be subject to the determination by Ofwat of our Draft and Final AMP submissions. We are required to review our WRMP every five years and will therefore be reviewing the impact of changes to the supply-demand balance and the risks and uncertainties that relate to it. In developing the detail of our supply-demand investment programme, we will be examining our plan to identify any synergies between schemes that would enable us to deliver them more efficiently and effectively.

4. We welcome comments on the detail of our Draft WRMP in the sections on the 12 WRZs that follow. Representations received will be addressed in our Statement of Response later this year and, where appropriate, taken into account during the preparation of the Final WRMP for submission to Defra in April 2009. The Final WRMP will take account of any changes to the main drivers of regional growth plans, climate change scenarios and environmental regulation. We would expect that these would affect the timing rather than the strategy of our WRMP.

WRZ1 - South Humberside (including non-potable supplies)

Current water supply arrangements

5. The main water resource for South Humberside WRZ is the Northern Lincolnshire Chalk aquifer. The zone includes the Elsham sourceworks, with both potable and non-potable treatment streams, and Covenham reservoir. Although the WRZ includes non-potable supplies, these are dealt with separately in the supply-demand balance analysis and are not included in the FORWARD model. The Elsham and Covenham surface water sourceworks export water to the Lincoln and Lincolnshire Coastal WRZs respectively through a well-integrated trunk main system. There are also small groundwater sourceworks in the Northern Lincolnshire Limestone at Winterton and Waddingham.

6. The Chalk outcrop is vulnerable to groundwater pollution by agriculture and there is a history of pollution from industrial and commercial premises on the industrialised Humber coastal plain. The boundary of the aquifer with the Humber estuary presents a risk of saline intrusion if pumping, during periods of naturally low groundwater levels, locally reverses the hydraulic gradient in the Chalk aquifer. We have entered into a water resources management agreement with the Environment Agency under section 20 of the Water Resources Act 1991. This restricts the use of the aquifer during drought to protect the aquifer and limits the average deployable outputs of 13 Chalk sourceworks. We are actively evaluating the impact of long-term sea level changes on the saline/fresh water interface in this area.

7. The Elsham WTW is reliant on augmentation of the flow of the River Ancholme by the Environment Agency's Trent-Witham-Ancholme scheme (TWAS) during lower summer flows. The TWAS also supports direct abstractors and in low flow periods peak licensed demand could exceed the augmentation capacity. This shortfall could be resolved by variation of the licence for the Environment Agency's Torksey Intake on the River Trent. We have assumed that the full daily licensed quantity is available for abstraction at our intake at Cadney on the River Ancholme. We are concerned at the potential shortfall in resources and have requested a more formal agreement on the security of the raw water supply and a forum for dialogue with the Environment Agency through a memorandum of understanding for the TWAS.

8. The yield of Covenham reservoir is dependent on baseflow from springs issuing from the Southern Lincolnshire Chalk and the return of treated effluent from Louth to the Louth Canal. The reservoir intake is required to pass a nominal 28 l/sec to tidal waters. When necessary, in low rainfall periods, the yield of Covenham reservoir is augmented by the transfer of water from our Great Eau transfer scheme that provides a significant increase to the contributory catchment area.

9. There is an increasing level of diffuse source nitrate in groundwater in the Northern Lincolnshire Chalk aquifer. This has been managed by the construction of the company's largest nitrate removal treatment plant at Barrow and by blending other high nitrate sources with water from Covenham WTW in the Irby treated water storage reservoir. The seasonal increase in nitrate in surface water treated at Elsham WTW is managed by treatment of the high nitrate groundwater source at Ulceby and then blending with the surface water treatment stream. An additional nitrate treatment stream was constructed at

Barrow during the AMP4 period to maintain compliance with water quality standards and rising nitrate at the Littlecoates sourceworks in Grimsby will be managed by careful blending with lower nitrate water in Irby storage reservoir.

10. The Lincolnshire Limestone is a fissured aquifer and borehole sources are vulnerable to pollution from agricultural run off and any fuel spillages along the Lincoln escarpment outcrop. Although these sourceworks are connected to the trunk main system and their loss can be managed to maintain local supplies, it can result in outage while investigations take place and if necessary remedial works are put in place.

11. The Environment Agency and local conservation bodies have expressed concern over the environmental impact of our abstractions on the streams that rise in the Chalk Wolds and then flow onto the coastal plain. The Chalk groundwater abstraction is known to affect the seven main springheads that lie along the boundary between the unconfined Chalk Wolds and the confined Chalk under the clays of the coastal plain. This has been addressed by the provision of support pumping to Laceby Beck at Laceby WWTW and at the Barnoldby sourceworks. There is also concern on the potential impact of abstraction on Barrow and Barton Clay Pits Special Protection Area for birds (SPA). An investigation has been carried out during the AMP4 period to assist the Environment Agency in determining if there is an adverse affect on the integrity of the conservation site.

12. The deployable output of Covenham reservoir was not reduced by our analysis for climate change impact. The reduction of the yield of groundwater sources is not significant given the restriction on abstraction under the Northern Chalk section 20 agreement. The Environment Agency uses a groundwater flow model to manage abstraction from the Chalk aquifer. The model is currently being refined and should be able to provide further information on the potential long-term impact of climate change on aquifer resources, particularly on the movement of the saline front.

13. A small bulk supply is imported to the village of Finningley from Yorkshire Water Services. This is a discrete area and has not been included in supply-demand balance analysis.

Current demands

14. The zone includes the demand centres of Scunthorpe, Grimsby and Cleethorpes together with the rural areas of the Lincolnshire Wolds. There is a high proportion of industrial demand that has declined in recent years and is expected to continue to do so. There is limited potential growth from residential development. Demand is being managed through active leakage control and increased metering of households. There is a significant latent demand from historical supply agreements with major industrial customers and a steady number of enquiries from potential industrial customers, some of which progress to implementation. An example is the new power station at Immingham and proposals from fuel and petrochemical companies. Only firm commitments are included in the demand forecast.

15. The zone experiences a low peak demand due to the high percentage of industrial demand and its local social and geographic characteristics. Historically the Chalk sourceworks were developed to meet peak demand with limited treated water storage. The construction of the Irby reservoir to provide

blending for nitrate compliance together with the decline in industrial demand has increased security and provides surplus water that can be used to support adjacent zones.

16. The demand for non-potable supplies from Elsham WTW is dependent upon a small number of customers. There is a large available headroom for non-potable supplies.

Forecasts and projections

17. Growth is forecast to take place over the planning period at the rate of some 1,100 dwellings per year with a population increasing from around 295,000 to 325,000. We expect the domestic demand to increase from 42 to 45 Ml/d. Commercial demand is expected to remain steady over the planning period at about 45 Ml/d. Leakage is expected to be controlled at around 16 Ml/d.

Target headroom deficits

18. The South Humberside WRZ target headroom is marginally above the regional average increasing from 4 to 16.6 per cent of demand over the planning period. This is primarily due to uncertainty over the forecast reduction in industrial demand. There is also uncertainty associated with domestic consumption and supply risk over the long term deterioration of groundwater quality, primarily due to the risk of contamination in the industrial and urban centres. We are currently experiencing a loss of sourceworks output due to a local contamination of groundwater that is forecast to last for up to 10 years. The allowance for outage is high at 8 per cent.

19. The WRZ as a whole has a surplus of available against target headroom at average and peak throughout the Plan period. However more detailed analysis shows three out of the six PZs are projected to have headroom deficits against dry year average and critical peak period forecasts by the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ02	Barrow	-0.41	-1.19
PZ03	Elsham	-0.34	-0.34
PZ06	Scunthorpe South	-3.27	-4.73

Feasible water management options

20. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
02	Covenham-Irby to Elsham WTW transfer	1.60	1.60
03	Covenham-Irby to Elsham WTW transfer	0.63	0.63
06	Covenham-Irby to Elsham WTW transfer	6.29	6.29

The Covenham-Irby scheme uses DO from licensed quantities at Coveham reservoir in the east of the WRZ for transfer to Elsham in the west by pumping water along the existing trunk main. The scheme will require a new pumping station in order to transfer the water. Further water can be made available to Irby reservoir by treatment of high nitrate Chalk groundwater in sources at Little London, Healing and Habrough, which are currently primarily used as non-potable supplies to industry.

21. The non-potable industrial demand for water in the WRZ is considered separately to the potable demand and is not included in the headroom calculation. There is a potential deficit in non-potable supplies from the change of use of the Chalk sources at Little London, Healing and Habrough combined with potential demand for industrial use. This could be met by extension to Elsham WTW augmented by the TWAS or by the treatment of water discharged from Pyewipe and Newton-le-Marsh WWTWs.

Preferred water management options

22. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency, particularly with large industrial customers, although significant savings have already been made. There were no major schemes to increase deployable output during AMP4. This was recognised in the reduction in 2005 of the annual licensed quantity for the Cadney intake, which feeds Elsham WTW. An application to restore the licensed quantity will be made if needed to meet increased industrial demand. On the basis of current forecasts both potable and non-potable supplies are secure throughout the planning period.

23. Minor investment is required to maintain the security of supplies through local enhancement to the trunk main and local distribution systems to facilitate increased internal transfers between Planning Zones within the Water Resources Zone. The selected schemes are summarised as:

PZ	Selected option	Period
02	Targeted cistern devices	AMP5
	Further targeted leakage control	AMP6
	Domestic water audits	AMP6
	Covenham-Irby to Elsham WTW transfer	AMP6
03	Pressure reduction to reduce leakage	AMP8
	Further targeted leakage control	AMP9
06	Covenham-Irby to Elsham WTW transfer	AMP5

24. Increased transfers to both Lincoln and Lincolnshire Coastal WRZs will be required in the future. The increased use of the trunk main system to balance supplies and demands may potentially result in some changes to the water quality supplied to customers. Although all water supplied meets the required standards, there may be differences in aesthetic characteristics, such as the level of hardness or chlorine.

25. The longer term analysis beyond 2020 shows that there is no need to develop additional water resources to maintain a secure supply-demand balance. Although not currently needed there are potential options to provide additional treatment to the discharges from our Pyewipe and Newton-le–Marsh WWTWs

in Grimsby and Cleethorpes to augment the water resources available to refill Covenham reservoir. There is also the potential for a link to the Trent-Witham-Ancholme transfer scheme to refill of Covenham reservoir during drought conditions. Similarly, discharges from Pyewipe WWTW could be used to replace non-potable industrial supplies on South Humberside or provide new ones with water treated to the customer's specification.

WRZ2 - Lincoln

Current water supply arrangements

26. The Lincoln WRZ utilises groundwater resources from the Sherwood Sandstone aquifer to the west of Lincoln and local sources in the Lincolnshire Limestone aquifer to the north and south of the city. Water is imported to the zone from Elsham WTW in the South Humberside WRZ to north Lincoln. The WRZ includes the surface water treatment works at Saltersford, which is linked to our treated water storage reservoir south of Lincoln by the Central Lincolnshire trunk main, although the full connection is not currently in use. The majority of the water treated at Saltersford is abstracted from Rutland Water rather than the local lower quality surface water sources to ensure that drinking water standards are always met.

27. Historically the increasing nitrate level in the Lincolnshire Limestone aquifer has been managed by developing groundwater sources in the confined limestone aquifer or by blending with water from sourceworks with lower nitrate. Some sourceworks require treatment to reduce the level of iron and manganese to meet the required standards.

28. The Environment Agency's Midlands region has expressed concern through the Catchment Abstraction Management Strategy (CAMS) process that the Sherwood Sandstone aquifer is over licensed. We carried out investigations into the impact of abstractions in collaboration with Severn Trent Water, as part of the AMP3 National Environment Programme, and have carried out further work in the Poulter and Idle catchments as part of our AMP4 Water Resources Environment Programme (WREP). The current position is that no sustainability reductions are required. The Environment Agency has also expressed concern at the impact of abstractions from the Lincolnshire Limestone on low flows in rivers and streams, notably at Sleaford and at Welton, north of Lincoln, although no work was required as part of the WREP.

29. Our analysis shows that the impact of climate change may effect the deployable outputs of sourceworks in the shallow Lincolnshire Limestone aquifer. A long-term reduction in aquifer recharge could result in the reduction of licences through the CAMS process. This is an issue for later in the plan period, by which time it is hoped that information will be available from the Agency's groundwater models.

30. The Environment Agency's Midlands region originally published the Trent Corridor CAMS in December 2003 and has recently completed a review, as the Lower Trent and Erewash CAMS, for publication in Spring 2008. We have commented in both consultations on the likely need for water resources developments using the River Trent in order to make best use of the augmentation that the river receives from discharges from the major Midlands conurbations of Birmingham, Nottingham, Leicester and Derby. The sources of water to these cities include the transfer of water from the Elan Valley reservoirs in Wales and large winter storage reservoirs within the Trent catchment. The water resource developments for the Anglian region would initially take the form of all-year-round abstractions from the Trent for a surface water treatment plant to the west of Lincoln and, subject to its agreement, a small increase of the Environment Agency's Torksey Intake licence for summer transfer using the existing TWAS. In the longer term, we envisage the use of winter augmentation for the River Witham to refill the potential raw water

storage reservoir in the Lower Witham that would enable water to be transferred to the east of the region. Further discussion is required with the Environment Agency and other stakeholders, including Severn Trent Water, to enable the water resources of the Trent, which benefit from imported water from Wales and winter water stored within the Trent catchment for use in the summer months, to be used sustainably.

Current demands

31. The zone includes the demand centres of Lincoln, Gainsborough, Grantham and rural western Lincolnshire. There is mixed industrial and household demand with growth promoted along the north-south trunk road and rail links and the recently improved road link from the A1 to Lincoln. The main demand centres for growth are likely to be Lincoln and Grantham, although the market town of Sleaford is being promoted for development. Historically the large power stations in the Trent Valley were supplied with mains water for steam generation and then by direct abstraction from the Sherwood Sandstone aquifer. This has been replaced with treated River Trent water, securing groundwater for potable use. Leakage in Lincoln has been progressively reduced by investment in the infrastructure and pressure control.

Forecasts and projections

32. Growth is forecast to take place over the planning period at the rate of some 2,000 dwellings per year with a population increasing from around 380,000 to 450,000. We expect the domestic demand to increase from 57 to 64 Ml/d. Commercial demand is expected to remain steady over the planning period at about 25 Ml/d. Leakage is expected to be controlled at around 25 Ml/d.

Target headroom deficits

33. In the Lincoln WRZ, target headroom is close to the regional average increasing from 4.4 to 15.8 per cent of demand through the planning period. It is driven by demand uncertainty over population growth and domestic consumption. The allowance for outage is average at 5 per cent.

34. The Lincoln WRZ as a whole is forecast to have a deficit of available against target headroom from early in the planning period. More detailed analysis shows eight of the 10 PZs are projected to have headroom deficits against dry year average and/or critical peak period forecasts by the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
08	Billingborough	-0.15	+0.2
09	Branston	-2.88	-0.52
10	East Retford	-1.78	-0.18
11	Everton	-0.46	-0.26
14	Lincoln	-11.95	-13.29
15	Sleaford	-2.97	-1.13
16	Waddingham	-4.07	-5.17
17	Welton	-5.67	-1.14

Feasible water management options

35. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
08	New Lincoln WTW and transfer	0.14	0.14
09	New Lincoln WTW and transfer	3.00	3.00
10	Grove WTW Extension	2.27	2.27
11	Grove WTW Extension	0.60	0.60
14	New Lincoln WTW	16.5	16.5
15	New Lincoln WTW and transfer	3.20	3.20
16	New Lincoln WTW and transfer	4.00	4.00
17	Covenham-Irby to Elsham WTW transfer	5.50	5.50

36. The resource development scheme for the New Lincoln WTW is for a new surface water source to meet the growth of Lincoln using flows augmented by the historical development of water resource systems in the Trent catchment. The scale of the plant would be increased from 5 Ml/d using innovative membrane filtration technology to meet the forecast demand for water and headroom of up to 30 Ml/d. The increased use of surface water could reduce the abstraction of groundwater if required by the Environment Agency in the future. The new treatment plant would be located outside the area at risk of one in 100-year flooding events.

37. The Grove WTW extension would use the current licensed quantities for local treatment and supply to the west of the River Trent, by retaining water that is currently transferred eastward for treatment as a supply for Lincoln. The loss of DO to Lincoln would be replaced by the New Lincoln WTW.

38. The transfer of water from the New Lincoln WTW to the adjacent PZs would initially use existing trunk mains, although these will need additional pumping capacity and some local reinforcement. Further reinforcement of the trunk main system would be needed in the longer term, which would improve the security and flexibility of water supplies.

Preferred water management options

39. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency, particularly with large industrial customers, although significant savings have already been made. Investment is required at the existing sourceworks at Grove and in a new surface water sourceworks for Lincoln, in the trunk main and local distribution systems to facilitate increased internal transfers between Planning Zones within the Water Resources Zone. The selected schemes are summarised as:

PZ	Selected option	Period
08	Further targeted leakage control	AMP5
	Targeted cistern devices	AMP5
	Targeted metering	AMP5
	Domestic water audits	AMP5
	New Lincoln WTW	AMP6
09	New Lincoln WTW	AMP5
10	Pressure reduction to reduce leakage	AMP5
	Further targeted leakage control	AMP6
	Targeted cistern devices	AMP6
	Domestic water audits	AMP7
	Targeted metering	AMP7
	Grove WTW Extension	AMP7
11	Targeted cistern devices	AMP7
	Further targeted leakage control	AMP7
	Domestic water audits	AMP8
	Grove WTW Extension	AMP8
14	Pressure reduction to reduce leakage	AMP5
	New Lincoln WTW	AMP5
15	Pressure reduction to reduce leakage	AMP5
	Targeted cistern devices	AMP5
	Further targeted leakage control	AMP5
	Domestic water audits	AMP6
	Targeted metering	AMP6
	Further targeted leakage control	AMP6
	New Lincoln WTW	AMP6
16	Pressure reduction to reduce leakage	AMP5
	Targeted cistern devices	AMP6
	Further targeted leakage control	AMP6
	New Lincoln WTW	AMP6
17	Covenham-Irby to Elsham WTW transfer	AMP5

40. The New Lincoln WTW is required initially during AMP5 (2010-15) to supply the Lincoln PZ with a nominal 5 Ml/d plant in AMP5, thereafter size of the plant will depend on evaluation of the need at the time. A New Lincoln WTW will require an all year abstraction licence from the River Trent that will need to be reliable during low flow conditions. We have discussed the principle of a new abstraction with the Environment Agency and propose to work with them to review the availability of a reliable resource. We consider that a new abstraction would be sustained by the import of water to the Trent catchment from the Severn catchment. After use and treatment, water would be returned to resources in the Witham catchment for re-use by abstraction to supply a New Lincolnshire Fens WTW.

41. Proposed investment in local demand management should defer an extension to Grove WTW until after 2020. The increased output of the works would meet local growth in Nottinghamshire, with discharges returned after treatment to the Trent catchment.

42. The forecast deficit in the Welton PZ occurs early in the plan period and would be met by an increased transfer of water from Elsham potable WTW in the South Humberside WRZ, utilising increased transfers from the Covenham-Irby to Elsham WTW transfer.

WRZ3 - Lincolnshire Coastal

Current water supply arrangements

43. The Lincolnshire Coastal WRZ utilises the water resources of the Spilsby Sandstone and Southern Lincolnshire Chalk aquifers. Water is also imported from Covenham WTW in the South Humberside WRZ. Historically the local groundwater has been used to supply the Louth and Skegness area since early in the 20th Century. Both aquifers are confined, the Chalk beneath glacial clays and the Spilsby Sandstone lies beneath the Chalk and Lower Cretaceous silts and clays. Recharge to the Southern Chalk is complex with some lateral flow from the Northern Chalk. The Spilsby Sandstone outcrops to the west of the area of our abstractions. Abstraction from the confined aquifer has led to groundwater mining resulting in depressed groundwater levels. The Spilsby Sandstone licences were increased in the early 1990s on the basis of groundwater modelling to assess the availability of water resources. However a downward trend in groundwater levels led to the reduction of the total licensed quantities for the aquifer to a sustainable quantity. Investment has been made in the reinforcement of trunk mains to transfer additional water south from Covenham WTW to the Skegness area to replace the reduction in licensed quantity.

44. There are no significant environmental concerns about abstraction from the confined aquifers although the sustainability of the current licensed quantities will be reviewed through the Environment Agency's regional aquifer modelling work. Abstractions have to be managed to prevent the movement of connate saline water from the east and local dewatering. A high percentage of the available aquifer resource is being used; hence the aquifers are potentially vulnerable to a long-term reduction of recharge resulting from climate change. This has not been included in the plan, pending advice from the development and use of the Agency's aquifer models.

45. The Spilsby Sandstone is a poorly sorted, partially cemented, unconsolidated aquifer. Older boreholes were designed to pump sand, although newer ones have screens designed to restrict sediment being drawn into the submersible borehole pumps, which causes wear, and onto sand filters, causing blockage. As such the boreholes have a relatively short asset life. We have a programme of borehole rehabilitation and replacement and seek to licence new abstraction points within the current licensed quantities in order to maintain deployable outputs.

Current demands

46. The zone includes the demand centres of Skegness, Mablethorpe and Louth together with the surrounding area of rural eastern Lincolnshire. Demand is characterised by mixed household and industrial customers with the addition of seasonal demands by the tourist industry along the coast. This results in exceptionally high peak demands during periods of hot dry weather when holidaymakers and day-trippers flock to the coast. These periods are unpredictable and require a large peak demand output compared with average in the Skegness PZ.

Forecasts and projections

47. Average demand is unlikely to increase under the current structure plans for

the region, although reinforcement of the trunk main and distribution network will be required to ensure that new developments do not affect the local supply-demand balance.

48. Growth is forecast to take place over the planning period at the rate of some 600 dwellings per year, with a population increasing from around 115,000 to 140,000. We expect the domestic demand to increase from 16 to 18 Ml/d. Commercial demand is expected to remain steady over the planning period at about 12 Ml/d. Leakage is expected to be controlled at around 9 Ml/d.

Target headroom deficits

49. In the Lincolnshire Coastal WRZ target headroom is below the regional average increasing from 3.3 to 13.1 per cent through the planning period. It is almost entirely driven by demand uncertainties on population growth and domestic consumption. In the short term, leakage related uncertainties are significant. The allowance for outage is below average at 5 falling to 4 per cent.

50. The Lincolnshire Coastal WRZ is forecast to have a surplus of available against target headroom until late in the planning period. More detailed analysis shows all three PZs are projected to have headroom deficits against dry year average and/or critical peak period forecasts before the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ18	Fulstow	-0.69	-0.85
PZ19	Louth	+0.78	-0.47
PZ20	Skegness	-0.65	2.58

Feasible water management options

51. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
18	Covenham WTW transfer	1.49	1.49
19	Covenham WTW transfer	1.90	1.90
20	Covenham WTW transfer	1.94	1.94

52. The coastal towns have a potential deficit against peak demands driven by the non-indigenous population. This requires investment to improve the internal transfer links and make more effective use of Covenham WTW water.

53. The need to maintain or replace boreholes in the Spilsby Sandstone on a regular basis is included in the maintenance programme. There are currently no issues with nitrate or other water quality parameters in the zone. The use of additional water from Covenham would enable average abstractions from the

Spilsby Sandstone to be reduced, if required. The rolling five year licences for the aquifer enable it to be used conjunctively with Covenham reservoir by using the confined aquifer storage during dry years. The aquifer has been identified as having potential for future development using Aquifer Storage Recovery (ASR) techniques.

Preferred water management options

54. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency. Investment is limited to increasing the transfer of treated water from Covenham reservoir using existing trunk mains, with local reinforcement of the trunk main and local distribution systems, subject to confirmation at design stage. The selected schemes are summarised as:

PZ	Selected option	Period
18	Further targeted leakage control	AMP7
	Covenham WTW transfer	AMP8
19	Pressure reduction to reduce leakage	AMP9
20	Covenham WTW transfer	AMP9

55. The additional transfer of water from Covenham WTW is small and towards the end of the planning period. It will be reviewed in subsequent WRMPs in the light of supply-demand deficits and headroom requirements.

WRZ4 - Lincolnshire Fens

Current water supply arrangements

56. The Lincolnshire Fens WRZ is predominantly supplied by local abstraction from the Southern Lincolnshire Limestone aquifer. The abstraction boreholes are all located in the confined aquifer beneath the Fens, which receives recharge through the narrow outcrop that runs north–south through Stamford. Historically the aquifer has been fully developed for public water supplies and, until the development of Rutland Water reservoir, provided the main water supply to Peterborough. As demand has grown this has been reversed by the transfer water into the WRZ.

57. The yields of boreholes in the confined aquifer are prolific and abstractions are only limited by the need to restrict drawdown in the aquifer to maintain confined discharges from natural springs, such as those at Horbling and Billingborough, and man-made ‘wild bores’ across the Fens. It is also necessary to protect the aquifer against inducing the flow of connate saline water from the east during periods of low groundwater recharge and hence low groundwater levels. A number of licences have specific conditions to restrict abstraction when water levels are low while retaining security and flexibility for public water supplies. The management of water resources was improved by the National Rivers Authority’s scheme in the early 1990s to seal and control the flow of ‘wild bores’ that secured flows to important conservation areas and for licensed abstraction.

58. There are environmental concerns about the impact of abstractions on the West Glen and East Glen streams that rise along the Lincolnshire Limestone aquifer outcrop and then turn east to flow across the Fens. The relationship between the streams and the aquifer has been extensively studied and a succession of mathematical flow models developed to seek to understand the relationships between the hydrology and ecology of the area. We have carried out further work under the WREP/AMP4 programme. From the water company perspective the work has shown that the ecological value of the upper reaches of the Glens has been compromised by changes to land use and management, although valuable stretches of habitat still remain in some tributaries, such as the River Tham and Holywell Brook. The flow of the lower reaches of the River Glen, beyond the confluence of the two headwater streams, is supported by pumping through the Environment Agency’s Gwash-Glen transfer scheme. The Gwash-Glen was commissioned in the early 1990s and is managed under a section 20 water resources management agreement. It transfers water released to the River Gwash from Rutland Water to the lower River Glen during periods of low flow. We are reviewing options with the Environment Agency to change the operation of the schemes to provide environmental benefit without loss of security to public water supplies.

59. Groundwater stored in the limestone aquifer requires little treatment although iron removal is needed at sourceworks in the east. The exception is the sourceworks at Etton, where the aquifer has been polluted by a pesticide from the nearby waste disposal site at Helpston. This is managed by treatment to remove the pesticide from groundwater near to the source of the pollution by the Environment Agency and carbon filtration at our Etton sourceworks to remove the residual pesticide from the public water supply. The sourceworks at Pilsgate is currently not in use due to the ingress of fine particles of marl to the boreholes at high pumping rates, although it could be recommissioned if required.

Current demands

60. The WRZ includes the demand centres of Boston, Spalding and Bourne together with the surrounding Lincolnshire Fens. Horticulture and food processing dominate the industrial demand. Apart from the PZ supplied by the small Billingborough sourceworks, the WRZ is served by a well-integrated trunk main system.

Forecasts and projections

61. Demand in the zone is forecast to grow due to economic activity through the promotion of links with Europe. This is driven by the food production and processing industry which can be volatile. A sustained demand from food production has been associated with previous droughts and the impact of buoyancy in the market for ‘salads’. This could result in a higher than average increase in dry year demand as well as higher peak demands during the summer season. An allowance for uncertainty is included as target headroom.

62. Growth is forecast to take place over the planning period at the rate of some 1,200 dwellings per year with a population increasing from around 230,000 to 270,000. We expect the domestic demand to increase from 39 to 43 Ml/d. Commercial demand is expected to remain steady over the planning period at about 22 Ml/d. Leakage is expected to be controlled at around 18 Ml/d.

Target headroom deficits

63. In the Lincolnshire Fens WRZ target headroom is initially 4.4 per cent, which is average, but then rises to be above average at 19.7 per cent of demand at the end of the planning period. It is largely driven by demand uncertainties over population growth, notably uncertainties in future migration patterns from EU member states and domestic consumption. The allowance for outage is above average at 6 falling to 5 per cent.

64. The Lincolnshire Fens WRZ as a whole is forecast to have deficits of available against target headroom from early in the planning period. Large deficits at both dry year average and critical peak period forecasts for available against target headroom develop in both of its two planning zones by the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ21	Boston	-15.56	-10.05
PZ22	Bourne	-8.42	-0.32

The size of the deficits is due in part to the target headroom which at 20 per cent is 4 per cent above the regional average, equivalent to 3 Ml/d at the WRZ level.

Feasible water management options

65. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition to these options made available to

the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
21	New Lincolnshire Fens WTW	26.45	26.45
22	New Lincolnshire Fens WTW		

66. The additional supplies from a surface water treatment plant are based on the model of the scheme for Lincoln, initially with a nominal 5 Ml/d plant in AMP5, thereafter size of the plant will depend on evaluation of the need at the time. The source of the surface water would be the Lower River Witham, supported during low flows by transfers through the TWAS and the increased discharges arising from Canwick WWTW from growth in Lincoln. The transfers of water are already complex, with water supplied in the Lincoln WRZ derived from resources outside the catchment through the import of water from Rutland Water to supply Grantham, from the Sherwood Sandstone aquifer and from the River Ancholme. Raw water resources are then transferred from the Lincoln WRZ to the Lincolnshire Fens WRZ by the River Witham.

67. The potential strategic development of the Witham, supported by the Trent, to meet demands in the Anglian region to the south and east was identified by the Agency's predecessor, the National Rivers Authority, in 1995[14]. The link was depicted in the NRA's regional report 'Water Resources in Anglia' and national report 'Water - Natures Precious Resource'. It was described in our WRP in 2004. Investment in investigations during AMP4 has addressed the environmental and engineering issues that would be associated with the development of increased transfers and also the construction of a large fully embanked winter storage reservoir in the Lincolnshire Fens. Further work will be required to confirm the availability of water resources in the Lower River Witham and to develop either a direct supply or winter storage scheme. This would include assessment under the Habitats Directive for any potential risk to The Wash SPA and to make the formal planning and licence applications needed to progress a scheme.

68. Although not included as an option, a Fenland reservoir may be needed in the longer term to address demands in the Lincolnshire Fens WRZ, to provide additional water resources to the Ruthamford WRZ, or to other water users. It could also form part of the raw water link to transfer water across the Fens to our treatment works located next to the man-made Cut-off-Channel in west Norfolk. A link to the Cut-off-Channel would effectively connect the Environment Agency's Trent to Witham and Ely-Ouse to Essex Transfer Schemes, with its potential for onward transfer south into Suffolk and Essex.

69. There are no sustainability reductions identified for the Southern Lincolnshire Limestone. Any reduction in the deployable output of the Lincolnshire Limestone sourceworks would advance the need to develop the surface water resources of the Lower Witham backed by the River Trent.

Preferred water management options

70. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the

[14] 'Water Resources in Anglia' and national report 'Water - Natures Precious Resource', NRA, 1995

promotion of water efficiency. Investment in resource development is based on utilisation of increased flows in the River Wiham augmented by additional discharges from growth in the Lincoln WRZ and by increasing the capacity of the transfer from the River Trent to the River Witham during periods of low flow. The selected schemes are summarised as:

PZ	Selected option	Period
21	New Lincolnshire Fens WTW	AMP5
22	Pressure reduction to reduce leakage	AMP5
	New Lincolnshire Fens WTW	AMP5

71. Although the development of a new WTW is required early in the AMP5 period, the commissioning of additional output from the extension to Rutland Water reservoir's WTW will enable the existing transfer from the Ruthamford WRZ to the Lincolnshire Fens WRZ to be increased for a period until the water is required within the Ruthamford WRZ. The need for additional water supplies in both WRZs is in part to allow for the risk and uncertainty in the supply-demand balance through increased target headroom. We will continue to monitor the demand for additional water supplies closely in order to ensure timely investment. However we will need to progress both investigations and design work for use of the Lower River Witham for direct abstraction and/or for reservoir refill in order to address the regulatory and planning issues that affect the implementation of large new schemes. The early development of a small scale plant would address these and technical issues on the commissioning of surface water sourceworks in an area currently supplied from groundwater sources.

WRZ 5 - Fenland

Current water supply arrangements

72. Despite the superficial abundance of water in the Fens, the area has limited reliable water resources and the Fenland WRZ is supplied from a range of sources around its periphery. The west of the Fens was linked to the Ruthamford system in the early 1990s and is supplied with water derived from Rutland Water and transferred via Peterborough. It is now included in the Ruthamford WRZ. The central area of the Fens is supplied from the Chalk aquifer either directly by abstractions from borehole sources on the thinning edge of the aquifer outcrop or indirectly from the Chalk-fed rivers of the Wissey and Nar before they enter the Fens. In the north, the thickening Chalk aquifer is again able to provide secure water resources. The Sandringham Sands aquifer in northwest Norfolk was developed during the early 1990s for blending with the overlying high nitrate Chalk groundwater to ensure water quality compliance.

73. The distance between the water sources and demand centres has required the development of trunk mains and relatively large treated water storage close to customers. This allows some flexibility in the use of alternative sourceworks that enhance the security of supplies during off peak periods.

74. Current abstractions are securely within current aggregate licensed average quantities that apply to the different aquifer units. A significant licensed surplus exists from the Cut-off-Channel as a source of raw water.

75. The main water quality issue for the zone is the high and rising nitrate trend in the Chalk aquifer. A nitrate removal plant has been installed at Marham to treat the groundwater stream and blend with water derived from the River Nar. High nitrate Chalk groundwater in the far north of the zone also requires treatment. Our surface water treatment works next to the Cut-off-Channel normally abstracts water from River Wissey and relies on a wellfield in the Chalk aquifer in the afforested area between the Rivers Little Ouse and Wissey to blend with high nitrate river water in the winter months. The Wellington Wellfield also provides ‘bankside storage’ protection against river pollution and to meet peak demands during drought conditions. A wellfield in the Sandringham Sands aquifer provides low nitrate water to five Chalk sourceworks to secure blending against current high nitrate. We propose to include work on catchment management in our draft PR09 Business Plan in order to address the long-term rising trend in nitrate at its source.

76. There are some environmental issues on the impact of abstractions on Chalk springflows along the edge of the aquifer, notably to Foulden Common SAC and the Stringside Drain tributary of the River Wissey. This was investigated under our AMP3 National Environment Programme (NEP) and is pending the outcome of the review of consents under the Habitats Directive before a decision is made by the Environment Agency on the need to implement any sustainability reductions. Similarly, in the north of the zone there is a theoretical impact of abstractions on the wetlands along The Wash and western end of the North Norfolk Coast SPA and SAC. These have been investigated as part of our WREP/AMP4 programme and no allowance has been made for sustainability reductions at this stage. The time-limited licence for the strategically important Sandringham Sands Wellfield is due for renewal early in the AMP5 and we assume that this will be renewed.

Current demands

77. The main demand centres are the Fenland towns of Wisbech, Kings Lynn and Downham Market with mixed household and industrial demand, notably for food processing. Inland the population in the Fens is sparse. The north of the zone includes the seaside towns of Hunstanton and Heacham that have the potential for climate-related unpredictable peak demands due the influx of holidaymakers.

Forecasts and projections

78. As with the Lincolnshire Fens the demand in the zone is forecast to grow due to economic activity through the promotion of links with Europe. This is driven by the food production and processing industry which can be volatile. This could result in a higher than average increases in dry year demand as well as higher than historical peak demands during the summer season. An allowance for uncertainty is included as target headroom.

79. Growth is forecast to take place over the planning period at the rate of some 1,000 dwellings per year with a population increasing from around 175,000 to 205,000. We expect the domestic demand to increase from 24 to 26 Ml/d. Commercial demand is expected to remain steady over the planning period at about 25 Ml/d. Leakage is expected to be controlled at around 9 Ml/d.

Target headroom deficits

80. The Fenland WRZ target headroom is below the regional average increasing from 3.1 per cent to 12.1 per cent over the planning period. It is driven by the risks of point source pollution, weather-related leakage effects and uncertainty over industrial demand, domestic consumption and population growth. No single effect dominates. The allowance for outage is above average at 7 falling to 6 per cent.

81. The Fenland WRZ as a whole is forecast to have a surplus of available against target headroom until well into the planning period. However more detailed analysis shows that one out of the five PZs is projected to have headroom deficits against dry year average and critical peak period forecasts by the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ27	Wisbech	-8.20	-5.27

Feasible water management options

82. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
27	Transfer from Snettisham PZ	1.41	2.27
	Transfer from March PZ	0.8	0.8
	Transfer from Kings Lynn PZ	1.49	0.64
	Extension to Cut-off-Channel / Wissey WTW	6.00	9.00

83. Forecast growth will require investment in increased supplies to Wisbech that can be provided as part of the uprating of the water treatment works abstracting from the Cut-off-Channel and the River Wissey. This will require the innovative use of treatment process technology to overcome the variable and often poor water quality. The new link from the water treatment works to Downham Market in the Wisbech PZ will also enhance security to the long trunk mains across the Fens.

84. The forecast shows that potential growth in Kings Lynn can be met from the existing sourceworks within current aggregate licences. Further investment is likely to be required to resolve the predicted increase in nitrate in the Chalk aquifer. Preliminary work has identified the need to maximise the use of the existing Sandringham Sands Wellfield by the re-zoning of local supplies to optimise blending ratios. This could be accompanied by the development of a new northern wellfield based on the current unused time-limited licence for the Sandringham Sands at Sedgeford that would be used to substitute for water pumped north from the existing wellfield. The development of a Northern Sandringham Sands wellfield would allow replacement of an existing ion exchange treatment plant with a more sustainable blending scheme.

85. Consideration was given in the preparation of the Draft WRMP to the longer term strategic development of the Cut-off Channel to meet target headroom will require the augmentation of water resources. Options include the re-use of discharges to tidal waters from Kings Lynn, Wisbech and Downham Market WWTWs and the transfer of water from the River Trent via a reservoir in the Lincolnshire Fens. We have undertaken desk-top investigations into these options during the AMP4 period and plan to develop proposals to the stage where applications could be made for the necessary permissions during the AMP5 period. The need for strategic developments would be advanced if required to meet sustainability reductions arising from the review of consents under the Habitats Directive, or other environmental programmes.

Preferred water management options

86. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency. Investment in securing additional supplies is based on the transfer of available surpluses from adjacent WRZs, followed by an extension to the existing WTW that abstracts water from the River Wissey to use the licensed quantity from the Cut-off-Channel. The selected schemes are summarised as:

PZ	Selected option	Period
27	Transfer from Snettisham PZ	AMP5
	Transfer from Ruthamford WRZ	AMP5
	Targeted cistern devices	AMP5
	Further targeted leakage control	AMP5
	Transfer from Kings Lynn PZ	AMP5
	Extension to Cut-off-Channel / Wissey WTW	AMP7

87. The Fenland WRZ has a strategic location between the Lincolnshire WRZs to the north with the links to the River Trent, the Ruthamford WRZ to the west with its integrated water resources and supply system and the water resources zones of the remainder of the Anglian region to the east. We would propose to carry out further investigations into the transfer of water through the Fenland region from the north and west to the east, using either the River Trent or water currently discharged to tidal waters as a water resource. The development of new water resources would be required to meet an extensive programme of sustainability reductions and/or as an alternative to the preferred options in the WRZs to the east that are dependant on the granting of licences by the Environment Agency.

WRZ6 - North Norfolk Coast

Current water supply arrangements

88. The North Norfolk Coast is the smallest WRZ in the WRMP. Its supplies come mainly from the water resources of the Chalk aquifer. There are 12 small sourceworks located in the small surface water catchments of the North Norfolk coastal rivers of the Stiffkey and Glaven, at the head of the Bure and Ant catchments, which flow south to the Norfolk Broads, and one in a tributary of the River Wensum. There is also one sourceworks that abstracts from the Crag aquifer.

89. There is limited trunk mains interconnection between sourceworks, although Glandford, Sheringham, Metton and Mundesley all supply the Sheringham zone. Supplies are returned to catchments remote from abstraction. Thus a proportion of the water abstracted in the Stiffkey catchment at Houghton St Giles is returned as discharges from Fakenham WWTW to the headwaters of the River Wensum. A proportion of the water from the Glandford, in the Glaven catchment, and Metton, in the Bure catchment, is discharged to the sea at Cromer WWTW. The discharge from North Walsham WWTW is derived from water supplies from local groundwater sources in the Bure and Ant catchments and is made direct to the sea.

90. The Sheringham sourceworks was included in the AMP3 NEP investigations for the impact of abstraction on Sheringham and Beeston Commons SAC with provision for implementation of a solution to maintain the integrity of the European conservation site, if agreed with the Environment Agency. The Environment Agency and Natural England have as yet not completed the review of the Sheringham licence as required by the Habitats Directive to determine the solution required. We have continued monitoring of deep Chalk and shallow drift boreholes in and around the conservation site. We have submitted a series of reports that show there is no evidence for a significant effect of abstractions from the Chalk boreholes on shallow water levels in the conservation site. The Environment Agency has taken a precautionary view and advised us that there should be a sustainability reduction of 1.6 Ml/d. This has been included in the Draft WRMP supply-demand model pending the outcome of the review of consents process.

91. The licences for Glandford, Houghton St. Giles and Wighton are being reviewed under the Habitats Directive for potential impact on the North Norfolk Coast SPA and SAC. The Metton, Matlaske and Aylsham licences have been listed as of concern to the Bure Broads and Marshes SAC review. The North Walsham, Royston Bridge, East Ruston and Ludham licences are being reviewed for impact on the Ant Broads and Marshes SAC and the Foulsham licence is being reviewed for impact on the Wensum SAC. Historical concerns on the reduction of low flows in the River Stiffkey by the Houghton St Giles abstraction have been addressed by the provision of a dedicated river support borehole at the sourceworks and support pumping is provided to an environmentally sensitive area near Alysham. The Environment Agency has informed us that no sustainability reductions should be applied for these licences in the Draft WRMP.

92. The water quality issues for the groundwater sources relate to nitrate pollution in the Stiffkey catchment that affects Houghton and Wighton sourceworks. This has been addressed during AMP4 by the provision of a blending scheme using

new source at Binham. A similar scheme is proposed for the Glandford sourceworks during AMP5. We shall be seeking holistic solutions to address the need to relocate sourceworks as a result of sustainability reductions alongside the development of new low nitrate sources. The majority of the sourceworks with low nitrate require iron removal treatment.

Current demands

93. The demand centres of the zone are the small coastal towns of Sheringham, Cromer and Wells and the rural market towns of Holt, Fakenham, Aylsham and North Walsham. There is limited industrial use and the zone's demand characteristics are governed by seasonal holiday use with the potential for peak demands in hot dry summer weather. The peak demand factor is the highest for the region reflecting both holiday use and garden watering by the resident population. The percentage of households with measured consumption is above the regional average.

Forecasts and projections

94. A large proportion of the residential population is retired with limited potential for economic growth, although there is ongoing slow but steady housing development in most existing communities. Significant growth in peak demand has come from the development of private facilities for both static and mobile caravans and through the conversion and development of properties for holiday letting with 'en suite' facilities.

95. Growth is forecast to take place over the planning period at the rate of some 500 dwellings per year with a population increasing from around 105,000 to 120,000. We expect the domestic demand to increase from 15 to 16 Ml/d. Commercial demand is expected to remain steady over the planning period at about 6 Ml/d. Leakage is expected to be controlled at around 5 Ml/d.

Target headroom deficits

96. In the North Norfolk Coast WRZ target headroom is average for the region increasing from 4.2 per cent to 15.3 per cent of demand over the planning period. It is driven by uncertainty over domestic consumption and population growth. The allowance for outage is average at 5 per cent.

97. The North Norfolk Coast WRZ is forecast to have a small deficit of available against target headroom from early on in the planning period. More detailed analysis shows that five out of six PZs are projected to have headroom deficits against dry year and critical peak period forecasts by the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ28	Aylsham	-0.94	-0.03
PZ29	Fakenham	-0.93	-1.82
PZ30	Foulsham	-0.40	-0.42
PZ31	Sheringham	-2.82	-2.15
PZ32	Stalham	-0.81	-2.14

Feasible water management options

98. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
28	Secondary groundwater treatment for use	1.05	1.05
	Bacton desalination and transfer	1.05	1.05
	Fenland re-use and transfer	1.05	1.05
29	Uprate Houghton St Giles WTW	0	1.00
	Secondary groundwater treatment for use	2.20	2.20
	Bacton desalination and transfer	2.20	2.20
	Fenland re-use and transfer	2.20	2.20
30	Secondary groundwater treatment for use	0.43	0.43
	Bacton desalination and transfer	0.43	0.43
	Fenland re-use and transfer	0.43	0.43
31	Uprate Sheringham WTW	0	0.50
	Secondary groundwater treatment for use	3.20	3.20
	Bacton desalination and transfer	3.20	3.20
	Fenland re-use and transfer	3.20	3.20
32	Secondary groundwater treatment for use	2.41	2.41
	Bacton desalination and transfer	2.41	2.41
	Fenland re-use and transfer	2.41	2.41

99. Analysis by the FORWARD model shows a widespread deficit in target headroom at forecast peak demands. The forecast deficit cannot be met by demand management measures alone leaving the options of providing additional output from local water resources or imports. A deciding factor will be the results of the Environment Agency's review of consents under the Habitats Directive which drives the deficit in the Sheringham PZ through a sustainability reduction of 1.6 Ml/d and the renewal of current time limited licences for the other main sourceworks that supply the WRZ. There is no current available surplus in the adjacent WRZs.

100. We have identified a potential new resource from the Environment Agency's Catchment Abstraction Management Strategy (CAMS)[15] in the confined aquifer of the Broads Chalk Unit. This aquifer has a water resource availability status of 'Water Available'; however the water quality is poor due to the presence of connate groundwater. This is older groundwater that contains a high concentration of minerals. The secondary groundwater resource is not suitable for direct use as a potable water supply without treatment to reduce the dissolved mineral content. The CAMS states that the groundwater management unit as whole has about 80 Ml/d available for abstraction. The proposed development of a secondary groundwater resource would be in the north of the Broads Chalk aquifer. It will be necessary to carry out hydrogeological studies at an early stage in the AMP5 period to confirm the feasibility of this option. The studies may be extended to include the use of

[15] The Broadland Rivers Catchment Abstraction Management Strategy, March 2006

hydraulic injection techniques to control the movement of the saline/fresh water interface.

101. Given the environmental concerns in adjacent zones the only feasible additional new water resources are the development of the surface water abstraction from the Cut-off-Channel, the use of secondary groundwater in the confined Chalk aquifer or a small-scale desalination scheme. The additional output from the use of the full current licence for the Cut-off-Channel is allocated to growth in the Fenland WRZ and the strategic link to the Rural Norfolk WRZ. An additional uprating of the Cut-off-Channel/Wissey WTW for the North Norfolk WRZ or the Norwich and Broads WRZ would require resource augmentation. This could be achieved by the re-use of water currently discharged to tidal waters at Kings Lynn, Wisbech and Downham Market through additional treatment to enable them to be discharged to the Cut-off-Channel, or by the potential transfer from a new reservoir in the Lincolnshire Fens WRZ.

102. This constraint on the availability of groundwater resources in the Chalk aquifer on the North Norfolk Coast arises from the work carried out by the Environment Agency for the Catchment Abstraction Management Strategy (CAMS) and the Habitats Directive review of consents. However, the hydrogeology of the Chalk aquifer on North Norfolk Coast is such that there is a considerable flow of water to the north that will ultimately discharge to the North Sea. This was the principle behind the uprating of the Sheringham WTW in 1991. The ability to develop this resource without having an adverse impact on conservation sites is intrinsic to the outcome of the review of consents. The Environment Agency has developed a groundwater flow model for the Yare and North Norfolk catchments to help them to determine whether the current abstraction regime is sustainable. We would hope to use the model once the review of consents is completed to determine whether the sub-tidal discharges from the Chalk could be further developed. The option has not been included for the Draft WRMP.

103. In the longer term, the local transfer of water between the small catchments as a result of the disparities between water distribution and wastewater collection networks could be addressed by the relocation of the return of treated wastewater to the catchment where it was abstracted. This would require redirection of part of the discharge from Fakenham WWTW from the headwaters or the River Wensum to the River Stiffkey. The status of the River Wensum as a SAC in its own right raises issues of effective and sustainable water resources management. The option to relocate discharges from one catchment to another is not included in the Draft WRMP.

Preferred water management options

104. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency. The selected schemes are summarised as:

PZ	Selected option	Period
28	Targeted cistern devices	AMP5
	Further targeted leakage control	AMP5
	Further targeted leakage control	AMP6
	Targeted metering	AMP7
	Secondary groundwater treatment for use	AMP7

PZ	Selected option	Period
29	Pressure reduction to reduce leakage	AMP5
	Targeted cistern devices	AMP5
	Further targeted leakage control	AMP5
	Targeted metering	AMP6
	Secondary groundwater treatment for use	AMP6
30	Pressure reduction to reduce leakage	AMP5
	Further targeted leakage control	AMP5
	Targeted cistern devices	AMP5
	Targeted metering	AMP5
	Secondary groundwater treatment for use	AMP6
31	Pressure reduction to reduce leakage	AMP5
	Targeted cistern devices	AMP5
	Further targeted leakage control	AMP5
	Domestic water audits	AMP5
	Secondary groundwater treatment for use	AMP5
32	Secondary groundwater treatment for use	AMP5

105. The preferred option is to maximise demand management and then to develop and treat secondary groundwater. This has been chosen ahead of the seawater desalination plant as a more sustainable scheme following consideration of the factors in the Environmental Report undertaken for the Strategic Environmental Assessment. This option is picked immediately for the Stalham PZ due to the location of the plant. Due to the low rate of growth in the PZs in the west of the WRZ and the dominance of peak deficits over average deficits, we will explore the options for local resource development of the Chalk aquifer, such as the option to uprate the maximum DO at Houghton St Giles WTW, with the Environment Agency in parallel with the proposal to develop the secondary groundwater resource. Our ability to do this is dependent upon the completion of the review of consents process.

WRZ7 – Norfolk Rural

Current water supply arrangements

106. The Norfolk Rural WRZ is totally supplied by abstractions from the Chalk aquifer that have been developed historically to provide increased supplies to the established local rural communities. Some of the borehole sources date back to the 19th Century with others being developed initially for military use during the Second World War. Most current sourceworks were in use by the 1970s with more recent developments undertaken to meet growth in local demand, improvements to security during low groundwater level conditions, and blending to meet drinking water standards for nitrate. There are poor trunk mains connections between sourceworks, which in many cases are the single supply to a local area through a single treated water storage reservoir or water tower.

107. The zone contains a large number of small wetland conservation sites, many of which are included in the Norfolk Valley Fens SAC. When the sites were first designated concern was voiced over the risk of impact by our abstractions and attention was focussed on the issue during the two droughts of the 1990s. This has resulted in the zone having a large share of the investigation of conservation sites in the AMP3 NEP and AMP4 WREP work. Many sites are also included in the Environment Agency's investigations that provide information for the review of consents process and RSA programme. Impact Assessment Reports by our consultants for the NEP work showed limited connection between the Chalk aquifer and drift deposits beneath the conservation sites. This has been confirmed by ongoing monitoring at those sites included in the AMP4 WREP. The Environment Agency has informed us that sustainability reductions should be applied to the Dereham, North Pickenham, East Watton and Beachamwell sourceworks. These have been included in the Draft WRMP supply-demand model pending the outcome of the review of consents process.

108. A number of the abstraction licences for Chalk sources in the WRZ were varied during the 1990s to authorise the use of additional boreholes or to increase licensed quantities to provide adequate headroom. The renewal of these licences and variations under the Habitats Regulations has proved to be problematic and we have worked with the Environment Agency and Natural England to secure renewal of licences until March 2010, pending outcome of the review of consents process. We have assumed for the Draft WRMP that licences will be further renewed without sustainability reductions.

109. The Carbrooke and Old Buckenham sourceworks are being recommissioned during the AMP4 period to maintain a secure supply-demand balance. Similarly, the Riddlesworth sourceworks has been developed during the AMP4 period to reduce nitrate and remove pesticides to enable the Quidenham source to be closed to address concerns on its potential impact on Quidenham Mere SSSI and to reduce the risk of pesticide pollution from a point source. The linking of Beetley and Dereham sourceworks has enabled us to blend water to meet the quality standard for naturally occurring nickel and improve the security of supplies through linking discrete supply zones.

Current demands

110. The demand centres in the zone are the market towns of Swaffham, Watton, Dereham, Wymondham and Attleborough. As well as use by local households there are rural industries, notably poultry rearing, and active promotion of tourism attracting visitors for short stays throughout the year. The peak demand factor is less than for the coastal area to the north, but higher than for the urban area of Norwich. Peak demands in the dry years present challenges to the existing supply network because of the limited treated water storage capacity across the zone and the lack of inter connection between the storage reservoirs and towers.

Forecasts and projections

111. The local authority structure plans do not forecast growth for the area, although the towns next to the improved A11 corridor are candidates for large new housing developments. Due to the small size of the Planning Zones, individual factory farming units form a significant proportion of demand and can be volatile businesses.

112. Growth is forecast to take place over the planning period at the rate of some 800 dwellings per year with a population increasing from around 150,000 to 180,000. We expect the domestic demand to increase from 21 to 24 Ml/d. Commercial demand is expected to remain steady over the planning period at about 8 Ml/d. Leakage is expected to be controlled at around 7 Ml/d.

Target headroom deficits

113. In the Norfolk Rural WRZ target headroom is average for the region increasing from 3.8 per cent to 15.1 per cent of demand over the planning period. It is driven by uncertainty on domestic consumption and population growth and the risk from weather-related leakage effects. The allowance for outage is average at 5 per cent.

114. The Rural Norfolk WRZ is forecast to have a surplus of available against target headroom at the start of the planning period as a result of investment during the AMP4 period. However it is forecast that a deficit will again develop in the AMP6 period. More detailed analysis shows four out of the eight PZs are projected to have headroom deficits against dry year average and/or critical peak period forecasts by the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ37	Dereham	-1.40	-1.34
PZ38	Didlington	-0.50	+0.61
PZ41	Swaffham	-0.63	+0.49
PZ42	Wymondham	-6.06	-2.25

Feasible water management options

115. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the

PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
37	Whitlingham re-use and transfer	1.4	1.4
	Great-Ouse Groundwater Development Scheme	1.4	1.4
38	Transfer from Brandon PZ	0.50	0.50
41	Transfer from Wisbech PZ	0.65	0.65
42	Whitlingham re-use and transfer	6.10	6.10
	Great-Ouse Groundwater Development Scheme	6.12	6.12

116. In our previous plans the limitation imposed by the availability of licences for local water resources has resulted in the need to seek options to import water supplies to the area to meet future needs and to transfer water east towards Norwich through connecting the main treated water storage reservoirs. Such a scheme would provide considerably enhanced security of supply to a number of single source supply zones providing flexibility to deal with local plant and mains failures. The advantages of trunk mains networks can already be seen in the north and west of the region where they have been developed due to the geographic separation between supplies and demand. However, as discussed in the Fenland WRZ section such a scheme would require augmentation by the transfer of water from a reservoir in the Lincolnshire Fens or the re-use of water currently discharged to tidal waters. The deficits currently forecast for the Norfolk Rural WRZ are insufficient to make such a scheme feasible and we have not included it as option for the Draft WRMP analysis.

117. In preparation for the Draft WRMP we have had discussions with the Environment Agency about the future use of its Great Ouse Groundwater Development Scheme (GOGDS). This scheme was promoted in the 1970s and developed primarily to increase the water resource available for public water supply. Boreholes were drilled in the Little Ouse and Thet catchments within the Norfolk Rural WRZ to augment the Ely-Ouse to Essex Transfer Scheme (EOETS), now owned and operated by the Environment Agency. The scheme is used primarily to augment the yield of the Essex and Suffolk Water company reservoirs at Abberton and Hanningfield during period of low rainfall. A small number of boreholes near to Thetford were transferred to the Cambridge Water Company in the late 1980s to provide a direct supply of water to meet their forecast growth in demand. The future use of the GOGDS is being reviewed in the light of the potential impact on the conservation sites of a high rate of abstraction during drought conditions and the development of alternative water resources by Essex and Suffolk Water. We consider that there is a potential new use of the GOGDS for direct supply to meet a target headroom deficit in the Norfolk rural WRZ and potentially for the transfer of potable water to the adjacent WRZs. This will represent a more sustainable use of the water resource through abstracting at a lower rate, on a continuous basis, and by using the groundwater directly rather than mixing it with surface water, leading to the need for extensive treatment processes.

118. The availability of the GOGDS for local direct supply depends upon the completion of the review of the existing abstraction licences required by the Habitats Directive review of consents and the development of the Abberton scheme by Essex and Suffolk Water. The review of consents is expected to be completed before the start of the AMP5 period and we anticipate that although the licensed quantity will be reduced there will still be a significant water

resource available for abstraction. Similarly, Essex and Suffolk Water has recently applied for planning permissions for the Abberton scheme that would increase the water resource available to them by a combination of optimising abstractions at Denver, increasing the transfer capacity of the EOETS to enhance their ability to refill Abberton reservoir and increasing the capacity of the reservoir itself. We understand that the Abberton scheme will increase the yield of the reservoir through optimising the use of the surface water resources in the River Stour and Ely-Ouse catchments, reducing the likelihood of needing the GOGDS to support the EOETS. Decisions on the permissions needed for the Abberton scheme are expected before the start of the AMP5 period. We have included partial use of the GOGDS for direct supply to the local area during the AMP5 period as a feasible option in the Draft WRMP. We will continue discussions on the redistribution of the GOGDS licences in order to be able to implement the first of three phases early in the AMP5 period.

Preferred water management options

119. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency. The selected schemes are summarised as:

PZ	Selected option	Period
37	Great-Ouse Groundwater Development Scheme	AMP5
38	Further targeted leakage control	AMP5
	Targeted cistern devices	AMP5
	Transfer from Brandon PZ	AMP5
41	Further targeted leakage control	AMP5
	Targeted metering	AMP5
	Domestic water audits	AMP6
	Transfer from Wisbech PZ	AMP6
42	Great-Ouse Groundwater Development Scheme	AMP5

120. The preferred option is to use the GOGDS for direct supply to meet planned growth in dormitory town of Wymondham on the fringes of Norwich and, to a lesser extent, the market town of East Dereham. While the option is selected to meet the deficit for the full planning period, it can be developed progressively to meet growth in demand and be replaced by the alternative of importing water to the WRZ, if necessary in the longer term. A major part the scheme would be investment in developing trunk mains to link planning zones, many of which are currently supplied by a single sourceworks. These would be required for the internal transfer of water imported from outside the WRZ if required later in the planning period due to limitations placed on the water available from the GOGDS wellfield.

WRZ8 - Norwich and The Broads

Current water supply arrangements

121. The zone relies on water storage within the Chalk aquifer to provide a reliable baseflow to the intakes on the River Wensum which are used to supply Norwich, as well as for direct abstraction from Chalk boreholes to supply the city and the rural area around it. The Chalk boreholes have considerable variation in yield and raw water quality. Some require treatment by chlorination only, while others have sophisticated treatment for high nitrate, pesticides, organic solvents or high levels of iron.

122. In common with the adjacent WRZs of the North Norfolk Coast and Norfolk Rural, there are concerns on the environmental impact of abstractions, particularly in the Norfolk Broads National Park. Schemes were included in the AMP3 NEP work, notably the solution scheme to relocate abstractions at East Ruston and to close the Strumpshaw sourceworks by transferring the local Brundall PZ onto the Norwich supply system. The Strumpshaw deployable output reduces to zero in 2008/09 period to reflect the sustainability reduction. The WRZ includes a number of conservation sites that are being investigated in the AMP4 WREP, including the Yare Broads and Marshes SAC, Bure Broads and Marshes SAC, Ant Broads and Marshes SAC and lower part of the River Wensum SAC. Although there is a significant risk that the Environment Agency will seek sustainability reductions, we have been advised to include only a nominal sustainability reduction for the river intake west of Norwich.

123. The potential effect of climate change on the river intake has been evaluated using the UKWIR methodology[16]. This concluded that the yield of intakes could be reduced but that the deployable outputs could be maintained on an average basis by the conjunctive use of surface and groundwater sources. There is, however, both risk and uncertainty in this assumption and climate change is included as a factor in the headroom calculation.

124. The source at Bowthorpe has been recommissioned during the AMP4 period and we have developed a new sourceworks to treat water abstracted from the Yare Valley Chalk to the west of Norwich.

Current demands

125. Demands in the zone are dominated by the City of Norwich with mixed urban household and light industrial use. Peak demands for the established urban area with its light industrial demand are lower than for the surrounding rural areas. Although the Broads attract a large number of day visitors, most stay in the nearby larger holiday resorts and so the additional demand from tourists is small.

Forecasts and projections

126. The forecast growth for Norfolk is centred on Norwich and dormitory developments, which could potentially be located to the west, north or east of the city. The development of a settlement of some 5,000 properties would represent a nominal additional demand of 2 Ml/d or less than 5 per cent of the

[16] ‘Effects of Climate Change on River Flows and Groundwater Recharge: A practical Methodology - Synthesis Report’, UKWIR, 2006

current sourceworks output. The effect on the local distribution network would be more significant. The location of development along the A11 corridor at Wymondham is currently included within the Norfolk Rural WRZ. The development within the Broads National Park is limited. We have been working with the Greater Norwich Development Partnership on a water cycle study to identify where new water and wastewater infrastructure will be needed to support the planned development of the city. The report on the Norwich Water Cycle Study was not available for the preparation of the Draft WRMP.

127. Growth is forecast to take place over the planning period at the rate of some 1,500 dwellings per year with a population increasing from around 310,000 to 360,000. We expect the domestic demand to increase from 41 to 46 Ml/d. Commercial demand is expected to remain steady over the planning period at about 14 Ml/d. Leakage is expected to be controlled at around 13 Ml/d.

Target headroom deficits

128. In the Norwich and the Broads WRZ target headroom is average for the region increasing from 4 per cent to 15.7 per cent of demand over the planning period. It is initially driven by the risk over point source pollution, weather-related leakage effects and uncertainty over domestic consumption and population growth. During the later stages of the planning period the uncertainties over domestic consumption and population growth dominate. The allowance for outage is the highest in the region at 10 per cent, due to the use of a direct surface water abstraction.

129. The Norwich and The Broads WRZ is forecast to have a surplus of available against target headroom at the start of the planning period as a result of investment during the AMP4 period. However it is forecast that a deficit will again develop during the AMP5 period. More detailed analysis shows three out of the five PZs are projected to have headroom deficits against dry year average and/or critical peak period forecasts at the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ45	Lyng	-1.39	+0.50
PZ46	Norwich	-13.15	-18.72
PZ47	Porringland	-0.23	+0.73

Feasible water management options

130. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
45	Uprate Lyng WTW	0	0.5
	Whitlingham re-use and transfer	1.40	1.40
	Great-Ouse Groundwater Development Scheme	1.40	1.40

PZ	Option	Output (Ml/d)	
		Average	Peak
46	Utilise full existing Norwich groundwater licence	4.00	4.00
	New Norwich urban groundwater source	4.00	4.00
	Whitlingham re-use and transfer	12.3	12.3
	Great-Ouse Groundwater Development Scheme	12.3	12.3
47	Whitlingham re-use and transfer	0.3	0.3
	Great-Ouse Groundwater Development Scheme	0.3	0.3

131. The current licence for an existing groundwater source in Norwich is not fully utilised. A scheme has been identified to uprate the sourceworks by improving the output of the existing boreholes, or by developing new ones nearby. Uprating the sourceworks to maximise the current licence may require further treatment to remove industrial contaminants from the groundwater. A further scheme has been identified for the development of a new groundwater source within the eastern fringes of Norwich that would enable the licence quantity allocated to the Strumpshaw source to be transferred to a less environmentally sensitive area following the closure of the Strumpshaw sourceworks during the AMP4 period.

132. The limitations imposed by the availability of abstraction licences result in the need to import from outside the WRZ. The potential use of the GOGDS for direct abstraction and supply is referred to in the description of the Norfolk Rural WRZ. The alternative of developing a surface water source derived from the Cut-off-Channel augmented during periods of low flow by the transfer of water from the River Trent, via a reservoir in the Lincolnshire Fens, or the re-use of water currently discharged to tidal waters, is referred to in the description of the Fenland WRZ.

133. We have considered the potential for the local re-use of water currently discharged to the tidal reaches of the River Yare at Whitlingham. The re-use option would require the transfer of part of this discharge, arising from the growth of Norwich, to be piped for discharge downstream of the river intake west of the city. The discharge would augment the flow in the River Wensum and enable the quantity of river water abstracted at our intake to be increased.

134. During the 1988 to 1992 drought we investigated the use of the Wensum Chalk aquifer to augment low flows in the River Wensum, working with the National Rivers Authority, predecessor to the Environment Agency. Boreholes constructed at North Elmham, Swanton Morley and Billingford wastewater treatment works proved good yields but were not developed due to concerns on the potential impact of abstraction on wetland areas within the River Wensum SSSI. Work was suspended when the drought ended. The River Wensum has subsequently been designated as an SAC and as such is included in the review of consents under the Habitats Directive. We have not included low flow augmentation of the River Wensum as an option for the Draft WRMP.

135. We have identified a number of ‘invisible’ internal trunk main and storage schemes needed to maintain secure supplies against local growth within Norwich and surrounding townships through the effective distribution of water savings made by current customers to help meet the demand from new ones.

Preferred water management options

136. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency. The selected schemes are summarised as:

PZ	Selected option	Period
45	Pressure reduction to reduce leakage	AMP5
	Targeted cistern devices	AMP5
	Further targeted leakage control	AMP5
	Domestic water audits	AMP5
	Great-Ouse Groundwater Development Scheme	AMP5
46	Targeted cistern devices	AMP5
	Further targeted leakage control	AMP5
	Domestic water audits	AMP5
	Utilise full existing Norwich groundwater licence	AMP5
	New Norwich urban groundwater source	AMP6
	Great-Ouse Groundwater Development Scheme	AMP7
47	Further targeted leakage control	AMP5

137. The GOGDS was selected to resolve the forecast deficit at average in the Lyng PZ during the AMP5 period. At this stage the potential deficit, which is due to the constraint of the abstraction licence will be small and should be contained within the target headroom allowance. We will monitor abstractions closely and review whether it is possible to use local rezoning to maintain a secure supply-demand balance in the short and medium term.

138. The proposed uprating of the existing Norwich sourceworks and the development of a new Norwich urban groundwater source is being progressed during the AMP4 period by selecting and acquiring sites for the construction of new boreholes. We propose to carry out the test pumping necessary to secure changes to abstraction licences as early as possible. The commissioning of the new works could then take place as required during the following AMP investment periods.

139. The FORWARD model analysis shows that the additional supply from the GOGDS development is not required until the AMP7 period. This is later than the need during AMP5 to meet the deficit in the Wymondham PZ in the adjacent Norfolk Rural WRZ. By its nature the GODGS is suited to phased development in line with the review of the supply-demand balance at the next WRMP and the Environment Agency's review of the availability of water resources. It should be noted that the alternative schemes to import water from the Fenland WRZ and beyond or the re-use of water current discharged from Whitlingham WWTW will take time to promote and deliver.

WRZ9 - Cambridgeshire and West Suffolk

Current water supply arrangements

140. The zone is totally supplied by abstractions from the Chalk aquifer that have been developed historically to provide increased supplies to the long established rural and urban communities. Many of the borehole sources in the towns date back to the 19th Century. Most current sourceworks were in use by the 1970s with more recent developments undertaken to meet growth in local demand, improvements to security of supply during low ground water level conditions, or for blending to meet drinking water standards for nitrate. There are local trunk main networks linking sourceworks and treated water storage in the larger planning zones of Ely, Newmarket, Bury St Edmunds and Thetford, but no strategic links between these zones.

141. There are environmental concerns over the impact of abstraction at a small number of conservation sites, notably on the edge of the Chalk outcrop in the west of the WRZ. The need to investigate concerns on low flows in the upper and lower reaches of the River Lark was included in the AMP3 WREP and at the request of the Environment Agency a nominal sustainability reduction has been included in the Draft WRMP supply-demand analysis.

142. Most of the Chalk groundwater sources in the WRZ contain significant nitrate from agricultural pollution and many have to be blended or have ion exchange treatment installed as part of the AMP4 water quality programme. There is little heavy industry in the area to pose a threat to groundwater quality, although local pollution exists around air bases in the WRZ and water treatment by forced aeration and filtration through granular activated carbon is required at one sourceworks.

143. The rising trend in nitrate in the Chalk aquifer required schemes in AMP4 for reducing nitrate in water into supply at Moulton and Lower Links sourceworks. We carried out investigation into the availability of a lower nitrate blend source in the aquifer, but it was necessary to provide a treatment plant in order to secure compliance with water quality requirements. As part of our response to the 2004-06 drought we developed a new borehole in Newmarket against the potential loss of yield deployable output at low water levels from the existing boreholes.

Current demands

144. Demands are centred around the commercial centres of Ely, Newmarket, Bury St Edmunds, Thetford, Haverhill and Sudbury, which lie on the interconnecting trunk road corridors of the A10, A14 and A11. Meter penetration in Bury St Edmunds is high as a result of the extended metering programme in the mid-1990s. Peak demands are relatively high, probably due to the relative affluence of the area with the development of housing stock having small gardens on sandy soils.

Forecasts and projections

145. There is potential for continued economic growth through both housing and light industrial developments. The towns lie within the three counties of Cambridgeshire, Suffolk and Norfolk along the routes of the A14 and A11 and to some extent compete at a local level for new development. We expect the

publication of the revised RSS14 report by the regional Government Office to inform us of the latest plans. We are working with the East of England Development Agency through Inspire East to make new development more water efficient.

146. Growth is forecast to take place over the planning period at the rate of some 1,500 dwellings per year with a population increasing from around 320,000 to 375,000. We expect the domestic demand to increase from 43 to 48 Ml/d. Commercial demand is expected to remain steady over the planning period at about 20 Ml/d. Leakage is expected to be controlled at around 14 Ml/d.

Target headroom deficits

147. In the Cambridgeshire and West Suffolk WRZ target headroom is above the regional average increasing from 3.8 per cent to 20.1 per cent of demand over the planning period. It is driven by demand uncertainty over domestic consumption and household growth. The allowance for outage is average at 5 per cent.

148. The Cambridgeshire and West Suffolk WRZ is forecast to have a surplus of available against target headroom until the middle of the planning period. More detailed analysis shows seven out of the nine PZs are projected to have headroom deficits against dry year average and critical peak period forecasts by the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ36	Brandon	-0.41	-0.59
PZ48	Bury St Edmunds	-2.72	-0.26
PZ49	Cheveley	-0.16	-0.43
PZ50	Ely	-1.17	-0.25
PZ52	Newmarket	-0.18	-2.70
PZ53	Thetford	-0.35	-0.64
PZ59	Haverhill	-4.43	-4.08

Feasible water management options

149. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
36	Fenland re-use and transfer	2.00	2.00
	Great Ouse GDS / Thetford PZ Transfer	2.00	2.00
48	Fenland re-use and transfer	2.75	2.75
	Great Ouse Groundwater Development Scheme	2.75	2.75
49	Ely PZ transfer	0.50	0.50
50	Fenland re-use and transfer	9.10	9.10
	Great Ouse Groundwater Development Scheme	9.10	9.10
52	Ely PZ transfer	2.70	2.70

PZ	Option	Output (Ml/d)	
		Average	Peak
53	Thetford new borehole source	0	0.7
	Great Ouse GDS / Brandon PZ	0.7	0.7
59	Great Wratting new borehole source	0	3.00
	Colchester PZ transfer	4.50	4.50

150. The main water resource development options of a transfer from a surface water development in the Fenland WRZ, augmented by the re-use of water currently discharged to tidal waters, and the reallocation of the water resources currently licensed for the Environment Agency's Great Ouse Groundwater Development Scheme (GOGDS), have been described in the sections on the Fenland WRZ and Norfolk Rural WRZ respectively. The use of both schemes for the Cambridgeshire and West Suffolk WRZ will require additional trunk main links to transfer water that will also allow supplies to be managed more efficiently and effectively.

151. The timing of the major development for transfer between PZs has to allow for the PZ that goes into deficit at the earliest time. However the GOGDS can be locally developed for the Brandon and Thetford PZs. As these two PZs are already linked, the local development in one would defer the need for the other. Similarly, the transfer of the small surplus from the Ixworth PZ to the Bury St Edmunds PZ and potential further development utilising the water resource in the Sapiston catchment, currently allocated to the GOGDS, is independent of the longer term development.

152. The recent growth of the City of Ely has been met through investment in local infrastructure for the construction of additional treated water storage close to the demand centre to maintain levels of service during peak demands. It is already planned to rezone the Sutton area from the Ely PZ to the March PZ during the AMP4 period. This will transfer some demand from the Cambridgeshire and West Suffolk WRZ to the Ruthamford WRZ and provides a new link across the physical barrier of the Ouse Washes. There would be potential for further re-zoning from the west in the longer term backed by supplies from Peterborough, in turn supported by the development of the Lower Witham reservoir as described in the section on the Lincolnshire Fens WRZ. Due to the complexity of the interrelationship of schemes in multiple WRZs, this has not been included as a feasible option in the FORWARD model for the Cambridgeshire and West Suffolk WRZ.

153. We have considered the potential for a river intake on the Little Ouse River, comparable to the existing intakes on the Rivers Nar and Wissey, with augmentation from the GOGDS during periods of low flow. Although this could have potential advantages in increasing natural river flows upstream of an intake it would have a much larger carbon footprint for water treatment and therefore would be less sustainable from the perspective of the strategic environmental assessment. It has therefore not been included as a feasible option for the Draft WRMP.

Preferred water management options

154. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency. The selected schemes are summarised as:

PZ	Selected option	Period
36	Further targeted leakage control	AMP5
	Great Ouse GDS / Thetford PZ Transfer	AMP5
48	Great Ouse GDS / Ixworth PZ transfer	AMP5
	Targeted cistern devices	AMP6
	Further targeted leakage control	AMP6
	Further targeted leakage control	AMP7
	Domestic water audits	AMP7
	Targeted metering	AMP7
49	Pressure reduction to reduce leakage	AMP5
	Targeted cistern devices	AMP6
	Further targeted leakage control	AMP6
	Targeted metering	AMP6
	Further targeted leakage control	AMP6
	Great Ouse GDS / Ely PZ transfer	AMP6
50	Great Ouse Groundwater Development Scheme	AMP6
	Pressure reduction to reduce leakage	AMP7
	Further targeted leakage control	AMP7
	Targeted cistern devices	AMP7
52	Pressure reduction to reduce leakage	AMP6
	Further targeted leakage control	AMP6
	Targeted cistern devices	AMP6
	Further targeted leakage control	AMP7
	Targeted metering	AMP7
	Great Ouse GDS / Ely PZ transfer	AMP7
53	Further targeted leakage control	AMP9
	Targeted cistern devices	AMP9
	Targeted metering	AMP9
	Domestic water audits	AMP9
	Great Ouse GDS / Brandon PZ	AMP9
59	Pressure reduction to reduce leakage	AMP5
	Further targeted leakage control	AMP5
	Further targeted leakage control	AMP7
	Targeted cistern devices	AMP7
	Domestic water audits	AMP7
	Targeted metering	AMP7
	Colchester PZ transfer	AMP7

155. In addition to the wide range of small demand management schemes across all the PZs, the forecast deficits result in the selection of reallocation of the water resource of the GOGDS. This is to be phased with early need in the Brandon and Bury PZs, but with a larger wellfield use for interzone transfer not required until later in the planning period.

156. The deficit in the Haverhill PZ is met by a scheme to link it to the Colchester PZ in the East Suffolk and Essex WRZ. The link is not required until near the end of the AMP7 planning period. The allocation of both the Haverhill and Sudbury PZs is a result of historical development by the West Suffolk Water Board, which became part of the Anglian Water Authority in 1974, before becoming Anglian Water Services in 1989. The geographic location of these PZs would lead to their linkage to the East Suffolk and Essex PZ in the longer term.

WRZ10 - East Suffolk and Essex

Current water supply arrangements

157. The East Suffolk and Essex WRZ has the third largest supplies after Ruthamford and South Humberside. The zone is predominantly supplied by groundwater with Chalk sources mostly semi-confined by glacial drift deposits or fully confined beneath the Tertiary silts and clays of the London Basin. The effective separation of the Chalk aquifer from the surface waters has allowed a higher percentage of the available aquifer resources to be developed than in other zones to the north of East Anglia because of minimal environmental impact. In some areas this has led to induced infiltration from augmented or supported rivers maximising the use of water resources.

158. Concern has been expressed by the Environment Agency on low flows in the rivers Deben, Gipping, Brett, Colne and Pant that were studied under the AMP3 NEP investigations. The work indicated that low flows are a function of the limited available storage in the drift deposits that results in relatively low baseflow indices compared to the Chalk streams of Norfolk.

159. In contrast to other areas of Chalk aquifer increasing nitrate is seldom a problem although a few sources that receive rapid recharge do have rising levels of nitrate. Many sources require iron removal and some need blending for high natural levels of fluoride in groundwater beneath the London Clay.

160. Surface water is developed through raw water storage reservoirs at Alton and at Ardleigh. The latter is jointly operated with Tendring Hundred Water Services [THWS] through the Ardleigh Reservoir Committee [ARC]. The reservoirs have individual yield characteristics. Alton Water reservoir is filled from the Gipping catchment that is characterised by low baseflow from groundwater and limited input from the return of treated effluents upstream. The river intake at Sproughton is licensed to require a relatively small residual flow to be passed during abstraction. The smaller Ardleigh reservoir has a shorter retention period and relies upon the return of treated effluent from towns along the Colne valley and baseflow from the glacial sand and gravel aquifer that overlies the Chalk and Tertiary clays, but is itself confined by boulder clay. There is no residual flow released to tide from the River Colne under low flow condition, other than the compensation release from Ardleigh reservoir to Salary Brook.

161. Both Alton and Ardleigh have augmentation schemes to secure their yield during low flow conditions. Alton Water is augmented from the Mill Stream at Bucklesham with water pumped under the Orwell estuary. An unlicensed Chalk augmentation borehole on the Mill River referred to as the ‘Waddling Duck’ source is included as a contingency drought order source in our Drought Plan. Ardleigh reservoir can be augmented by use of the Balkerne Chalk borehole in Colchester that cannot be used direct into supply because of high fluoride content in connate groundwater. The Environment Agency has powers to augment the flow of the River Colne using the Ely-Ouse to Essex Transfer Scheme [EOETS], although this part of the scheme is not operational due to high losses from the Toppersfield Brook in the upper reaches of the River Colne.

162. There is an entitlement to a bulk supply from Essex and Suffolk Water company (ESW) by virtue of historical statutes. Supplies can be taken at Colchester, Tiptree and Braintree PZs, although only the Tiptree supply is currently in use. We have an agreement to provide a small supply to ESW at Silver End that is set against the bulk supply.

163. Planning permission has been granted for the extension of Ardleigh Reservoir through the restoration of gravel workings adjacent to the reservoir. Although the extension is not expected to be available until after 2020 it will increase the yield of the reservoir and the separate storage will increase the security and flexibility of operation. Engineering works will be required to convert the mineral workings into a sealed raw water storage reservoir.

164. We have increased supplies to Colchester by improved blending for waters with naturally occurring fluoride and by re-allocation of the proportion of the deployable output at Ardleigh reservoir that has resulted in increased use of surface water resources.

Current demands

165. Demands are centred on the large towns of Ipswich, Colchester and Braintree, all of which are served by major road and rail links to London. They have attracted fringe growth both from commuters and from company relocation and are designated for growth as an area for planned growth as the Haven Gateway development centred on the hinterland of the major port of Felixstowe. A high proportion of customers in Braintree had water meters installed as the result of a scheme in the 1990s. We are currently implementing a project for enhanced metering in Ipswich to install household meters at as many properties as possible. We are providing information on the relative cost of their measured and unmeasured charges and how to save water and money. We anticipate that over time all the meters will be used with changes to house ownership.

Forecasts and projections

166. The zone is adjacent to the M11 corridor with development included in the strategic plans first published by government in 2003 and later incorporated into the sustainable housing and affordable homes programme. It is anticipated that growth in the M11 corridor and around Stansted airport will extend into our supply area using the A120 and A12 and join with the Haven Gateway.

167. Growth is forecast to take place over the planning period at the rate of some 2,500 dwellings per year with a population increasing from around 560,000 to 640,000. We expect the domestic demand to increase from 82 to 90 Ml/d. Commercial demand is expected to remain steady over the planning period at about 25 Ml/d. Leakage is expected to be controlled at around 19 Ml/d.

Target headroom deficits

168. In the East Suffolk and Essex WRZ target headroom is marginally above the regional average increasing from 4 per cent to 16.6 per cent of demand over the planning period. It is driven by uncertainty over domestic consumption and population growth. The allowance for outage is slightly below the regional average at 4 per cent.

169. The East Suffolk and Essex WRZ is forecast to have a small surplus of available against target headroom at the start of the planning period, however it is forecast that a deficit develops by the end of the AMP5 period. More detailed analysis shows seven out of the nine PZs are projected to have headroom deficits against dry year average and/or critical peak period forecasts by the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ54	Braintree	-2.56	-2.20
PZ55	Bures	-0.14	+0.35
PZ56	Colchester	-4.91	-1.17
PZ57	Halstead Rural	-1.70	-1.21
PZ60	Ipswich	-16.68	+9.20
PZ63	Tiptree	-1.16	-1.92
PZ64	Woodbridge	-2.51	+0.62

The large deficits in both Colchester and Ipswich PZs are due to planned growth and also to the predicted impact of climate change on the reservoir supplies.

Feasible water management options

170. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
54	Uprate Petches Bridge, Wethersfield WTW	0	2.00
	Colchester PZ transfer	2.60	2.60
55	Colchester PZ transfer	0.20	0.20
56	Colchester re-use with enhanced metering	17.00	17.00
	Ipswich PZ transfer with enhanced metering	11.00	11.00
	Commission Great Horkesley borehole	0	2.00
	Ardleigh reservoir extension	3.00	3.00
57	Colchester PZ transfer	1.70	1.70
60	Uprate Whitton WTW	0	2.00
	Uprate Raydon WTW	0	2.00
	Ipswich discharges re-use	25.00	25.00
	Bucklesham Aquifer Storage Recovery scheme	4.00	4.00
63	Colchester PZ transfer	1.20	1.20
64	Ipswich PZ transfer	2.60	2.60

171. We have agreed a further amendment to the Ardleigh Reservoir Agreement with our partners on the Ardleigh Reservoir Committee, Tendring Hundred Water Services with a view to maximising the use of the reservoir's yield and increasing the deployable output available during the AMP5 period. The increase in DO has been included in the baseline forecast. The yield of the reservoir will be further increased by an extension to the reservoir storage

planned for the middle of the planning period following completion of mineral workings. A further increase in reservoir yield can be achieved by a Colchester discharges re-use scheme whereby a portion of water currently discharged from Colchester WWTW to the tidal River Colne is returned after additional treatment to the inland waters of the River Colne for subsequent abstraction to refill Ardleigh reservoir. We have implemented a project for enhanced metering in Ipswich during the AMP4 period and would propose to undertake a similar scheme in Colchester as part of the investment in the discharge re-use scheme to maximise benefit from it to the supply-demand balance.

172. A similar scheme is proposed for Ipswich by returning discharges to the tidal River Orwell after additional treatment to the River Gipping for abstraction to refill Alton Water reservoir. The Ipswich and Colchester discharge re-use schemes would be similar to the scheme commissioned by Essex and Suffolk Water in the late 1990s to return the discharge of water from Chelmsford WWTW to the River Chelmer for subsequent abstraction downstream to refill Hanningfield reservoir, rather than be discharged to the tidal Blackwater Estuary. We have evaluated the option of phasing the Ipswich and Colchester discharge re-use schemes by construction of a trunk main between the Ipswich and Colchester PZs. This link would make output from an enlarged Ipswich discharge re-use scheme available in Colchester as an alternative to the Colchester re-use scheme.

173. The supply side options for the Braintree, Bures, Halstead and Tiptree PZs are all dependent upon the transfer of water from the Colchester PZ using existing or planned trunk main links. These are therefore dependent upon the Colchester re-use scheme, although the deficits against target headroom are all small during the early part of the planning period or do not develop until later in the planning period. There is flexibility provided transfers through the existing connections between the zones.

174. The Ely-Ouse to Essex transfer scheme could be developed to refill both Alton Water and Ardleigh reservoirs. We have considered with Essex and Suffolk Water (ESW) how their proposals for water resources development through the Abberton scheme may produce surplus capacity in the EOETS for a limited period that could be used to augment the yield of Alton Water from a new intake at Cattawade at the tidal limit of the River Stour and could also potentially discharge into Ardleigh reservoir. However we have concluded that the option is not sufficiently developed to include in the Draft WRMP, although we will continue to review options for sharing resources with ESW.

175. We identified options to uprate the peak DO for sourceworks abstracting from the Chalk aquifer beneath the confining cover of London Clay. These have been offered as options for peak use only as the aquifer resources are designated as fully committed.

176. The option for a Bucklesham Aquifer Storage Recovery (ASR) scheme would use the current licence to abstract from the Mill River to the east of Ipswich. The Mill River was used to supply Ipswich before the development of Alton Water reservoir and is still used to augment the yield of Alton Water during drought periods, when the available water resource is fully utilised. The scheme would treat the surface water resource of the Mill River for direct supply and store surplus surface water when available in the underlying confined Chalk aquifer for abstraction when flows in the river were low. Desktop hydrogeological investigations carried out during the AMP4 period

have confirmed the feasibility of the ASR technique in this area.

Preferred water management options

177. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency. The selected schemes are summarised as:

PZ	Selected option	Period
54	Targeted cistern devices	AMP7
	Further targeted leakage control	AMP7
	Targeted metering	AMP7
	Domestic water audits	AMP7
	Further targeted leakage control	AMP7
	Colchester PZ transfer	AMP8
55	Targeted cistern devices	AMP8
	Further targeted leakage control	AMP8
	Targeted metering	AMP8
	Further targeted leakage control	AMP8
	Domestic water audits	AMP9
	Colchester PZ transfer	AMP9
56	Pressure reduction to reduce leakage	AMP5
	Further targeted leakage control	AMP5
	Targeted cistern devices	AMP5
	Domestic water audits	AMP5
	Ardleigh reservoir extension	AMP7
	Ipswich PZ transfer with enhanced metering	AMP8
57	Targeted cistern devices	AMP5
	Further targeted leakage control	AMP5
	Domestic water audits	AMP5
	Targeted metering	AMP5
	Colchester PZ transfer	AMP5
60	Pressure reduction to reduce leakage	AMP5
	Further targeted leakage control	AMP5
	Targeted cistern devices	AMP5
	Domestic water audits	AMP5
	Bucklesham Aquifer Storage Recovery scheme	AMP5
	Ipswich discharge re-use	AMP6
63	Colchester PZ transfer	AMP5
64	Ipswich PZ transfer	AMP5

178. In addition to the wide range of demand management schemes across all of the PZs the forecast deficits result in the selection of a discharge re-use scheme Ipswich in AMP6, following the recommissioning of the Bucklesham WTW, with an aquifer storage recovery scheme, in AMP5. Output from the discharge re-use scheme is further selected early in AMP8 as the solution for

deficits in Colchester. The water will be delivered to Colchester a strategic link main between the two PZs. Transfers from the Colchester and Ipswich PZs are required for adjacent PZs at various points in the planning period. Whilst the alternatives for the East Suffolk and Essex WRZ are limited we have well connected and flexible supply systems that through the use of both ground and surface water storage offer some additional security of supplies through conjunctive use. We will continue to explore options for sharing raw and treated water resources with the neighbouring water companies.

WRZ11 - Ruthamford

Current water supply arrangements

179. The Ruthamford WRZ is named after the integrated water resources and supply system formed by the use of Rutland Water Grafham Water and Pitsford reservoirs. The zone also includes the smaller surface water sourceworks at Ravensthorpe reservoir and on the Bedford Ouse, and the groundwater sources abstracting from the Woburn Sands aquifer. The supply system in the zone is characterised by long strategic trunk mains connecting large treated water storage reservoirs. The yield of the water resources system is founded on the large clay catchments with high winter runoff and a significant proportion of returned to rivers from the large towns in the upstream catchments. With the exception of Ravensthorpe and its satellite at Hollowell all reservoirs are filled by pumping from rivers.

180. Water is abstracted directly from the River Ouse at Bedford and is used conjunctively with supplies from Grafham Water during periods of high river flow. Grafham Water is also used to blend for high nitrate during the winter months. The Bedford abstraction is downstream of Cotton Valley WWTW, which serves the expanding population of Milton Keynes. The minimum 7-day reliable flow of the Bedford Ouse has increased significantly along with the population of Milton Keynes and will increase further with proposed housing development.

181. The Ruthamford system is a net exporter of water with bulk supplies to Three Valleys Water Services (TVWS) and to Severn Trent Water (STW). Both of these bulk supplies are under longstanding statutory agreements. It has been agreed with both companies that these arrangements will remain as at present for the Draft WRMP.

182. The Ruthamford WRZ has progressively expanded to meet demand in the adjacent zones. As raw water supply from Rutland Water reservoir has provided an alternative to the use of the river Witham to supply Grantham in the Lincoln WRZ and part of the South Lincolnshire Fens WRZ can now be supplied treated water via Peterborough. The March PZ has been supplied via Peterborough since the early 1990s and is included as part of the Ruthamford WRZ with a further extension to the Ely PZ in the Cambridgeshire and West Suffolk WRZ. These changes show how a large integrated water supply and water resources system can be managed to accommodate temporal surpluses and deficits in the supply-demand balance within and outside the zone. Thus the implementation of a scheme to treat the remaining yield of Rutland Water will increase the water available from use within the WRZ and adjacent WRZs and potential future development of reservoir storage in the Lincolnshire Fens WRZ could be used to supply the Peterborough area in the Ruthamford WRZ.

183. The environmental concerns in the zone have arisen from the management of surface water resources in the large European-designated wetland conservation sites of The Wash, Nene Washes, Ouse Washes and Rutland Water SPAs. The Habitats Directive review of consents has been progressed to confirm that there is no significant risk to The Wash and the Ouse and Nene Washes. Following an extensive study to secure the use of Rutland Water to increase the output from the reservoir a package of habitat creation works has been agreed that will protect the integrity of the reservoir as an SPA against drawdown during a period of drought.

184. Water quality issues have been addressed through improvements to the surface water treatment works by the provision of ozone and granular activated carbon treatment processes. Standards around the operation of plant have tightened as a result of the review of the risk of a breakthrough of pathogens. This led to a consequent loss of peak deployable output resulting from the tighter control of filter flow rates and contact times and an increase in the proportion of water used in the treatment process. The reservoir simulation models for Grafham and Pitsford show that both reservoirs could exceed the maximum permitted level for nitrate during refill after draw down during a critical drought period. However, all our major reservoirs benefit from long retention periods for natural denitrification and have been managed during previous droughts to avoid problems during refill. The future need will be reviewed in the light of operational experience.

Current demands

185. The WRZ is by far the largest and includes the major towns in the west of the region of Peterborough, Huntingdon, Corby, Kettering, Bedford, Wellingborough, Northampton, Milton Keynes and Daventry. The Ruthamford system also indirectly supplies towns of Luton and Stevenage in the TVWS supply area and the market town of Oakham in the STW supply area through bulk supplies.

186. The zone has shown steady growth in parallel with development of Grafham Water in the 1960s and Rutland Water in the 1970s. Demand management has progressed through the control of leakage and pressure management in the distribution system, household metering and the more efficient use of water by customers. This, together with the extension of Grafham WTW in the mid 1990s, has maintained secure supplies. However the continued growth of the East Midlands region will require further development of water resources. Both in 2001 and again in 2003 local problems have been experienced in maintaining a secure level in treated water storage reservoirs in the south-west corner of the region, at the extremes of the Ruthamford distribution system. Although the disruption to water supplies was short-lived these incidents confirm the need invest in both trunk mains and water treatment works to meet the economic development of the region.

Forecasts and projections

187. Potential growth comes from both housing and light industrial development in the existing towns of Milton Keynes, Northampton and Peterborough, which are on the major north-south transport links and within commuting range of London. The potential growth from the extension of Milton Keynes was included in the former Office of the Deputy Prime Minister's 'sustainable communities' in initiative in 2003. This has been confirmed by the Regional Spatial Strategy for the East Midlands and the Milton Keynes and South Midlands sub-region strategy.

188. Growth is forecast to take place over the planning period at the rate of some 10,000 dwellings per year with a population increasing from around 1.6 million to nearly 2 million. We expect the domestic demand to increase from 225 to over 250 Ml/d. Commercial demand is expected to remain steady over the planning period at about 110 Ml/d. Leakage is expected to be controlled at around 70 Ml/d.

Target headroom deficits

189. In the Ruthamford WRZ target headroom is at the regional average increasing from 3.9 per cent to 15.5 per cent of demand over the planning period. It is driven by uncertainty in population growth, domestic consumption and industrial demand. The allowance for outage is slightly below the regional average of 5 per cent reducing to 4 per cent by the end of the planning period.

190. The Ruthamford WRZ is forecast to have a surplus of available against target headroom at the start of the planning period as a result of investment in additional output from Rutland Water's WTW during the AMP4 period. However, it is forecast that a deficit will develop by the end of the AMP6 period. The analysis of target deficits is complex as there is good connection between PZs and so surpluses and deficits can be shared. However, there are bottlenecks in any water supply and distribution system and we have reflected these in our allocation of the peak and average DO between the 21 PZs. The detailed analysis with the FORWARD model shows that 15 of the PZs are projected to have headroom deficits against dry year average and/or critical peak period forecasts by the end of the planning period. These are:

Planning Zone (see Fig 2.3)		Forecast Deficit in 2035-36	
		Average (Ml/d)	Peak (Ml/d)
PZ65	Bedford	-7.86	-2.72
PZ66	Biggleswade	-5.49	-6.36
PZ67	Buckingham	-2.57	+1.28
PZ68	Clapham	-1.80	-0.85
PZ70	Daventry	-10.07	-18.13
PZ71	Huntingdon	-9.14	-9.42
PZ74	March	-0.02	+1.72
PZ75	Meppershall	-0.76	+0.40
PZ76	Milton Keynes	-21.88	-20.64
PZ77	Mursley	-1.78	-0.93
PZ78	Newport Pagnell	-0.35	-0.16
PZ79	Northampton	-11.11	-12.26
PZ82	Ravensthorpe	-1.43	+4.22
PZ83	Rushden	-11.9	-13.60
PZ84	Wellingborough	-3.02	-0.29

Feasible water management options

191. The FORWARD model has been used to select schemes that would maintain the supply-demand balance, including an allowance for target headroom at the PZ level. The model includes generic demand management options for targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control. In addition, the options made available to the PZs requiring investment were:

PZ	Option	Output (Ml/d)	
		Average	Peak
ALL	Ruthamford Combined Resource Schemes	47	27
	Bedford Ouse WTW Phase 2 extension	10	10
	Recommission Pulloxhill WTW	4	6

192. The integrated nature of the Ruthamford WRZ means that resource schemes

can benefit all PZs, although associated reinforcement of the trunk main and local distribution systems are required to ensure that the increased supplies are distributed to where the demand is. For the purpose of the Draft WRMP we have identified a single combined resource scheme that will be needed as the increase in output from uprating the output of Rutland Water's WTW is commissioned at ten end of the AMP4 period. The components of the combined resource schemes are:

Scheme	Output (Ml/d)	
	Average	Peak
Recommissioning of Foxcote reservoir WTW	7	12
Uprating of Bedford Ouse WTW	up to 20	
Peterborough discharge re-use	up to 20	
Integrated enhanced metering in Ruthamford WRZ	up to 10	
Total	47	47

193. The small pump filled reservoir at Foxcote was closed in 1994 and was replaced by surplus water from the Ruthamford system. The abstraction licences for the reservoir and the intake on the River Ouse remain in force and the infrastructure remains in place for recommissioning through the construction of a new WTW. Similarly, the groundwater sourceworks at Pulloxhill was closed in 1996 and the sourceworks can be recommissioned with the provision of new treatment plant. The gravity filled reservoir at Eyebrook is privately owned and has a limited reliable yield. Water flowing through Eyebrook joins the River Welland where it can be abstracted at the Tinwell intake to Rutland Water reservoir. For these reasons we have not included the use of Eyebrook reservoir in the Draft WRMP.

194. The potential to uprate the Bedford Ouse WTW arises due to the progressive increase in flow in the upper reaches of the river from the growth of Milton Keynes increasing the discharge from Cotton Valley WWTW. We have included a separate phase for a further increase in the Bedford WTW late in the planning period to use the additional resource that comes available from growth.

195. The Peterborough discharge re-use scheme also relies upon a progressive increase in the volume of water used by the growing city that will increase the discharge from Flag Fen WWTW to a tidal tributary of the River Nene. The re-use option would require the transfer of part of this discharge arising from the growth of Peterborough to be piped for discharge downstream of the river intake at Wansford. The discharge would augment the flow in the River Nene and enable the quantity of river water abstracted to fill Rutland Water to be increased.

196. We implemented a project for enhanced metering in Ipswich during the AMP4 period and would propose to undertake similar schemes in the main urban centres in the Ruthamford WRZ alongside investment in the Ruthamford Combined Resource Schemes to maximise benefit from it to the supply-demand balance.

197. In the longer term, the strategic development of the River Trent through a new winter storage reservoir in the Lincolnshire Fens WRZ could provide additional water resources for the Ruthamford WRZ and also for increasing bulk supplies to adjacent water companies. Our analysis shows that a new reservoir would be required until after the current planning period. However we are aware that

in preparing their Draft WRMP Three Valleys Water Services has considered the option to the bulk supply provided from the Ruthamford system towards the end of the 25-year planning period. This together with the time taken promote a large new reservoir scheme will needs further work to confirm the availability of water resources in the Lower River Witham and to develop a direct supply of winter storage scheme, as described in the Lincolnshire Fens WRZ.

Preferred water management options

198. The final planning scenario for the Draft WRMP is based upon maintaining demand management through leakage control, household metering and the promotion of water efficiency in all PZs at the appropriate time. The mixture of schemes follows the same pattern as the smaller WRZ. They are not included for the 15 individual PZ in the table below to for reason of clarity.

199. The phasing of the combined resource schemes will follow the completion of the AMP4 scheme to increase the DO available from Rutland Water, that includes a tranche of trunk main reinforcement schemes. We will be carrying out further work for the preparation of our Draft Business Plan to consider the optimal; investment in the sourceworks and trunk main systems to meet growth in the 'hot-spots' identified by the FORWARD model, notably in the Daventry, Huntingdon, Milton Keynes, Northampton and Rushden PZs. To do this we will be using our MISER strategic planning model that considers the optimisation of the abstraction, treatment and distribution of water resources. The likely phasing for the commissioning of the selected schemes is summarised below, although the uptake of the use of the water available will extend over the planning period.

PZ	Selected option	Period
ALL	Integrated enhanced metering in Ruthamford WRZ	AMP5
	Uprating of Bedford Ouse WTW	AMP5
	Recommission Pulloxhill WTW	AMP6
	Recommissioning of Foxcote reservoir WTW	AMP6
	Peterborough discharge re-use	AMP7
	Bedford Ouse WTW Phase 2 extensions	AMP9

WRZ12 - Hartlepool

Current water supply arrangements

200. The Hartlepool WRZ is geographically separate from the rest of our supply area, although Grimsby is closer to Hartlepool than it is to Colchester. Average rainfall is slightly higher than East Anglia but the more northerly location has a cooler climate and the effective rainfall is significantly higher and summer soil moisture deficits are lower. The Hartlepool area is included in the Drought Plan 2008, although Hartlepool has never experienced an impact on the security of water supplies during drought conditions.

201. The Hartlepool area is supplied solely by the local Magnesian Limestone aquifer with all groundwater sources pumping to a single treated water storage reservoir where groundwater from the different groundwater sources is blended to maintain compliant water quality. The well integrated system supplies a small area.

202. The two small gravity-filled raw surface water reservoirs at Crookfoot and Hurworth Burn have been used historically to provide non-potable industrial supplies but with the decline in demand they have been closed in favour of the use of water from the potable water system, although a small licensed quantity has been retained for maintenance use.

203. A new source has been developed in the Magnesian Limestone at Butterwick and licensed within an aggregate-licensed quantity to reflect the upper bound of demands and hence the need for water resources. The development of the Butterwick source is not needed to secure the supply-demand balance, but is included as a contingency option in the 2003 Drought Plan.

204. The closure of coal mines in the area and the reduction in pumping to de-water mine workings has resulted in the migration of highly mineralised water into parts of the aquifer system. There is currently no risk to public water supplies, although the potential for this to effect the quality of water in the Magnesian Limestone that is used for public water supply is being investigated with the Coal Authority and the Environment Agency.

205. There are no significant links with the adjacent Northumbrian Water supply, which is understood to have a significant surplus of supplies over demand. The potential for new links has not been raised.

Current demands

206. Demand is only for the town of Hartlepool and the adjacent industrial area on north Teeside with demand split equally between household and industrial. Historically industrial demand was much higher and the closure of heavy industry has created a large available headroom. The surplus water has been used to supply the new development at Wynyard Park through an inset appointment.

207. The northern location of Hartlepool and the high proportion of industrial demand results in a peak demand that is the lowest in our supply area.

Forecasts and projections

208. Growth is forecast to take place over the planning period at the rate of some 200 dwellings per year with a population increasing marginally from around 90,000 to 92,000. We expect the domestic demand to decline from 12 to 10 Ml/d. Commercial demand is expected to remain steady over the planning period at about 9 Ml/d. Leakage is expected to be controlled at around 5 Ml/d.

Target headroom deficits

209. In the Hartlepool WRZ target headroom is relatively low and well below the average for the Anglian region. It is almost entirely driven by demand uncertainties, with an initial increase due to uncertainty over leakage and the forecast continued reduction in industrial demand.

210. The Hartlepool WRZ has a surplus of available against target headroom throughout the Plan period.

Preferred Water Management Options

211. Apart from the generic demand management and leakage control initiatives there are no specific schemes intended to be implemented to restore the supply demand balance headroom. Since target headroom for both average and peak demands are fully met there is no need for further investment in any supply or demand management initiatives. The current ELL will apply throughout the planning period.

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5 OUR PROPOSED WATER RESOURCES PLAN

Introduction

1. The preceding chapters describe in detail how we forecast the supply-demand balance to 2035-36 to enable us to plan to maintain secure water supplies for our domestic and commercial customers.

2. To forecast demand, we combined population and housing growth data with expected patterns of water use. This enabled us to predict where demand is likely to increase and by how much. To forecast supplies, we amended our current estimate of deployable output to take account of the effects of climate change, sustainability reductions and the AMP4 supply-demand programme schemes that have either been planned or are under construction. We then compared supplies and demand and identified where investment is likely to be needed to maintain a balance between the two.

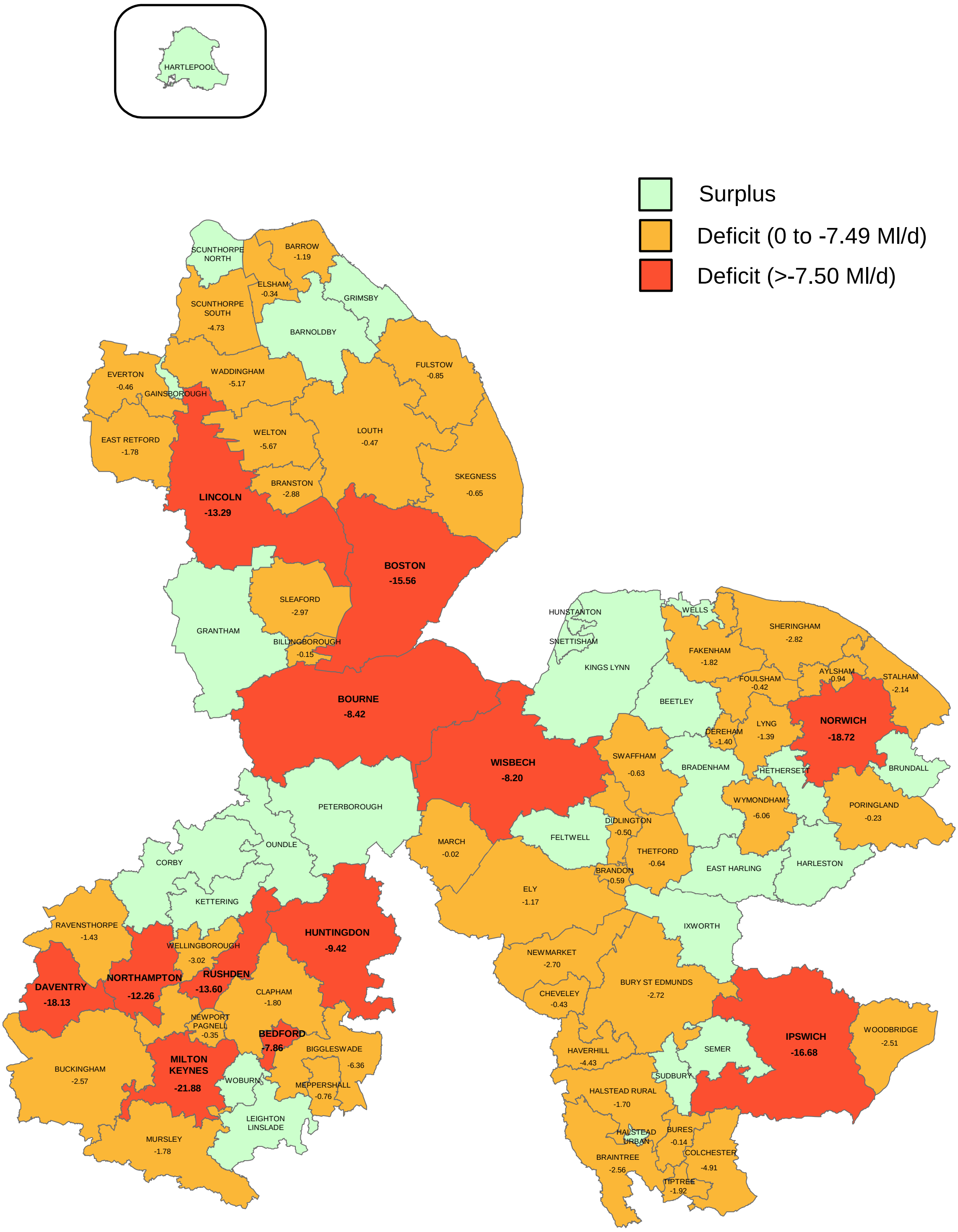
3. Our forecast is based on 85 Planning Zones (PZs). These are grouped into 12 Water Resource Zones (WRZs). For each PZ, we used a suite of numerical models to determine the supply-demand balance and to identify the preferred solution for maintaining that balance. The preferred solutions were identified from a set of feasible options; these were selected from an unconstrained set of all possible options. In developing the feasible option set, we applied a twin-track approach; including options for proactively managing demand as well as developing new supplies.

4. Our process for identifying investment need and selecting the preferred option is in accordance with industry best practice. It takes account of the size of the deficit, the capital and operating costs of each possible solution as well as the associated environmental and social costs and the cost of carbon. The process is robust and has been previously used by us in five-yearly reviews to plan large-scale investment in our water resources and supply systems.

Forecast Deficits

5. Figure 5.1 summarises the output of the FORWARD model in terms of those PZs that are forecast to have a deficit of available headroom against target headroom at average or peak demands at the end of the planning period in 2035. It reflects the areas where growth in demand for water is expected to be greatest, namely Lincoln, the Lincolnshire and Cambridge Fens, the Milton Keynes & South Midlands Sub Region, Huntingdon, Norwich and Ipswich.

Figure 5.1 Planning Zone deficits in 2035



Note: Deficit represents the largest average or peak deficit by 2035/36.
Data from FORWARD - Baseline FINAL with Dry Year Uplift with Enhanced Metering

Twin-Track Solutions

6. Chapter 4 listed the demand management measures that were selected across the PZs according to the need to reduce demand and the availability of options. In summary the savings that are estimated to be delivered by the selected demand management options are:

Option	Estimated saving Ml/d
Targeted metering	0.5
Further targeted leakage control	39.3
Pressure reduction	9.5
Domestic water audits	2.3
Water efficiency devices	0.9

The demand management options are usually selected by the FORWARD model in advance of resource development options, except where they are insufficient to meet an early forecast deficit, or the cost is excessive.

7. Savings through metering of the remainder of our customers who do not already have a water meter are included in our baseline forecast as meter optants. By using enhanced metering we will accelerate the savings and either defer the need for resource development, or extend the length of time before a further scheme is needed.

8. Similarly, we currently apply the twin–track approach through leakage control as an integral part of maintaining a secure balance between supplies and demands. Our baseline forecast produced using the FORWARD model calculates an increase in the level of leakage due to an increase in the length of water mains and an increase in the number of properties that we supply. The least cost forecast uses the twin-track approach to address the PZ supply-demand balance deficits and reduces leakage by 39.3 Ml/d to below the future economic level defined in the baseline forecast. As a result we plan to maintain leakage at around the current level of 210 Ml/d, although we will reduce leakage during periods of water resources stress, as we did during the drought of 2006-07. Maintaining the current level going forward will result in leakage rates falling in relation to both a unit length of main and per customer connection. The provision of pressure reduction will contribute to savings needed to maintain the current level of leakage. Our mains replacement programme will in addition contribute to leakage control.

9. Chapter 4 also lists the resource development schemes selected for each PZ. In many cases a scheme will provide water to more than one PZ with the scheme being extended by improving the trunk main and local water distribution system to deliver additional water supplies to new and existing customers. Table 5.1 lists the resource developments that we propose in our final planning solution. The proportion of supplies developed from existing licences, new groundwater resources and new surface water resources is shown in Figure 5.2. The main schemes and the links required to provide water supplies where they are needed are shown on Figure 5.3.

Table 5.1 Selected new resource development schemes

Location - WRZ	Scheme name	Period	Output Ml/d
Lincoln	New Lincoln WTW phase 1	AMP5	5
	Grove WTW extension	AMP7	3
	New Lincoln WTW phase 2	AMP6	25
Lincolnshire Fens	New Lincolnshire Fens WTW phase 1	AMP5	5
	New Lincolnshire Fens WTW phase 2	AMP6	20
Fenland	Ext^{n} to Cut-off-Channel/Wissey WTW	AMP7	9
N. Norfolk Coast	Secondary groundwater use	AMP5	6
Norfolk Rural	Reallocation of Gt Ouse Groundwater ph1	AMP5	5
	Reallocation of Gt Ouse Groundwater ph2	AMP6	2
	Reallocation of Gt Ouse Groundwater ph3	AMP7+	2
Norwich & The Broads	Utilise full Norwich groundwater licence	AMP5	4
	New Norwich urban groundwater source	AMP5	4
	Reallocation of Gt Ouse Groundwater ph1	AMP5	2
	Reallocation of Gt Ouse Groundwater ph2	AMP6	4
	Reallocation of Gt Ouse Groundwater ph3	AMP7+	4
Cambs & W Suffolk	Reallocation of Gt Ouse Groundwater ph1	AMP5	3
	Reallocation of Gt Ouse Groundwater ph2	AMP7	3
	Reallocation of Gt Ouse Groundwater ph3	AMP7+	3
E. Suffolk & Essex	Bucklesham recommissioning with ASR	AMP5	4
	Ipswich discharge re-use	AMP7	14
	Ipswich PZ transfer with enhanced metering	AMP8	11
	Ardleigh reservoir extension	AMP8	3
Ruthamford	Recommisioning of Foxcote reservoir	AMP6+	12
	Uprating of Bedford Ouse WTW ph1	AMP6+	10
	Recommisioning of Pulloxhill WTW	AMP6+	6
	Peterborough discharge re-use	AMP6+	19
	Uprating of Bedford Ouse WTW ph2	AMP9	10
Total			198

Figure 5.2 New supplies by resource category

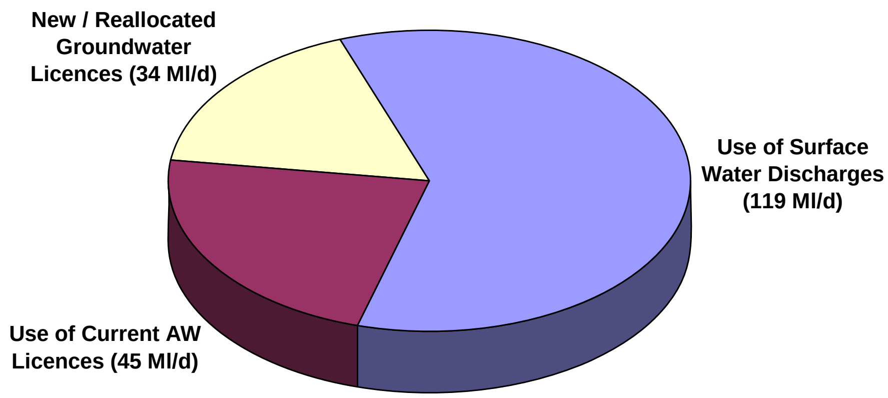
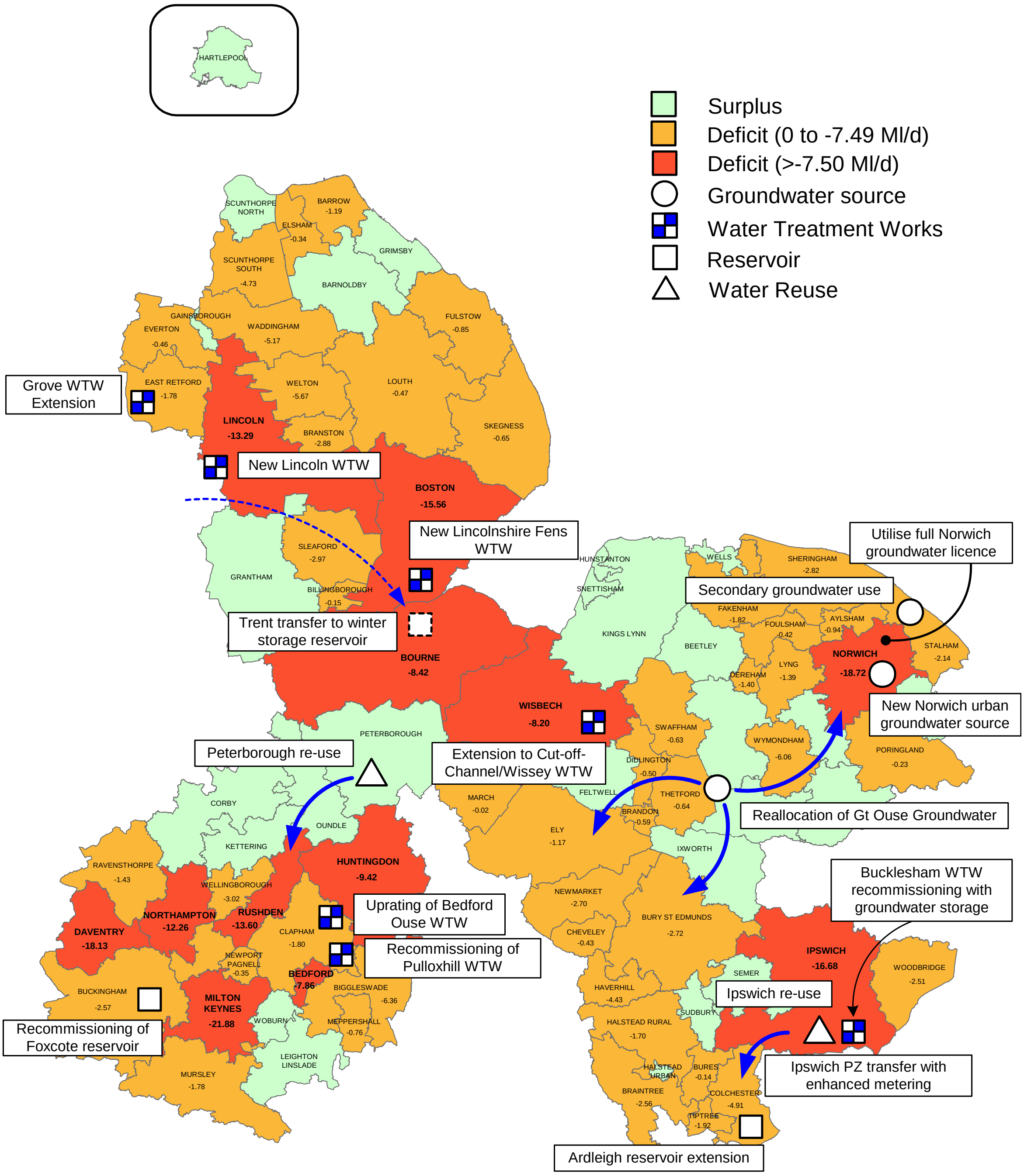


Figure 5.3 Selected resource development options



Note: Deficit represents the largest average or peak deficit by 2035/36.
Data from FORWARD - Baseline FINAL with Dry Year Uplift with Enhanced Metering

10. The proposal for a small plant abstracting water from the River Trent and the Lower Witham will provide operational experience on the treatment of the new surface water resource and an opportunity to trial new more efficient physical treatment processes. We propose to build on this work by carrying out further studies during the AMP5 period into the availability and reliability of a larger water resource. This would include further consideration of water storage, the risk of adverse environmental impact and the outline design to transfer treated or raw water from the Lincolnshire Fens WRZ to other parts of the region using watercourses or pipelines.

11. We have selected two active water re-use schemes, one for the return of coastal discharges after additional treatment to inland waters for subsequent abstraction downstream to refill Alton Water reservoir and one to replace flows downstream of a river intake with the additional water resulting from growth in Peterborough. As well as these two active water re-use schemes the development of the Bedford Ouse WTW, the New Lincoln WTW and the New Lincolnshire Fens WTW make passive use of increased discharges of wastewater from developments higher in their river catchments. These schemes represent an opportunity for the sustainable use of approximately 120 Ml/d of water resources that would otherwise be lost.

12. The remaining schemes develop approximately 80 Ml/d of deployable output using a combination of currently licensed water resources and the reallocation or licensing of new groundwater resources. The currently licensed water sources are located across the region and include Foxcote reservoir in Buckinghamshire, the Cut-off-Channel in Norfolk together with smaller groundwater sources. The new and reallocated groundwater resources are those of the Great Ouse Groundwater Development Scheme (GOGDS) licensed to the Environment Agency and the Broads Chalk aquifer next to the northeast Norfolk Coast, which has been identified as having poor quality water available for abstraction. We expect that the Environment Agency will recognise the need for redistributing water resources for the GOGDS by working with us following its completion of the review of consents before the start of the AMP5 period.

13. The schemes include those for the innovative use of the Chalk aquifer beneath the Felixstowe Peninsula as an underground storage reservoir through the Bucklesham ASR scheme and the development of secondary groundwater on the Northeast Norfolk Coast. Both of these schemes will require research to achieve the high level of efficiency that we will require for sustainable use.

14. The main driver for the development of a secondary groundwater source on the Northeast Norfolk Coast is the indicative sustainability reduction for our Sheringham sourceworks. We are conscious that an increase in the need for sustainability reductions of up to 70 Ml/d would bring forward the need for the development of additional water resources, notably the Fenland re-use and transfer scheme to augment the flow in the Cut-off-Channel in west Norfolk with discharges from Kings Lynn, Wisbech and Downham Market as a faster track option than the development of the Trent transfer via a new large winter storage reservoir in the Lincolnshire Fens. The Environment Agency has told us that additional information on sustainability reductions will be available in August 2008 for us to take into account in preparing our Final WRMP and PR09 Business Plan for submission in April 2009.

Managing Risk and Uncertainty

15. Our analysis covers a 30-year period between the base year of 2006-07 and 2035-36. To build the numerical models needed to forecast the supply-demand balance over this period, we have to make a number of assumptions. These relate to both the demand that we are likely to experience and to the availability of new or existing supplies.

16. Given the extended forecast period, the assumptions we have made are subject to a degree of uncertainty. This is recognised in the water industry and the Environment Agency's Water resource planning guideline through an

allowance in our plan to take account of uncertainty. The allowance also includes risk to supplies, for example from the deterioration of raw water quality. It is called target headroom and in our plan it increases from around 5 per cent of demand at the start of the forecast period to around 15 per cent at the end. A variety of factors contribute to our target headroom over the forecast period, however, uncertainties with respect to population growth and domestic consumption dominate.

17. As we have included target headroom in our demand forecasts and we have sufficient options to maintain the supply-demand balance, we are confident that we can manage the risks and uncertainties that are inherent in the 25-year plan we are proposing. Periodic reviews of the supply-demand balance will help us to monitor this situation and to ensure that any emerging risks are proactively managed.

18. There are, however, a number of assumption-related uncertainties which we have not taken account of in our plan. These are significant and include:

    - On the advice of the Environment Agency, we have assumed that sustainability reductions will be 5 Ml/d. However, some recent reports published by the Environment Agency refer to sustainability reductions of up to 70 Ml/d in the Anglian region
    - We have assumed that it will be possible to develop the licensed water resources of the Great Ouse Groundwater Development Scheme, currently held by the Environment Agency for river augmentation use, for the direct supply of potable water. If this is not available, we would be required to develop approximately 30 Ml/d from an alternative water resource
    - We have assumed that it will be possible to further use the growth in existing discharges or new discharges that augment the flows of the Rivers Trent, Witham, Nene, Gipping and Colne for water supply. If these resources are not available, we would be required to develop approximately 60 Ml/d from an alternative water resource
    - We have assumed that there will be no growth in the statutory allocation for exports from our Ruthamford system. However, in discussion with our neighbouring water companies the possibility of making significant additional quantities of water available from this system has been raised

19. If any of these assumptions are incorrect it is likely that we would be required to develop an alternative Plan. Given the quantities involved, this would be based on the use of the extensive water resources of the River Trent during periods of high flow and the development of an associated winter storage reservoir in the South Lincolnshire Fens.

20. To manage the risks associated with the uncertainties not included in target headroom and constraints through the planning system, we feel it is necessary to progress our current preliminary works on the South Lincolnshire winter storage reservoir during the AMP5 period and to review the need to promote it as a major scheme in our next Water Resources Management Plan in five years time.

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ABBREVIATIONS, ACRONYMS AND TERMS

Abbreviations and Acronyms

£/Ml	Pounds (sterling) per Megalitre
AIC	Average Incremental Cost
AISC	Average Incremental Social Cost
AMP	Asset Management Plan
ARC	Ardleigh Reservoir Committee
ASR	Aquifer Storage Recovery
CAMS	Catchment Abstraction Management Scheme
Defra	Department for Environment, Food and Rural Affairs
DO	Deployable Output from sourceworks
EA	Environment Agency
EBSD	Economics of Balancing Supply and Demand
ELL	Economic Level of Leakage
EOETS	Ely-Ouse to Essex Transfer Scheme
EU	European Union
FORWARD	FORecasting WAter Resources and Demand
GCM	General Circulation Model
GOGDS	Great Ouse Groundwater Development Scheme
HOURUS	Headroom Output Utilising Risk and Uncertainty in a Spreadsheet
l/h/d	Litres per head per day
l/sec	Litres per second
LARS	Licensed Abstraction Reporting System
LCF	Least Cost Forecast
LoS	Levels of Service
Ml/d	Megalitres (1,000,000 litres or 1,000 cubic metres) per day
MLE	Maximum Likelihood Estimate
NEP	National Environment Programme
NPV	Net Present Value
NRA	National Rivers Authority
ONS	Office of National Statistics
PCC	Per Capita Consumption
PR	Periodic Review
PZ	Planning Zone
RSA	Restoring Sustainable Abstractions
RSS	Regional Spatial Strategy
SAC	Special Area of Conservation
S-D	Supply-Demand
SDS	Strategic Direction Statement
SEA	Strategic Environmental Assessment
SoSI	Security of Supply Index
SPA	Special Protection Area
SR	Sustainability Reduction
SSSI	Site of Special Scientific Interest
SWORPS	Source Works Output RePorting System
TMAS	Traffic Management Act
TWAS	Trent-Witham-Ancholme Scheme
UKCIP	United Kingdom Climate Impacts Programme
UKWIR	United Kingdom Water Industry Research
WAFU	Water Available For Use
WET	Water Efficiency Target
WREP	Water Resources Environment Programme
WRMP	Water Resources Management Plan
WRP	Water Resource Planning
WRZ	Water Resources Zone
WTW	Water Treatment Works

Key Terms

Target Headroom	A planning margin providing an allowance for the risks and uncertainties associated with the forecast components.
Outage	Allowance for the unplanned loss of Deployable Output from sourceworks.
Deployable Output	The quantity of water that can be produced at a water treatment woks on average and at maximum output as limited by abstraction licence, plant capacity or other constraint.
WAFU	Deployable Output from sourceworks less Outage.
Available Headroom	The difference between WAFU and total demand resulting in a resource surplus or deficit.

Appendix

List on Consultees in accordance with Water Resources Management Plan Regulations 2007 (SI 2007/ 727)

National Bodies
Broads Authority
British Waterways
Consumer Council for Water
English Heritage
Environment Agency
Natural England
Ofwat

District Councils
Aylesbury Vale District Council
Babergh District Council
Bassetlaw District Council
Braintree District Council
Breckland Council
Broadland District Council
Daventry District Council
East Cambridge District Council
East Lindsey District Council
East Northamptonshire District Council
Fenland District Council
Forest Heath District Council
Huntingdon District Council
Mid Beds District Council
Mid Suffolk District Council
North East Lincolnshire Council
North Kesteven District Council
North Lincolnshire Council
North Norfolk District Council
South Beds District Council
South Holland District Council
South Kesteven District Council
South Norfolk District Council
South Northants District Council
Suffolk Coastal District Council
West Lindsey District Council

Borough Councils
Bedford Borough Council
Boston Borough Council
Colchester Borough Council
Corby Borough Council
Great Yarmouth Borough Council
Hartlepool Borough Council
Ipswich Borough Council
Kettering Borough Council
Kings Lynn and West Norfolk Borough Council
Lincoln City Council
Milton Keynes Council
Northampton Borough Council
Norwich City Council
Peterborough City Council
St Edmundsbury Borough Council
Wellingborough Borough Council

County Councils
Bedfordshire County Council
Buckinghamshire County Council
Cambridgeshire County Council
Essex County Council
Leicestershire County Council
Lincolnshire County Council
Norfolk County Council
Northamptonshire County Council
Nottinghamshire County Council
Rutland County Council
Suffolk County Council

Regional Development Agencies
Yorkshire Forward Development Agency
East Midlands Development Agency
East of England Development Agency
South East England Development Agency
North East England Development Agency

Regional Assemblies
Yorkshire & The Humber Regional Assembly
East Midlands Regional Assembly
East of England Regional Assembly
South East Regional Assembly
North East Regional Assembly

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Anglian Water Services Limited
Water Resources Management Plan

Strategic Environmental Assessment
Environmental Report: Non-Technical Summary

April 2008

Introduction

This report summarises the findings of the Environmental Report prepared for the Strategic Environmental Assessment (SEA) of Anglian Water Services Limited's (Anglian Water) Draft Water Resource Management Plan.

Background

All water companies are required to prepare a Water Resource Management Plan (WRMP) to set out how they intend to deliver water supplies to their catchment over a period of 25 years. The WRMP sets out the strategy for maintaining a secure supply-demand balance through a combination of demand management measures and water resource development. New WRMPs are prepared every 5 years, known as Asset Management Planning (AMP) periods, and reviewed annually through the June Return Process through the production of a stand alone report and tables that are submitted to Ofwat (Water Services Regulation Authority).

An SEA has been carried out on the new Draft WRMP, currently the subject of a public consultation, which will cover the planning period 2010–2035. The Environment Report is the output of that SEA. The Draft WRMP sets out the options for managing demand and supplying additional water to the region. These have been chosen from a long list of feasible options that included, reservoir schemes, wastewater reuse, aquifer recharge and raw and treated water transfers as well as leakage reduction, metering and water efficiency measures.

The SEA has formed part of the decision-making process that will enable Anglian Water to meet its statutory objectives. The SEA process is integrated into the WRMP process allowing environmental issues to be considered at an early stage of plan development.

Anglian Water Services

Geographically, Anglian Water is the largest water and wastewater company in England and Wales, covering some 27,000km^2. It has just over 5 million customers from the Humber estuary to the Thames estuary and from Northamptonshire to the east coast of England plus a small area around Hartlepool in the northeast of England.

The Anglian Water region is shown in Figure 1. Its water supply area is split in to 12 Water Resource Zones (WRZs) for the purposes of water resource planning. These WRZs are split into smaller Planning Zones (PZs) to enable detailed analysis of the balance between water supplies and demand. These WRZs and PZs are shown in Figure 2.

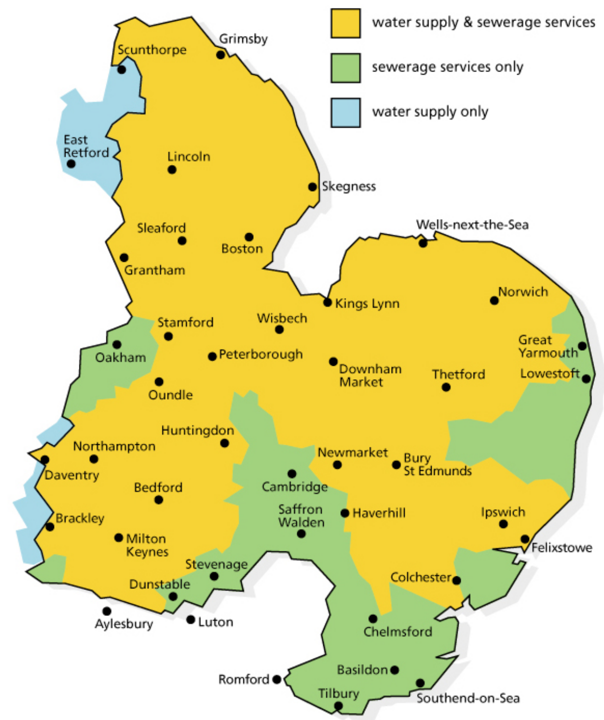

Figure 1 The Anglian Water Services region

Figure 2 Water resource zones and planning zones

Requirement for Strategic Environmental Assessment

European Directive 2001/42/EC 'on the assessment of effects of certain plans and programmes on the environment' (the SEA Directive), was transposed into English Law via the Environment Assessment of Plans and Programmes Regulations 2004, Statutory Instrument 2004 No.1633, (the SEA Regulations).

The SEA Directive applies to a wide range of plans and programmes and the overarching aim is to "provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development" (Article 1).

The SEA Directive defines 'environmental assessment' (Article 2(b)) as a procedure comprising:

- *preparing an Environmental Report on the likely significant effects of the draft plan or programme and reasonable alternatives;*
- *carrying out consultation on the draft plan or programme and the accompanying Environmental Report;*
- *taking into account the Environmental Report and the results of consultation in decision making; and*
- *providing information when the plan or programme is adopted and showing how the results of the environmental assessment have been taken into account.*

A screening assessment was carried out in early 2007 which determined that an SEA was required as part of the WRMP process. The report was sent to the Environment Agency, Natural England and English Heritage in order to determine their views as statutory consultees. All three statutory consultees confirmed that an SEA would be required for Anglian Water's WRMP.

The requirement for SEA was determined on the basis that the WRMP falls within the scope of Article 3.2(a) of the SEA Directive, which provides that an environmental assessment shall be carried out for any plan or programme where:

a) *it is prepared for, inter alia, water management; and*
b) *sets the framework for future development consent of projects listed in Annex I and II to Directive 85/337/EEC (the EIA Directive, as amended by Council Directive 97/11/EC) and additionally under Article 2(a) of the SEA Directive.*

Anglian Water is considered to be an 'authority' preparing a plan (the WRMP) for adoption through a legislative provision, in this case under the Water Act 2003 amending the Water Industry Act 1991.

Level of Detail

The scale of the WRMP and the wide geographic area which it covers has meant the nature of the assessment undertaken for the SEA is of a high level, utilising information generally available at a regional level. This accords with the aspiration of the SEA Directive when it states in Article 5 that the geographic scope of the plan should be taken into consideration when evaluating the environmental effects.

The SEA is a high level assessment aimed at highlighting potential environmental concerns which can be examined in greater detail through further scheme specific study through the undertaking of an Environmental Impact Assessment as part of the planning process required for schemes.

The SEA Process

There are five mains stages to the SEA process:

- Stage A: Setting the context and objectives, establishing the baseline and deciding on the scope
- Stage B: Developing and refining alternatives and assessing effects
- Stage C: Preparing the Environmental Report
- Stage D: Consulting on the Draft WRMP and Environmental Report
- Stage E: Monitoring implementation of the WRMP

SEA Scoping

Stage A of the process involves scoping the SEA. The baseline information collected at this stage was readily available from key sources such as the Environment Agency, Natural England, English Heritage, Defra and national and local government. No primary research or data gathering was conducted. This process enabled the existing environmental issues to be identified and provided a reference point from which the potential environmental effects of the WRMP could be assessed.

The output of the scoping study was a report that:

- identified relevant plans, programmes, and environmental protection objectives which influence, or are influenced by, the WRMP;
- described the environmental baseline within the Anglian Water region;
- identified key environmental issues; and
- identified the SEA objectives.

Other Relevant Policies, Plans and Programmes

The SEA Regulations require consideration of other relevant policies, plans and programmes (PPP) that may influence the choice of water resource schemes included in the Draft WRMP. A detailed review of international, national and regional documents was undertaken in parallel with the collation of environmental baseline information. The list of PPPs reviewed by the SEA is provided in Appendix 1.

Environmental Baseline

Environmental baseline information was collected to gain an understanding of the current environmental situation in the Anglian Water region. This process enabled the existing environmental issues to be identified and provide a reference point from which to assess the potential environmental effects of the Draft WRMP.

Data has been collated relating to the key SEA topic areas as set out in Annex 1(f) of the SEA Directive. For the purposes of this SEA some of the topics have been combined to make them more relevant to the WRMP, the categories that have been chosen to represent the SEA topics for this assessment are:

1) Biodiversity, Flora and Fauna)
2) Human Beings (incorporating Population and Human Health)
3) Land use and development (incorporating Soil)
4) Water
5) Material Assets
6) Cultural Heritage (Archaeology and Architecture)
7) Landscape
8) Air Quality (incorporating Climate Change)

The environmental baseline for the Anglian Water region is summarised here in relation to the eight topic categories. In describing the environmental baseline this section also identifies the key issues facing the environment within the Anglian Water region.

Biodiversity, Flora and Fauna

Designated Sites

The Anglian Water region is environmentally diverse and sensitive, containing a range of habitats and species. This is reflected in the many designated sites of national and international importance. This includes up to 819 Sites of Special Scientific Interest (SSSIs) covering some 6.6% of the land area (around 115,700 hectares), 38 Special Areas of Conservation (SAC), 25 Special Protection Areas (SPA), 30 Ramsar sites and many other non-statutory sites. Anglian Water also owns or manages 50 SSSIs including Rutland Water, Tetney Blow Wells, Taverham Mills alongside the River Wensum and Stannet's Creek Lagoon (part of the Crouch and Roach SSSI).

Biodiversity Action Plan

Anglian Water is committed to making a positive contribution to biodiversity through delivering its 10-year Biodiversity Action Plan (BAP) (1999). The plan has been successful in reintroducing two species to England, the osprey and the pool frog, the latter's habitat had been under pressure from water abstraction and poor water quality.

Catchment Abstraction Management Strategies

A significant water management issue with implications for biodiversity is water abstraction for public water supply, agriculture and industry. Unsustainable abstraction to supply water can cause ecological impacts in rivers and estuaries by reducing low river flows and levels or in wetlands by lowering the level of groundwater. This is a matter for consideration in the WRMP as the largest demand for water in the Anglian River Basin District comes from public water supply, although there are also a large number of smaller abstractions across the district to supply agriculture and industrial uses.

The Environment Agency's Catchment Abstraction Management Strategies (CAMS) outline the approach to managing water resources in local catchment areas. Through the abstraction licensing regime surface water and groundwater availability is managed in water resource management units, helping to balance the needs of water users and the environment. To fully appreciate the potential effects, the baseline for water related designated sites in the Anglian Water region has been established from a review of the relevant CAMS.

Human Beings

Population and Water Usage

Population growth in the Anglian Water region has been driven by a rise in inward migration from other regions in the UK and from Eastern Europe. The Anglian Water region's close proximity to London has meant it has become attractive for commuters working in the capital, this has also led to population growth. The regional plans propose an increase of some 50% in the historic rate of house building, much of this focussed in the growth areas, such as Milton Keynes. By 2035 the region's population is expected to grow by some 850,000.

Anglian Water has lobbied for tighter mandatory standards for water efficient designs and specifications in new builds. Domestic customer water usage is a core driver of the Draft WRMP with activities such as metering and water efficiency influencing the demand for water. Over 60% of Anglian Water's customers already have a water meter fitted. In recent years Anglian Water has consistently installed some 20,000 meters into new domestic properties and over 20,000 existing customers opt to move to measured water charges each year.

Recreation

Sixteen of Anglian Water's operational sites are open to the public for recreational purposes. Thirteen of the sites have public access and of these, 10 operate as nature reserves, 10 as coarse angling centres, 5 accommodate cycling centres, 7 have sailing and windsurfing centres and 5 accommodate canoeing centres. The promotion of recreation and community involvement at their water based sites is important to Anglian Water.

Land Use and Development (incorporating soil)

The East of England and East Midlands are well known for their agricultural production. Indeed, the East of England alone contains 58% of the UK's grade 1 and 2 agricultural soils, defined as excellent and very good quality land. The Regional Assemblies covering the Anglian Water region have reported in recent years a rising trend in the quantity of land being utilised for wheat, barley and rapeseed production, emphasising the importance of agriculture to the local economy.

The relationship between the WRMP and the high level of agricultural activity is two-fold. The significance of the agricultural land to the economy means that the WRMP should look to locate potential water resource development options in areas which limit the amount of agricultural land take, thus protecting the agricultural economy of the region. To take the pressure off agricultural land future development should be focussed on existing operational sites.

Furthermore, a large proportion of land in agricultural production means the risk of fertilisers and other agricultural chemicals leaching into water resources is high.

Water

Water Resources

The East of England is the driest region in the UK, experiencing an average of 600 mm of rainfall annually in contrast to an average of 900 mm for England and Wales. In an average year only a quarter of the rainfall is available as a water resource after evaporation and use by plants. Consequently water availability is a key issue for Anglian Water and the WRMP.

The Environment Agency identified the Anglian Water region as an area of moderate water stress in its 2007 consultation on water stressed areas. This was revised to one of serious water stress in the final designation.

The Anglian Water region's water resources are highly utilised. The predictions for growth in the region means water resources are going to need to be carefully managed to provide additional water supplies and manage customer demand to ensure a secure supply of water without damaging the natural environment.

Water Quality

The Water Framework Directive will place increasingly stringent targets on water quality. Currently only 46% of river lengths in the Environment Agency's Anglian region are rated 'Good' in terms of chemical water quality as opposed to the average for England as a whole of 64%. In terms of Biological water quality the region fares better with on average 70% of river lengths being classified as 'good' in comparison to a total of 71% for England as a whole.

The diffuse pollution of water is a widespread problem and action to tackle it is required. The single biggest threat of diffuse water pollution is from agriculture. This is unsurprising, as agriculture makes up a large proportion of the land area of the Anglian Water region and the sources of diffuse pollution, including nutrients from fertilisers and manure, are essential parts of farming. Increases in nutrient levels can result in toxic algal blooms, resulting in adverse impacts on the food chain which supports fish, animals and birds.

Flooding

Flooding is an issue pertinent to the Anglian Water WRMP for two reasons. Firstly, the potential impact of flooding on Anglian Water owned assets, both water and wastewater services infrastructure and secondly, the potential for water resource development options to reduce the quantity of floodplain within the Anglian Water region.

Material Assets

Anglian Water currently manages a total of some 37,000km of water mains, distributing water from 139 water treatment works located throughout the region. In addition to this the company operates 1,083 wastewater treatment works (WWTWs), the highest concentration of WWTWs per head of population in the country.

The SEA considers the additional infrastructure which might be added to the Anglian Water assets through the identification of new resource development options. In terms of environmental effects of the additional infrastructure the SEA evaluates these in terms of energy use, biodiversity, landscape and cultural heritage rather than a specific material assets indicator.

Cultural Heritage

The Anglian Water region contains a wealth of archaeology and cultural heritage, in particular, a significant number of Grade I and II listed buildings. Anglian Water currently owns and manages 6 listed buildings.

The SEA acknowledges that not all archaeological features have already been identified within the Anglian Water region. The archaeological potential of the area needs to be considered when evaluating any proposed options at the scheme / EIA level assessment. With this in mind, the SEA aims to give an indication of the sensitivity of the region to archaeological impact based on existing evidence.

Landscape

The Anglian Water region has a diverse and contrasting landscape, ranging from the open and flat agricultural landscape of the Fens, to the rolling uplands of the Lincolnshire Wolds, the unique coastal landscapes, and the woodlands of the Breckland. The region also contains landscapes of national importance including Areas of Outstanding Natural Beauty (AONBs), each recognised for their unique landscape character – the Lincolnshire Wolds, the Norfolk Coast, the Suffolk and

Heath Coasts, the Chilterns and Dedham Vale, and the Norfolk and Suffolk Broads (National Park). The Broads is Britain's largest wetland covering an area of 303km^2, and is recognised for its distinctive landscape, consisting of rivers, broads (shallow lakes), marshes and fens, rich in rare habitats, supporting a myriad of plants and animals.

The diversity of the landscape is reflected by the number of distinctive 'Joint Character Areas' (JCA) identified in the Anglian Water region. JCAs describe the physical (geology, topography, soils), cultural and historical influences that define a distinctive 'character area'. Whilst the landscape character of the Anglian Water region is still apparent, the general trend has been a steady decline in distinctiveness both within and between character areas. This has been the result of changes to agricultural practices, the impact of built development, roads and service infrastructure, and other human activity, such as recreation.

Air Quality (incorporating climate change)

In the context of the WRMP the SEA indicator 'Air' has been used to encompass greenhouse gas emissions and consequently the link with climate change. For the 2006/07 reporting period Anglian Water generated:

- CO_2 eqs: 144,873, 630 kg (144.87 thousand tonnes)
- C eqs: 39,510,990 kg (39.51 thousand tonnes)

The energy usage required by future water resource and demand management activities has been assessed within the SEA.

The key environmental issues and the SEA topics relevant to them are shown in Table 1.

SEA Objectives and Indicators

The objectives for the SEA relevant to the potential water resource development schemes for the Draft WRMP were identified from the 8 topic areas categorised by the review of the relevant PPPs and establishment of the environmental baseline as being the most pertinent to the Anglian Water region. A total of 20 objectives were assigned to the topics to reflect the emphasis that needs to be placed on them; in particular on biodiversity, cultural heritage, water and landscape.

For each of the objectives indicators of sensitivity and magnitude of impact matrices were developed to allow evaluation of the potential significance of effects to be made. The indicators included a combination of quantitative and qualitative elements, the latter involving professional judgement.

The SEA objectives and their respective indicators are shown in Table 2.

Application of the UK Habitats Regulations

The European Court of Justice (ECJ) ruled in 2005 that the provisions of Articles 6(3) and 6(4) of the Habitats Directive (Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna and Flora) had not been correctly interpreted and transposed into the UK Habitats Regulations, the mechanism for delivering the Habitats Directive in the UK.

The focus of the Habitats Directive is to protect the network of European designated sites known as Natura 2000, which comprises, Special Protection Areas (SPAs), designated under the Birds Directive, and Special Areas of Conservation (SACs) designated under the Habitats Directive. The UK Government had originally only transposed the Habitats Directive as it applies to projects, but since the ECJ ruling, has now broadened the UK Habitats Regulations to encompass ***land use plans only***, '*to ensure that the protection and integrity of European Sites is a part of the planning process at regional and local level.*'[1]

Following the UK Government's interpretation of the Habitats Directive into the Habitats Regulations it has been concluded that an Appropriate Assessment of the WRMP is not required because the WRMP is not classified as a land use plan and does not set a statutory framework for permitted development. This view corresponds to the advice received from Natural England during the initial consultation on the SEA.

[1] Planning for the protection of European Sites: Appropriate Assessment. Guidance for Regional Spatial Strategies and Local Development Documents, DCLG, August 2006.

Table 1 Key environmental issues

Key Issues	Summary	Implications for WRMP	SEA Topic(s)
Maintenance and Enhancement of Biodiversity	There are a large number of nationally and internationally protected sites (SSSIs, SACs, SPAs and Ramsar) throughout the Anglian Water region. Because of the high density of protected sites Biodiversity considered to be the most significant of the SEA topics with regard to the WRMP SEA. Currently, all Anglian Water owned or managed SSSIs are meeting the UK Government's Public Service Agreement Target of 95% of SSSI sites in 'favourable' or 'recovering' condition by 2010, however, but a number of SSSIs not managed by Anglian Water are not. The Anglian Water region also encompasses a wide range of biodiversity character areas comprising key BAP habitats which will also need to be considered within the SEA.	The WRMP has the potential to have a significant effect on designated sites, particularly those dependent on water, e.g. the fens. Any works carried out for the WRMP should avoid damaging both designated and undesignated sites, and where possible seek to enhance biodiversity. For Anglian Water owned or managed SSSIs favourable conditions should be maintained, whilst for those not managed by Anglian Water the WRMP should not cause a decline in the condition.	Biodiversity, Flora and Fauna
Improvement in Water Quality	Chemical and biological river water quality has improved over the last three years. However, both biological and chemical water quality for the region are below the national average, significantly below the national average in the case of chemical water quality where only 46% of rives are considered to be of 'good' quality as opposed to the national average of 64%.	The WRMP is an important mechanism for helping to maintain and improve chemical and biological river water quality, though careful management of water sources to maintain river flows and to support ecological activities and habitats.	Water, Biodiversity
Monitor Water Resources	In areas of the Anglian Water region surface waters are already fully committed during summer months, whilst some winter abstractions are no longer reliable. Likewise, groundwater is considered to be over licensed or over abstracted in some areas. The Anglian Water region has been classified as in serious water stress by the Environment Agency.	Water sources need to be identified which can be used without causing adverse environmental effects, either through being used when water is plentiful or looking at alternative sources of raw water. Steps should be taken to reduce the quantity of water being used by both domestic and commercial customers. Leakage reduction measures should be identified to reduce wastage where appropriate.	Water, Humans
High Soil Quality	The Anglian Water region contains some of the best and most versatile agricultural land in England. 58% of the UK's grade 1 & 2 agricultural soils are located within the East of England region.	The WRMP should seek to avoid development on high grade agricultural land.	Soil, Landscape

Key Issues	Summary	Implications for WRMP	SEA Topic(s)
Reduce the risk of flooding	The Anglian Water region contains areas of both fluvial and coastal floodplain, which serve an important role for wildlife whilst protecting built up areas from the affects of flooding.	The WRMP should avoid proposing developments within the floodplain to both maintain the quantity and quality of flood plain for wildlife whilst also reducing the likelihood of Anglian Water assets being affected by flooding.	Water, Climatic Factors
Reduce Greenhouse Gas Emissions	Anglian Water as a company produces a significant volume of greenhouse gases as a consequence of the energy intensive processes required to both treat and transport water.	The WRMP can contribute towards the UK targets for greenhouse gas emission reductions, by ensuring the impacts of operations are minimised, and through the provision of sustainable water resources with less reliance on energy intensive processes or alternatively the use of renewable energy.	Climatic Factors
Population Growth	The Anglian Water region population is predicted to grow by some 850,000 by 2035. Growth areas such as Milton Keynes have high targets for house building over the next 25 years.	The WRMP needs to take account of the increased growth within its demand forecast. New developments should be fitted with water efficient devices to follow policy in the Government 'Future Water' report and ensure the targets within the Code for Sustainable Homes are achieved. Access and Recreation – maximise potential for developments as valuable 'Green Infrastructure'.	Population
Protect the Landscape Character	There are several important designated landscapes, 4 AONBs and a National Park and distinctive landscape character areas within the Anglian Water region, some of which have experienced changes inconsistent with character. For example, changes in woodlands, agricultural practices, and development pressure.	The WRMP needs to ensure that future water resource developments are not located in areas of high landscape importance and that sympathetic design is promoted.	Landscape

Table 2 SEA objectives and indicators

SEA Topic / Objective	Indicator(s)
1. To maintain, protect and, where practicable, enhance all designated conservation sites within the Anglian Water region.	Number of SSSIs, SACs and SPAs in favourable condition
2. To ensure that the WRMP does not lead to the fragmentation of habitats.	Variety of UKBAP habitats affected by the plan
3. To ensure the sustainable management of non-designated wildlife sites and the ecological processes on which they depend.	Number of Local Nature Reserves
4. To promote the efficient use of water by new and existing domestic customers.	Code for Sustainable Homes per capita consumption indicators
5. To promote the efficient use of water by new and existing commercial customers.	Water Delivered
6. To continue to promote recreational and access opportunities for the wider community of Anglian Water owned sites.	Number of visitor centres / public access to conservation sites
7. To minimise the quantity of Grade 1 and 2 agricultural land taken out of permanent production for water resource development.	Ha of land / % of total Grade 1 and 2 land taken out of agricultural production
8. To focus the development of future resources on brownfield sites.	Utilisation of brownfield land, existing Anglian Water sites/facilities or greenfield land for the development of the scheme/plan
	% of brownfield land used as a total of the WRMP
9. To ensure abstractions are made from sustainable water resources.	Availability of surface water for abstraction
	Availability of groundwater for abstraction
10. To improve and maintain water quality in surface and ground waters.	Potential to affect biological and chemical river water quality (based on existing predominant WQ grade)
	Potential to adversely impact on groundwater quality at abstraction point (based on groundwater source protection zone)
11. To maintain or progress towards achieving good ecological status under the WFD for all surface and groundwater resources within the Anglian Water region.	Potential impact on status of surface and groundwater resources under WFD risk criteria

SEA Topic / Objective	Indicator(s)
12. To minimise the risk of flooding by ensuring existing floodplain is not used for water resources developments.	Potential impact of proposed scheme on flood risk
13. To site future above ground water resources infrastructure beyond the limit of the floodplain to reduce damage to assets from flooding or increase the risk of flooding within the wider area.	Risk posed by floodplain on proposed scheme
14. To maintain leakage at the economic level.	Reported leakage level in comparison to Economic Level of Leakage (ELL).
15. To preserve and enhance sites, features, areas and settings of archaeological, historical and cultural heritage importance.	Number of historical/archaeological assets of international/national importance within a 500m or 1km radius of the proposed scheme (site or pipeline).
16. To protect areas with known high potential for archaeological resources where the full significance and extent of archaeological remains has yet to be determined.	Professional judgement using data from publications, English Heritage National Monuments Register and County Historic Environment Register. Consideration of sites and artefact find spots within a 500m or 1km radius of the proposed scheme depending on whether a pipeline or site.
17.To protect and enhance the landscape character of designated and undesignated areas within the Anglian Water region	Will the scheme or plan have an adverse impact on landscape character and visual amenity, including setting of AONBs and national parks?
18. To protect and enhance the quality of historic parkland and gardens within the Anglian Water Water region.	Presence of registered historic parks and gardens
19. To reduce the energy use and increase the energy efficiency of the water supply network.	Energy (KWh) / Ml
20. To address the causes of climate change by reducing the energy consumed during water treatment and distribution.	CO_2 (tonnes) CO_2 (tonnes) / Ml supplied

Assessment of WRMP Options

In developing the Draft WRMP, Anglian Water identified a long list of scheme options that could be implemented to achieve the required level of water supply within each of the 12 WRZs. In assessing the potential environmental effects of the Draft WRMP, Anglian Water adopted the UKWIR Guidance which advocates undertaking the assessment of the WRMP in two stages:

Stage 1: assessment of water resource and demand management schemes
Stage 2: assessment of the WRMP programme (combination of schemes).

This way the potential environmental effects of the programme can be understood from the scheme level up. Each scheme was subjected to evaluation against each of the SEA objectives identified in Table 2 utilising data held on a Geographical Information System (GIS) developed for Anglian Water specifically in relation to water resource development schemes, allowing both quantitative and qualitative judgements to be made.

Over 50 individual schemes were assessed in the first stage and feedback on the potential environmental effects provided to the WRMP team.

The programme level assessment took a more strategic look at the potential environmental effects of the schemes, by looking beyond the environment surrounding the individual options at the bigger picture, focussing on the potential impact on systems, in particular the water resource capabilities of the Anglian Water region as a whole. The baseline analysis of Anglian Water's water resource planning model forecasts relatively small deficits in water supplies in most of the WRZs and consequently, there has been no need to include major water resource developments at this stage. The Draft WRMP therefore comprises demand management and a number of small scale water resource developments.

The combinations of schemes for water resource development with treated water transfers and demand management included within each WRZ for the Draft WRMP are shown in Table 3.

Assessment of Alternatives

Demand management through metering, promoting the efficient use of water and leakage control is at the heart of Anglian Water's WRMP and therefore the impacts of these measures are taken into account in its supply-demand model. The outcome of the model is a Least Cost Forecast which indicates that the forecast level of deficit within the WRZs does not currently require major water resource developments such as reservoir storage or the bulk transfer of raw water across the region. It is planned to meet the forecast deficits through relatively small scale phased schemes using current underused licensed quantities and the increased discharges that will result from plans for growth in the region. Demand management and leakage control will remain a priority alongside or in advance of water resource developments.

As a consequence of the limited need for water resource development no alternative WRMPs have been developed or assessed within the SEA. However, Anglian Water recognises that in the longer term beyond the current WRMP period (2010 – 2035) there may be a need to consider other strategic water resource options such as a major reservoir or bulk raw water transfers if, for example, demand is greater than forecast, or factors such as climate change or environmental legislation influence supply. Anglian Water proposes to carry out further more detailed investigations during the next 5 years into the availability of water resources for transfer from the lower River Trent and the storage of winter flows in a new reservoir in South Lincolnshire.

The demand forecast is derived from estimates for the growth in population and property numbers provided to Anglian Water from Government and the regional and local planning authorities. All statutory water undertakers have a legal obligation to supply water to new households and commercial premises for domestic use. Consequently, although the SEA Directive requires the "do-nothing" scenario to be considered, for WRMPs this is not an option that a statutory water undertaker can consider and has therefore not been included in the SEA.

Table 3 Water resource development/treated water transfers and demand management schemes in the Draft WRMP within WRZs

WRZ1: South Humberside

Covenham – Irby to Elsham WTW transfer
Active Leakage Control
Pressure Reduction
Cistern Displacement Devices
Household Water Audits

WRZ2: Lincoln

Covenham – Irby to Elsham WTW transfer
New Lincoln WTW
Grove WTW extension
Targeted Metering
Active Leakage Control
Pressure Reduction
Cistern Displacement Devices
Household Water Audits

WRZ3: Lincolnshire Coastal

Covenham WTW transfer
Active Leakage Control
Pressure Reduction

WRZ4: Lincolnshire Fens

New Lincolnshire Fens WTW
Pressure Management

WRZ5: Fenland

Snettisham PZ transfer
Ruthamford WRZ transfer
Kings Lynn PZ transfer
Extension to Fenland WTW
Active Leakage Control
Cistern Displacement Devices

WRZ6: North Norfolk Coast

Secondary Groundwater use
Targeted Metering
Active Leakage Control
Pressure Reduction
Cistern Displacement Devices
Household Water Audits

WRZ7: Norfolk Rural

Great Ouse Groundwater reallocation
Brandon PZ transfer
Transfer from Wisbech PZ
Targeted Metering
Active Leakage Control
Cistern Displacement Devices
Household Water Audits

WRZ8: Norwich and The Broads

Great Ouse Groundwater reallocation
Norwich Groundwater Source
Norwich Urban Source
Active Leakage Control
Pressure Reduction
Household Water Audits

WRZ9: Cambridgeshire and West Suffolk

Great Ouse Groundwater reallocation
Thetford PZ transfer
Ely PZ transfer
Colchester PZ transfer
Brandon PZ transfer
Cistern Displacement Devices
Pressure Reduction
Metering
Active Leakage Control

WRZ 10: East Suffolk and Essex

Ipswich PZ transfer
Colchester PZ transfer
Ipswich discharge reuse
Re-comission of Bucklesham WTW with aquifer storage
Targeted Metering
Active Leakage Control
Pressure Reduction
Cistern Displacement Devices
Household Water Audits

WRZ11: Ruthamford

Integrating enhanced metering in WRZ
Uprating of Bedford Ouse WTW
Re-commission of Pulloxhill WTW
Re-commission of Foxcote Reservoir WTW
Peterborough discharge reuse

WRZ12: Hartlepool

No schemes required

Summary of Environmental Effects of the Draft WRMP

The key potential environmental effects of the Draft WRMP are described in the following sections.

Biodiversity, Flora and Fauna

There are a large number of national and international designated nature conservation sites within the Anglian Water region, several of which are within Anglian Water land. Those sites most likely to be affected by water resource schemes are those that are water dependent. Increased abstraction of groundwater could influence river levels and groundwater levels in sensitive sites.

The scale of water resource development schemes included in the Draft WRMP are not generally considered likely to give rise to any significant impacts on major designated sites. However, schemes proposed to increase abstractions may have an adverse effect on surface water flows or groundwater levels. Similarly schemes to relocate or reuse discharges from WWTWs may effect surface flows and the water quality of the receiving watercourse or coastal water. In all cases, more detailed investigations will be required to identify and quantify impacts as part of the normal process for seeking permissions necessary for implementation. Appropriate Assessment under the Habitats Regulations 2004 may also be required in some cases.

Human Beings

The provision of adequate supplies of clean water is considered an important part of maintaining the health of the population and therefore the benefit of the Draft WRMP in achieving this is self evident. Good health is also achieved through maintaining the amenity value of the land and providing recreational facilities.

The Draft WRMP will contribute to the general amenity value of the environment through maintaining good water supplies and utilising brownfield land for new developments. Existing recreational facilities at Anglian Water sites will be unaffected by the proposed water resource schemes. Some disturbance to community assets such as footpaths, bridleways and open areas is anticipated for some of the new schemes, however, impacts are unlikely to be significant and will be temporary during the construction phase.

Land Use and Development

Urban creep is a growing problem in rural areas and the use of greenfield land is seen as being both undesirable and unsustainable, particularly for industrial uses.

Re-use of existing sites or other brownfield land is considered a more sustainable option.

The Draft WRMP does not require significant new above ground infrastructure to be constructed. For the most part, new infrastructure will be confined to underground pipelines or additional treatment facilities at existing Anglian Water sites. The use of brownfield land will be maximised.

A large part of the Anglian Water region is taken up by agricultural land and indeed, the region contains some of the best (Grade 1 and 2) agricultural land in the country. Such land is vital to the production of food and other agricultural commodities.

Only one scheme is currently anticipated to require use of agricultural land but this is a very small area and would have no significant impact on the productivity of the area.

Water

Anglian Water currently provides water supplies for over 4 million customers within its region. The forecast of a need to provide additional water supplies available over the plan period is due to planned growth in the regional population of around 18% and the need for increased headroom to allow for risk and uncertainty in the water resource planning process. Although this can be achieved, Anglian Water will be maintaining and increasing its demand management and water efficiency initiatives in order to achieve reductions in demand wherever possible. Within its plan Anglian Water expects to achieve a decline in measured water consumption to 129 litres per person per day over the plan period.

Measured water quality in rivers and watercourses in the region (data collected by the Environment Agency) indicates a trend of improvement over recent years, with biological and chemical indicators showing ‘good’ or ‘very good’ quality. It is anticipated that the water resource schemes within the Draft WRMP will contribute to continued improvements in the major rivers and groundwater resources. Some minor localised water quality reductions may occur in some areas due to changes in the location or quantity of surface water discharges, however, these changes may also result in improvements elsewhere.

Flood risk is considered to be a potential problem at some locations where additions to existing or new treatment facilities are being proposed. However, for the most part the risk is to flooding of the facility rather than adverse impacts on floodplain storage. Appropriate flood control measures will need to be incorporated into the detailed design of new facilities.

Archaeology and Cultural Heritage

The Anglian Water region has a rich and diverse archaeological heritage which is reflected in the large number of sites and features that have been recorded. Anglian Water currently undertakes significant archaeological work for many of its infrastructure schemes and adopts a proactive approach to dealing with archaeological and cultural heritage assets.

Most of the pipeline schemes proposed within the Draft WRMP have the potential to impact on known and unknown archaeological assets, however, without more detailed investigation it is not possible to quantify the likely significance. Pipeline routes will be subject to further detailed study and investigation. Such studies will be undertaken in consultation with English Heritage and the local planning authorities and dealt with on a project by project basis.

Landscape

The landscape character of the Anglian Water region is dominated by low lying fenland with some higher such as the Lincolnshire Wolds, the Lincoln Edge and the Suffolk Heights. Many areas are also considered to be of historic value in relation to the archaeology. The introduction of new structures into the landscape can change the amenity value and sense of place.

The Draft WRMP does not include any major above ground infrastructure developments that could result in long term impacts on the landscape. Temporary impacts during the construction of pipelines are expected but without more detail on the routes and construction methods etc., it is not possible to quantify the impacts. These will be subject to project level studies, most informing wider EIAs.

Air and Climate

The world's climate is dynamic and naturally fluctuates in cycles, some of which have now been shown to be affected by human activities. One of the main human causes of climate change is recognised as being from emissions of 'greenhouse gases', such as carbon dioxide, which are by—products of energy generation.

The abstraction, treatment and distribution of drinking water all require energy and therefore it would be expected that increased demand for water would result in a matching demand for energy consumption. The resource development schemes within the Draft WRMP will result in an increase in energy consumption and therefore increased CO_2 emissions. Although the effect of active leakage control, demand management and water efficiency measures will counteract this a net reduction in CO_2 emissions will only be achieved by improvements to the efficiency of existing plant. No specific allowance has been made for this in the Draft WRMP, although Anglian Water is addressing its use of energy as part of its business planning process. The 5-yearly review of the Plan will review the overall carbon footprint and also allow changes to be made in response to climate change.

Mitigation

The assessment of the demand management and water resource development schemes undertaken for the SEA indicates that the Draft WRMP represents a sustainable approach to meeting Anglian Water's statutory responsibility to supply potable water to its customers over the plan period.

There will, however, still be environmental and social impacts that need to be addressed at the project level. Many of the schemes proposed within the Draft WRMP include pipelines and greater use of existing abstraction licences to deliver the required level of water supply. A 'best fit' approach has been employed, through the use of GIS-based constraints mapping, to try and avoid causing significant environmental effects. However, the level of detail available at this strategic level is such that it is impossible to consider all potential impacts. Many of the schemes in the Draft WRMP will require more detailed assessments as part of EIAs to be undertaken when they are taken forward to detailed design and planning. It is expected that these studies will further delineate and quantify potential impacts, many of which it is anticipated can be avoided or minimised through changes to the scheme design or, in the case of pipelines, to the route alignment.

Monitoring

In general, mitigation monitoring will be required by conditions imposed by the relevant consenting authority, such as the Environment Agency, for abstraction licences and discharge consents, or the local planning authorities in planning consents. For schemes requiring EIA, the need for specific monitoring will be dependent on the nature and scale of identified impacts. At this stage, it is not possible to describe what this might include at the project level.

Impact monitoring is also dependent to a large extent on the findings of future studies that will inform the development of individual schemes within the WRMP.

A series of measures has been proposed to monitor the performance of the WRMP and to assess whether predicted significant effects in the SEA are accurate. These include a combination of data from third party monitoring, such as that done by the Environment Agency and other statutory stakeholders, and specific monitoring of environmental parameters to be undertaken by Anglian Water.

Conclusion

The Draft WRMP has been developed to meet the forecast demand for water supply in the Anglian Water region over the period 2010 – 2035, taking into account forecast surplus and deficits across its 12 WRZs. The Draft WRMP comprises a combination of demand management measures, water network transfers and water resource development schemes.

In undertaking an SEA of the Draft WRMP, potentially significant environmental effects have been identified for some schemes in some areas. For the most part, the risks of significant effects are a result of the lack of detailed information available for individual schemes at the planning stage and in all likelihood, can be avoided or minimised during future detailed design work and as a result of EIA studies.

Measures have been identified to allow Anglian Water to monitor the performance of the WRMP when implemented.

Overall, in addition to ensuring a reliable, secure supply of clean drinking water, the Draft WRMP will have some environmental benefits including, improving aquatic environments through enhanced wastewater treatment, enabling the further development of recreational facilities, and making water savings through continued leakage control and enhanced metering of domestic households.

Environmental Report and Comments on the SEA

Copies of the full Environmental Report can be obtained from the address below.

David Harker
Regulatory Water Resources Manager
Anglian Water Services
Henderson House
Lancaster Way
Huntingdon
Cambridgeshire
PE29 6XQ

Comments on the SEA can be sent to the same address. Comments on the Draft WRMP as a whole should be sent direct to Defra, who will forward them to Anglian Water. The Summary Report and Main Report for the Draft WRMP are published along with this report on the website (www.anglianwater.co.uk) with details of how to comment on them.

The closing date for comments on the Draft WRMP and its Environmental Report is **4th August 2008.** Anglian Water will publish a Statement of Response to representations received later in 2008.

Appendix 1: Relevant Policies, Plans and Programmes

Relevant Policies, Plans and Programmes	
International	
• World Summit on Sustainable Development (WSSD, 2002) Commitments • Millennium Development Goals (MDGs, 2000) • UN Framework Convention of Climate Change (UNFCCC, 1992) • Kyoto Protocol (1997)	• Berne Convention on the Conservation of European Wildlife and Natural Habitats (1979) • Bonn Convention on the Conservation of Migratory Species of Wild Animals (1979) • Ramsar Convention on Wetlands of International Importance especially as Wildfowl Habitat (1971)
European	
Water • Water Framework Directive – Integrated River Basin Management for Europe (2000/60/EC) • Council Directive concerning Urban Waste Water Treatment (91/271EEC) • Council Directive on the Quality of Water intended for Human Consumption (98/83/EC) • Council Directive concerning the quality of Bathing Water (76/160/EEC) • Directive concerning the management of bathing water quality and repealing Directive 76/160/EEC (2006/7/EEC) • EC Freshwater Fish Directive (78/659/EEC) • Council Directive on the protection of groundwater against pollution caused by certain dangerous substances	**Nature and Biodiversity** • Council Directive on the Conservation of Wild Birds (79/409/EEC) • Council Directive on the Conservation of Natural Habitats and of Wild Flora and Fauna (92/43/EEC) **Air and Climate** • Air Quality Framework Directive (96/62/EC) • Second European Climate Change Programme (ECCP II, 2005) • Council Directive establishing a Scheme for Greenhouse Gas Emission Allowance Trading (2003/87/EC) **Landscape** • European Landscape Convention
National (United Kingdom)	
Legislation • Wildlife and Countryside Act 1981 • The Natural Environment and Rural Communities Act 2006 • Countryside and Rights of Way Act 2000 • Planning (Listed Buildings and Conservation Areas) Act 1990 • Ancient Monuments and Archaeological Areas Act 1979	• Future Water – The Government's water strategy for England (Feb 2008) • Making space for water: taking forward a new Government strategy for flood and coastal erosion risk management in England (March 2005) • Code for Sustainable Buildings. A step change in sustainable building practice, December 2006. • White Paper Heritage Protection for the 21st Century (8th march 2007) • The Government Statement 'The Historic Environment: a force for our future' (DCMS

Relevant Policies, Plans and Programmes

- Draft Climate Change Bill

UK Policies and Strategies

- Securing the future – UK Government Sustainable Development Strategy (2005)
- Sustainable Communities Plan: Building the Future (2003)
- Sustainable Communities: People, Places and Prosperity (2005)
- Sustainable Communities: Homes for All (2005)
- Sustainable Farming and Food Strategy – Forward Look (2006)
- Climate Change – UK Programme (2006)
- UK Biodiversity Action Plan (UKBAP)
- Working with the grain of nature – A biodiversity strategy for England (2002)
- Directing the flow – priorities for future water policy (Nov 2002)

2001)

Planning Policy Guidance and Statements

- PPS 1: Delivering Sustainable Development
- PPG2: Green Belts
- PPS 3: Housing
- PPS 6: Planning for Town Centres
- PPS 7: Sustainable Development in Rural Areas
- PPS 9: Biodiversity and Geological Conservation
- PPG15: Planning and the historic environment
- PPG16: Archaeology and Planning
- PPS 25: Development and Flood Risk

Regional

East of England

- Sustainable Futures: The Integrated Regional Strategy for the East of England (2005)
- East of England Plan: Draft Revision to the Regional Spatial Strategy (RSS) for the East of England (Dec 2004)
- East of England Plan – the Secretary of State's proposed changes to the Draft revision of the regional spatial strategy for the East of England, December 2006.
- A Shared Vision: The Regional Economic Strategy for the East of England (Nov 2004)
- Our Environment, Our Future: The Regional Environment Strategy for the East of England (July 2003)
- Regional Housing Strategy for the East of England: 2005-2010 (July 2005)
- Sustainable Tourism Strategy for the East of England (March 2004)

East Midlands

- East Midlands, Integrated Regional Strategy – Our Sustainable Development Framework (Jan 2005)
- Draft East Midlands Regional Plan (Sept 2006)
- Putting Wildlife Back on the Map – A Biodiversity Strategy for the East Midlands (May 2006)
- Regional Economic Strategy for the East Midlands 2006-2020 East Midlands,
- Regional Environment Strategy (Aug 2002)

North East of England

- The Integrated Regional Framework – Achieving a better quality of life (2004)Regional Spatial Strategy – VIEW: Shaping the North East (Draft Submission, June 2005)
- Regional Economic Strategy 2006-2016 – Leading the way
- North East Strategy for the Environment (Consultation Draft, Dec 2006)
- Regional Housing Strategy – A new housing strategy for the North East
- North East England Tourism Strategy 2005-2010

Yorkshire and Humber

- Advancing Together, The Vision and Strategic Framework for Yorkshire and Humber Regional Spatial Strategy, The Yorkshire and Humber Plan (Draft for Public Consultation, Dec 2005)
- The Regional Economic Strategy for Yorkshire and Humber 2006-2015
- The Regional Environmental Enhancement Strategy for Yorkshire and the Humber (Sept 2003)
- Yorkshire and The Humber, Regional Housing Strategy 2005-2021

South East of England

- Integrated Regional Framework 2004: A Better Quality of Life in the South East
- The South East Plan: A Clear Vision for the South East (Draft, March 2006)

Relevant Policies, Plans and Programmes	
• The East Midlands Tourism Strategy 2003-2010 (Oct 2003) • The East Midlands, Regional Housing Strategy 2004-2010	• The Regional Economic Strategy 2006-2016: A Framework for Sustainable Prosperity • South East Regional Housing Strategy (2006 Onwards) • Tourism ExSEllence: The Strategy for Tourism in the South East (2004)
Sub-regional	
• Broads National Park Management Plan • AONB Management Plans (Lincolnshire Wolds; Norfolk Coast; Suffolk Coast and Heaths; Dedham Vale and Chilterns)	
Environment Agency Strategies	
Regional Water Resource Strategies • Water resources for the future – A Strategy for North East Region (2001) • Water resources for the future – A Strategy for Anglian Region (2001) **Catchment Flood Management Plans** • Grimsby and Ancholme CFMP (Draft Plan, June 2006) • River Witham CFMP (Scoping Report, Oct 2006) • Louth Coastal CFMP (Draft Plan, Nov 2006) • North Norfolk CFMP (Scoping Report, Dec 2006) • Broadland Rivers CFMP (Draft Plan, June 2006) • East Suffolk CFMP (Scoping Report, Sept 2006) • River Nene CFMP (Draft Plan, July 2006) • Great Ouse CFMP (Draft Plan, Feb 2007) • River Welland CFMP (Scoping Report, Nov 2006) • North Essex CFMP (Draft Plan, April 2006) • South Essex CFMP (Scoping Report, May 2006) • River Tees CFMP (Scoping Report, Jan 2007)	**Catchment Abstraction Management Strategies** • The Grimsby, Ancholme and Louth CAMS (April 2006) • The Nene CAMS (March 2005) • The Steeping, Great Eau and Long Eau CAMS (Consultation Draft, Jan 2007) • The Welland CAMS (Consultation Draft, Dec 2006) • The Witham CAMS (March 2004) • The Broadland Rivers CAMS (March 2006) • The Combined Essex CAMS (Feb 2007) • The North Norfolk CAMS (March 2005) • The South Essex CAMS (June 2004) • The Cam and Ely Ouse CAMS (March 2007) • The North West Norfolk CAMS (March 2005) • The East Suffolk CAMS (Jan 2008) • The Old Bedford including Middle Level CAMS (March 2006) • The Upper Ouse and Bedford Ouse CAMS (March 2005) • The Thame and South Chilterns CAMS (March 2007) • The Trent Corridor CAMS (Dec 2003) • The Lower Trent and Erewash CAMS (March 2008) • The Wear CAMS (Sept 2006)

Want to know more about Anglian Water?
Visit www.anglianwater.co.uk to see the full range of our services.

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AW055/03/08

This report summarises our plan to maintain a secure balance between water supplies and demands in the region served by **anglianwater**

Draft Water Resources Management Plan
Summary Report, April 2008

Background to the plan

This Summary Report has been prepared from the Draft Water Resources Management Plan (WRMP) Main Report. It is intended for readers wanting an overview of the Draft WRMP and the strategy that it describes, without the detail of the process described in the fuller Main Report. This report provides a regional overview of our strategy for the management of water resources over the planning period 2010 to 2035.

This is the first time that the new statutory process for a WRMP has been used and we are pleased to consult on the Plan and welcome comments that should be sent to us via Defra. We will be publishing our Statement of Response to representations received later in 2008 and we will be submitting our Final WRMP to Defra in April 2009 for its approval. Defra is advised by the Environment Agency throughout the process.

The Draft WRMP follows the guideline, provided by the Environment Agency, that recommends a structure based on four separate parts:

- Summary Report
- Main Report
- WRP Tables
- Technical Reports

The Summary and Main Reports of our Draft WRMP are published on our website for consultation, visit www.anglianwater.co.uk

The Introduction to the Main Report gives details of how you can make a formal representation on our Draft WRMP, which should be sent to Defra before the end of July 2008.

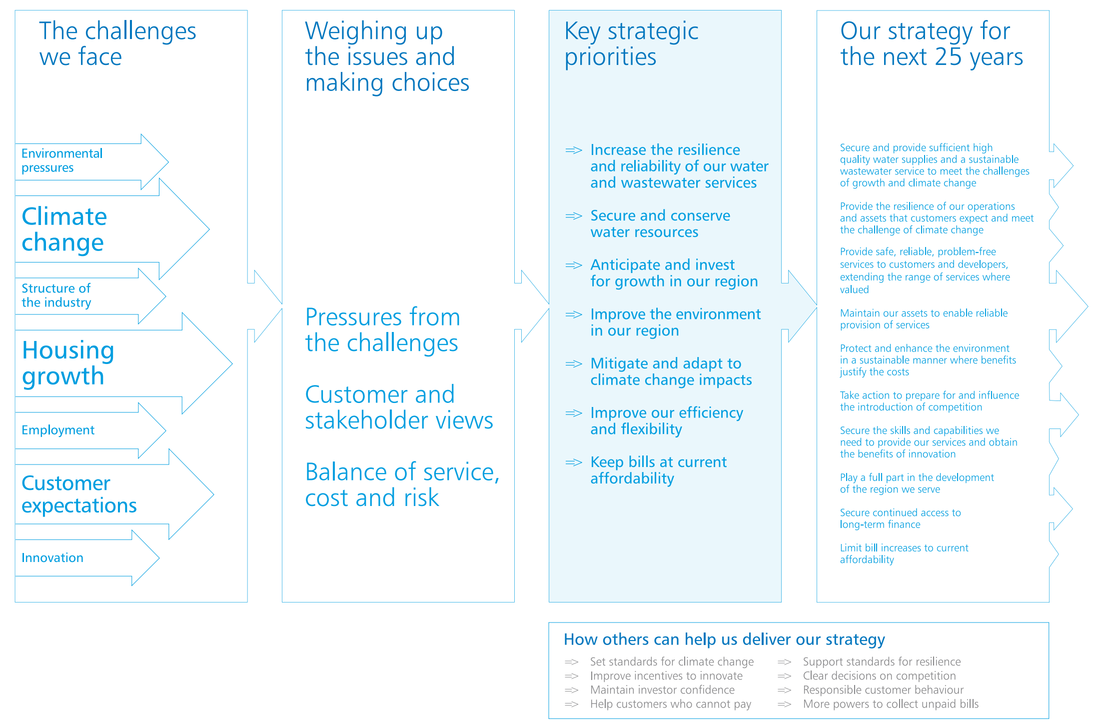
The main factors that influence our plan

Our Strategic Approach

The challenges we face as a water services company are detailed in our Strategic Direction Statement (SDS) published in December 2007.
In particular, the impact of housing growth, environmental pressures, climate change and customer expectations have a strong bearing on this plan. We operate in one of the fastest growing regions in the country, we operate in the driest region of the country and therefore have vulnerability to drought, and we have more water-dependent, European-designated conservation sites in our supply area than any other water company.

Our strategic priorities identified that we will increase the resilience of our water and wastewater services, secure and conserve water resources, anticipate and invest for growth in our region and mitigate and adapt to climate change impacts. Figure 1, taken from our SDS, shows the linkages between the challenges we face, our key priorities and our company strategy for the next 25 years.

Figure 1 Strategic direction (see our published Strategic Direction Statement for more details)



We have submitted our Draft WRMP to Defra and are confident that the Plan addresses the Government's priorities, as detailed in its 'Future Water' water strategy for England. We have in large part achieved this through the proactive promotion of household metering, resulting in our high level of over 60 per cent of customers paying measured water charges, which is double the national average. Also our level of leakage is among the lowest in the industry and our domestic customers' water consumption is below the national average.

The 2004 to 2006 drought tested the resilience of our water resources and water supply system. We were pleased that with the help of our customers' response to the need to save water and proactive management of the system, we were able to maintain supplies without the need for any restrictions on water use. However, we are mindful of the growing number of factors that influence the resilience of our system, including the impact of climate change, environmental pressures and a major loss of plant output resulting from a major incident. The need to enhance the resilience of our network by developing alternative supplies is an important aspect of our Plan.

We have worked with the Environment Agency, Natural England and conservation groups to understand the needs of the environment. Our major water supply scheme during the current planning period is to abstract and treat additional water from Rutland Water reservoir to meet growth in the west of our area. As part of this work we are creating new shallow wetlands adjacent to the reservoir to ensure that the internationally recognised wildlife is not affected when water levels fluctuate in the main body of the reservoir.

What Affects Demand

Our analysis confirms that the main driver in the demand for water is the planned economic development of the region. The plans published by the Government, regional and local authorities tell us that we should plan for an increase in the population we serve of some 850,000 people by 2035. It is expected that over 600,000 new homes will be built in our supply area over this period.

It is the people who live in homes that make up the largest part of the demand for water. We actively promote behaviour in the efficient use of water in the home through our 'Waterwise' message. This provides advice to all our customers through billing literature, on our website and at a variety of events within the region on how they can save water and money. Using less hot water adds to savings by using less energy for heating. We recognise that we will need to increase our activity to promote the 'Waterwise' message in the next five years and beyond.

We fully support the progress made in water-efficient design for new homes through the standards in the Government's Code for Sustainable Homes. We urge Government to make these standards mandatory and be backed up through tighter controls on building construction and on water fittings and appliances installed in them. All new homes are fitted with water meters and with the increasing proportion of our existing customers being metered, more water-efficient housing stock will enable us to promote water efficiency more effectively. Regulatory action is also required to provide the incentives for home improvements to be made to the same high standards for water efficiency as new build.

We are working with local authorities and the Environment Agency on water cycle studies for major new developments. These identify issues that need to be addressed in a timely manner to ensure that water supplies are provided without affecting existing customers, that wastewater can be collected, treated and returned to the environment without adverse effects and that surface water is managed to control flooding.

We work with our commercial and industrial customers through our Business Customer Services teams who offer a leakage detection service and water efficiency advice.

Water is heavy and is pumped under pressure; as a result a significant proportion is lost in distribution through our network of 38,000 kilometres of water mains, through joints between pipes and buried fittings. We control leakage by continuously monitoring the flow of water in our network, using over 3,500 zonal and district meters and repairing leaks both proactively and in response to reports made to us. Leakage from customers' supply pipes that run underground from the connection to a water main to their house accounts for about a third of all water lost. We continue to offer to repair these leaks without charge, subject to some conditions. Along with a number of other water companies we are exploring the feasibility of assuming the ownership of our customers' supply pipes.

What Affects Supplies

The water we abstract comes from ground and surface water resources in roughly equal amounts. Most of the surface water is taken from large storage reservoirs that are in turn filled by pumping water from rivers when flows are high enough. We describe below how our boreholes, shown in Figure 4, are mostly located in the Chalk aquifer in the east of the region, although we utilise the water resources of sandstone and limestone aquifers in the north. The west of the area is largely underlain by clay and uses surface water run-off stored in the large reservoirs located there.

We have analysed the potential effect of climate change on water resources. The current information indicates that the impact on water availability over the period until 2035 is relatively low compared to the effect of growth in our region. This is because we use large, pumped, storage reservoirs and boreholes abstracting from deep major aquifers. Many of the rivers we abstract from benefit during low flows from the discharge of treated water from our inland wastewater treatment works. However it is likely that we will experience more extreme events as both droughts and floods. We are taking this into account in planning for resilience and for adaptation to and mitigation of climate change. We will review the impact of climate change when advice from the UK Climate Impact Programme is updated later in the 2008 and we include a planning factor for uncertainty in our calculations.

The Anglian region has been highly developed to support a growing population and regional economy. The area is farmed intensively and there are local areas where industry produces fuel and chemicals that pose a risk to the water quality in rivers and aquifers. We have invested in complex water treatment plant with ozonation and carbon filtration treatment at our surface water sites. Many of our groundwater sites require relatively little treatment beyond the addition of chlorine as a disinfectant to safeguard against risks of contamination. However the number of groundwater sites that require treatment to remove pollution from agricultural, commercial and industrial activities has increased significantly over the last 20 years.

We intend to seek support from the Drinking Water Inspectorate, other regulators and stakeholders, to trial catchment management solutions as a more sustainable long-term option than further treatment schemes to maintain compliance with drinking water quality standards. We have experienced a number of cases of contamination of groundwater and will be working with the Environment Agency through its River Basin District Liaison Panel to protect groundwater quality as required by the Water Framework Directive. We include an allowance for the unplanned loss of water supplies as a result of pollution incidents in our calculations.

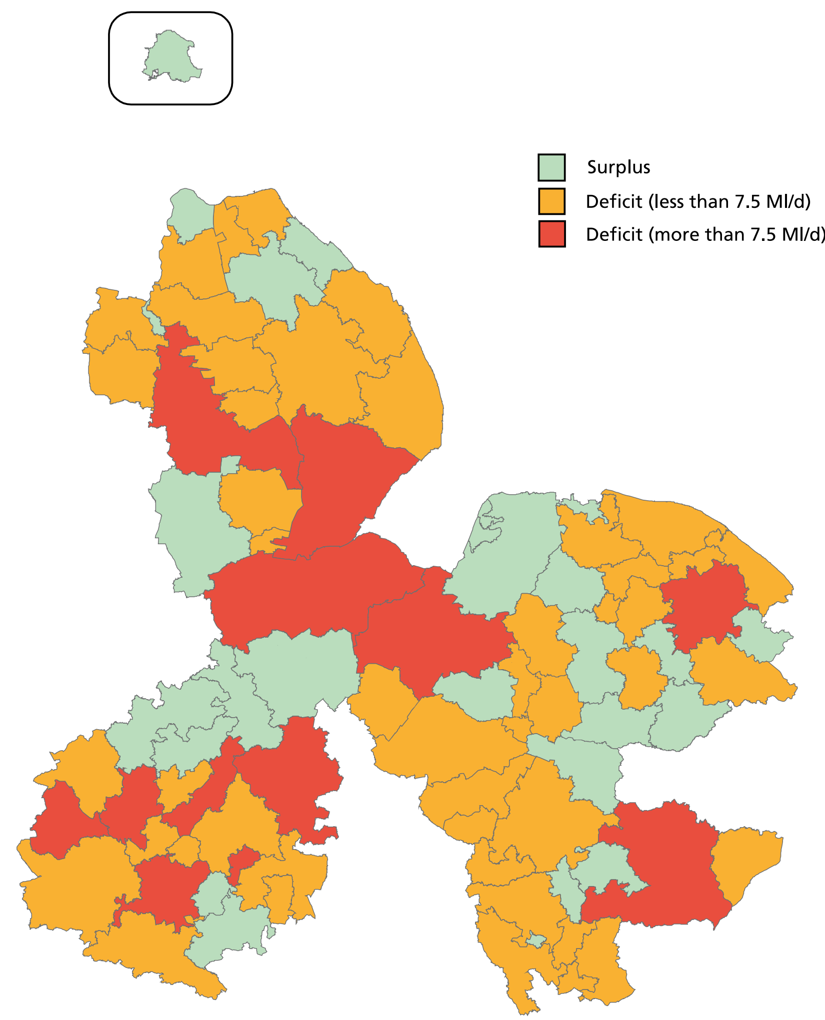
The potential impact of water abstraction on the water dependent environment is being addressed by the Environment Agency through its review of abstraction licences under the EU Habitats Directive as part of its Restoring Sustainable Abstractions programme. We have worked with the Environment Agency on investigations at over 50 conservation sites to understand the local hydrology and hydrogeology and assess what impact, if any, our abstractions may have. The Environment Agency can seek to reduce our abstraction licences in the future where it considers that there is a risk of adverse impact to a conservation site. These are referred to as sustainability reductions.

The Environment Agency has provided us with quantities for sustainability reductions that we should use at a small number of sites in our Draft WRMP, but further work is required for them to advise on whether they consider that further more significant reductions are needed. The reduction of any of our licences requires the provision of alternative water resources. The Government has told us that sustainability reductions will have to be timed so that they do not jeopardise water supplies. We have not included an allowance for additional sustainability reduction in our calculations.

The Need for Headroom

We calculate water balances between the quantity of water that we can supply and the actual demand for water over the year as a whole and at times of peak demand. As there is uncertainty in the measurement and calculation and the risk that supplies can be lost due to a major plant failure or pollution incident, we incorporate a safety margin in the supply-demand balance. This planning margin is referred to as target headroom. The target headroom is calculated for each of our 12 WRZs and varies between them due to local factors. It averages about 10 per cent of demand at the start of the planning period. As both risk and uncertainty, particularly over the forecasts for population and water consumption, grow through the planning period target headroom needs to increase. We calculate that it needs to double over 25 years to ensure that we have a robust plan to maintain secure water supplies throughout the planning period.

Our first step in identifying the need for investment in managing demand and developing additional water resources during the planning period is to calculate the headroom that is available now and throughout the planning period in the 85 Planning Zones described below. We then compare the available headroom with the requirement for target headroom to identify which zones are in surplus and which are in deficit and when deficits are forecast to occour. Figure 2 shows the situation in 2035 if nothing was done. The red areas, or 'hot-spots', are those where highest growth is planned, notably in the Milton Keynes and East Midlands sub-region in the west, the Haven Gateway on the East Coast and Lincoln and the Fens to the north.



Note: Deficit represents the largest average or peak deficit by 2035/36.
Data from FORWARD - Baseline FINAL with Dry Year Uplift with Enhanced Metering

Figure 2 Forecast Planning Zone deficits in 2035

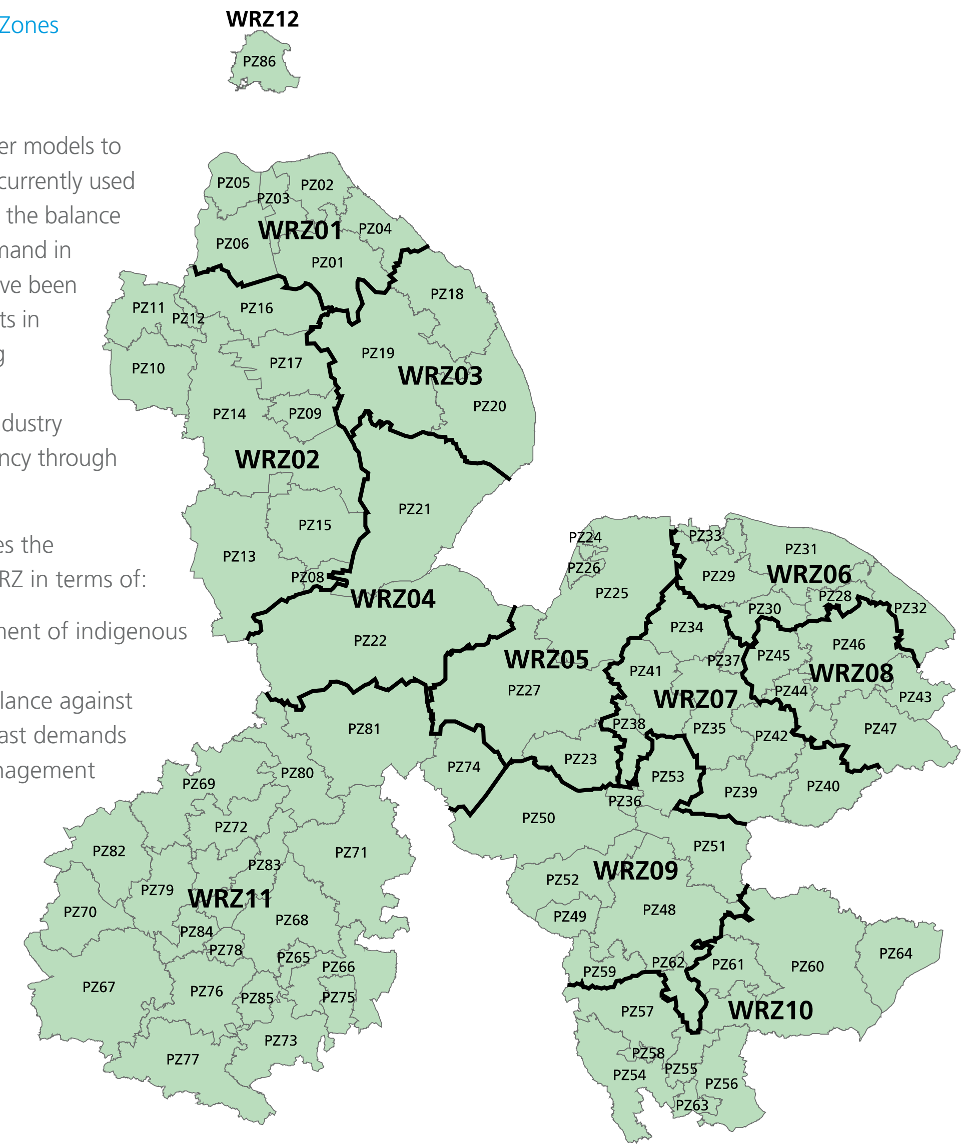
How our WRMP is prepared

The WRMP is structured on 12 water resource zones (WRZs). The WRZs are based on the existing water supply system and represent the largest area in which water resources can be shared. The WRZs are subdivided into 85 Planning Zones (PZs) that we use to calculate the balance between supplies and demands on a more local basis. Table 1 lists the WRZ and the PZs that they contain and Figure 3 shows their location.

Table 1 Water Resources Zones and Planning Zones:

Water Resorces Zones		Planning Zones	
WRZ01	South Humberside	PZ01	Barnoldby
		PZ02	Barrow
		PZ03	Elsham
		PZ04	Grimsby
		PZ05	Scunthorpe North
		PZ06	Scunthorpe South
WRZ02	Lincoln	PZ08	Billingborough
		PZ09	Branston
		PZ10	East Retford
		PZ11	Everton
		PZ12	Gainsborough
		PZ13	Grantham
		PZ14	Lincoln
		PZ15	Sleaford
		PZ16	Waddingham
		PZ17	Welton
WRZ03	Lincolnshire Coastal	PZ18	Fulstow
		PZ19	Louth
WRZ04	Lincolnshire Fens	PZ20	Skegness
		PZ21	Boston
		PZ22	Bourne
WRZ05	Fenland	PZ23	Feltwell
		PZ24	Hunstanton
		PZ25	Kings Lynn
		PZ26	Snettisham
		PZ27	Wisbech
WRZ06	North Norfolk Coast	PZ28	Aylsham
		PZ29	Fakenham
		PZ30	Foulsham
		PZ31	Sheringham
		PZ32	Stalham
		PZ33	Wells
WRZ07	Norfolk Rural	PZ34	Beetley
		PZ35	Bradenham
		PZ37	Dereham
		PZ38	Didlington
		PZ39	East Harling
		PZ40	Harleston
		PZ41	Swaffham
		PZ42	Wymondham
WRZ08	Norwich & The Broads	PZ43	Brundall
		PZ44	Hethersett
		PZ45	Lyng
		PZ46	Norwich
		PZ47	Poringland
WRZ09	Cambridgeshire & West Suffolk	PZ36	Brandon
		PZ48	Bury St Edmunds
		PZ49	Cheveley
		PZ50	Ely
		PZ51	Ixworth
		PZ52	Newmarket
		PZ53	Thetford
		PZ59	Haverhill
		PZ62	Sudbury
WRZ10	East Suffolk & Essex	PZ54	Braintree
		PZ55	Bures
		PZ56	Colchester
		PZ57	Halstead Rural
		PZ58	Halstead Urban
		PZ60	Ipswich
		PZ61	Semer
		PZ63	Tiptree
		PZ64	Woodbridge
WRZ11	Ruthamford	PZ65	Bedford
		PZ66	Biggleswade
		PZ67	Buckingham
		PZ68	Clapham
		PZ69	Corby
		PZ70	Daventry
		PZ71	Huntingdon
		PZ72	Kettering
		PZ73	Leighton Linslade
		PZ74	March
		PZ75	Meppershall
		PZ76	Milton Keynes
		PZ77	Mursley
		PZ78	Newport Pagnell
		PZ79	Northampton
		PZ80	Oundle
		PZ81	Peterborough
		PZ82	Ravensthorpe
		PZ83	Rushden
		PZ84	Wellingborough
		PZ85	Woburn
WRZ12	Hartlepool	PZ86	Hartlepool

Figure 3 Water Resource Zones and Planning Zones



We use a suite of computer models to understand how water is currently used in each PZ and to forecast the balance between supplies and demand in the future. The models have been developed for us by experts in different consultants using standard methodologies developed by the water industry and the Environment Agency through collaborative research.

The Main Report describes the characteristics of each WRZ in terms of:

- The historical development of indigenous water resources
- The supply-demand balance against both current and forecast demands
- The feasible water management options identified
- The preferred list of water management options selected.

Background to our use of water resources

The history of public water supplies starts with the development of local groundwater sources in the form of a community natural spring or hand pump. These were progressively replaced from around the mid 19th Century with piped water supplies using larger sources, including treated surface water supplies. It was the middle of the 20th Century before potable mains water supplies reached many small villages, by which time most private water supplies were also replaced with less than 1 per cent of the population now using private water sources. The original driver to improve public health is now taken for granted, being replaced by an expectation of the provision of piped water and wastewater services as the norm for living.

The preferred option for water supply has traditionally been controlled by the availability of local groundwater and surface water sources. As the demand for water increased and local supplies were developed to their sustainable level, a network of raw and treated water transfers was developed along with strategic storage reservoirs, resulting in the extensive network that provides water services today.

Figure 4 shows the location of the water sources that supply the Anglian region.

The amount of water supplied increased as a result of economic growth and technological advances, with the demand for water increasing as a result of more washing machines and dishwashers and improved bathrooms and kitchens. Figure 5 shows how the amount of water we supply grew steadily from the 1960s through to 1990, but has stabilised over the last 15 years in response to better leakage control, household metering and a decline in water used by industry. Since 1989 the number of properties that we supply has increased by 20 per cent.

Looking forward over the new planning period to 2035, we face challenges from plans for regional growth, climate change impacts and environmental legislation.

The potential impact of growth in particular has risen markedly since our last review and plays a major role in the need to invest in water resource management to maintain the security of public water supplies.

Figure 4 Water sources

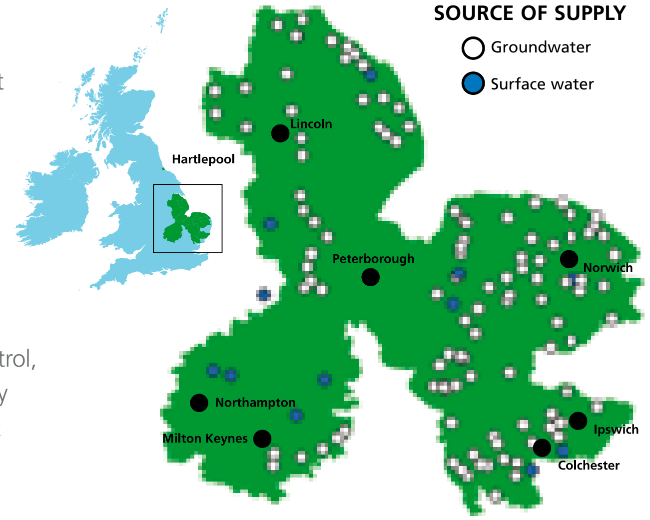
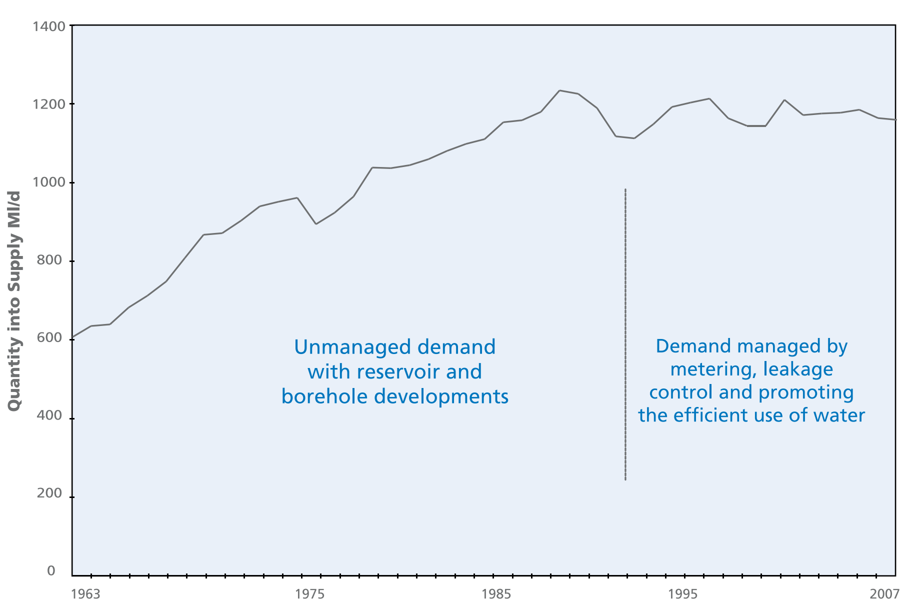


Figure 5 Water supplied 1963-2007



Our proposed water resources plan

Twin-Track Solutions

Our proposed water resources plan sets out how we address the forecast deficits between supplies and demand by continuing to apply the principles of the 'twin-track' approach that we have successfully used to date. We have included generic demand management options in our supply-demand modelling by targeted customer metering and water efficiency schemes as well as the use of further targeted leakage control in determining the optimal mix of schemes. The options for resource development depend on the local availability of water resources.

The demand management options are usually selected by our supply-demand model in advance of resource development options, except where they are insufficient to meet an early forecast deficit, or the cost is excessive. Savings in demand, or a surplus in supplies can be transferred where there is a connection between areas with a surplus and those with a deficit. Savings through metering of the remaining third of our customers who do not already have a water meter are included in our forecast to become metered by 2035. By using enhanced metering we will accelerate the savings and either defer the need for resource development, or extend the length of time before a further scheme is needed.

Similarly, we currently apply the twin-track approach through leakage control as an integral part of maintaining a secure balance between supplies and demands. Our supply-demand model calculates a potential increase in the level of leakage due to an increase in the length of water mains and an increase in the number of properties that we supply. The model is used to ensure that we are controlling leakage at a level that takes all costs into account. The result is that we plan to maintain leakage at around the current level, although we will reduce leakage during periods of water resources stress, as we did during the recent drought in 2006-07.

Maintaining the current level of leakage going forward will result in leakage rates falling in relation to both a unit length of main and per customer connection.

The savings through our continued promotion of water efficiency are incorporated into our demand forecast for a reduction in both per capita domestic consumption and industrial demand. The savings through targeted water efficiency schemes to supply devices to reduce WC flushes and for home water audits, are not expected to contribute significant savings on a regional basis. We are reliant upon Government to introduce regulations for higher standards of water efficiency in new homes and to improve the current housing stock. We urge Government to do so, so that the effectiveness of our promotion of 'Waterwise' behaviour can be maximised.

Resource development schemes are needed in the majority of PZs where we forecast a deficit of available headroom against target headroom. In many cases a scheme will provide water to more than one PZ, with the scheme being extended by improving the trunk main and local water distribution system to deliver additional water supplies to new and existing customers. Table 2 lists the resource developments that we propose in our water resources plan. The proportion of supplies developed from the use of current unused licences, reallocating or licensing new groundwater resources and through the re-use of surface water discharges is shown in Figure 6. The main schemes and the links required to provide water supplies where they are needed are shown on Figure 7.

Table 2 Selected new resource development schemes

Location – WRZ	Scheme name
Lincoln	New Lincoln water treatment works Grove WTW extension
Lincolnshire Fens	New Lincolnshire Fens water treatment works
Fenland	Extn to Cut-off-Channel/Wissey water treatment works
North Norfolk	Secondary groundwater use
North Rural Development	Reallocation of the Great Ouse Groundwater
Norwich & The Broads Development	Utilise full Norwich groundwater licence New Norwich urban groundwater source Reallocation of the Great Ouse Groundwater
Cambs & West Suffolk	Reallocation of the Great Ouse Groundwater
East Suffolk & Essex	Bucklesham recommissioning with groundwater storage Ipswich discharge re-use Ipswich PZ transfer with enhanced metering Ardleigh reservoir extension
Ruthamford	Recommissioning of Foxcote reservoir Uprating of Bedford Ouse water treatment works Recommissioning of Pulloxhill water treatment works Peterborough discharge re-use

Figure 6 New supplies by resource category

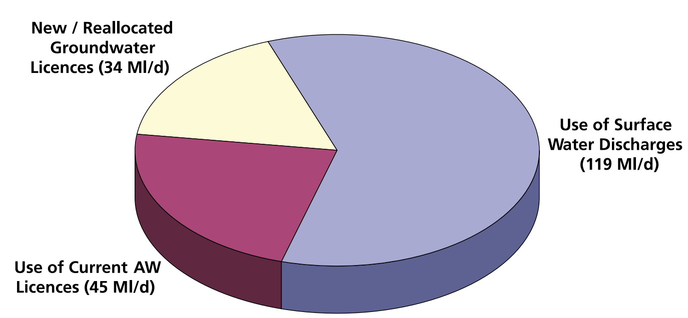
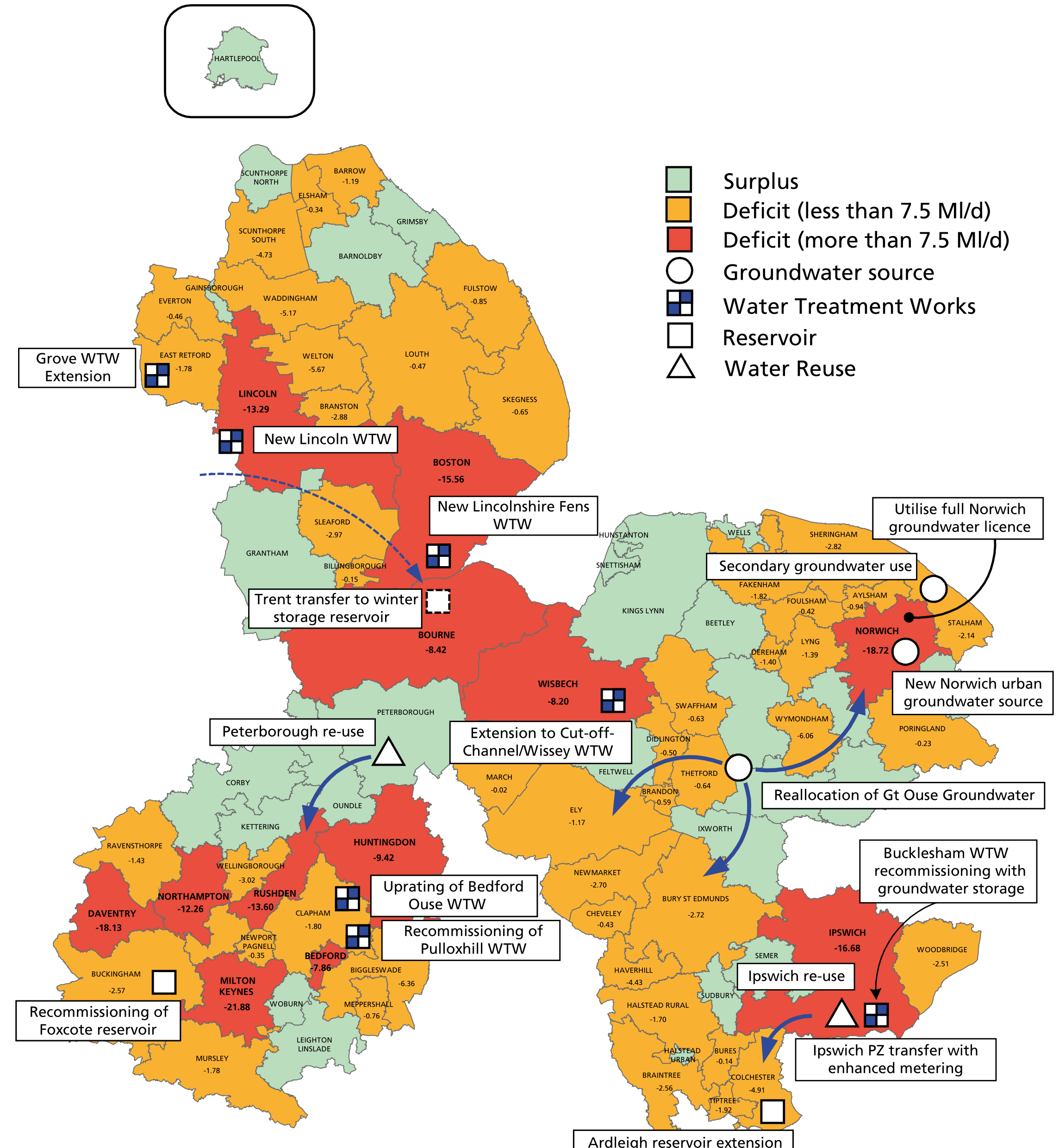


Figure 7 Selected resource development options



Note: Deficit represents the largest average or peak deficit by 2035/36.
Data from FORWARD - Baseline FINAL with Dry Year Uplift with Enhanced Metering

The proposals for a plant abstracting water from the River Trent for a New Lincoln WTW and the Lower River Witham for a New Lincolnshire Fens WTW will be phased to provide operational experience on the treatment of the new surface water resources and an opportunity to trial new, more efficient, physical treatment processes. The extension of the existing WTW at Grove in Nottinghamshire will reduce supplies available to Lincoln, with these being replaced by the New Lincoln WTW.

We have selected two active discharge re-use schemes, one for the return of coastal discharges after additional treatment to inland waters, for subsequent abstraction downstream to refill Alton Water reservoir, and one to replace flows downstream of a river intake, with the additional water resulting from growth in Peterborough. As well as these two active discharge re-use schemes the development of the Bedford Ouse WTW, the New Lincoln WTW and the New Lincolnshire Fens WTW make passive use of increased discharges of wastewater from developments higher in their river catchments. These schemes represent an opportunity for the sustainable use of water resources that would otherwise be lost.

The remaining schemes develop additional water supplies using a combination of currently licensed water resources and the reallocation or licensing of new groundwater resources. The currently licensed water sources are located across the region and include Foxcote reservoir in Buckinghamshire, the Cut-off-Channel in Norfolk together with smaller groundwater sources. The new and reallocated groundwater resources are those of the Great Ouse Groundwater Development Scheme (GOGDS) licensed to the Environment Agency and the Broads Chalk aquifer next to the northeast Norfolk Coast, which has been identified as having poor quality water available for abstraction. We expect that the Environment Agency will recognise the need for redistributing water resources for the GOGDS by working with us following the completion of the review of consents before the start of the planning period.

The proposed schemes include those for the innovative use of the Chalk aquifer beneath the Felixstowe Peninsula around Bucklesham as an underground storage reservoir and the development of secondary groundwater on the northeast Norfolk Coast. Both of these schemes will require research to achieve the high level of efficiency that we will require for sustainable use.

Managing Risk and Uncertainty

Our full analysis covers a 30-year period between the base year of 2006-07 and 2035-36. To build the numerical models needed to forecast the supply-demand balance over this period, we have to make a number of assumptions. These relate to both the demand that we are likely to experience and to the availability of new or existing supplies.

Given the extended forecast period, the assumptions we have made are subject to a degree of uncertainty. This is recognised through the allowance of target headroom in our plan to take account of uncertainty. As we have included target headroom in our demand forecasts and we have sufficient options to maintain the supply-demand balance, we are confident that we can manage the risks and uncertainties that are inherent in the 25-year plan we are proposing. Future five yearly reviews of the supply-demand balance will help us to monitor this situation and to ensure that any emerging risks are proactively managed.

There are, however, a number of assumption-related uncertainties which we have not taken account of in our plan. These are significant and include:

- On the advice of the Environment Agency, we have assumed a low level of sustainability reductions in our Draft WRMP. However, some recent reports published by the Environment Agency refer to sustainability reductions over 10 times greater in the Anglian region. We will continue to work with the Environment Agency to confirm the appropriate level to include in our Final Plan
- We have assumed that it will be possible to develop the licensed water resources of the GOGDS, currently held by the Environment Agency for river augmentation use, for the direct supply of potable water. If this is not available, we would be required to develop an alternative water resource
- We have assumed that it will be possible to further use the growth in existing discharges or new discharges that augment the flows of the Rivers Trent, Witham, Nene, Gipping and Colne for water supply. If these resources are not available, we would be required to develop an alternative water resource
- We have assumed that there will be no growth in the statutory allocation for exports from our Ruthamford system. However, in discussion with our neighbouring water companies, the possibility of making significant additional quantities of water available from this system has been raised

If any of these assumptions are incorrect it is likely that we would be required to develop an alternative Plan. Given the quantities of water involved, this would be based on the use of the extensive water resources of the River Trent during periods of high flow and the development of an associated winter storage reservoir in the South Lincolnshire Fens.

To manage the risks associated with the uncertainties not included in target headroom and constraints through the planning system, we propose to progress our current preliminary works on the South Lincolnshire winter storage reservoir during the next five years and to review the need to promote it as a major scheme in our next Water Resources Management Plan in five years time.

Developing our Draft Plan to a Final Plan

We believe that our Draft WRMP encompasses the Government's priorities for water resources, as detailed in its 'Future Water' water strategy for England. We have also worked closely with the Environment Agency, Natural England and others through the consultation on our Strategic Direction Statement and continue to work with them through the Business Planning process for the next Periodic Review to understand and consider their respective priorities.

We welcome your comments on our Draft WRMP, which should be sent to Defra for forwarding to us. We will respond to representations received during the next phase of formal consultation before preparing our Final WRMP for submission to Defra for approval in April 2009.