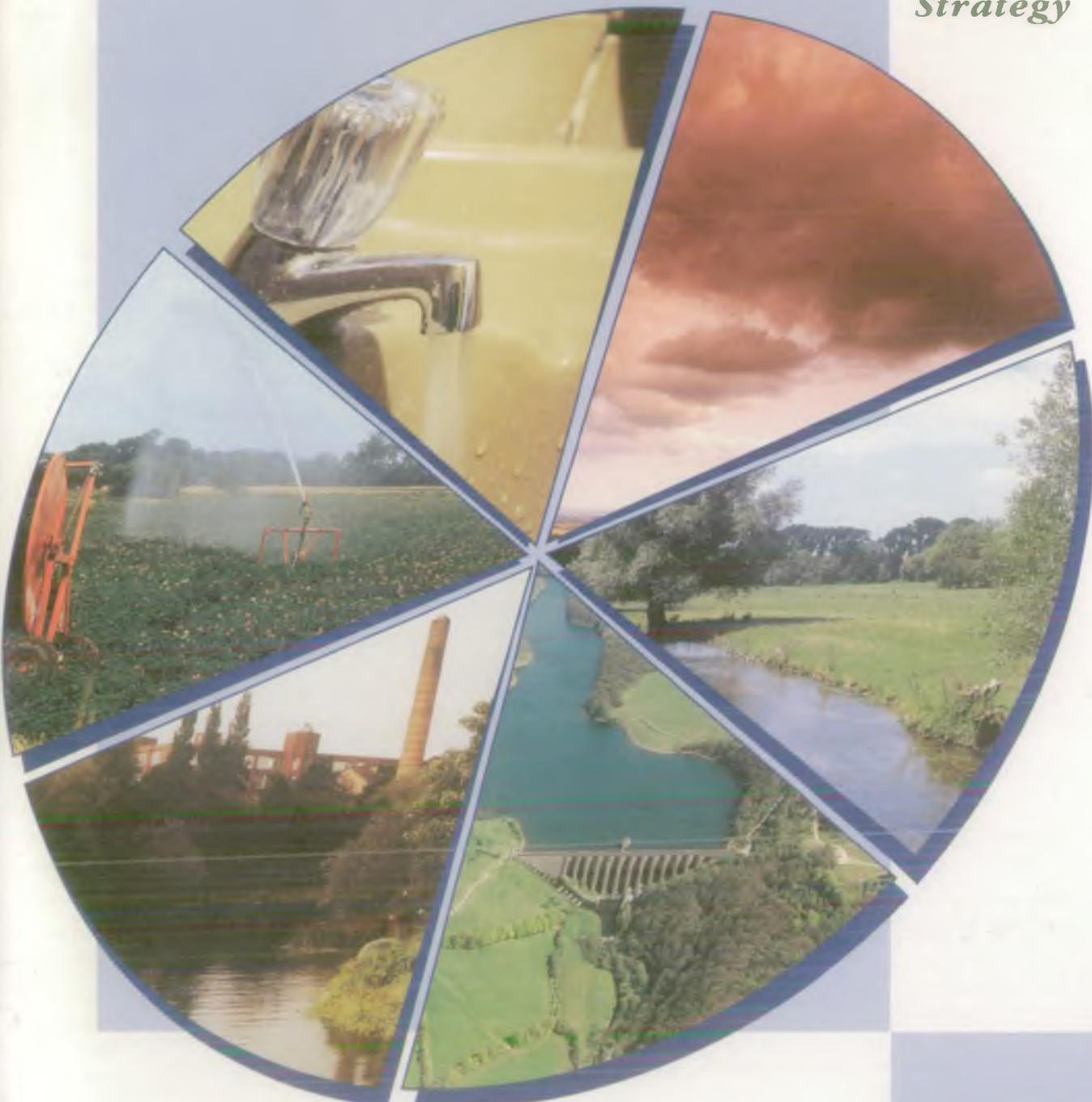


TOMORROW'S WATER

*Water
Resources
Development
Strategy*



NRA

*National Rivers Authority
South Western Region
April 1995*

FOREWORD

The NRA has a duty to take such action as is necessary to conserve, redistribute or augment and to secure the proper use of water resources. This document sets out the regional water resources strategy for maintaining and creating sustainable resources for abstraction while protecting the aquatic environment.

I commend the publication of the first Regional Water Resources Development Strategy as a valuable step forward in pursuing the NRA's responsibility in this area. It follows a full and useful period of public consultation. Comments received on the consultation documents have either been incorporated in the main text or are generally addressed in Appendix 1.

Whilst this strategy will need to be reviewed periodically, it will provide a firm foundation for the water resources development aspects of the catchment management plans which are the cornerstone of our integrated approach to river management.

Katharine Bryan
Regional General Manager

ACKNOWLEDGEMENTS

The NRA acknowledges the help and advice given throughout the preparation and publication of this strategy by numerous organisations and environmental bodies such as:

Bournemouth and West Hampshire Water Plc
Bristol Water Plc
British Trout Association
British Waterways Board
Council for the Protection of Rural England
Country Landowners Association
Department of the Environment
English Nature
Friends of the Earth
National Farmers Union
Office of Water Services

South West Water Services Ltd
Wessex Water Services Ltd

In addition valuable contributions were received from various groups and individuals in response to the public consultations. These include:

Angling Associations
County, District and Parish Councils
Nature conservancy/Environmental protection Groups
Port/Harbour Authorities



5.1.3 Transfers And Imports/Exports

Imports of water into the South Western Region of the NRA are used by three of the water companies operating within the Region and represent 12% of the Region's public water supply resources. The largest is an import from the River Severn via the Gloucester and Sharpness Canal at up to 190 MI/d. The other imports represent only a minor resource and originate from groundwater within the neighbouring NRA Southern and Thames Regions.

The Fawley oil refinery, located on Southampton Water, is Esso's principal refinery in Europe. Water is exported out of the South Wessex Area to supply the refinery, located in the Southern Region of the NRA, from the Bournemouth and West Hampshire Water Company's river source at Knapp Mill. The average demand is 42 MI/d and there is limited scope to increase this to the agreed maximum of 45 MI/d. The water company does not envisage any increase in demand on the Knapp Mill source from the Fawley oil refinery in the future.

There are numerous transfers of water within the Region as a consequence of integrated use of sources within a water company supply zone. There are also instances where a water company transfers water to another or between their own supply zones. The major transfers are:

- A transfer from Bristol Water to Wessex Water
- A transfer from Wimbleball reservoir located within South West Water's supply zone to Maundown Water Treatment Works for use in Wessex Water's Somerset supply zone
- A transfer from the Wylde catchment by Wessex Water for use in its Somerset supply zone
- A transfer from Blashford Lakes located within Bournemouth and West Hampshire Water Company's supply zone for use in Wessex Water's Dorset supply zone
- A transfer from the River Exe by South West Water for use in their North Devon supply zone

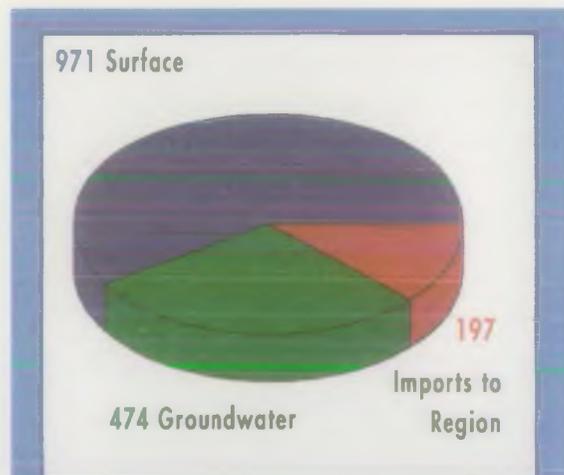


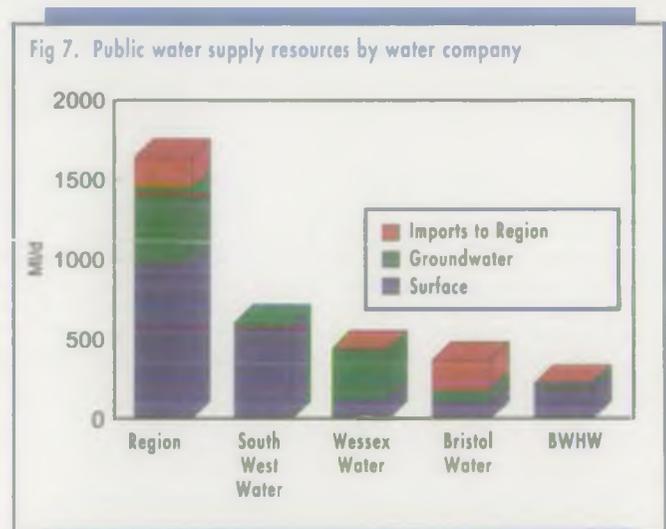
Fig 6. Public water supply sources - regional (MI/d)

5.1.4 Water Company Resources

The total reliable resources available to the companies in a drought year are 1644 MI/d. This total is comprised as follows:

Water Company	Zone	Total Reliable Resources
Bournemouth and West Hampshire Water		227 MI/d
Bristol Water		370 MI/d
Cholderton and District Water Company		< 1 MI/d
South West Water	Colliford	170 MI/d
	Roadford	334 MI/d
	Wimbleball	101 MI/d
Wessex Water	Avon/Wiltshire	159 MI/d
	Dorset	164 MI/d
	Somerset	118 MI/d
TOTAL		1644 MI/d

The total reliable resources have been calculated using data held by the NRA and data supplied by the water companies. The totals represent the maximum quantity of water that can be reliably supplied from a source during a drought of a severity similar to 1975/1976.



The available resources have been reduced by 2.5% from these figures to allow for 'outage'. Outage is a reduction in the apparently available total supply caused unpredictably by part, or all, of a source of supply being temporarily unavailable at any one time. The NRA, in conjunction with the water companies, is researching 'outage' to seek a better measure for this allowance.

Cholderton and District Water Company, which supplies 2000 people, has been identified as needing only a minor groundwater development to meet future needs. This requirement will have little impact upon the Regional resource development strategy and is not considered further.

5.1.5 Drought

Current standards of service guidelines are laid down by the water industry regulator OFWAT, for example, a hose pipe ban not more than once in 10 years to manage resources during periods when these are under stress. Other more stringent temporary powers obtained under Drought Orders are accepted by OFWAT, but the use of such measures is not generally welcomed.

The NRA will seek to ensure that adequate, sustainable resources are developed to reduce the frequency with which water companies seek temporary powers which may impair the water environment. In order to limit the possible adverse effects of such unplanned powers the NRA is keen to embody drought contingency plans into the accepted operating rules for licensed sources, particularly conjunctive use resource systems.

5.2 Private Water Supply Resources

Private supply refers to the volumes of water abstracted from surface and groundwater sources by individuals and industrial concerns for their own purposes. These private abstractions are, in most instances, required to be licensed by the NRA. Typically, users take less than their licence entitlement, but in determining new licences the NRA must protect existing authorised abstractions.

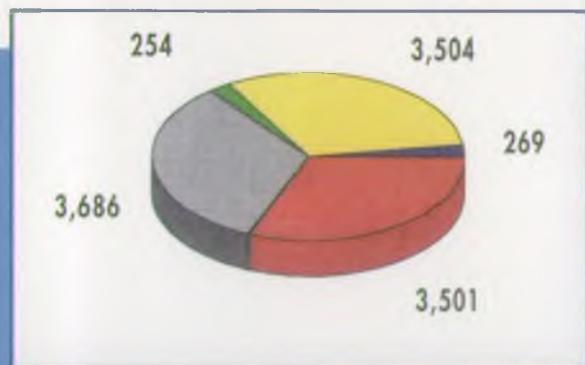


Fig 8. Gross private licensed sources (Ml/d)

Key

- Agriculture
- Spray Irrigation
- Fish Farming
- Industrial
- Hydropower
- (Others = 21)

Use of licensed private water supplies can be grouped into a number of purposes. The main groups are:

	number of licences
- spray irrigation	858
- agriculture (excluding spray irrigation)	8233
- fish farming	318
- industry/commerce	992
- hydropower	85
- other private water undertakings	830

Crown Establishments are exempt from licensing but make abstraction returns to the NRA and pay an abstraction charge. From recent annual returns their average abstraction is in the order of 13 Ml/d. More than 90% of this is from groundwater abstractions operated by the Ministry of Defence from the Chalk of Salisbury Plain.

The greatest spray irrigation demands arise in the Hampshire Avon, Dorset Stour, Exe, Piddle/Frome, Axe, Otter, West Cornwall and the upper Tone catchments; the last being the largest potato growing area in the Region. Spray irrigators have a high nett use of water, with virtually none being returned to the catchment. In addition, the season of highest need for spray irrigation is between May and September which coincides with the period when water resources are most limited and environmental needs are high.

Fish farming accounts for 25% of private water abstraction, with by far the most abstracted from the Hampshire Avon catchment. Fish farming has no nett loss. Water abstracted is returned to the catchment. Other abstractions with effectively no nett loss include those for hydro-power and diversions to leats and millstreams; although such abstractions can cause localised low flow problems for the bypassed reach. The daily abstraction for these uses amounts to 7005 Ml/d; some 60% of the total private supplies.

Industrial/commercial use includes water used in manufacturing, food processing, hydro-electric power generation, hotels, some leisure purposes and cooling. This category of abstractor also encompasses the aggregate and mineral extraction companies such as the china clay works in Cornwall and gravel extraction companies across the Region. The daily abstraction for these purposes is 3686 Ml/d and accounts for 33% of all private use. Included in this figure is Nuclear Electric's tidal abstraction from the River Severn at Oldbury Power Station where virtually the whole abstraction is returned to the abstraction point. Conversely the National Power abstractions from the river Tavy to supply Mary Tavy and Morwellham Power Stations are not returned to the point of abstraction and in the latter case not to the same catchment. This is being addressed in one of the specific low flow investigations in the Region.



6. PRESENT AND FUTURE DEMAND FOR WATER

In preparing this water resources strategy, the NRA has examined the present level of public water supply resource development and private resource commitment in the South Western Region. The current balance of resources against the use of that water needs to be established to assess future needs for resource development.

6.1 Present Public Demand

The water supplied by the water companies in 1991 was as follows:

Bournemouth and West	
Hampshire Water	154 MI/d
Bristol Water	310 MI/d
Cholderton and District	
Water Company	0.6 MI/d
South West Water	483 MI/d
Wessex Water	403 MI/d
Total	1351 MI/d

6.2 Present Private Demand

Commitment to private water resources in the Region, as defined by gross licensed entitlement, totals over 11200 MI/d. This appears to exceed the available resources in some areas, assuming each unit of water can only be abstracted once (100% nett use). In reality, water is often returned to the catchment (eg fish farming 0% nett use) and is re-used. This is also the case with public water supplies when effluent is returned to the river; although in this Region the majority of treated effluent is discharged to the sea and lower/tidal reaches. It is the nett resource commitment which is of most relevance to environmental impact.

Assuming the following rates of nett use:

- agriculture	25%
- spray irrigation	100%
- fish farming	0%
- industry/commerce	30%
- MOD	30%
- hydropower	0%
- other private water undertakings	25%

Then the nett commitment is estimated to be 617 MI/d. This is less than half the current total public water supply use and private supply is from many more abstraction points that are widely dispersed.

6.3 Future Demand For Public Supplies

Public water supply consumption can be divided into three categories; domestic, industrial/commercial, and system losses.

The extent to which demand will increase over the next 30 years will depend on several factors including:

- population growth
- personal use of water
- number of dwellings built
- level of economic activity
- levels of leakage control
- measures to reduce demand
- climate change

Until recently, demand has been predicted solely by the water companies, using component and /or historical extrapolation methods which combine different techniques and assumptions.

In 1994 the NRA developed a nationally consistent method of forecasting demand for water. This method was used to produce the forecasts published in the NRA National water resources strategy and has been also used in this document. Current collaborative studies aim to reconcile the forecasting methods used by the NRA, water companies and OFWAT to achieve a uniform approach to producing future demand forecasts.

The NRA method uses the now generally accepted component technique for predicting demand with three components:

- domestic demand
- industrial and commercial demand
- total water losses

The domestic and industrial and commercial demand components are further sub-divided into metered and unmetered sub-components. Total water losses are sub-divided into customer and water company losses. The growth of each component varies depending on different assumptions used in the forecast to produce a number of scenarios for total demand prediction. For the purposes of this document a range of forecasts are considered which describe low and high growth scenarios. The table below describes in detail the assumptions used in these scenarios as based upon the National Strategy.

NRA Assumptions	High	Low
	<p>Per Capita Consumption Growth</p> <p>1. Growth by compound annual rate of 1%. Upper limit of 189 l/h/day.</p> <p>2. Growth by compound annual rate from Binnie & Herrington (1992). Upper limit of 180 l/h/day.</p>	■
<p>Commercial Growth</p> <p>3. Growth in metered and unmetered non-domestic consumption by compound annual rate of 0.75%.</p> <p>4. No growth in metered and unmetered non-domestic consumption above 1992 level.</p>	■	■
<p>Metering</p> <p>5. No increase in proportion of domestic metered properties subject to metering above 1991 levels.</p> <p>6. For Bristol Water/BWHW/Wessex Water 30% of households will have meters by 2006 (ongoing from 1996 with equal phasing each year). For South West Water Assumption no. 5 applies.</p>	■	■
<p>Leakage</p> <p>7. 1991 levels held to simulate effect of no improvements to reduce leakage. If existing leakage >290 l/prop/day then it is expected to be reduced to this figure at rate of 10 l/prop/day/year.</p> <p>8. Targets achieved - reduction in Bristol Water/BWHW/Wessex Water to 120 l/prop/day and in South West Water to 200 l/prop/day. The expected rate of reduction is 20 l/prop/day/year.</p>	■	■

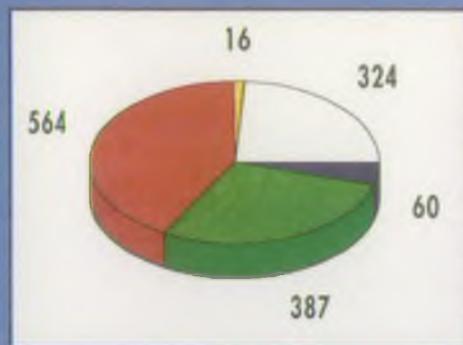


Fig 9. Public Water Supply demand components



The high growth prediction combines high growth of domestic and industrial and commercial consumption with no improvements to reduce company losses to target levels, or any increase in domestic metering which is assumed to reduce water use.

The low growth prediction assumes low domestic growth, no increase in industrial/commercial consumption and company loss targets are achieved as a result of metering and leakage control.

The predicted demands to 2021 are shown in five graphs below. The graphs depict individual forecasts for each of the larger water companies and the regional aggregate.

In 2021 the predicted demands are:

Water Company	2021	
	High	Low
Bournemouth and West Hampshire Water	191	164
Bristol Water	427	380
Cholderton and District Water Company	1	1
South West Water		
Colliford Zone	222	183
Roadford Zone	347	291
Wimbleball Zone	121	108
Sub-Total	690	582
Wessex Water		
Avon/Wilts Zone	196	146
Somerset Zone	175	131
Dorset Zone	193	137
Sub-Total	564	414
South Western Region	1873	1541

The Bristol Water predicted demands have been adjusted to take account of existing legal obligations to provide bulk supplies to ICT and Wessex Water.

6.3.1 Possible Climate Change

There is international concern that increased greenhouse gases in the atmosphere may lead to global warming and cause climate change. This has been heightened in the UK by the recent incidence of droughts, followed by periods of flooding.

The burning of fossil fuels to provide energy contributes to the build up of greenhouse gases. However, the potential causes and effects of global warming are still uncertain and the processes little understood. A recent study predicted that per capita consumption of water could rise by an additional 10 litres/head/day by 2021 if a mean temperature change of up to 2 degrees centigrade occurred. If this were to be applied to the South Western Region, the forecast demands under the high scenario could increase by up to 2.5%. Given that such increases would occur primarily in existing centres of population then no specific alternative development options are required just for climate change. One effect of climate change would be to bring forward the necessity for pumped storage of strategic reservoirs and the phased increase in imports. The impact on effective rainfall is likely to be marginal.

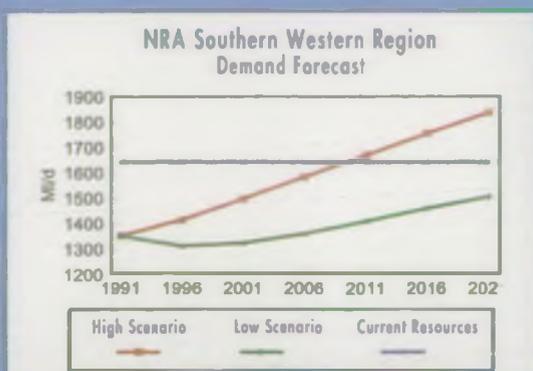
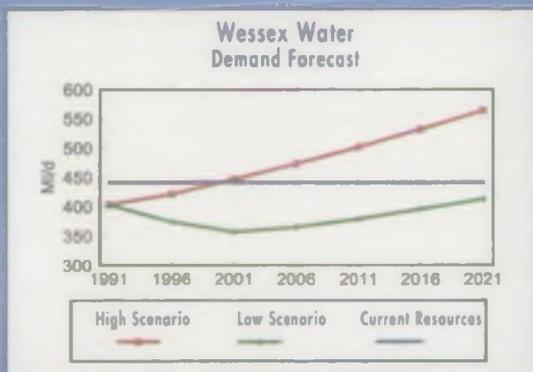
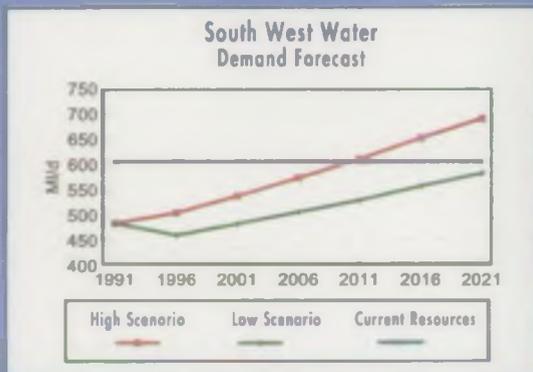
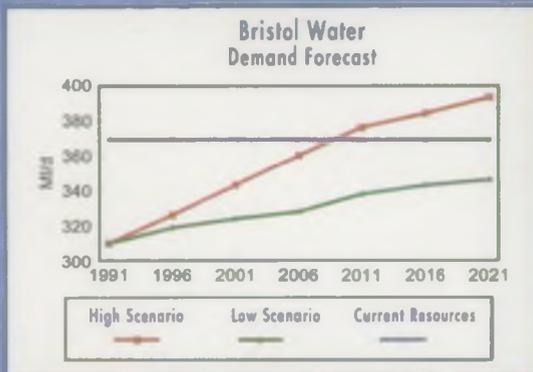
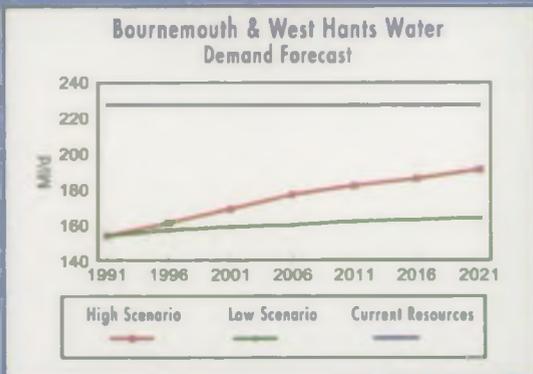
6.4 Future Demand For Private Supplies

The nett private resource commitment for 1995 is calculated to be 617 MI/d. Forecasts of growth in this sector are beset by even more uncertainties than for public water supplies. The use is influenced by numerous and differing political, economic and environmental factors. Current national studies aim to reduce some of the uncertainties associated with these factors but forecasts are always likely to be vulnerable to volatile influences of commercial markets.

The forecast growth rate of private demand has been calculated using the following:

	growth rate per year
spray irrigation	1.7% (1995-2001) and 1% (2002-2021)
industry/commerce	0.75%
all other uses	0%

Applying these rates to the nett resource commitment, it is predicted that private demand will increase by some 309 MI/d by 2021. Growth in private supplies tends to be geographically dispersed in contrast to the more concentrated point sources for public water supply. The growth rate for industrial water use may be misleading given that abstraction of water is not a necessary adjunct to industrial growth. In that case all additional future demand would be attributable to spray irrigation and would represent an increase of 95 MI/d by 2021.



7 BALANCING DEMAND FOR WATER SUPPLY & ENVIRONMENT

Water is used to meet:

- environmental needs
- public and private demand

The NRA has a role to balance these needs which frequently are seen to be in conflict, and to ensure water resources are sustainable in the long term.

NRA Water Resources Policies:

The NRA has adopted a range of key policies to help achieve an environmentally sustainable water resources strategy. Foremost amongst these are:

Sustainable Development	ensuring there will be no long-term deterioration in the water environment due to water resources development and water use.
Precautionary Principle	making sure that decisions made and measures implemented err on the side of caution if significant environmental damage may occur, or if knowledge on the matter is incomplete.
Demand Management and Better Use	ensuring due attention has been given to the management and conservation of water resources by measures to control waste and manage demand and to make best use of existing resources, before licensing the development of additional resources.

7.1 Present Public Water Supply Balances

The current public water supply demand/resource balance is: *

Bournemouth and West	
Hampshire Water:	67 MI/d surplus
Bristol Water:	17 MI/d surplus
South West Water -	
Colliford zone:	15 MI/d surplus
Roadford zone:	80 MI/d surplus
Wimbleball zone:	12 MI/d surplus
Sub-total:	107 MI/d surplus
Wessex Water -	
Avon/Wilts. zone:	14 MI/d surplus
Dorset zone:	22 MI/d surplus
Somerset zone:	9 MI/d deficit
Sub-total:	27 MI/d surplus
South Western Region:	218 MI/d surplus

* based on data for 1991 & 1992 (Sum of available resource is restricted to the zonal boundaries).

7.2 Forecast Public Water Supply Balances

The resource demand balance can be used to identify where and when any resource deficits will occur. Deficits are shown in the table opposite as shaded entries.

Under the NRA policy of encouraging demand management, leakage control and displacement of surpluses there should be no need for major new sources for 20 years or more.

Predicted Annual Average PWS Surpluses and Deficits (-) in the South Western Region (Ml/d)

Water Company	2001		2011		2021	
	High	Low	High	Low	High	Low
Bournemouth and West Hampshire Water	52	62	39	59	30	57
Bristol Water	-16	3	-49	-11	-66	-19
South West Water Colliford Zone	-3	18	-29	2	-57	-17
South West Water Roadford Zone	54	83	18	61	-21	35
South West Water Wimbleball Zone	2	6	-10	-2	-22	-10
Wessex Water Avon/Wilts Zone	0	30	-17	23	-41	9
Wessex Water Dorset Zone	6	41	-17	31	-33	23
Wessex Water Somerset Zone	-24	1	-38	-4	-60	-16
Total Surpluses(+)/ Deficits(-)	71	244	-103	159	-270	62

Alternatively, if demands should rise at the high rate, for a presently unforeseeable reason, major new sources would be widely needed. As it is likely to take up to 20 years to plan, promote and build a major new source, it must be prudent to start the planning process in time to enable realistic and environmentally acceptable schemes to be brought forward to meet this rate of genuine growth.

The predicted annual average surpluses and deficits do not provide an entire picture for the future. Peak demands, for example during the summer holiday season, may exceed the available immediate output from water sources. Without adequate storage or effective management this may lead to a requirement for new source developments. The NRA believes that it is good practice to design future needs in the first instance on the basis of average demands; only allowing an excess for peaks where plans for constraint on demands or the provision of greater storage of water would be unreasonable. In addition assessment of demands at these strategic levels may mask potential local deficits. The NRA will continue to refine demand predictions to smaller zones of supply, preferably of around 50000 people or less.

7.3 Forecast Private Water Supplies Balance

The predicted growth in private demand in the region by 2021 is 309 Ml/d, entirely due to anticipated increased spray irrigation and industrial/commercial use.

Growth in spray irrigation need is anticipated primarily in the Hampshire Avon, Dorset Stour, Exe, Otter, Piddle and Tone river catchments. Resources in some of these catchments are already well-developed and the licensing of

additional summer abstractions for spray irrigation may not be approved because of environmental flow needs at such times. It is likely in these cases that new licences will be granted only for schemes which make use of excess winter rainfall to fill off-stream reservoirs and ponds, for subsequent abstraction during the growing season.

In recent years, due to the recession and changes in the economy, there has been a marked decline in the uptake of private licensed resources for industrial use. Any future growth in industrial use will be met in part by uptake of existing licensed resources and in part by the development of sustainable new resources.

7.4 Ensuring Environmental Needs Are Met

Application of the precautionary principle, with appropriate attention to proper resource use and conservation and adoption of the principles of sustainable development, will help to ensure proper protection of environmental needs.

The NRA will continue to develop techniques which help define environmental needs more clearly and continue to promote arrangements and schemes which help alleviate detrimental impacts resulting from historical licence conditions.

Environmental Assessments will be required for all major development schemes to ensure such needs are properly taken into account.



8 DEVELOPMENT OPTIONS PUBLIC WATER SUPPLY

The NRA must have particular regard to the statutory obligations of water supply companies to supply potable water to the level of service required by OFWAT. It has been identified that under the two demand scenarios some deficits might occur. The options for meeting these deficits are examined below. In descending order of preference these include:

- demand management
- resource management
- resource development

The first option requires the efficient use of water, for example recycling of water by industry and a reduction in leakage from pipework systems. The second option embraces the more efficient and spatially wider use of the resources already developed, and the third includes development of new resources; from groundwater, surface waters or as transfers from other areas.

8.1 Demand Management

8.1.1 Metering

Almost all industrial and commercial public water supply customers in the Region pay for their water through metering. In contrast, less than 3% of domestic properties are currently metered.

Metering of domestic supplies is seen by many to be a more equitable basis of charging for domestic water than the present rating systems; and is recognised by OFWAT as having the potential, with the appropriate tariff structure, to restrain excessive use and to reduce and control demand.

The demand savings which can be achieved through metering of domestic properties is still the subject of much debate. Large scale national metering trials, show that on average an 11% reduction may be expected. Reductions of as much as 22% have been reported on the Isle of Wight. On the other hand, it has yet to be proved that such reductions will be sustained in the long-term.

Whilst the NRA does not expect companies to meter all domestic properties due to the costs and uncertainties involved, the NRA encourages the installation of water meters in all new properties and a policy of selective metering in areas where water resources are under stress. The widespread use of domestic metering is a genuine technical and economic alternative to the development of new water sources; the potential water saving of increased metering can itself be considered as a resource. Once the true cost of meter installation, reading and billing becomes clear, this option can be properly assessed.

Limited levels of metering may be economic in areas where: ¹

- peak demands are particularly high due to seasonal factors; or
- new sources cannot be developed in time to prevent the onset of a resource deficit; or
- new sources can only be secured at high capital or environmental cost.

At present three of the four largest water companies in the Region have policies to meter all new properties. South West Water currently has a policy to meter all new businesses but this does not include all new domestic properties. None of the companies however have made a public commitment to more general metering, even on a localised basis.

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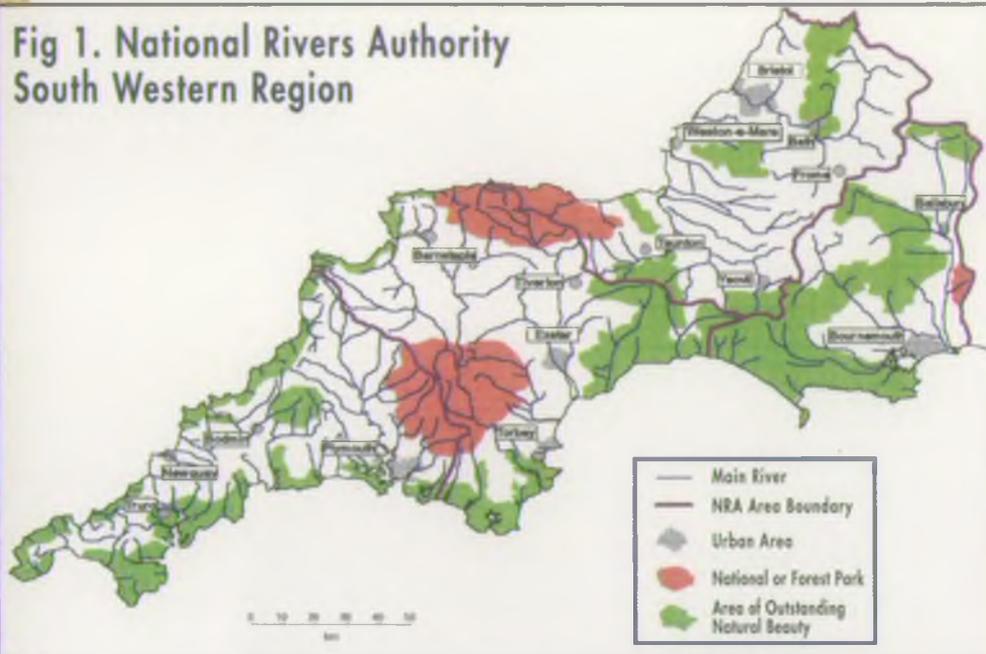
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ENVIRONMENT AGENCY



099870

**Fig 1. National Rivers Authority
South Western Region**



minimise waste, and the use of water saving domestic appliances. One of the strategy's aims is to inform people of the benefits of using water wisely, changing attitudes towards water consumption so that demand for water does not create unnecessary pressures on the environment.

The requirement for all large, new abstractions to be metered encourages abstractors to monitor their water consumption closely. The NRA supports also selective metering of domestic properties as recent studies show it reduces average and peak demand in most instances. This can delay the need for additional resource development. The NRA is expecting water companies to devise charging tariffs that will provide incentives for the wider acceptance of domestic meters as a fair method of paying for water use.

domestic meters as a fair method of paying for water use.

1 EXECUTIVE SUMMARY

The NRA has a duty to conserve, redistribute, augment and ensure the proper use of water resources in England and Wales, whilst conserving and where possible enhancing the environment. This regional water resources strategy follows on from the NRA's national strategy and forms the basis on which the proper use and sustainable development of resources can be assured well into the next century.

The comments and recommendations of 124 organisations and individuals have assisted in the preparation of this strategy, following consultation through two documents covering the Cornwall/Devon and North/South Wessex Areas.

By comparing the available developed resources with the forecast demands for public water supply it is possible to identify areas of potential surplus and deficit to the end of the current planning period in 2021. If the NRA's policy of encouraging demand management and leakage control is successful, there should be no need for any major new sources for 20 years or more. Minor deficits within water company supply zones could be met by a combination of improved conjunctive use, increased imports, transfers from areas of surplus within the region, and small localised developments.

Virtually all the predicted growth in demand for private abstractors is for spray irrigation. This growth is likely to be centred in catchments where a significant proportion of the water resource is already committed. Therefore, where the potential for additional direct abstraction from the rivers is limited the NRA encourages winter abstractions to bankside or off-stream storage reservoirs.

All consumers should strive to ensure that their water use is as efficient as possible. Ways to achieve this include reviewing current operations and practices in order to

The NRA needs to be satisfied that adequate steps have been taken by the water companies to operate their existing sources efficiently and to reduce leakage when considering any new application to abstract additional quantities. Reduced input of water into supply as a result of effective leakage control can itself be viewed as creating a resource which can be utilised as an alternative to new resource development where this is shown to be cost effective. (The cost to the environment must be included in this assessment to allow for any environmental mitigation that a new development might necessitate).

The target levels of leakage to which the NRA believe water companies should be aiming as a maximum are: 200 litres/property/day in Cornwall and Devon Areas and 120 litres/property/day in the North and South Wessex Areas. Water companies are expected by the NRA to produce acceptable local leakage targets which will eventually eliminate this artificial division.

If the NRA can succeed in its aims to improve demand management and leakage control within water company supply zones then demands will increase at a low rate. Implementing, and subsequently increasing, the already approved pumped storage of Wimbleball reservoir would more than satisfy the potential resource deficit in east Devon. The forecast deficit for Cornwall towards the end of the planning horizon may be met by zonal transfers or a similar scheme involving Colliford reservoir. Deficits in the Somerset supply zone of Wessex Water could be solved by either a transfer of water from Wimbleball reservoir (as part of the pumped storage scheme) or an abstraction from the lower reaches of the Bristol Avon at Newton Meadows. This could possibly be a shared scheme with Bristol Water which would also help to meet their demands. Bristol Water are about to commission a new treatment works at Purton to enable additional imports from the Gloucester and Sharpness canal which will be used to meet the growing demand in and around Bristol.

2 PRODUCTION OF THE STRATEGY

2.1 Introduction

This document sets out the way in which the National Rivers Authority (NRA) intends to manage water resources to meet the growing demand for water over the next thirty years. It describes how new water resource development proposals are to be appraised to ensure that only environmentally sustainable options are approved. The strategy also identifies those abstractions believed to be causing environmental problems and describes some instances where remedial measures are sought.

The NRA has a duty under the 1991 Water Resources Act to conserve, redistribute, augment and secure the proper use of water resources in England and Wales. In fulfilling this role the NRA must also carry out its general duties of environmental conservation and have particular regard to the statutory obligations of water supply companies. It is the responsibility of the water companies to provide an adequate supply of good quality water to the public. The NRA's role is to regulate the abstraction of water by water companies and other users. The publication of this water resources strategy for the South Western Region is an important step in fulfilling part of the NRA's role. Achievement of the NRA's duty to manage water resources requires the implementation of the following policies:

- manage water resources to secure the best use of water whilst having regard to the needs of the environment and those of abstractors
- plan for the sustainable development of water resources, developing and improving criteria to assess the reasonable needs of abstractors and of the environment
- expect existing abstractors to take positive steps to control leakage before the NRA issues a licence for additional water
- promote the efficient use of water by industry, agriculture and domestic users
- investigate and where possible ameliorate inherited river low flow problems caused by licensed abstraction
- encourage the introduction of selective domestic metering, with appropriate tariffs, by water companies where resources are under stress

2.2 The Consultation Process

This Regional strategy incorporates the comments arising from the publication of two separate consultation documents. Between these publication dates the South West and Wessex Regions merged to create the South Western Region.

In August 1992 the NRA published a consultation document for Cornwall and Devon to inform and encourage comments from organisations, companies and individuals on the proposed strategy for future development of water resources. In July 1994, a similar exercise was conducted for the Avon, Dorset, Somerset and Wiltshire areas, now comprising the North and South Wessex Areas of the South Western Region.



2.3 National Water Resources Development Strategy

A National water resource strategy to meet forecast demands for the next 30 years, "Water - Nature's Precious Resource", was published by the NRA in March 1994.

The national strategy assesses current regional resources against NRA demand forecasts to the year 2021. The difference between the forecast demands and present resources indicates the need for water resources development for a Region. The strategy also examines development options to meet predicted shortfalls including national transfers of water.

2.4 Regional Water Resources Development Strategy

This document complements the National Strategy by providing an outline of regional detail. The forecasts are modified to reflect local variations of water company supply zones. However the same principles and method of demand forecasting have been applied to ensure consistency. As forecasting methods are refined and development takes place so the regional water resources strategy will need to evolve. Estimates of the amount a source can reliably yield mirror the current national study although much work remains to be done by the NRA to audit and fully evaluate these. For this reason we will update the figures and review relevant development options regularly. A full revision of the South Western Regional strategy will be produced by May 1998.

3 SOUTH WESTERN REGION

3.1 Background

NRA South Western Region covers an area of 20,802 square kilometres, incorporating over 7,000 kilometres of rivers and has a resident population of 4 million. It encompasses the counties of Avon, Cornwall, Devon, Dorset, Somerset, most of Wiltshire and parts of Gloucestershire and Hampshire. There are four operational areas; namely, Cornwall, Devon, North and South Wessex Areas; the boundaries of which are delineated by river catchments.

The map on the inside cover shows the South Western Region, National Parks/Areas of Outstanding Natural Beauty (AONB) and some centres of population.

The largest urban and industrial areas are the cities of Bristol, Bath, Exeter and Plymouth. Towns like Bournemouth, Christchurch, Poole, Newquay, Weston-super-Mare and the resort of Torbay on the south coast have seasonally large influxes of population due to tourism in addition to their resident population.

The South Western Region contains a rich and extremely varied landscape, including the National Parks of Exmoor, Dartmoor and part of the New Forest, together with 27 AONB's. Much of its dramatic coastline is designated as Heritage Coast and the countryside supports a rich diversity of animals and plants much of which is dependent on plentiful fresh water; as supplied by the chalk rivers of South Wessex and in the Somerset Moors of North Wessex.

3.2 Hydrology

The region enjoys relatively abundant rainfall under average conditions, although its distribution can vary greatly, ranging from less than 800 mm/year in the Somerset lowlands and the Vale of Pewsey to over 2000 mm/year on Dartmoor. Figure 2 shows the monthly distribution of rainfall in an average year. Average annual rainfall is 1037 mm but more than 50% is lost through evaporation and transpiration by plants. The remainder is available to replenish rivers and

aquifers which together support all uses of freshwater. This portion of the total rainfall is known as the effective rainfall.

Normally during the winter months there is more effective rainfall compared with the summer months when there is relatively little replenishment of aquifers and reservoirs or indeed direct run-off. Heavy summer rainfall occasionally produces sufficient run-off in the "hard rock" areas of Devon and Cornwall to allow some recovery of reservoir storage and river flow although this is usually short lived. The effective rainfall for the Region in an average year is 450 mm and this reduces to 250 mm in a severe drought period such as 1975/76.

The level of exploitation of this naturally sustainable resource must be carefully defined and controlled to avoid unacceptable effects on the water environment.

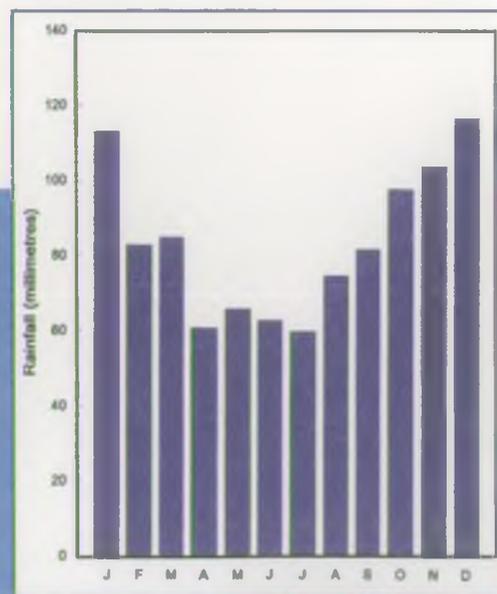
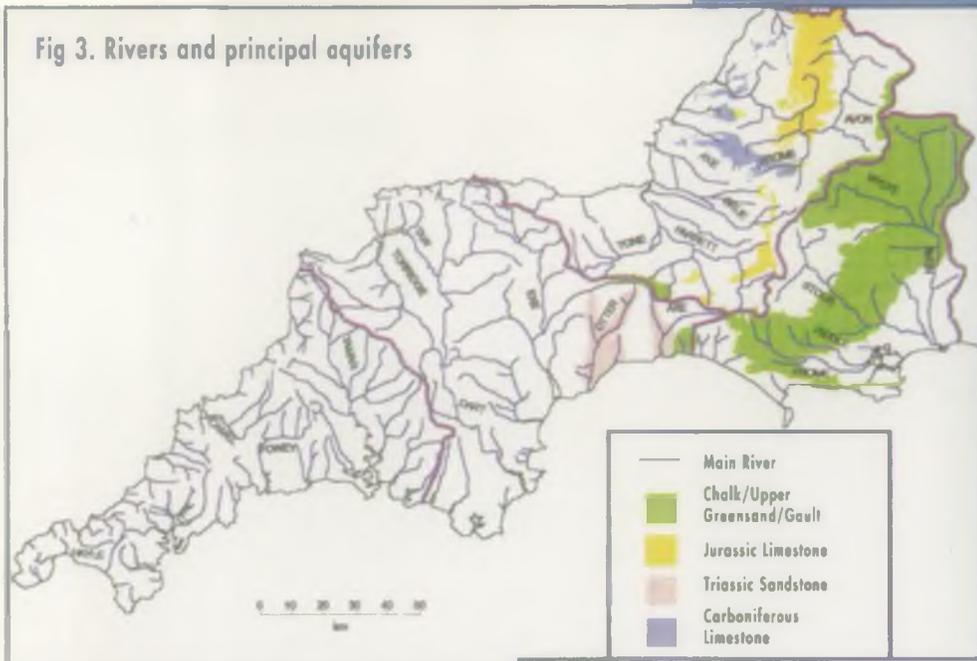


Fig 2. Average rainfall (1961-1990) for the NRA South Western Region

Fig 3. Rivers and principal aquifers



The total water resources available in an average year in the region for all uses is some 25600 million litres per day (ML/d). However, resources can become stressed during drought periods (such as 1988-1992) and at such times the level of exploitation is critical.

This is because during drought periods:

- water is scarce
- the aquatic environment is stressed
- demand for water is high

The level of water supply development should be sufficient to ensure that during a drought it is not necessary to resort unduly to restrictive measures such as hose pipe bans or the introduction of drought orders.

3.3 Public Water Supply - Water Companies

Emphasis is placed on public water supplies in this development strategy as they represent the dominant use of water in the Region and the one most likely to need large water developments.

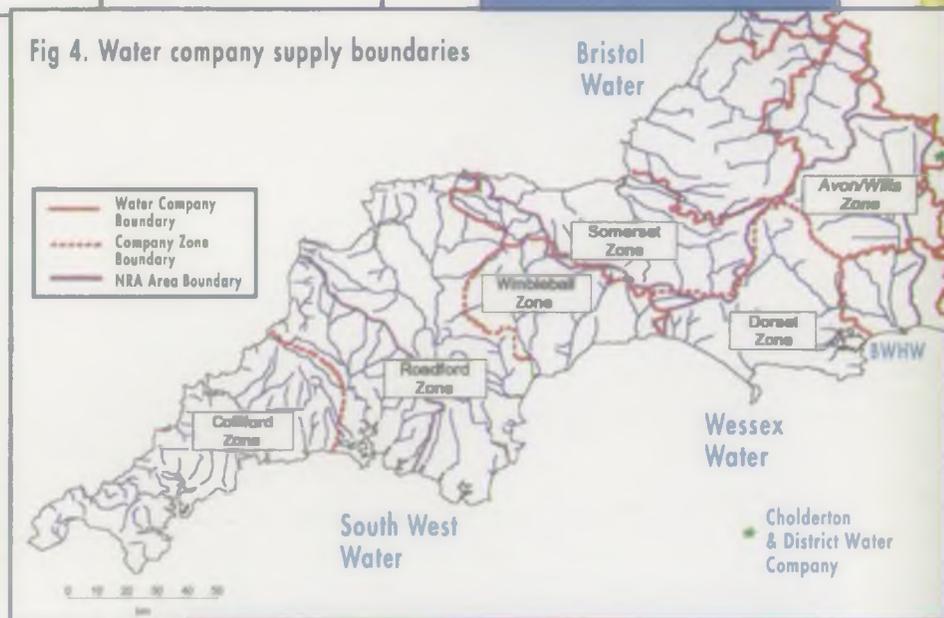
There are five water companies providing water supplies in the South Western Region. They are:

- Bournemouth and West Hampshire Water Company
- Bristol Water plc
- Cholderton and District Water Company
- South West Water Services Ltd
- Wessex Water Services Ltd

South West Water and Wessex Water together cover the largest geographic area and each are divided into three strategic supply zones namely:

- | | |
|------------------------|-----------------------|
| For South West Water - | For Wessex Water - |
| - Colliford zone | - Avon/Wiltshire zone |
| - Roadford zone | - Somerset zone |
| - Wimbleball zone | - Dorset zone |

Fig 4. Water company supply boundaries



The water company supply areas do not correspond exactly with the NRA Regional boundaries. There are small parts of the North and South Wessex Areas which are supplied by surrounding water companies; Severn Trent Water Plc, Thames Water Utilities Ltd and Southern Water Plc. These companies' resources and demands are considered in the strategies produced by neighbouring NRA regions.

3.4 Private Water Supply - Other Abstractors

Private water supplies are abstractions which are made directly from rivers, lakes/reservoirs or groundwater and are not supplied through water company distribution systems. The water is mainly used by agriculture and industry. Not all private uses require an abstraction licence; for instance, utilising rainfall collected in a water butt; or certain small, domestic sources. As these do not represent a significant demand on water resources they are not considered further.



4 THE WATER ENVIRONMENT

4.1 General Considerations

The needs of the environment require sufficient water of suitable quality in rivers, lakes and aquifers. The requirements both of plants and animals are not easily defined due to the large diversity of species and the complexities of their response to changes in water availability.

Low flows and water levels can have unacceptable impacts on:

- water quality
- landscape, amenity and recreation
- aquatic animals and plants
- wetlands
- archaeology and cultural heritage

4.2 Water Quality

Clean water is essential for not only human consumption but also to support the aquatic environment. Abstraction, therefore, must be regulated to ensure that rivers have an adequate flow to maintain their quality objectives and ensure sufficient dilution of treated domestic and industrial effluent. The aquatic ecosystem responds in a complex way to changes in water quality. Changes in water quality resulting from discharges of effluent, leaching of fertilisers or additives used in industrial processes can: reduce oxygen levels; and produce algal blooms which may cause fish kills; produce excessive plant growth which, if left unmanaged, could block river channels.

The majority of rivers in the region are of an acceptable quality for potable supply, subject to appropriate treatment. Some rivers though, are of unsuitable quality due to the effects of historic mine workings and intensive agricultural activities.

Groundwater quality in the major aquifers in the region is generally good but in some locations usable water has been prejudiced by increasing nitrate levels. The NRA is assigning source protection zones for each public water supply source to ensure future developments do not jeopardise these groundwater supplies. These developments not only include additional abstraction but also waste management proposals and quarrying activities, the latter causing permanent damage to the aquifer yields as well as the water quality.

4.3 Landscape, Amenity And Recreation

This Region enjoys a landscape heritage possibly unmatched by any other in its rich diversity. The range and character of its designated landscapes: National Parks, Areas of Outstanding Natural Beauty, Areas of Great Landscape Value, and other Heritage areas; present formidable constraints on water resources developments of an intrusive nature. Rivers, lakes and streams are themselves a vital ingredient in much of this treasured landscape; in some cases the very cause for its designation. The essence of the beauty of such rivers as the Dart, the Barle, the Exe and the Hampshire Avon is as much due to their reliability of flows as to their high water quality. It is essential that the character of these and other rivers is not jeopardised by ill-considered abstraction.

These same rivers provide unrivalled opportunities for recreation. The scope for recreation is wide, ranging from the more vigorous water sports to the more passive pursuits such as angling. Leisure pursuits extend to activities such as walking or bird-watching which, though not water contact sports, are stimulated by the very presence of water. Unrestricted recreational activities may sometimes bring conflict between different uses and occasionally overwhelm the quality of the water environment.

Where water resources developments are permitted the NRA will seek not only to conserve the natural water environment but also to promote an increase in its recreational or amenity value through the inclusion of beneficial features in the development proposals.

4.4 Aquatic Animals And Plants

The NRA seeks to maintain and enhance the aquatic environment to sustain healthy rivers. Fish are an integral part of this environment and often provide the best indicators of a well balanced ecosystem due to their position towards the top of the food chain. If other parts of the ecosystem are adversely affected this can be reflected in the availability of fish stocks.

Rivers in the South Western Region support fish stocks and fisheries comprising both resident and migratory fish. The three main categories are salmon, trout and coarse fish. Water availability influences their survival and deterioration of water quality may have a profound effect on fish stocks and their supporting food chain. Healthy trout and salmon fisheries demand good river water quality.

Trout fisheries are often located in the upper tributaries of catchments and are particularly sensitive to pollution. Healthy river flows and spate flows are needed to promote sufficient migration runs to the headwater spawning grounds.

There is some evidence that lower flows are a factor in the siltation of valuable gravel beds for fish spawning and the uneven distribution of the resident fish populations along the river. Any new water resources developments must take account, at the detailed planning stage, of the need to protect and foster fisheries and to make provision for recreation and conservation mitigation if these are likely to be affected.

4.5 Wetlands

Water resource developments may impact on wetlands. Important wetlands in the Region include the Somerset Levels and Moors; the water meadow systems within the Hampshire Avon Valley; the River Axe, Exminster Marshes and Braunton Burrows in Devon; and Amble Marshes in north Cornwall. Also of importance are the many smaller wetland areas associated with groundwater springs and periodic river flooding. These areas support important plant communities and a varied fauna, and are very sensitive to changes in the water level regime. In addition to their natural conservation value, wetlands preserve sites of archaeological importance and are now known to provide other valuable functions in terms of transient water storage and recycling of nutrients.

The NRA maintains close liaison with individuals and organisations who have specific interests in wetlands particularly with regard to the Somerset Moors. These include the Internal Drainage Boards who are consulted on all proposed water resource developments in their area.

Some reservoirs created for public water supply such as Chew Valley Lake, in the Mendips, now have valued wetlands at and beyond their margins.

4.6 Archaeology And Cultural Heritage

Water resource developments affect not only the water environment but also terrestrial and social environments. Archaeology and cultural heritage are two aspects which must be considered. The construction of river intake works, treatment works, pumping stations, pipelines and reservoirs may cause direct damage to archaeological sites and have indirect impacts upon the local community - particularly in relation to reservoirs. The NRA is conscious of these issues and the need to resolve potential conflicts.

4.7 Specific Investigations

The NRA is currently investigating a number of questions concerning artificial influences both on river flow and on groundwater levels within the region. Each project is at a different stage of investigation and practical solutions cannot yet be specified for every one.

There are seven major investigations in the South Western Region where low flow problems generated by abstractions are of major public concern:

- Allen (Dorset) - Following investigations to confirm the affect on river flow caused by a Bournemouth and West Hampshire groundwater source, the NRA has devised an Action Plan which includes a reduction in the authorised quantities by up to 12.5 Ml/d.
- Avon at Malmesbury (upper Bristol Avon) - Studies are continuing on the cumulative impact of several groundwater sources operated by Bristol Water and Wessex Water upon flows of the tributaries comprising the Malmesbury Avon. Possible remedial measures to alleviate the problem include relocating and/or increasing the number of stream support boreholes, adjusting the operation of the stream support and in the long term reducing the authorised abstraction quantities by up to 20 Ml/d.
- Otter (Devon) - The effects of abstraction from Otterhead Lakes by Wessex Water, and from groundwater sources within the Otter Valley, operated by South West Water, are being investigated. The study will enable the NRA to decide whether any change to the operation of the sources is necessary. This investigation will determine the extent to which development of resources within existing licence limits might be restructured for environmental benefit.
- Piddle (Dorset) - Wessex Water abstract from groundwater sources at Alton Pancras, Briantspuddle, Dewlish and Milborne St Andrew. The NRA is implementing an Action Plan to alleviate low flows associated with the first three of these sources. This includes investigating a possible alternative source in the lower catchment near Wareham, looking at the feasibility of a recirculation scheme around Briantspuddle and examining the scope for a reduction in abstraction from the catchment by up to 13.5 Ml/d.

- Tavy (Devon) - There are a number of low flow issues associated with this catchment. The impacts of abstraction/water transfer for power generation by National Power at and upstream of Tavistock; and abstraction for public water supply by South West Water at the tidal limit are currently subject to investigation. Solutions to the problems are likely to be in the form of operational management strategies which will limit the impact on the natural flow regime to an acceptable level.
- Wey (Dorset) - Changes have been agreed with Wessex Water for the operation of its groundwater source at Friar Waddon and the success of their implementation are being monitored.
- Upper tributaries of the Hampshire Avon (Wiltshire) - The effect of groundwater abstractions on flows in the Bourne and Wylye may require changes to be made to existing river support arrangements and possibly a long term reduction in abstraction from the sources, operated by Wessex Water, of up to 20 Ml/d. The latter will have to be considered in the knowledge that such a reduction will be unacceptable in the absence of an identified alternative supply.



River Piddle at Briantspuddle in drought conditions (1990).

The Allen, Piddle and Wey schemes were placed before OFWAT and the Department of the Environment (DOE) by the NRA as necessary expenditure under the second periodic review of the water companies' Asset Management Plans. Only the Wey was supported by OFWAT and the DOE as part of the determination of the second periodic review. The NRA will continue to argue the case with OFWAT and the DOE for appropriate joint NRA /water company solutions to low flow problems. Investigations will continue and action plans will be introduced to achieve acceptable solutions at value-for-money and on a priority basis. The NRA and the water companies may put agreed solutions to OFWAT and the DOE prior to the next periodic review. The potential for achieving this will be explored if it means solutions to alleviating low flows may be implemented before the next periodic review.

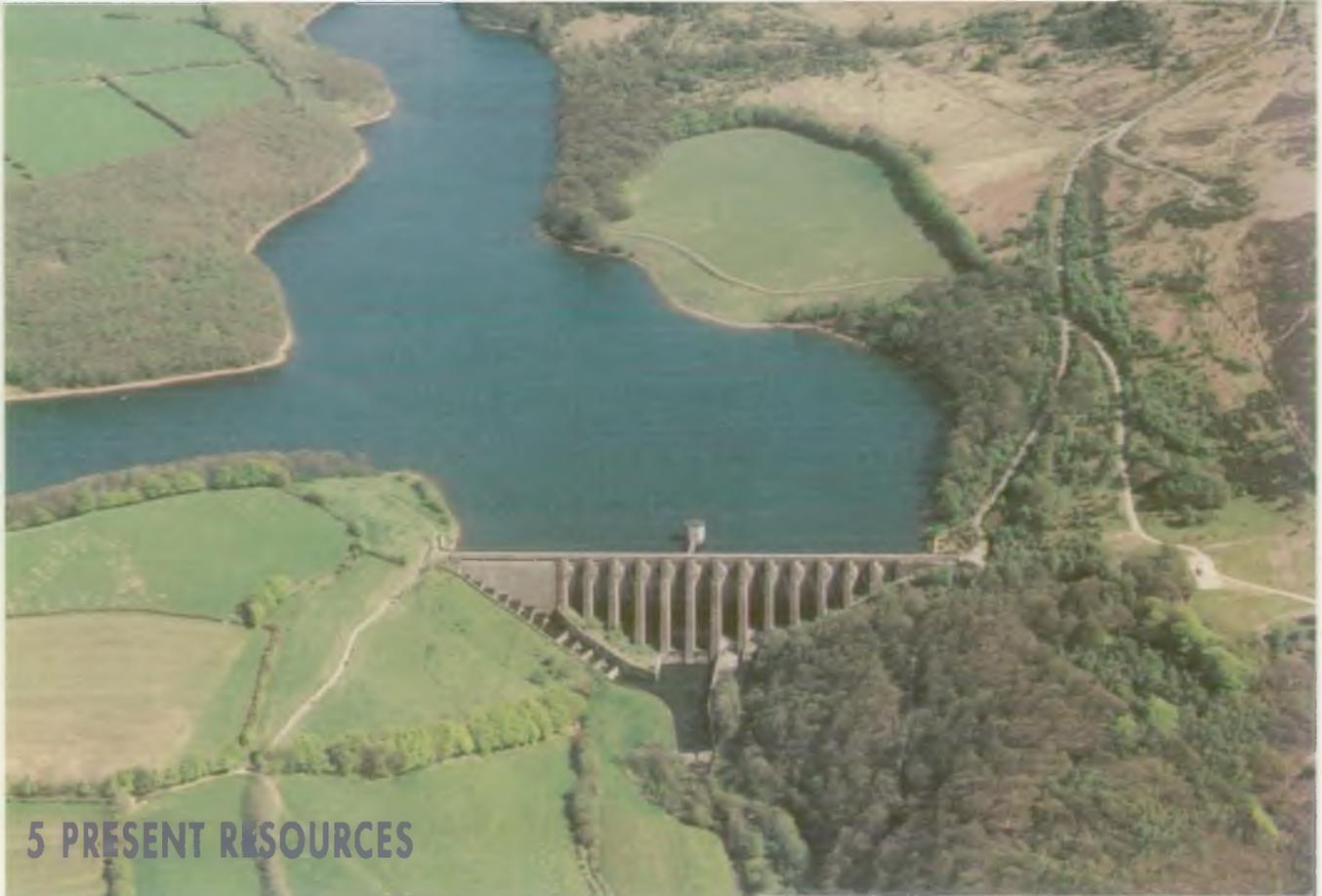
The areas experiencing low flow problems resulting from direct river abstractions are mainly concentrated within the Cornwall and Devon Areas. They mostly relate to private abstractions, which have a localised effect on particular rivers by-passed by abstraction, usually of a non-consumptive nature eg. some fish farms, leats. An initial survey revealed that there may be in excess of 100 such localised low flow sites but very few have strategic implications or permanently deplete the available resource for other uses. A national R & D project is underway to provide a robust method to broadly characterise the impacts of these low flow sites. Results of the project will be used in 1995 to consider what measures may be justified to resolve low flows at these sites.

Other major investigations in the Devon and Cornwall Areas are seeking to establish Operational Management Schemes (OMS) linked to large water company reservoirs with the aim of achieving environmental benefit without endangering the security of public water supply. In carrying out this work other issues such as potential for further resource development and how this might be allocated will be addressed. These studies, initiated in early 1995, cover each of the Colliford, Roadford and Wimbleball strategic supply zones. Similar investigations may be needed in other supply zones.

Some smaller investigations involve South West Water in the operation of the Lower Tamar Lake within the Cornwall Area; River Bray at Leehamford, the effects of Burrator reservoir on the River Meavy, and Taw Marsh in Devon Area.

Each investigation considers not only the extent of any impact an abstraction has upon river flows and/or groundwater levels but also the associated effects, such as the drying out of wetlands where these form part of the study area. The NRA is carrying out a number of research projects to improve the scientific basis for defining the river flows and groundwater levels below which problems are likely to occur.

A widely accepted and robust definition of acceptable flow constraints is required to safeguard flows for environmental needs.



5 PRESENT RESOURCES

5.1 Public Water Supply Resources

Present resources for public water supply can be categorised by the following types of source:

- Groundwater
- River abstraction
- Reservoirs
- Transfers/Imports

Many river abstractions, however, are augmented by reservoir releases at certain times of the year and these two categories are described together.

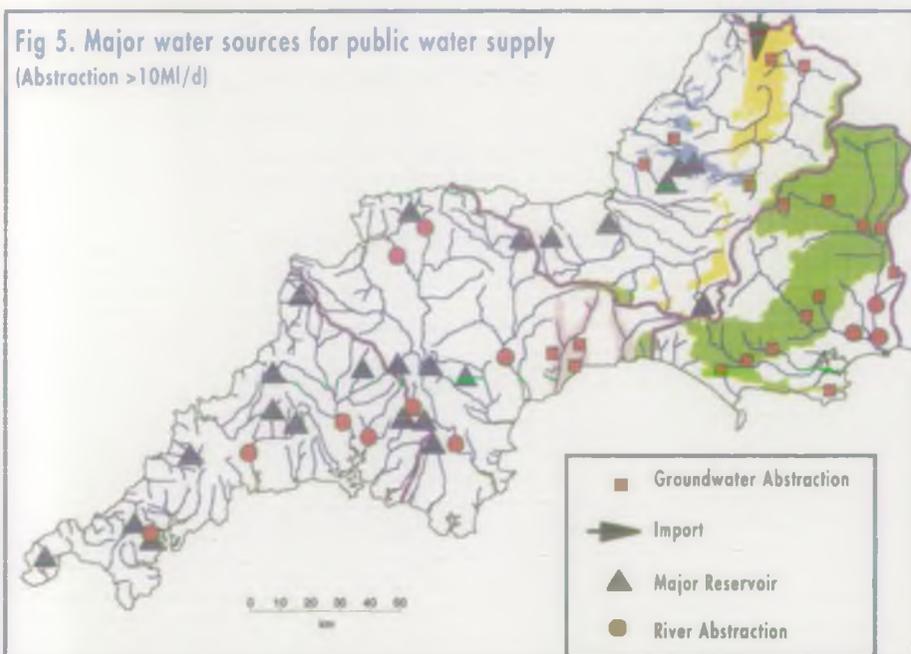
5.1.1 Groundwater

Groundwater supplies represent 29% of the reliable water resources available to water companies within the Region. These are mainly located in the North and South Wessex Areas, although the groundwater sources of east Devon are of local significance (see figure 5). Wessex Water rely on groundwater sources to provide up to 72% of the company's total supply. In Devon and Cornwall groundwater sources represent only 7% of the overall available resource due to the lack of extensive aquifers in the south west peninsular. There are four main aquifers of strategic importance in the Region:

- the Cretaceous Chalk and Upper Greensand
- the Jurassic Oolites
- the Triassic Sandstones
- the Carboniferous Limestones

These provide a relatively cheap and, to some extent, reliable resource, as the groundwater requires little treatment and the aquifers are less sensitive than rivers to short, severe droughts. After prolonged drought, however, groundwater reserves take longer to fully recover. Groundwater and river interactions are complex, and abstractions can easily disturb the balance of the water environment if not properly managed.

Fig 5. Major water sources for public water supply (Abstraction >10Ml/d)



The Chalk together with the Upper Greensand, in the South Wessex Area, is the most important aquifer providing approximately 50% of the groundwater reserves developed for public water supply. In the east it underlies the Wylde, Upper Hampshire Avon, Ebble, and Nadder catchments and in the south the Allen, Stour, Piddle and Frome catchments. Eight sources account for over 100 Ml/d. Water from the Chalk aquifer is used to meet demand in the cities of Salisbury and Bath and the towns of Trowbridge, Warminster, Westbury and Poole. It is also pumped from the Wylde catchment to support supplies in Somerset.

Another important aquifer is the Jurassic Oolite, the useful extent of which is limited almost wholly to the North Wessex Area. It is particularly important to the upper Bristol Avon catchment. Its largest development is centred around Malmesbury where up to 48 Ml/d is abstracted in a drought year. The sources in this aquifer are used to meet demand in Bristol Water Plc's supply area and Wessex Water's Avon/Wiltshire supply zone.

The largest groundwater resources in the western part of the Region are in east Devon where South West Water abstract from sources in the Otter Sandstone to supply local demand in towns such as Honiton, Chard and Sidmouth. The output from the boreholes during a dry period is around 30 Ml/d. The supply to this part of Devon is also supported by Wimbleball reservoir which augments abstraction from the River Exe at Bolham.

The Carboniferous Limestone aquifer outcrops or underlies the Mendip Hills and north Somerset. In addition to those spring sources which are used conjunctively with the Mendip reservoirs, there are major sources at Chelvey and Banwell springs, east of Weston-super-Mare, totalling 23 Ml/d.

Supplies in parts of Cornwall include groundwater sources developed from old mine adits which provide sufficient yield to meet local demands but are not supported by such large aquifers such as described above. Examples are the Boswyn Shaft, Copper Hill Adit and Fortescue Shaft which supply the districts of Camborne and Redruth.

5.1.2 Abstractions From Rivers And Reservoirs

Rivers and reservoirs together provide 59% of the developed reliable resources available to the water companies within the Region.

The topographic and geological variations across the Region have influenced the distribution and the subsequent operation of these sources. For example, lack of suitable reservoir sites in the Chalk areas of Dorset and Hampshire has meant that groundwater developments predominate with some direct abstractions from the lower reaches of rivers such as the Hampshire Avon and Dorset Stour (having reliable resource yields of 155Ml/d and 32Ml/d respectively). There are no present river abstractions of this scale from the rivers within the North Wessex Area. In general direct river abstractions not supported by reservoir storage tend to be more sensitive to short severe droughts.

In contrast there are large reservoir developments in Devon and Cornwall where the majority of river abstractions

are to some extent supported by augmentation releases or inter-catchment transfers from reservoirs. Reservoirs are often located in the upper reaches of catchments which experience relatively high rainfall, such as Bodmin Moor, Dartmoor, Exmoor, the Mendip, Brendon and Quantock Hills.

There are numerous examples of conjunctive use schemes within the Region which involve the joint operation of reservoirs and river abstractions to increase the overall yield of a group of sources. The major clusters of these sources across the Region can be summarised as follows:

- The Cornwall reservoirs - Colliford Lake and Siblyback reservoir are used conjunctively with river abstractions from the Fowey, Camel and Lynher catchments to provide a reliable supply of 104 Ml/d. When aggregated with the other reservoirs; Argal & College, Crowdy, Drift, Stithians and Porth this system provides virtually all the reliable resource for the Cornwall supply zone.
- The Dartmoor reservoirs - Roadford, Burrator and Meldon reservoirs are used selectively to support abstractions from the rivers Tamar and Taw and are used with abstractions from the rivers Dart and Tavy. This conjunctive use combined with smaller direct supplies from Avon, Fernworthy, Kennick, Tottiford and Trenchford reservoirs results in a reliable resource of 255 Ml/d. This group of reservoirs supplies North Devon, South West Devon and Plymouth.
- The Exmoor system - Wimbleball reservoir is the principal source for the east Devon area and together with the conjunctive use of abstractions from the River Exe provides a reliable supply of 60 Ml/d. This water serves not only Exeter and towns within the Exe and Culm catchments and provides a back-up for the groundwater sources serving the Otter and Axe catchments, but can also supplement supplies to north Devon (via a transfer to the Taw catchment). Wimbleball also provides a direct supply to Somerset of up to 30 Ml/d.
- The Mendip reservoirs - Chew Valley Lake, Blagdon Lake and Cheddar together with some conjunctive use with associated sources reliably supply 92 Ml/d. These reservoirs serve as supplies for the City of Bristol and associated rural areas.
- The Parrett and Tone system reservoirs - Durleigh, Clatworthy, Sutton Bingham and Hawkrig/Ashford reservoirs have a reliable supply of 56 Ml/d. These serve the Somerset towns of Yeovil, Bridgwater and Taunton and provide almost half the public water supply for Somerset.

The concept of conjunctive use of sources is currently receiving greater attention than previously, not least as a result of a more sympathetic approach to the aquatic environment. Several of the low flow problems may be resolved in part by greater conjunctive use of sources as part of the solution.

The subject of compulsory domestic metering on whatever scale has currently a high political profile, largely fuelled by concerns about social welfare. In the view of the NRA there is a no more logical and fair means of charging for water than by its volume of consumption. What has been lacking in the debate is information about possible charging tariffs to meet the dual criteria of minimum cost for essential needs and of high cost for excessive use.

The water companies have only until the year 2000 to introduce a replacement to the present system of charges linked to rateable value. If there is a viable alternative to the introduction of domestic meters then it should offer a genuine incentive mechanism for property holders to opt for a metered supply. The real issue is about future tariff structures which would be sensitive to the social welfare debate and would lead to a target of 30% of all domestic properties being metered. The wider introduction of domestic metering in itself is seen as fundamental to the principle of making the most efficient use of available water resources. The NRA's powers are limited with respect to ensuring the achievement of this aim; failure in the aim, however, would inhibit the NRA in authorising the development of new water resources.

8.1.2 Efficient Water Use

Efficient use of water encompasses:

- voluntary restraint in the use of water achieved through better public information
- the development and public acceptance of domestic appliances and plumbing systems that are more efficient in their water use; and
- the promotion of more efficient industrial use of water, eg recycling and reuse.

Examples of more economical use of water are ...

- toilet cisterns having a 6 litre flush or less
- Washing machines requiring less than 20 litres/kilogram of load as are common in other European countries.
- use of showers rather than baths
- greater recycling of industrial process and cooling water
- application of water to crops and gardens during the cooler evening hours.
- reduced losses from water company distribution systems by consistent leak detection and repair activity
- reduced losses from household plumbing fittings by better maintenance.

In particular, the NRA supports moves toward the use of water efficient domestic appliances to economise on consumption. This is more likely to be achieved through the mechanism of domestic metering than through entreaties to save water. The manufacturers of water-using appliances are more likely to promote a culture of water economy when their products can be advertised as cost saving.

8.2 Resource Management

8.2.1 Leakage Control

Leakage is the collective name for water lost from overflows, burst pipes, leaking joints and dripping taps. Since this treated water is lost in leakage and not used for its intended purpose, it represents a waste of resources. Leakage levels vary across the Region and across water company supply zones and is historically given as litres of water lost per property per day. The current range of water company leakage figures is from 282 litres/prop./day to 64 litres/prop./day. However the assessment of leakage is very sensitive to the per capita use value used by a water company.

The NRA expects leakage to be reduced to economic levels and in considering applications for increases in public water supply abstractions will expect water companies to be taking steps to ensure leakage is at acceptable levels, especially in areas where leakage is high.

A National Leakage Control Initiative with representation both from the water companies and the regulatory authorities has recently devised a common methodology "Managing Leakage" to determine realistic and achievable levels of leakage for a given situation. In the absence of widespread application of the methodology the broad target levels of leakage as described in the NRA's National Strategy are used in this Regional Strategy:

The NRA's broad leakage target is 120 litres/property/day for water companies in the North and South Wessex Areas, and 200 litres/property/day in Cornwall and Devon areas. The difference in leakage targets arises as a result of the variation in resource availability across the Region coupled with other factors such as pressure considerations and length of rural mains. Not to acknowledge these differences would introduce an element of unfairness to those water companies with remote demand centres, supplied by considerable lengths of mains, where demand management measures are not paramount due to the good resource availability. The principle of assigning different leakage targets to smaller supply areas will be extended through the application of the Managing Leakage approach. Over time this will remove the somewhat artificial distinction of leakage targets that exists across the Region.

8.2.2 Operational Improvements

The yield available from a resource can sometimes be enhanced by operational and structural improvements to the supply system. These include:

- conjunctive use
- resource integration (the inter-connection of sources)
- inter-company transfers
- effluent re-use

8.2.3 Conjunctive Use

The NRA encourages the better usage of groundwater and surface water with emphasis on storage of surface water during winter months and early spring when there is usually ample water to meet both supply and environmental requirements.

There are several examples of sources being operated conjunctively in the Region. The following schemes offer potential for extending this principle...

- Wimbleball Reservoir pumped storage
- Augmentation of the Hampshire and Bristol Avons from existing groundwater sources

The pumped storage of Wimbleball is a conjunctive use scheme where the future resource allocation is currently under investigation. Water would be pumped into Wimbleball from the River Exe during the winter to ensure the reservoir has capacity for increased augmentation of the River Exe the following summer. The planned scheme has the potential to enhance the yield available to South West Water and Wessex Water.

In the case of augmentation from groundwater, the aquifer acts as a reservoir with water being pumped seasonally to the river and abstracted downstream. There are two aquifers with close association to major river systems, and positions conducive to major demand centres, that make them evident candidates for further study. These are the Chalk in the Upper Hampshire Avon catchment and the Oolite in the Upper Bristol Avon catchment. In both cases, water is at present abstracted continuously from the aquifer and taken by pipeline to the areas of demand.

Conversion of reservoirs to river augmentation and groundwater pumping to augment flows for downstream abstraction can have a stabilising effect on the river environment. The largest quantity of water is retained within the river for the greatest possible length, to the benefit of the river's wildlife. Although there are negative aspects in water supply economics, the NRA feels that they are outweighed by the environmental benefits and the development of this type of scheme will be encouraged.

8.2.4 Resource Integration

Water resources are supplied to the areas of demand through a water company's distribution system. In any water company area there will be areas where there is a surplus of resources and areas where there are impending deficits. If resources are to be managed effectively, the number and scale of these imbalances should be minimised. This can be achieved through an extension and expansion of the main distribution system to increase the inter-connection between the resources and areas of demand to economic and practical limits.

The distribution systems in the Bristol Water area are well integrated. There is some potential for improvement in the systems of the Bournemouth and West Hampshire Water area. Initial analysis of the Wessex Water system also pointed to potential for improved integration but later information which the NRA is still considering may show limited scope for improvement.

Currently in the three Wessex Water zones a deficit exists in the Somerset zone and surpluses in the Wiltshire and Dorset zones. The deficit in the Somerset zone is met by a transfer from the Wiltshire zone using groundwater sources. This represents a nett loss from the Wiltshire zone as water is not returned as treated effluent to the source catchment.

Additional links between and within the three strategic zones of Colliford, Roadford and Wimbleball will help make best use of the existing water resources of South West Water for public water supply purposes.

8.2.5 Inter-company Transfers

The pattern and range of forecast surpluses and deficits clearly shows that at any one time a water company may have a deficit in its area of supply adjacent to an area of surplus of a neighbouring water company. The possibility of short or long term inter-company transfers in North and South Wessex Areas and Devon should be examined as an alternative to new resource developments or as a means of postponing expensive new schemes.

At the present stage it appears unlikely that significant transfers will be achieved without a positive will by the water companies to negotiate on behalf of their respective customers the most favourable economic use of surplus resources.

8.2.6 Effluent Re-use

Effluent reuse concerns the return of suitably treated waste water usually to the river to augment flows which may then be abstracted further downstream. Effluent re-use is common in the UK, particularly on large rivers, with towns discharging effluent to rivers with public water supply abstraction points downstream. By this means, the river flows between the discharge and the abstraction points are augmented and the reliable supply of the river system is increased. Modern water treatment technology can ensure the maintenance of wholesome drinking water supplies.

The NRA will have regard to the point of effluent discharge in relation to the abstraction point when considering abstraction proposals. This is to ensure that rivers are not unnecessarily depleted of flow and sufficient dilution of effluent is assured.

8.2.7 Abstraction Licensing Procedure

The process of granting an abstraction licence requires the applicant to make a statement of the effect of the abstraction on the environment. This is independently reviewed by the NRA in all cases. Current legislation does not provide for the subsequent revocation of licensed rights without the risk to the NRA of an unspecified compensation payment. Historically, abstraction licences have thus been issued on the basis of a virtually assured permanence despite the frequent environmental uncertainties.

Where uncertainty remains about the environmental impact of a proposed new abstraction, even following a detailed environmental appraisal of the development, and where it is practicable for the abstractor, a licence can be granted for a limited time period to allow the effects to be assessed. This can ensure that these uncertainties are resolved without irreversible risk to the environment.

Licensed entitlement and actual usage are often very different quantities. The granting of a new licence may be constrained by water resources already committed to existing licences. In such circumstances, it may be possible either by partially or fully revoking unused licences, to make resources available for other new legitimate uses.

Possible alternative ways of releasing the potential of under-utilized abstraction licences could be by:

- granting most new licences on a time limited basis
- incentive charging to encourage non-users to revoke their licences.

This would require changes in licensing policy and amendment to the charging scheme.

Resources can also be better utilised by encouraging winter abstractions with bank-side or off-stream lined storage. This is especially the case with a high nett use, such as spray irrigation.

When determining any licence application the NRA will...

- ensure the abstraction will not be in excess of the renewable resources
- consider the effects on existing abstractors and will not allow abstractions which derogate existing rights to abstract unless suitable remedial arrangements are agreed with affected parties
- consider the impact on river flows to ensure that flows are not reduced to environmentally unacceptable low levels
- consider the potential effect on wetlands and pools, and not allow abstractions which would be damaging to them
- consider the effect of any associated infrastructure on the environment.

Those catchments which are already currently considered over-exploited for abstraction will be targeted by the NRA and opportunities taken to redress the balance.

8.3 Resource Development

The amount of new resource development needed by 2021 will depend upon the success of the demand and resource management measures which are advocated. If these measures are implemented by the water companies and have the anticipated effect, demands will be contained to the low level. In this case, the deficits in 2021 would be limited to 19 MI/d for Bristol Water plc, 10 MI/d and 17 MI/d for the South West Water Wimbleball and Colliford zones respectively and 16 MI/d in the Somerset zone of Wessex Water.

2021 deficits at the high and low levels of demand would be distributed as set out in the following table:

Water Company	High Level Demand (MI/d)	Low Level Demand (MI/d)
Bristol Water	66	19
South West Water		
Colliford Zone	57	17
Roadford Zone	21	0
Wimbleball Zone	22	10
Wessex Water		
Avon/Wiltshire Zone	41	0
Dorset Zone	33	0
Somerset Zone	60	16

Any new development should fully address environmental needs and provide an element of environmental benefit. This will be achieved by practical measures such as:

- protective abstraction licence provisions, eg prescribed flow conditions
- river intake screening
- provision of freshet releases from reservoirs
- augmentation of low river flows
- transfer of licensed resources and/or reduction of licensed resources at environmentally sensitive locations

8.3.1 Groundwater Options

Some further development of the Otter Valley groundwater near the mouth of the River Otter may be possible. The appropriate level of use of the groundwater in the middle of the valley is currently part of a low flow investigation. If further developments prove feasible they are likely to require down-catchment transfers of existing licensed resources to contribute an appropriate element of environmental benefit.

Wessex Water have plans, under an existing abstraction licence, to abstract up to around 18 MI/d from the Chalk aquifer at Lulworth, Dorset. These resources will be used to meet demand deficits in the Dorset supply zone. However, the potential for inducing saline flow into the aquifer has been identified as a possible constraint on the reliable supply which might therefore be closer to 10 MI/d.

There are areas in the Upper Hampshire Avon and Dorset Frome catchments where there is relatively little development of groundwater resources. In view of the effect caused by abstraction in other parts of the Chalk aquifer, any applications for development would require rigorous investigation. The NRA believes that conventional development of this type of groundwater for direct pumping to public water supplies is not the most efficient use of resources.

8.3.2 River Options

South West Water already hold an abstraction licence to allow pumped storage of Wimbleball reservoir from the River Exe. Pumped storage of Roadford and Colliford reservoirs are options to meet future shortfalls in water resources. These schemes are attractive because they make best use of the existing reservoirs and would place the requirement for new reservoir developments past the end of the current forecasting period. In addition the conjunctive use of sources associated with Roadford will need to be clarified by developing an operational management strategy which might result in a reduction in the reliable output in order to meet environmental requirements.

Wessex Water already has an abstraction licence for 30 MI/d from the Bristol Avon at Newton Meadows, downstream of Bath. The source and infrastructure are not yet developed but could be used to meet growth in demand in the Wiltshire supply zone.

Bristol Water has undertaken studies of an abstraction point on the lower reaches of the Bristol Avon. Bristol Water has estimated that by using a source at Newton Meadows for pumped storage of the existing Chew Valley reservoir, an additional 55 MI/d could be available. Such a scheme might be of shared value to Wessex Water.

None of the other rivers in the Region have the potential for further substantial sustainable resource development without provision of reservoir storage.

8.3.3 Reservoirs

Forecasts indicate that no new reservoirs are needed in the Devon & Cornwall Areas until after the 2021 planning horizon.

Reservoir development opportunities in the North and South Wessex Areas are limited. Potential schemes include:

- Chew Valley reservoir pumped storage and enlargement
- River Stour, Hampshire Avon and Dorset Frome bank-side storage

The pumped storage of the Chew Valley reservoir as discussed previously would provide an estimated 55 MI/d. A study showed that raising of the reservoirs water level by 2 metres could provide a further 55 MI/d of yield. Full development of Chew could therefore provide an additional 110 MI/d subject to a more detailed assessment of the environmental needs of the river Avon upstream of Bristol.

The whole of Chew Valley Lake is designated a SSSI, being noted for its bird populations and extensive marginal wetland habitats, disturbance of which would be met with considerable resistance. The pumped storage of the reservoir would have minimal impact on the lake, but the raising of the dam would cause the loss of important semi-natural plant communities and wetland created by the reservoir construction some 40 years ago. If the option to raise the height of the dam was pursued in the future it would have to be considered with respect to the environmental policy prevailing at the time.

The reliable abstraction from the rivers Stour and Hampshire Avon could be enhanced if they are used conjunctively with bank-side storage. Both Wessex Water and Bournemouth and West Hampshire Water are investigating the possibility of extending or excavating existing gravel pit workings to provide bank-side storage at Blashford and Longham. The additional environmental impact of developing sites for storage reservoirs is likely to be small in those areas that have historically been used for gravel extraction. New sites would have to be carefully appraised to ensure that there is no unacceptable impact upon the environment. Sites for similar storage in the vicinity of the Dorset Frome may be possible. The reliable supply from these reservoirs could be up to 100 MI/d.

The present bank-side storage development at Blashford Lakes, owned by Wessex Water, is in limited use. It is small compared with the potential new reservoirs in the locality. For these, large amounts of gravel would need to be excavated to provide the storage volumes to support abstraction through the year. The rate at which the gravel can be extracted and therefore the amount of storage available for development will be constrained by the demand for gravel by the construction industry. There are also landscape planning constraints and water-tightness concerns of the reservoirs to be considered.

A number of potential reservoir schemes associated with the lowland rivers of Somerset have been studied in detail. In the Parrett catchment, several reservoir sites have been studied. In the Brue catchment, the Avalon Lakes scheme which would have made use of abandoned peat workings on the Somerset Levels was assessed. The studies showed these schemes to be unattractive on either environmental or financial grounds.

Further work to establish the impacts and suitability of the more promising development options will take place through the NRA Catchment Management Plan process.

8.3.4 Transfers

During 1995 Bristol Water Plc will, with the enlargement of Purton water treatment works, complete phase 1 of the River Severn transfer scheme to give an additional 55 MI/d. Phase 2 would provide a further 55 MI/d and is licensed by the NRA with supporting resources from Shropshire groundwater to augment the River Severn. A third phase 55 MI/d transfer would depend on the further development of resources in the River Severn or Wye catchments, since recent demand forecasts indicate that the Shropshire groundwater is likely to be fully committed by the time the Wessex Areas need the water.

Wessex Water is currently discussing with South West Water the possibility of a share of the increased yield from Wimbleball once the proposed pumped storage scheme is in place. This has the potential to provide Wessex Water with up to 10 MI/d.

8.4 Summary Of Resource Development Options

The new resource options are tabulated below:

Scheme	Estimate of reliable resource (Ml/d)	To Supply
Lulworth groundwater	10	Wessex Water (Dorset)
Bristol Avon, at Newton Meadows	30	Wessex Water (Avon/Wilts)
Chew Valley Lake pumped storage	55	Bristol Water /Wessex Water (Avon/Wilts)
Wimbleball pumped storage	5 - 10	Wessex Water (Somerset)
Colliford pumped storage	50	South West Water (Colliford)
Roadford pumped storage	50	South West Water (Roadford)
Wimbleball pumped storage	25-30	South West Water (Wimbleball)
Hampshire Avon and Dorset Stour gravel pit reservoirs (including the possibility of the Lower Frome gravel pit reservoirs)	50 to 100	Wessex Water (Dorset) and Bournemouth and West Hampshire Water
Imports via Sharpness Canal	100+	Bristol Water /Wessex Water

For the low demand prediction, deficits can be met by the combination of small groundwater schemes, the Bristol Avon at Newton Meadows, the Wimbleball pumped storage scheme and some development of reservoirs in gravel pits adjacent to the Hampshire Avon and Stour.

If the high demand prediction is approached the Region is unlikely to be self sufficient and substantial imports into North and South Wessex Areas would be inevitable. The NRA's national strategy has looked at this provision through transfers from the Severn, via the Sharpness Canal. This may, in turn, depend upon the availability of water to supply the Sharpness canal, via new developments in the Severn catchment. This matter is being addressed through NRA's national water resource strategy; it would also involve the need to develop trunk mains to transfer the imported water to areas of deficit.

9 PREFERRED STRATEGY

The preferred strategy represents the approach the NRA will adopt when faced with a new development proposal.

All major new resource developments will require a full environmental assessment before being considered. The assessment will identify the positive and negative impacts of any scheme and where applicable the measures necessary to mitigate any negative impacts. The NRA will encourage those schemes which incorporate an element of environmental benefit.

Some low environmental impact options may be expensive to develop and conversely, some options with high impact may be economically attractive. To develop a water resources strategy which is acceptable to the developer and water users without unacceptable effect on the environment, there has to be an understanding about the cost of environmental conservation.

The NRA has a clear commitment to seek satisfaction on both resource and demand management before new resources are developed. This is reflected in the policy statements on both leakage and metering.

Increased domestic metering to a moderate level (30%) in conjunction with the NRA preferred leakage targets for the low demand scenario could help to reduce demand by some 332 MI/d by 2021. This is equivalent to several major resource developments. It should be noted however, that the high and low scenarios contain different assumptions for how an individual's consumption of water as well as the

rates of industrial and commercial growth might change over time (see assumptions table on page 14). These assumptions also contribute to the perceived potential reduction in public demand.

Transfer of surplus water between companies and strategic zones would mean that only in the case of the higher predictions becoming a reality would further resources be required. The NRA will support studies of new schemes which may be needed in the event of the higher demands materialising. However, the decision to proceed with the construction of new schemes should not be taken unless demands have been found to continue rising despite the introduction of reasonable measures to manage demands and reduce leakage.

The water resource options listed in the table on page 23 are the type of development favoured in principle by the NRA. But as stated already each development will be considered in the light of a full environmental assessment of the proposed scheme.

The NRA favours schemes which:

- allow augmentation of rivers at times of drought or provide benefit to low flow rivers;
- make use of under-utilised water resources, rather than development of new sources, including reallocation between companies;
- have net environmental benefits such as the provision of releases which improve the water environment;
- avoid piecemeal development, except where this is relatively small development to meet local demand;
- benefit all classes of abstractor;
- make use of development opportunities within the local catchment in preference to inter-basin transfers if the overall impacts and costs are judged to be similar;
- are economically efficient;
- return treated effluent of a high standard at or near the point of abstraction or at a site which will augment other stressed resources.

Effective catchment management planning is crucial to the success of this strategy to ensure any new developments are sustainable and are not to the detriment of the water environment. Planning at catchment level will enable the NRA to identify more precisely the spatial distribution of the available resource and the demand. This will highlight areas where there could be potential for sustainable development and help avoid unnecessary consideration of schemes in catchments lacking such potential.



NRA

10 FUTURE WORK

A number of key aspects will need further detailed consideration in order that this Regional strategy can evolve. In summary these are:

- NRA audit of reliable source output values
- Resource planning modelling of the strategic options identified in the preferred strategy
- Continued investigation and amelioration of low flow problems
- Conclude post-scheme appraisals of low flow alleviation schemes with the water companies for OFWAT
- Investigate and, where applicable define, ecologically acceptable flows
- Produce and update local demand predictions in line with National methodology
- Monitor the water companies' progress on leakage control
- Develop water resource strategies for individual catchments through catchment management plans
- Analyse the impact of metering on average and peak demands
- Seek and implement improved demand prediction methods for public water supply and industrial and agricultural abstractions
- Develop methods for assessing economics of resource development or redistribution
- Keep up to date with and encourage research into the effects of inter-catchment transfers
- Continue hydrometric monitoring of natural resource availability

A total of 124 comments were received as a result of the two separate consultation documents. They can be summarised in the following categories which broadly cover the main issues the Regional strategy has addressed.

It should be noted, however, that many of the responses to the Devon and Cornwall Areas consultation were in relation to the proposals to meet the growing demand in East Devon by the development of additional reservoir storage, possibly in the Axe valley. Since the completion of the consultation process in 1992 efforts have been made to progress the alternative of developing Wimbleball pumped storage scheme. This scheme, once implemented, will delay the necessity to develop additional water resources beyond the current forecasting period.

Environmental Considerations -

Wetlands were emphasised as warranting specific attention to highlight the effects that changes in land use and water resource development have had throughout the Region.

The NRA has already undertaken investigations of wetlands within specific ALF schemes but there may be other instances which warrant further study.

Several comments were received questioning the use of fish as an indicator species for the general state of a river. Other fauna were suggested as alternatives.

Fish are particularly valuable because of their relatively high position in the food chain and their sensitivity to changes in the river environment, such as a deterioration in water quality.

In order to gain maximum benefit for fish stocks from reservoir releases it was suggested that subsequent abstractions should preferably be below important fisheries.

Wherever practicable the NRA encourages abstraction from the lower reaches of a river. In this way maximum benefit is derived from the augmented reach by all water users.

Some concern was raised that the environment should be treated as part of the resource rather than as a demand on it.

The environment does play a significant part in determining the amount of effective rainfall and ultimately water available for use at any time. However, the aquatic environment itself places a demand upon the water resource which the NRA aims to continue to meet irrespective of future development.

Demand Management -

The prospect of increasing the penetration of metering within the Region produced a very mixed response. The fact that the majority of non-domestic supplies are already metered was welcomed but there is concern that some people will be disadvantaged by having a metered domestic supply. Greatest support was received from the majority of local authorities and environmental organisations who perceive metering as the best means of managing demand. Incentive charging for particular uses was commonly proposed as an alternative to metering of domestic properties.

The principal cause for disagreement with the NRA's metering policy stems from the perceived increase in cost of water and the restrictions this would impose on an individuals use of water. Whilst the NRA should have regard to the costs in terms of managing the resource effectively the issue of paying for actual water use is one which the water companies and OFWAT need to address. National metering trials have shown that water use can be significantly reduced especially at times of peak demand, as well as facilitating the identification of leakage from customer supply pipes. There are already some instances of incentive charging for private abstractors through the NRA's scheme of abstraction charges. The potential for its wider application would need to be investigated.

Efficient water use options were suggested by a number of individuals and organisations. These ranged from the implementation of a permanent hose pipe ban, to methods of collecting rainfall for household use and re-use of water for non-potable applications. The wise use of water is a theme many wished the Authority to strongly promote through education initiatives.

Many of the suggested ways of achieving more efficient use of water are supported by the NRA although the extent to which each one would produce noticeable reductions in water consumption have yet to be fully assessed. The examples incorporated into the strategy are those which are known to result in more economical use of water.

Resource Management -

The reference to leakage control in the strategy and the specified target levels provoked questions from the water industry as to the figures used and to whether there is scope to refine these targets at a more local level.

The actual figures used are the nationally agreed targets based on information contained within WRc Report No.26 (Leakage Control Policy & Practice) and are considered to be reasonable targets for companies in areas with constraints on resources. Data from the water companies has yet to be received by the NRA to facilitate the monitoring of local leakage targets.

Strong representations were made both for and against transfers of water between catchments.

The NRA nationally and within this Region accept inter-catchment transfers to meet marginal demands providing it is proven that the donor catchment is not adversely affected by abstraction from the sources supporting the transfer.

Pumped storage schemes and a greater emphasis on conjunctive use of sources were seen by many as the most important types of development because they aim to make optimum use of existing resources as an alternative to new development. With improved resource integration it is possible to meet future demands without the need for expensive and potentially damaging development.

These comments are encouraging as they support the strategy. Further work is necessary to identify those sources which might realistically be operated conjunctively in order to achieve maximum environmental benefit. Work has already started to investigate the potential for pumped storage of existing reservoirs.

Resource Development -

There was strong support for the environmental needs to be clearly defined and adequately protected as part of any future water resource development. This includes both the natural requirements of the environment but also those of other water users. There was also a wish to consider the impact of any type of development upon the water environment. The proposed method of quantifying the environmental impact should be in the form of Environmental Assessment (EA).

It is a statutory duty of the NRA to have due regard for the water environment when considering new developments. This also applies to sites of archaeological, architectural and historical interest as well as sites possessing a natural value in terms of flora and fauna. The requirement for full EA will need to be specified at an early stage of the planning process, involving other authorities as well as the NRA. The outcome of these assessments will be vital in the decision making process when considering which specific development option is most appropriate for a given location. The NRA is consulted by other authorities regarding all development proposals that might have implications for the water environment.

As part of the comments received regarding the alleviation of low flows there were strong calls for the revocation of abstraction licences for public water supply.

This is only one method by which AIF's can be tackled and where a company's resources are already stretched the only way to reach agreement on the revocation will be via the development of alternative sustainable sources. However, where revocation is shown to be the only solution the NRA will act.

Rather than continuing to develop groundwater, river and reservoir sources the option to install desalination plants should be investigated.

The NRA as part of its National Strategy has already identified that desalination is currently not a cost effective option; certainly in terms of providing a significant alternative resource. However there may be instances in the future where desalination may be used to meet peak demands in remote locations if the costs of alternative supplies are excessive.

Demand Forecasts -

The water companies expressed concern, and occasionally disagreed, over some of the figures derived for source yields and forecast demands as these are different to those used in their company business plans. The discrepancies are not great but may be of significance at the local level.

In the absence of suitable data to support the claims made by the water companies the NRA has, for the purposes of this strategy, used the most recent data obtained from the water companies and used assumptions where appropriate. Since this is not the preferred situation future work to harmonise the data sets and produce mutually acceptable figures has already begun. A joint national R & D study is in progress to seek common methods.

Several people observed the emphasis on average rather than peak demands. Further consideration of the latter was judged as vital, particularly in the South Western region with its significant periodic fluctuation in population related to tourism.

Peak demand data is notoriously difficult to forecast. This may be tackled in the on-going Water Industry Demand Forecasting Methodology work. Arguably it can be managed by the provision of storage within the distribution system rather than by new resource developments. Also as supply systems become increasingly linked the issue becomes less important in terms of water resource development.

A number of comments were received calling for the forecast rise in private demand to be assessed in a thorough manner as in the case of the public supply forecasting methodology. The analogy was extended in additional comments calling for the introduction of demand management measures for private supplies.

Current national studies aim to resolve some of these uncertainties and the results will be incorporated in subsequent reviews of the strategy. As with all abstraction proposals, the reasonableness of a requirement for a private water supply is subject to the scrutiny of the abstraction licensing process as is its environmental context. Demands having a potentially detrimental effect on the water environment will not be allowed or will need to be curtailed.

GLOSSARY

Abstraction is the removal of water from sources of supply. Most abstractions of water require an **abstraction licence** from the NRA permitting water abstraction up to a given maximum daily and annual quantity. Many licences have conditions attached which restrict the quantity abstracted or even cause it to cease where it is necessary to protect river flow, the river environment and existing abstractors' rights.

ALF schemes, or Alleviation of Low Flow schemes, have been initiated by the NRA to ameliorate inherited low flow problems caused by historical abstractions.

Aquifer is a geological formation which is capable of storing and transmitting groundwater in sufficient quantities to supply a water source such as a well or borehole.

Conjunctive use is the operation of two or more sources in a systematic manner, to provide a yield greater than the sum of those sources if operated independently.

Distribution system describes the pipework and pumping stations owned by the water companies by which water from the source and treatment works is transferred to the customer.

OFWAT The Office of Water Services, regulates the business of the water companies.

Reliable yield or output is the amount of water reliably available from a source during critical dry periods.

Reservoir pumped storage is the supplementation of the natural inflow to reservoirs with river water abstracted from downstream, or transferred between catchments, and pumped to the reservoir at times of high flow. Pumped storage ensures the reservoir is refilled sufficiently for the start of the next summer drawdown period.

River augmentation is the addition of water for a downstream river abstraction by releasing equivalent quantities of water from an upstream source (whether it be a reservoir or borehole) and using the river as a natural conduit system at times when the river is below a prescribed flow.

Water resources in this context is a general term describing the reliable quantity of water available for abstraction from sources such as rivers, reservoirs or groundwater without significant long term damage to the environment.

The volume of water used is expressed in metric units as megalitres per day (a million litres per day) abbreviated to Ml/d, when describing water supply systems or river flows.

REFERENCES

- NRA (1994) - Water, Nature's Precious Resource - an environmentally sustainable water resource development strategy for England and Wales
- Halcrow (1992) - Water Resources Development Strategy - NRA South West Region
- Halcrow (1994) - Water Resources Strategy For Wessex - NRA South Western Region
- National Metering Trials Working Group (1993) - National Water Metering Trials Final Report
- OFWAT occasional paper 1 (1993) - Future Levels of Demand and Supply for Water
- Binnie and Herrington (1992) - Effect of Climate Change on Water Resources and Demands
- National Water Council/Department of the Environment (1980) - Leakage Control Policy and Practice (Standing Technical Committee Report No. 26)

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NRA

Public Information

The wise use of water involves everybody. Most dwellings are connected to public water supplies so use of water in the homes does affect the quantity of water abstracted from the environment. Individuals use on average about 140 litres (30 gallons) each day.

The NRA is committed to a programme of continued public awareness about water resources, particularly for children.

Further background information on water resources is available in main libraries from two documents, or can be obtained by contacting the public relations department of the NRA:

NRA Water Resources Strategy, 1993 - ISBN, 87316048 8 and Water, Nature's Precious Resource, March 1994 - ISBN 011 886523 4.



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