

YARE CATCHMENT MANAGEMENT PLAN CONSULTATION REPORT



NRA

*National Rivers Authority
Anglian Region*

January 1994



ENVIRONMENT AGENCY

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YARE CATCHMENT MANAGEMENT PLAN

FOREWORD

Established in 1989 the National Rivers Authority has as it's role the "Guardians of the Water Environment". As such it is committed to protecting and improving the water environment in its broadest sense. Establishing a sound planning base for the development of river catchments is essential to our future management.

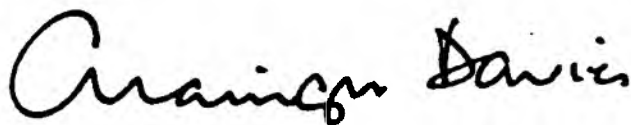
Integrated Catchment Management Planning will play an increasingly important role in the NRA's management of the water environment. Demands upon catchments are many and varied, and conflicts require careful consideration. The enhancement of the water environment is one of the main aims of consultation with individuals and organisations having an interest in the catchment is seen as essential.

This report examines the Rivers Yare, Wensum, Bure and Waveney catchments. A large proportion of the plan area is recognised internationally as being environmentally important and the tidal reaches of the rivers form one of Europe's most important lowland wetlands.

The Broads which are a fundamental part of the unique nature of the catchment are under stress due to over-enrichment. Our current research is central to Broads Restoration and reflects the NRA's belief that such initiatives alongside this consultation form an important way of maintaining co-operation and collaboration within the catchment.

Much of Broadland and Great Yarmouth is susceptible to flooding and the NRA is keen to improve the standard of flood defences while being concerned that it should maintain and where possible, enhance the character of the area.

This is the sixth such Plan produced in the Anglian Region. This Report is for public consultation and I look forward to receiving comments from those interested to produce a final Plan balancing the conflicting demands placed upon an integral feature of the Nation's heritage. Please make any contributions in writing to Yare Catchment Management Plan, Area Manager, National Rivers Authority, Eastern Area, Cobham Road, Ipswich, Suffolk, IP3 9JE. The final date for responses is 20 April 1994.



GRAINGER DAVIES
Regional General Manager

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1.0 CONCEPT

1.1 The National Rivers Authority

The National Rivers Authority (NRA) is the major environmental protection agency responsible for safeguarding and improving the natural water environment in England and Wales. The nature of its responsibilities are wide reaching and include:-

- Control of pollution and improving the quality of rivers, groundwaters and coastal waters.
- Flood defence, including the protection of people and property.
- Flood warning.
- Effective management of water resources.
- Maintenance, development and improvement of fisheries.
- Conservation of the natural water environment.
- Promotion of water based recreation including navigation.

To achieve success in all these areas the NRA works with industry, commerce, farming, local authorities, other statutory and non statutory agencies and the general public, to promote environmental awareness and to enforce appropriate environmental standards.

Catchment management assists the NRA to use its authority and work with others to ensure that the rivers, lakes, coastal and underground waters are protected and where possible improved for the benefit of present and future generations.

River catchments are subject to increasing use by a variety of activities. Many of these interact and some conflicts arise. The competing requirements and interests of users and beneficiaries must be balanced.

The NRA will use its resources to:-

- Respond promptly to all reported pollution incidents.
- Control pollution by working with dischargers to achieve improvement and monitor effluent compliance with appropriate standards.
- Monitor, survey and investigate the existing quality of controlled waters to determine short and long term changes.

- Maintain existing and invest in new assets to provide flood protection, develop water resources and provide other NRA services.
- Determine, police, enforce and review the conditions in water abstraction licences, discharge consents and land drainage consents to achieve operational objectives.
- Maintain, develop and improve fisheries and promote recreation, navigation and conservation.
- Influence planning authorities to control development so as to avoid conflict with NRA objectives and initiatives through Town and Country planning liaison.
- Assess, manage, plan and conserve water resources.

1.2

Scope and Process of Catchment Management Planning

This draft catchment plan consolidates the policies, objectives and options, for the overall improvement of the water environment for the Yare Catchment. It must be emphasised that the Catchment Management Plan is not an end in itself. Its aim is to provide a comprehensive guide to the present status and future of the Catchment. It is the essential first step in providing the basis for drawing up a plan of action. The timetable for the planning process is given in Table 1 below. The plan is drawn up as follows:-

1. Uses of the Catchment

For the identified uses of the water environment up to three pages of text is produced, supported by a map indicating where in the catchment each use occurs. Objectives for the use are identified and targets set, (where applicable), for Water Quality, Water Quantity, Flood Defence and Physical Features.

2. Catchment Targets

By taking the targets for individual uses, overall targets for Water Quality, Water Quantity, Flood Defence and Physical Features are set for the catchment.

3. Current Shortfalls of the Catchment

Having set targets, it is now possible to view the current state of the catchment and identify issues that need addressing to meet the future catchment targets.

4. Issues and Options

Individual issues are now identified and options suggested to resolve these problems. These options identify the responsible bodies and also suggest advantages and disadvantages.

The Plan is now released for public consultation in draft form. Comments on the objectives/targets and Issues/Options are invited before the plan is finalised to produce an Action Plan for the Catchment.

The issues and options as presented are the initial thoughts of the NRA Anglian Region and do not constitute policy statements. Following the consultation period all comments will be drawn together and considered in drawing up the Action Plan.

TABLE 1

THE CATCHMENT MANAGEMENT PLANNING (CMP) PROCESS

<u>Timescale</u>	<u>Steps</u>
0 months	1. Set up an NRA CMP Group.
	2. Identify and describe catchment uses.
	3. Identify catchment targets for the catchment.
	4. Compare current status with targets for the catchment.
	5. Identify catchment issues and options.
	6. NRA Internal Consultation
6 months	7. External Consultation.
9 months	8. Draw up Action Plan version of the CMP.
12 months Periodic Review	9. Monitor and review the CMP.

1.3 Limitations

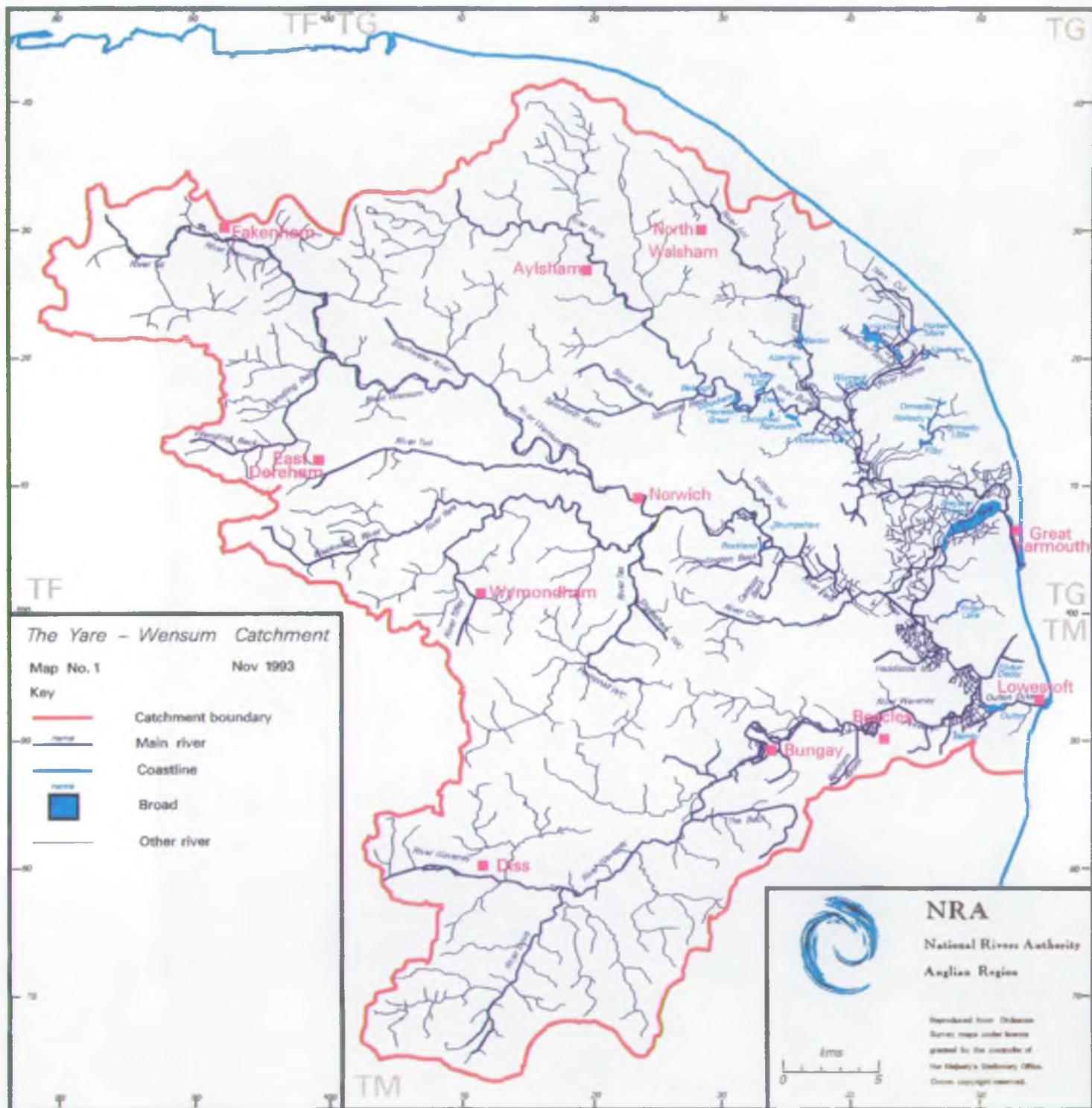
The finished CMP will inevitably be subject to some limitations, the major examples of which are as follows:-

Where improvement works are required to overcome catchment problems, these works will, in many cases, be the responsibility of other organisations or individuals. The NRA may have no powers to control the necessary actions directly. The responsible party may be a Company who may see little or no financial benefit in carrying out the actions, or a Local Authority with restricted capital budgets.

It will inevitably be the case that the achievement of some objectives will depend upon the Town and Country Planning Policy of the County or District Council. The NRA is a consultee to such policy, but it is recognised that the Councils are subject to many other constraints in meeting their obligations to the Planning process and will not always be able to put the needs of the river catchment first.

The land-use within a catchment is obviously a major contributor to the state of that catchment, as is apparent from this report. In area terms, the largest land use is agriculture, over which, apart from restricted areas (such as SSSI and ESA), there are few relevant controls. In cases where farming practice will need to change to permit the catchment improvements to proceed, it will be necessary to obtain the support of the landowners concerned and for them to make such changes voluntarily.

Whilst these limitations will inevitably hamper the achievement of some of the plan objectives, it is essential that these objectives should still be set and striven after. Alternative means of achieving them might be identified, or the very fact of their identification and publication might bring the necessary pressure to encourage those involved to work towards their achievement.



2.0 OVERVIEW

2.1 Introduction

The area covered by this plan can be divided into three major freshwater catchments. The River Waveney in the south, the Rivers Yare and Wensum, which combine at Norwich and the River Bure to the north. It includes all the tributaries of these rivers and approximately 40 shallow lakes of the Norfolk Broads. Also included is the coastal zone between Hopton (south of Lowestoft) and Walcott, just northwest of Happisburgh.

The catchment drains a substantial area of Norfolk and part of North Suffolk. A large proportion of the catchment has exceptional environmental importance. The Rivers Yare, Bure and Waveney, in their tidal reaches, form the main arteries of Broadland, which is designated with the same status as a National Park. They are all parts of the Broads Environmentally Sensitive Area (ESA) and the non-tidal River Wensum has recently been designated as a Site of Special Scientific Interest (SSSI). Most of the Broadland lakes are also designated as SSSI's and several are classified as National Nature Reserves or recognised as RAMSAR sites. Breydon Water estuary is an important area for birds and together with the whole of the Broads is now proposed as a RAMSAR site.

Broadland is one of Europe's most important lowland wetlands. Its management needs to be considered as a single entity. The management of the Broadland reaches however, is in many ways dependent on the management of the upper catchments of these rivers, which is not within the National Park Boundary. As a consequence the catchment management plans for each of these major Norfolk rivers have been combined into a single plan.

Land use in the area is predominantly agricultural, with slightly heavier soils and more intensive livestock production in the south of the area, within the River Waveney catchment. Elsewhere land use is mainly arable, although in the middle reaches of all of these rivers, riparian grazing meadows are a characteristic feature. The nature of the rivers is strongly influenced by the surface geology and natural gradients. Thus the upper reaches of the Rivers Bure and Wensum, and to a lesser extent the River Yare, flow through sands and gravels and near Norwich through chalk, resulting in naturally high quality rivers capable of supporting salmonid fish. In all of the rivers the middle reaches have been managed and are now characterised by numerous water mills, creating a series of ponded river sections.

The rivers support a range of uses which give rise to potential conflicts. Water abstraction for public water supply is taken from the Rivers Bure, Wensum and Waveney and from major groundwater sources. This, together with abstraction for industry and agriculture, makes demands on

water quantity which need to be balanced with environmental requirements. The lower reaches of the rivers are tidal and, during periods of low flow, saline incursion can become a problem. Recreation, particularly angling and in the tidal stretches boating, is an important use.

In Broadland a large proportion of the catchment is below sea level and potentially at risk from tidal flooding and a detailed strategy for the alleviation of flooding in Broadland is currently being undertaken, the implementation of which will be circa £200 million over 50 years. Navigation is the responsibility of the Broads Authority and not the National Rivers Authority. Boat traffic is intensive during the holiday season and wash creates substantial bank erosion, threatening the integrity of the river flood embankments.

There is no large scale industrial development, although a number of industrial estates have developed in many of the major towns, which in some cases have led to problems with contaminated surface water drainage. Sewage effluents are discharged from all of the principal towns, either to the rivers or direct to the sea. The rural areas are served by a large number of small sewage works, although a substantial proportion of the area is not covered by mains sewer and relies on septic tanks. In general, although sewage effluents do not give rise to major water quality problems, their enriching effect creates algal growth in the slower flowing areas and the associated Broads. This has led to a major initiative to control the supply of nutrients to the Rivers Ant and Bure, as the first of a series of steps to improve the environmental quality of these rivers.

This plan shows how the NRA proposes to discharge its responsibilities throughout this complex and extremely sensitive catchment. In doing so it will work with other agencies to recognise all legitimate interests and resolve potentially conflicting uses. In view of the importance of Broadland as a National Park, the National Rivers Authority will work closely with the Broads Authority to promote improvements in the environmental quality of the Broads. To this end the NRA has contributed to the development of the Broads Authority Draft Broads Plan, "No Easy Answers" (1993), to produce joint policy statements¹. It is not possible in this plan to provide detailed proposals covering all aspects of work within the catchment and other documents, such as the Flood Alleviation Strategy for Broadland, will serve this purpose. It does, however, provide an overview of the catchment and an integrated approach to its future management.

¹Where objectives or targets in this plan overlap with those of the Draft Broads Plan these are shown in the text.

2.2 Land Use

The catchment is predominantly rural with the population centred on the City of Norwich, the major towns of Great Yarmouth and Lowestoft, and numerous market towns and scattered villages.

Agriculture is the most important and widespread land use in the catchment. In the river valleys, traditional grazing practices continue, encouraged by recent initiatives of ESA and compensation payments. In Broadland, the unique landscape has been influenced by centuries of cattle grazing. This was threatened in the 1970's when almost a quarter of the Broadland marsh landscape was ploughed up, with farmers encouraged by grants from the Ministry of Agriculture, Fisheries and Food. However, recent initiatives to support landowners to revert back to more traditional farming methods, have been partially successful.

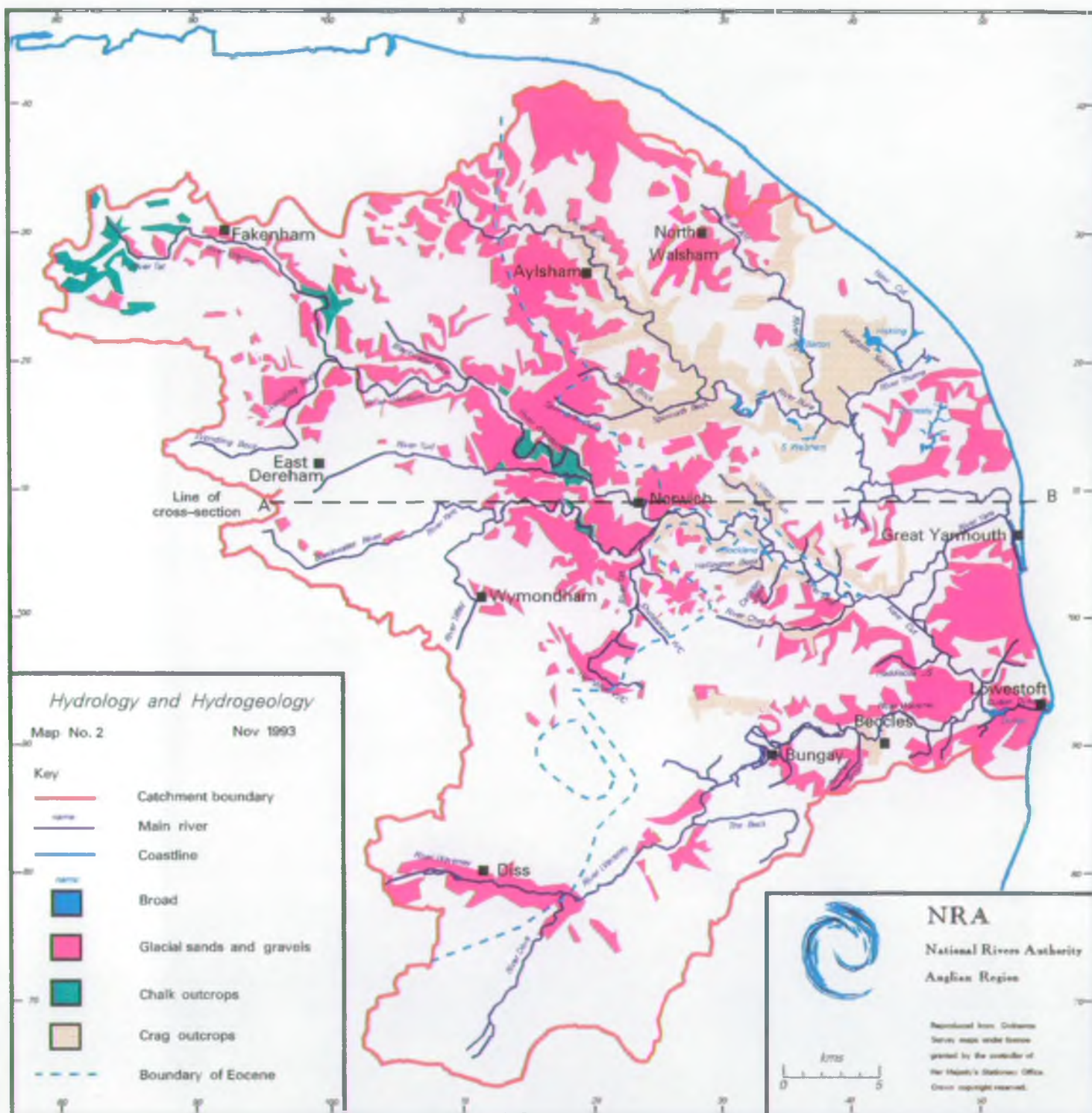
The total population in the catchment is approximately 605,000, with 235,000 being located in the main towns, and the remainder in rural areas. Much of the traditional industry, although in decline, is still agriculturally based and tourism is now an important feature of the local economy. This substantially increases the population during the holiday season and needs to be reflected in the provision of appropriate facilities.

The coastal fringe has always attracted holidaymakers and the area contains six EC Bathing Beaches. Inland, Broadland not only provides for holidays afloat but increasingly, facilities are being developed to allow people to visit and appreciate the environmental diversity of the area. Norwich, as an ancient cathedral city, provides a base for holidaymakers wishing to enjoy the rural charm, history and unspoilt natural beauty of this catchment.

2.3 Hydrology

Annual average rainfall is around 600 mm and the yearly evapotranspiration losses is around 450 mm, but as this is largely concentrated in the summer months, effective rainfall is much higher in the winter than the summer.

The catchment is one of relatively low relief, the maximum elevation being 101 m above sea level. The surface geology consists principally of boulder clay although in the northern part of the catchment this becomes more permeable thus allowing a greater infiltration and retention of rainfall. This is evident in the flows in the upper reaches of the Rivers Bure, Ant and Wensum, which have a relatively high baseflow component and are therefore less variable than further south, where more impermeable boulder clay is encountered and the degree of natural regulation is less.



The principal aquifer of the catchment is the chalk which is present throughout the whole area. It is overlain in two main areas; to the west by the boulder clay and in the extreme east by London clay, beneath which the chalk groundwater is saline. The London clay is itself overlain by crag which forms a separate aquifer. In the area to the east of Norwich and west of the London clay boundary, the chalk is broadly overlain by glacial sands and gravels.

The water level in the chalk reaches a maximum within the catchment of approximately 60 m. A.O.D. near the headwaters of the River Bure, decreasing to about sea level near Great Yarmouth. Groundwater flow is broadly in an easterly direction. Some of the water recharge to the chalk aquifer is derived from the outcrop area beyond the western boundary of the catchment, although the greater proportion penetrates through the less permeable overlying strata within the catchment.

During dry summers, flows in the River Waveney can be supported by water from a series of boreholes (four sunk into the chalk aquifer and one into the crag) in the catchment of the River Dove, a tributary of the Waveney.

There is an extensive network of hydrometric monitoring stations within the catchment, covering rainfall, river flows, groundwater levels, salinity, tide levels (both coastal and within the tidal rivers and broads) and wind speed parameters. Where these are needed for flood warning purposes the gauges are connected to the Authority's telemetry system.

2.4 Water Resources

Within the NRA's role is the requirement to balance the varied and competing needs for water resources. These include human needs, such as potable water supply, industry and agriculture, as well as those of the general water environment such as rivers, springs and wetlands.

Water resources within the catchment are derived from both surface (rivers/lakes) and groundwater. Overall availability is assessed by reference to river flow and the long term average recharge to the aquifer from rainfall. The allocation of water resources is controlled by abstraction licences issued by the National Rivers Authority under the *Water Resources Act 1991* (previously the *Water Resources Act 1963*). These licences are only issued if there is sufficient water available and the need for the water is justified; all rights of existing users are protected and rivers, springs or wetland sites, are not unacceptably affected. As water resources continue to be developed it is becoming common practice to include conditions in licences to safeguard these interests.

The current policy with respect to the availability of water for licensed abstraction is as follows:-

- With a few exceptions, sufficient groundwater resources exist in the catchment to meet predicted local demands. Development of the resource, however, is subject to increasing environmental consideration. Abstractions will need to be carefully located, or incorporate ameliorative works to ensure that rivers and wetlands are not unacceptably affected.
- Some additional surface water is available during winter periods when river flows are naturally higher and abstractors are encouraged to store this in reservoirs for summer use. Additional summer surface water is not generally available for abstraction

2.5 Water Quality

Within this catchment ecological and environmental considerations are of paramount importance, and in order to protect the many and varied uses of waters within the catchment, a comprehensive chemical and biological sampling and monitoring programme is undertaken throughout the catchment.

Two major ports, significant areas of industry and the predominance of agricultural activities within the catchment, make it essential that pollution risks are minimised if acceptable water quality is to be maintained. Although most of the area is utilised for cereal cropping and sugar beet production there are numerous livestock units, particularly in the Waveney sub-catchment which represent a particular threat from organic pollution. It is therefore necessary that adequate pollution prevention measures are enforced to ensure that pollution from agricultural activities does not occur.

The supply of good quality water for public drinking water purposes is of major importance. Large abstractions are undertaken by the Water Companies from the rivers Wensum, Bure and Waveney; Fritton Lake and Ormesby Broad. The Water Companies also abstract groundwater for public supply from many sources within the catchment. It is essential that the quality of these public surface and ground supply sources are protected. To assist in this, multi-parameter water quality monitoring stations are located at Morton-on-the-Hill on the River Wensum and at Ellingham on the River Waveney.

Recreation and conservation feature strongly across the catchment particularly in the Broads area. These activities require a relatively high water quality and must be catered for. However pollution problems, resulting from the concentration of large numbers of people undertaking these activities, may impinge on the environmental requirements of the area. Oil pollution from boats can be a major problem and the effects of

enrichment with plant nutrients (nitrates and phosphates) from treated sewage effluents causes excessive algal growth in the slow flowing broads and tidal rivers.

During periods of very low river flow, or when tidal surges occur, saline water can threaten the Broadland river reaches. To assess the extent of this problem fixed monitoring stations at Repps on the River Thurne, Acle on the River Bure, Cantley on the River Yare and Burgh St Peter on the River Waveney have been installed.

The water quality needs of the coastal waters must take into account the popular holiday resorts along the coast and it is necessary that the EC Designated bathing waters maintain their existing quality, or are improved to meet the conditions imposed by the EC Directive.

2.6 Flood Defence

Flood defence deals with the provision of effective defence for people and property against flooding from rivers and the sea. Normally flooding is a result of extreme climatic conditions, such as tidal surges or very heavy rainfall. Flood events are described in terms of the frequency at which, on average, a certain severity of flood is exceeded. This frequency is usually expressed as a return period in years eg. 1 in 50 years. A similar approach is used to measure the effectiveness of flood defences and the level of protection is given as the likelihood of the defences being overwhelmed. . It is clear that different types of land use, for example, urban areas and pasture land, require different levels of effectiveness for the defences.

Flood defence capital improvements fall into two categories, tidal and fluvial. Tidal flooding has a higher priority due to the potential threat to human life and the more damaging effect of saline water. Fluvial improvements within the Yare catchment are likely to be limited to the replacement and automation of river control structures at the end of their useful life.

In addition to engineering studies most schemes are subject to benefit cost analysis and an environmental assessment in order to demonstrate compliance with the following criteria:-

- Economic viability
- Technical soundness
- Environmental acceptability

Subject to the above criteria being met, schemes are then funded with currently up to 75% grant in aid from the Ministry of Agriculture, Fisheries and Food, the balance being funded from levies on County Council's and Internal Drainage Boards.

To ensure that the target standards of protection are achieved, and having completed any initial capital improvements, planned preventative maintenance to coastal frontages, river channels and control structures forms part of the annual routine maintenance programme.

These works help preserve the integrity of the sea and tidal defences and maintain the flood discharge capacity of the Main Rivers. All works are carried out in accordance with guidelines to ensure that maintenance is sympathetic to the environment, by limiting damage and wherever possible, carrying out positive enhancement works as part of the operations works.

Minimum recommended maintenance frequencies for identified river lengths and sea defences are shown in Appendix V. These frequencies are desirable but are not mandatory.

The programme is funded principally by a levy on the County Councils and Internal Drainage Boards supported by General Drainage Charge contributions within the Norfolk and Suffolk Flood Defence Committee Area.

KEY DETAILS

Administrative Details

County Councils:

Norfolk
Suffolk

District Councils:

Breckland	Norwich
Broadland	South Norfolk
Great Yarmouth	Waveney
North Norfolk	Mid Suffolk

National Rivers Authority:

Anglian Region
Eastern Area

Water Companies:

Anglian Water Services (AWS)
Suffolk Water Company (SWC)

National Park:

Broads Authority

Public Sewage Treatment Works Anglian Water Services 193

Public Water Supply Abstractions:

	AWS Number	Vol *	SWC Number	Vol *
Groundwater boreholes	24	30.2	12	12.75
Surface water sources	2	17.0	5	20.45

* Million cubic metres per year

Internal Drainage Boards:

River Wensum	Smallburgh
Lower Yare 1st	Repps Martham Thurne
Lower Yare 2nd	Muckflat & South Flegg
Lower Yare 3rd	Upper Yare and Tas
Lower Yare 4th	Waveney Valley
Limpenhoe and Reedham	Lower Waveney
Langley Chedgrave &	Lower Waveney 2nd
Toft Monks	Lower Waveney 3rd
{Burgh Castle Bradwell	Blundeston, Flixton, Oulton
Gorleston	{Oulton, Carleton Colville,
{South town & Cobham	{and Barnby
Island	
Upper Bure	
Middle Bure	

2. Catchment Details

Catchment	River	Catchment Area (Km ²)	Length Main River (Km)
Yare/Wensum	Wensum	560	132
	Tud	77)
	Yare-fluvial	280) 127
	Tas	186)
	Yare-tidal	312	56
	SUB TOTAL	1415	315
Bure	Bure-fluvial	331)
	Spixworth Beck	62) 54
	North Walsham & Dilham Canal	49)
	Bure-tidal))
	Ant) 435) 116
	Thurne))
	SUB TOTAL	877	170
Waveney	Waveney fluvial	470) 44
	Dove	200)
	Waveney-tidal	219	49
	SUB TOTAL	889	93
Total Catchment		3181	578

Flood Protection

	Area at Risk Ha	Domestic Properties Protected No	(incl Agricultural Buildings) Industrial Properties Protected No	Caravans & Chalets No
Broadland	21,300	667	1105	141
Great Yarmouth	--	5450	747	1247
Sea defences - Frontal			14 Km	
Tidal Hard Defences (Yarmouth Walls)			12 Km	

Tidal Embankments	240 Km
Fluvial Embankments	70 Km
River control structures	22 No
Floodgates (Great Yarmouth)	19 No
Tidal Outfalls	57 No

Population

Yare catchment total	604.723
Norwich	120,895)
Great Yarmouth	47,668)
Lowestoft	57,122) 1991 census
Beccles	9,418)

Geology

River Yare: Loam, some Boulder Clay. Outcrops of Chalk in the valleys of Rivers Yare and Tas near Norwich. Valley deposits in lower reaches including crag.

River Wensum: Some Boulder Clay. Outcrops of sands and gravels overlay either boulder clay or brickearth in upper reaches. Chalk outcrops near Norwich.

River Bure: Loam, sand gravel exposed chalk in the valley above Hoveton. Valley deposits in lower reaches.

River Waveney: Boulder Clay. Exposed chalk in the valley upstream of confluence with River Dove. Crag is found in lower reaches.

Topography

Ground levels.	Maximum	101 m AOD
	Minimum	- 1 m AOD

Sea levels

Mean highwater springs

King's Lynn	3.9 m AOD
Wells	2.8
Blakeney	2.6
Cromer	2.5
Winterton	1.4
Great Yarmouth	0.8

Tidal Limit

	<u>Tidal</u>	<u>Saline Limits</u>
River Bure	Horstead Mill	St Benet's Abbey
River Ant	Honing Lock	
River Thurne	Hickling and Horsey	
River Yare/Wensum	Trowse Mill and New Mills Norwich	Cantley
River Waveney	Ellingham	Burgh St Peter

Water Resources Availability:

<u>River</u>	<u>Hydrometric Sub-Catchment</u>	<u>Availability</u>	<u>Nominal Surplus (tcmd)</u>
Bure	34/6 Chalk	- No Water Available **	Zero
Spixworth	34/7 Chalk	- Nominal Surplus	1.0
Ant	34/8 Chalk	- No Water Available	Zero
Bure/Ant	34/9 Chalk	- No Water Available	Zero
Thurne	34/10a Crag	- Nominal Surplus	5.0
Ormesby/Filby	34/10b Crag	- No Water Available	Zero
Bure	34/10c Crag	- Nominal Surplus	2.6
Tidal Yare	34/15b Crag	- No Water Available	Zero
Tidal Waveney	34/19b Crag	- Nominal Surplus	3.6
Wensum	34/11 Chalk	- Nominal Surplus	61.1
Tud	34/12 Chalk	- Nominal Surplus	7.0
Yare	34/13 Chalk	- Nominal Surplus	17.0
Tas	34/14 Chalk	- Nominal Surplus	12.7
Tidal Yare	34/15a Chalk	- No Water Available	Zero
Waveney	34/16 Chalk	- Nominal Surplus	5.3
Dove	34/17 Chalk	- Nominal Surplus	3.8
Waveney	34/18 Chalk	- No Water Available	Zero
Tidal Waveney	34/19a Chalk	- No Water Available	Zero

** Denotes allocation to the environment under review.

Fisheries

	<u>River Yare and Tributaries</u>	<u>River Waveney</u>	<u>Total</u>
Length of Salmonid fishery (km)	95	0	95
Length of Course fishery (km)	168	84	252

Conservation

Number of SSSI's

Yare Catchment	76
Waveney Catchment	<u>15</u>
Total	<u>91</u>





3.0 CATCHMENT USES

3.1 Development - Housing and Commerce

3.1.1 General

Development must be considered when planning the use of the river catchment. This use relates to existing and predicted future residential, commercial and industrial development. Planning permission for future development within the catchment will be dependant on the Norfolk and Suffolk county structure plans and the eight District/Borough/City local plans which cover the catchment.

The NRA seeks to pursue its aims and policies in relation to development through the planning consultation process. It is a statutory consultee under planning legislation and advises county and local authorities on development proposals which may have an impact on matters relevant to the NRA. Although the final decision on planning matters rest with the planning authority, via the Secretary of State, government guidelines advise on the need to consider the NRA's concern in determining proposals. Irrespective of obtaining planning consent from the Local Authority, the NRA may use its relevant powers and byelaws under the *Water Resources Act 1991* to control the nature of development proposals.

The present structure and local plans are now being revised to take into consideration both existing and future demands for development, but as the rates and direction of development are dependant on other factors which lie beyond the planning procedure the phasing of works cannot be accurately assessed and will need constant monitoring.

3.1.2 Objectives

Water Quantity

- To protect inland and groundwaters from unacceptable impact arising from development.

Water Quality

- To protect the water environment from unacceptable deterioration due to development.
- To protect inland, coastal and groundwaters from pollution.
- To ensure that adequate pollution prevention methods are incorporated into new developments and are consistent with the NRA's national Groundwater Protection Policy.



Physical Features

- To enhance the water environment in conjunction with development.
- To ensure new development is not at risk from flooding and does not put other areas at risk of flooding which could endanger life and damage property.
- To ensure any work which is needed to reduce the risk of flooding created by new development is paid for by the developer and not the public.
- To ensure that there is no further development in undefended areas.

3.1.3 **Local Perspective** (Refer to Map Nos 3 and 4)

The catchment of the Yare and its tributaries is situated in the county of Norfolk. The catchment of the Waveney and its tributary is situated in the counties of Norfolk and Suffolk.

The Norfolk structure plan revised by the Secretary of State has indicated that the provisions for new housing up to the year 2006 should be broadly distributed as follows, it should, however, be noted that only part of Breckland and Broadland, and none of King's Lynn and West Norfolk lie within the catchment.

<u>District Council</u>	<u>Plan provision for housing units</u>	
Breckland	10,600	
Broadland	11,500	
Great Yarmouth	6,800	
King's Lynn & West Norfolk	13,500	
North Norfolk	8,700)
Norwich	7,200) (Norwich Policy Area 22,000)
South Norfolk	10,700)
Total	69,000	

It can be concluded from the above distribution and other policies within the structure plans, that the future allocations for housing beyond that contained in the Norwich Policy Area which includes Long Stratton, will primarily be centred on the existing towns and rural villages of Great Yarmouth, Diss, East Dereham, Fakenham, North Walsham, Bungay and Eye.

Protection against flooding from rivers and the sea, conservation of water resources and protection of ground and surface waters from pollution is of particular concern in the catchment and this plan proposes the following policy:

- There will be a presumption against development, including the raising of land where, in the opinion of the NRA, such development would be likely to impede the flow of flood water, or increase the risk of flooding elsewhere or increase the number of people or properties at risk.
- There will be a general presumption against any developments which will have an adverse environmental impact on the water environment particularly in relation to rivers, ponds, wetlands, public access in river corridors, and appropriate water related recreation.
- The conservation and enhancement of wildlife, landscape and archaeological features associated with rivers, ponds, lakes, estuaries, etc will be encouraged.
- There will be a presumption against development including changes in land use which, in the opinion of the NRA, will pose an unacceptable risk to the quality of ground and surface water.
- There will be a presumption against development including changes in land use which, in the opinion of the NRA, will have a detrimental impact on water resources.

3.2 Potable Water Supply

3.2.1 General

This use relates to the abstraction of water for public consumption (ie drinking, washing, etc). Water is abstracted from wells and boreholes constructed into the underground rocks called aquifers (groundwater abstraction) or from rivers and springs (surface water abstraction).

Abstractions are made by the Anglian and Suffolk water companies. In addition, individual householders abstract water from wells or boreholes for their own domestic use. Abstractions are controlled by abstraction licences issued by the NRA or its predecessors. Abstractions made by private individuals for their own domestic use would only require a licence if the abstraction is greater than 20 cubic metres per day.

3.2.2 Objectives

Water Quantity

- To conserve water resources, for example by encouraging efficient water use and leakage control.
- In terms of level of service the NRA follows the present policy of operational standards given by OFWAT for public water supply. These are:
 - A hosepipe ban on average not more than once every 10 years,
 - The need for voluntary savings of water on average not more than once in 20 years,
 - The risk of rota cuts or use of standpipes on average not more than once in one 100 years.

Water Quality

- Standards are set in accordance with EC Directives and proposed Statutory Quality Objectives. For surface water this is the *EC Surface Water intended for Drinking Water Abstraction Directive 75/440/EC* and for ground water the *EC Groundwater Directive 80/68 EC*.
- To protect existing licensed groundwater public potable water abstractions from pollution using protection zones.
- To protect all groundwater as a potential future resource in accordance with the NRA Groundwater Protection Policy.

3.2.3 Local Perspective

Within this report Water Resources (groundwater followed by surface water) for the total Yare Catchment are considered within three component catchments; the Yare/Wensum, the Bure and the Waveney.

3.2.3.1 Groundwater (Refer to Map No 5)

Yare/Wensum Catchment

Anglian Water Services operate 14 Chalk borehole sites in the catchment for public water supply. The total quantity of groundwater licensed for use by Anglian Water Services in this catchment is 21 million cubic metres per year.

The water company operates a comprehensive water supply mains network which can distribute water from the borehole source to the point of demand. The major demand centre within the catchment is Norwich, though much of this demand is satisfied through the combined use of surface and groundwater sources. Generally, the supply needs of other communities in the catchment are met locally with Chalk groundwater.

The other major demand centre in the catchment is Great Yarmouth, this area is supplied from outside the Yare/Wensum catchment by Suffolk Water Company essentially utilising surface water resources from within the adjacent Bure Catchment.

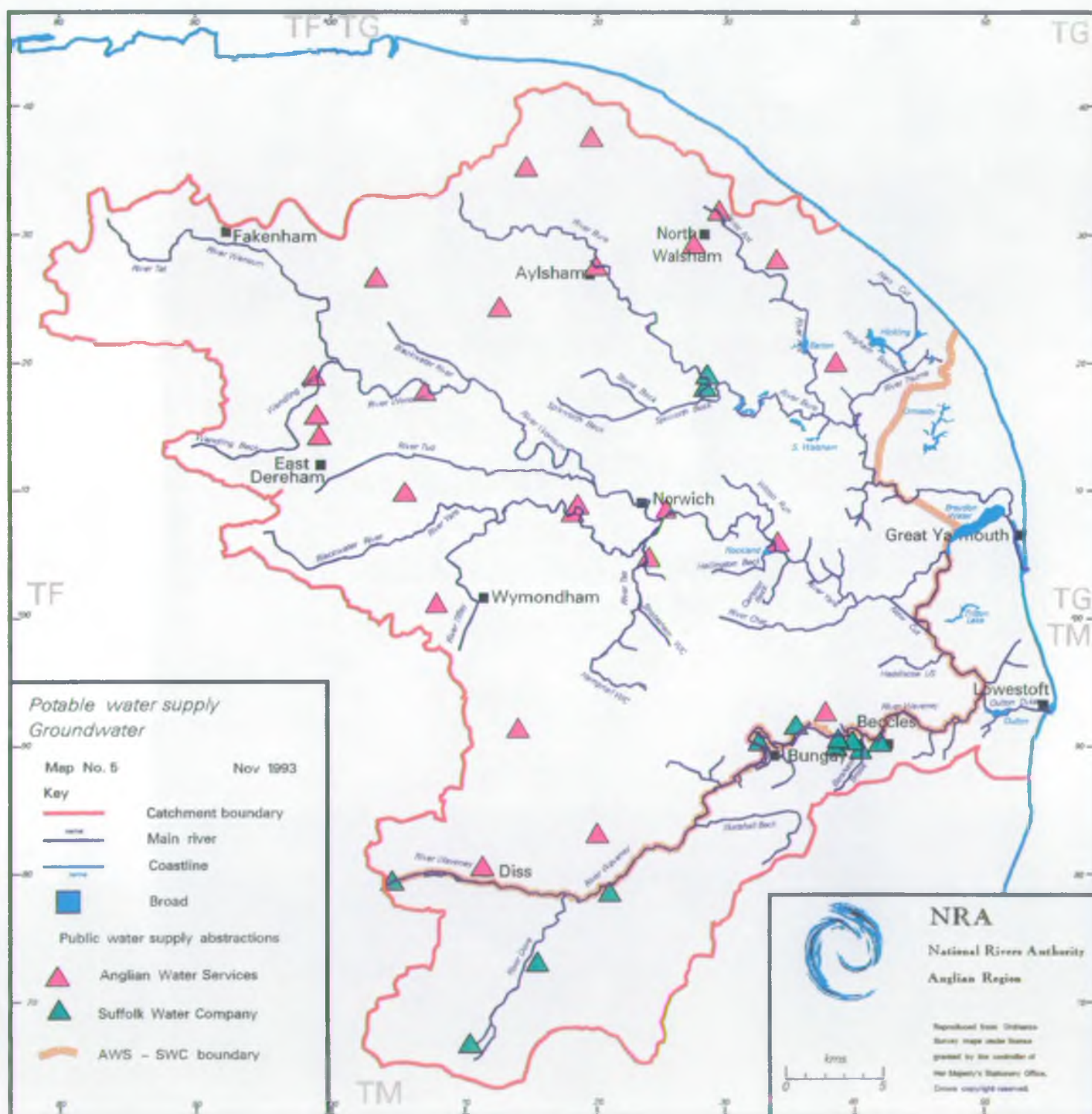
The catchment is characterised by a large number of private groundwater sources used for domestic supply. These abstractions are principally shallow wells and boreholes into the Chalk.

Actual abstraction for public water supply from groundwater is currently 66% of that licensed.

Surplus groundwater resources exist in the catchment to meet future predicted demands, however, this will be subject to careful development having particular regard to the water environment, ie rivers and wetlands. The potential for development of this resource is recognised and included in the Region's Water Resources Strategy.

Bure Catchment

There are 9 borehole sites licensed in the catchment for public water supply. Anglian Water Services operate 1 Crag and 6 Chalk sites whilst Suffolk Water Company operate 2 No. Chalk sites in conjunction with surface water abstraction.



The major demand centre within the catchment is Great Yarmouth, supplied by Suffolk Water Company, though the majority of this demand is satisfied through the use of surface water. Generally, the supply needs of other communities in the catchment are met locally with Chalk groundwater by Anglian Water Services.

The total quantity of groundwater licensed for use by Anglian Water Services in this catchment is 5.2 million cubic metres per year. Suffolk Water Company are licensed to abstract 1.75 million cubic metres per year.

The catchment is characterised by a large number of private groundwater sources used for domestic supply. These abstractions are principally shallow wells and boreholes into the Chalk and Crag aquifers.

Actual abstraction for public water supply from groundwater is currently 60% of that licensed.

Essentially, groundwater resources within the Bure catchment are fully committed. Current resource assessments, however, incorporate what is believed to be a high allocation of the groundwater resource to the river as base flows. This environmental allocation is subjective and currently under review for the Bure. The review may confirm a nominal surplus sufficient to meet local demands. The draft Regional Water Resources Strategy invited comments on this and these will be incorporated into the final strategy documents. Meanwhile an interim policy identifies the area as having 'no water available' for additional net abstraction.

Notwithstanding this an embargo on further groundwater development exists in the Ormesby area, the Broads Executive Area and the sub-catchments of the Ant where wetlands and river flows are known to have been affected.

Of particular concern is the maintenance of flows into Broadland and the potential effect of Anglian Water Services groundwater abstraction on East Ruston Fen SSSI. (Draft Broads Plan Policy 2)

Waveney Catchment

There are 13 borehole sites licensed in the catchment for public water supply. Anglian Water Services operate 1 Sand and Gravel and 2 Chalk sites whilst Suffolk Water Company operate 8 Chalk and 2 Gravel sources.

The major demand centre within the catchment is Lowestoft supplied by Suffolk Water Company, though much of this demand is satisfied through the combined use of surface and groundwater sources. Generally, the supply needs of other communities in the catchment are met locally by Anglian Water Services in Norfolk and Suffolk Water Company in Suffolk.

The total quantity of groundwater licensed for use by Anglian Water Services in this catchment is 4 million cubic metres per year. Suffolk Water Company are licensed to abstract 11 million cubic metres per year, though some of this entitlement is authorised for emergency use only when surface water in the River Waveney is unsuitable for abstraction at the Company's Shipmeadow Intake.

The catchment is characterised by a large number of private groundwater sources used for domestic supply. These abstractions are principally shallow wells and boreholes into the Chalk and Gravel aquifers.

Actual abstraction for public water supply from groundwater is currently 75 % of that licensed.

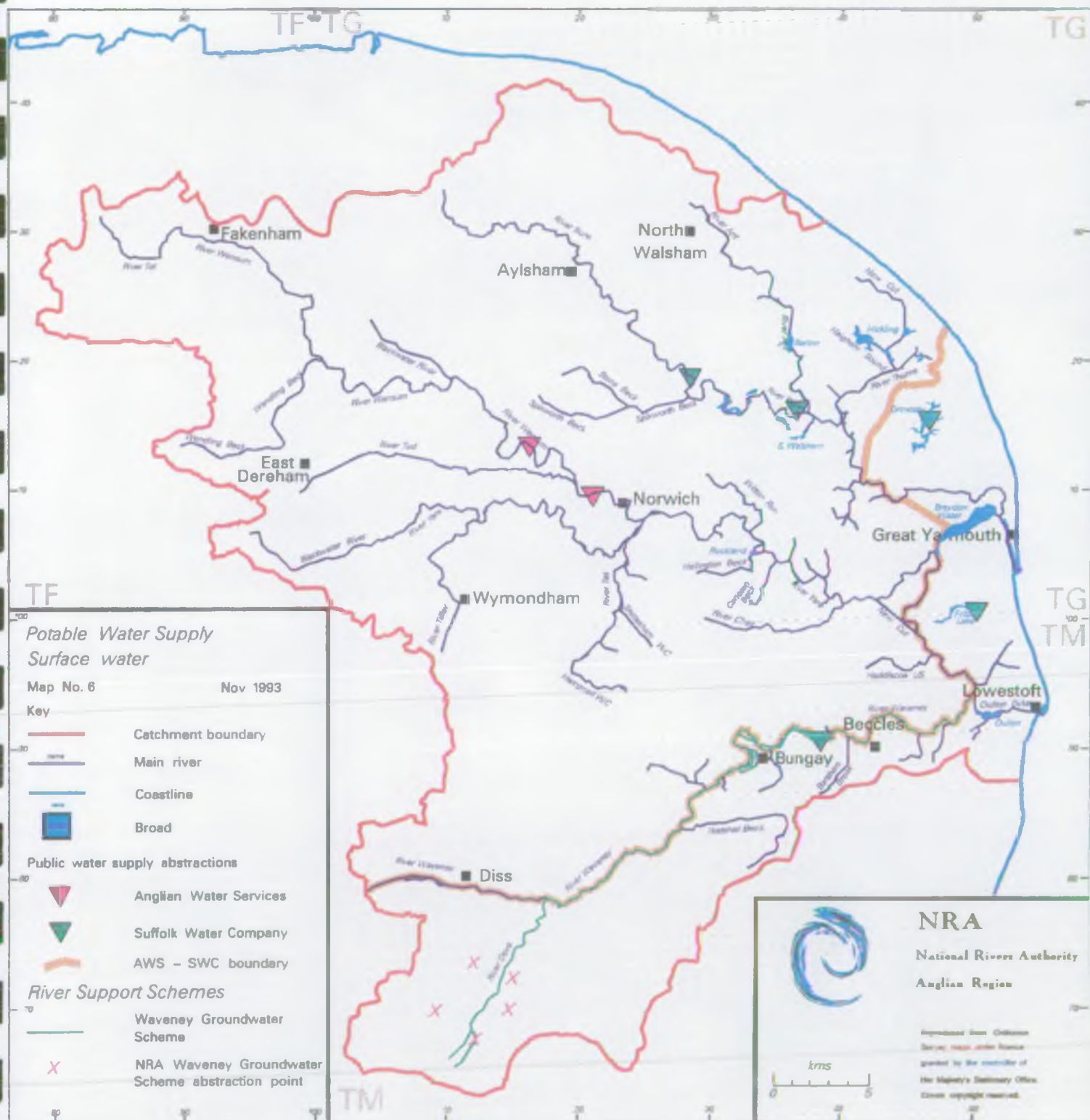
Some surplus groundwater resources exist in parts of the catchment to meet future predicted demands. However, this will be subject to careful development having particular regard to the water environment, ie rivers and wetlands. Groundwater resources in the Middle to Lower Waveney are fully committed, however, surface water development affecting river flows in the lower section can to some extent be offset by river support pumping utilising the NRA's Waveney Groundwater scheme.

Groundwater resources in the Upper Waveney above Billingford have a nominal surplus. However, this will be subject to careful development, having particular regard to the water environment. Suffolk Water Company's existing Redgrave abstraction, located in the headwaters of the Waveney, is causing an undesirable impact on the Redgrave and Lopham Fens SSSI; a wetland of international importance. It is proposed to relocate the abstraction away from the fen or undertake remedial works to mitigate these effects.

3.2.3.2 Surface Water (Refer to Map No 6)

Yare/Wensum Catchment

Anglian Water Services operate two surface water supply works in the catchment to provide water for public supply to the Norwich area. Abstraction is from the River Wensum at Heigham and Costessey. Water abstracted at Costessey can be stored in Costessey Pits, where it also provides recreational and amenity facilities, before being transferred to Heigham works for treatment and subsequent distribution. Quantities licensed for abstraction at Costessey and Heigham Intakes are linked, authorising a total of 17 million cubic metres per year. The Company abstract at Costessey in preference to Heigham because of its bankside storage facility and reduced risk of pollution. Abstraction at Costessey is subject to providing a minimum flow of 44.4 thousand cubic metres per day in the Wensum at Costessey Mill Gauging Station. There is no flow restriction on abstraction at the Heigham intake.



During the 1989-1992 drought the NRA constructed and operated a multi-purpose "emergency" river support scheme by pumping groundwater into the River Wensum at times of low flow. This was to improve the amenity value and increase flow through Norwich, whilst at the same time helping to secure Anglian Water Services abstraction for public water supply at Costessey. The scheme consisted of 2 boreholes near the confluence of the Wensum and Wendling Beck, discharging groundwater directly into the river. It was operated under Drought Order in 1990. Since then the temporary works, ie overland pipelines and river discharge arrangements have been removed.

NRA's Regional Water Resources Strategy for meeting future demands also considers the option of river support utilising River Trent transfers, but recommends against it. Meanwhile, Anglian Water Services are considering developing a river augmentation scheme to support their public water supply abstraction at Costessey.

Bure Catchment

Suffolk Water Company operate three surface water sources in the catchment to provide water for public supply to the Great Yarmouth area. Abstractions are from the River Bure at Belaugh and Horning and from Ormesby Broad. Quantities licensed for abstraction at Belaugh, Horning and Ormesby Broad are linked authorising a total of 10 million cubic metres per year in conjunction with a small amount of groundwater. The Company abstract directly from the river at Belaugh in preference to Horning where saline intrusion can cause water quality problems. Abstraction is subject to a variable minimum flow requirement in the River Bure at Ingworth Gauging Station of 33.34 thousand cubic metres per day.

In 1979 a groundwater support scheme was instigated to meet projected increased industrial demands on Suffolk Water Company's Belaugh abstraction from the Bure. These demands have not materialised and promotion of the scheme has not progressed. The need and timing of the scheme is to be reviewed in the light of flow requirements into Broadland and the consequent depletion of flows from groundwater development in the catchment. (Draft Broads Plan Policy 1)

Currently the scheme consists of 4 boreholes sunk into the Chalk aquifer. They are unlicensed and untested. It is believed that two of these sources may be suitable for development subject to adequate yield and net gain to the river, as well as acceptable impact on existing water users and the environment.

Waveney Catchment

Suffolk Water Company operate two surface water sources in the catchment to provide water for public supply to the Lowestoft area.

Abstractions are from the River Waveney at Shipmeadow and from Fritton Lake at Lound.

The quantity licensed for abstraction at Shipmeadow is 7.5 million cubic metres per year and from Fritton Lake is 2.95 million cubic metres per year. Abstraction rates at Shipmeadow are controlled by minimum flow requirements in the river measured at Ellingham Mill, which are set to control tidal salt water invasion of the river system. The minimum flow requirement is 34 thousand cubic metres per day. Flows in the Waveney can be augmented during times of low flow by operation of the NRA's Waveney Groundwater Scheme.

The scheme consists of 5 boreholes sunk into the Chalk and Crag aquifers situated in North Suffolk, in the catchment of the River Dove; the Waveney's main tributary. The scheme was licensed in 1990 to support the River Waveney at times of low flow and to meet predicted demands for public water supply and spray irrigation from the river downstream. The scheme is designed for intermittent use, essentially during the summer months of any year, when river flows are lowest. It is licensed to discharge a total of 43 thousand cubic metres per day (tcmd) and 6.0 million cubic metres per year into the river system to support flows in the Waveney. Not all of this quantity is available for subsequent re-abstraction due to associated natural losses. However, the system is capable of reliably increasing river flows by 28 tcmd, sufficient to satisfy predicted demands into the next century.

Groundwater resources currently exist in the Dove catchment to support further enhancements of the scheme. However, this would be subject to careful development, having particular regard to existing water users and the environment.

3.3 **Agricultural and Industrial Abstraction**

3.3.1. **General**

This use relates to the abstraction of water from ground and surface sources for agricultural and industrial uses including spray irrigation, general agriculture (stock watering, crop spraying etc), industrial processes, cooling and mineral washing. All such uses, except for general agriculture from surface sources of less than 20 cubic metres per day, require a licence from the NRA.

3.3.3 **Objectives**

Water Quantity

- The Region's level of service objective for spray irrigation is that on average irrigation restrictions should occur not more than once in 12 years.
- To encourage the storage of surplus winter flows in reservoirs for subsequent use during dry periods.

Water Quality

- To maintain and improve water quality in accordance with NRA river quality objectives and proposed statutory water quality objectives.

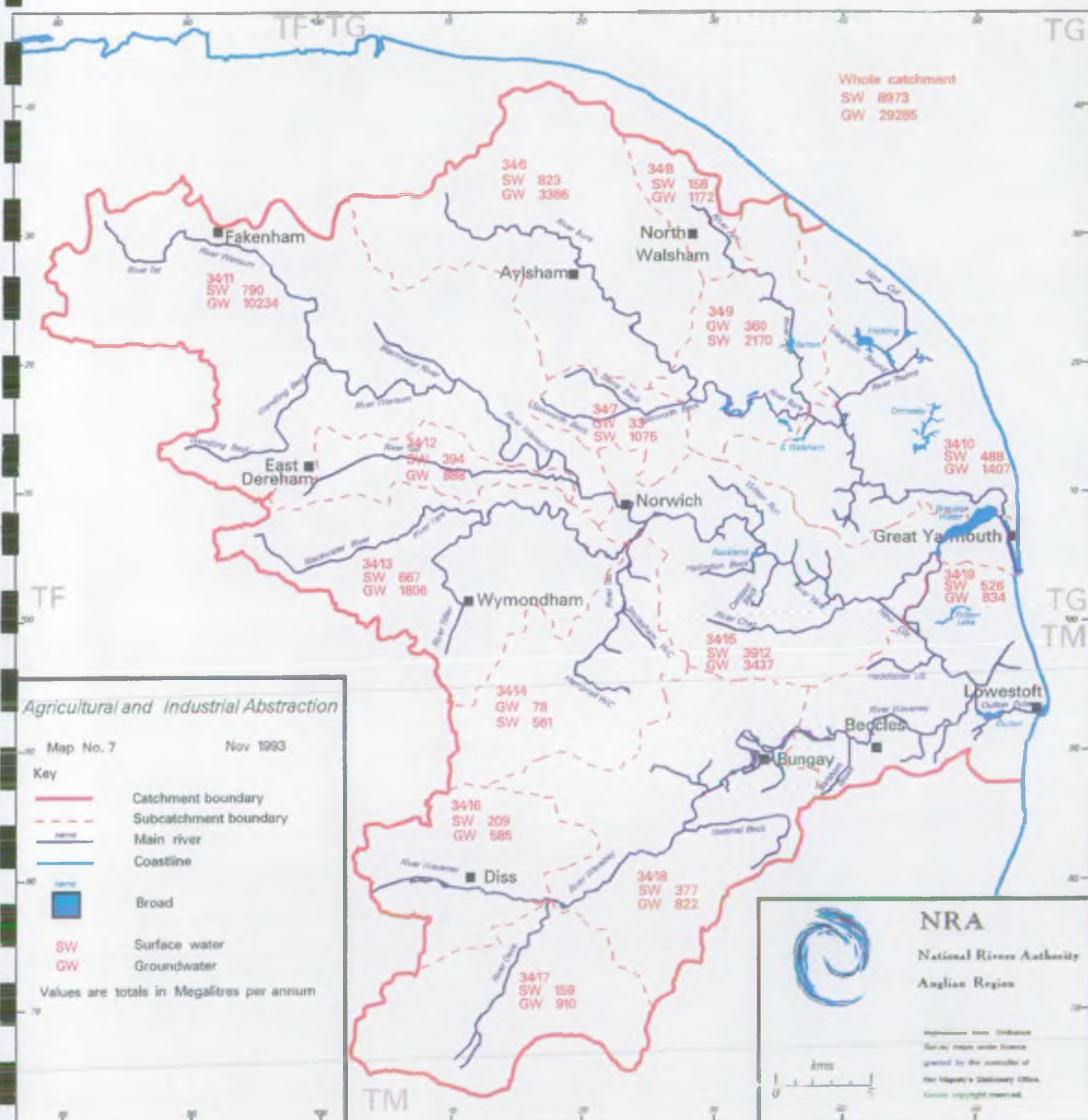
3.3.2 **Local Perspective** (Refer to Map No 7)

Spray Irrigation

Spray irrigation is widely practised across the catchment. There are a total of 434 licences which permit abstraction for this use. Since the mid 1960s it has been the policy of the NRA and its predecessors to encourage the use of groundwater in preference to surface water for this purpose. Those surface water licences which do exist (168) are, in the main, licences of right issued under the terms of the *Water Resources Act 1963*.

The total quantities licensed are 5.1 million cubic metres per annum from surface water and 13.3 million cubic metres per annum from groundwater.

This use is virtually wholly consumed, ie not returned to the system after use, and therefore considered lost to the resource.



There is likely to be an increase in future demand for this use which is estimated to be around 2-3% per year. Groundwater resources in much of the catchment still offer some scope for further development although unacceptable local effects, particularly on low river flows and wetlands must be avoided. This can often be achieved by careful siting of abstraction points but in many cases, stringent conditions or licence refusal may be necessary (Draft Broads Plan Policy 2).

General Agriculture

There are 1056 licences to abstract a total of 5.0 million cubic metres per annum for this purpose. In the main they are small abstractions having little impact either locally or on overall resources.

Industrial

There are 167 licensed abstractions in the catchment, permitted to take up to 14.8 million cubic metres per annum. Fifteen abstractions draw water from surface sources (a total of 3.8 million cubic metres per annum), the remainder being from groundwater. Water used in industrial processes generally represents an overall loss but uses such as cooling or mineral washing result in a high proportion being returned to the system.

3.4 **Effluent Disposal**

3.4.1 **General**

Discharges of effluent are controlled by ensuring compliance with NRA consents which stipulate the quality and quantity of the material released.

Consents are calculated by taking into account upstream water quality, the dilution available in the receiving watercourse and the desired quality of the receiving watercourse. Consents are designed to ensure that downstream water quality remains acceptable for its many uses and compliant with prescribed water quality standards.

Results of the routine monitoring of the treated effluent from all discharges is available from the *Water Resources Act 1991* Register at Regional Headquarters, Peterborough.

3.4.2 **Objectives**

Water Quantity

- To ensure where possible that river flows do not decrease below the existing value used to determine the quality limits of the consent.
- To ensure that undue reliance is not placed on effluents to maintain minimum river flows.

Water Quality

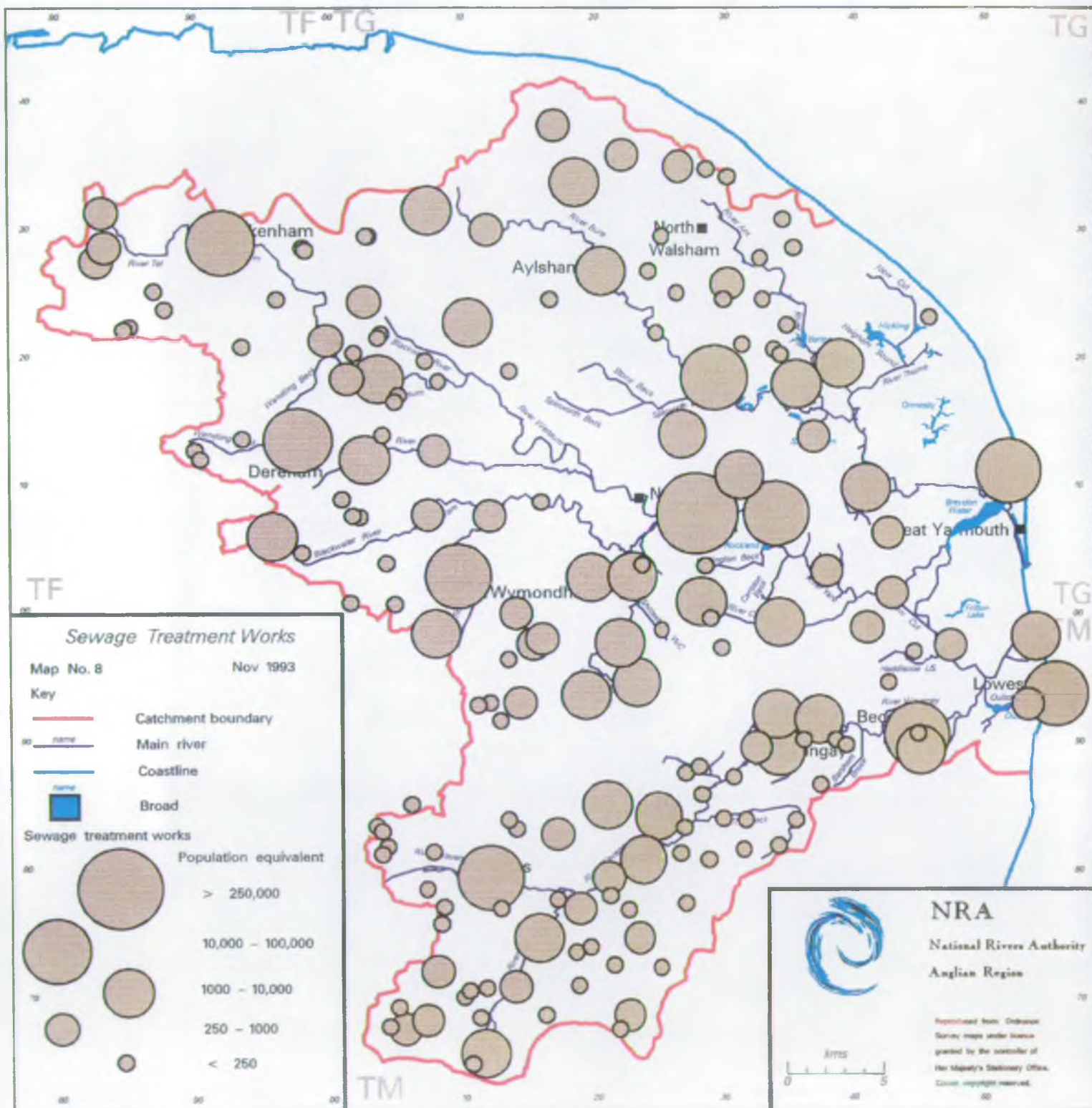
- To ensure consent conditions prevent exceedence of EC Directives and adequately safeguard river quality objectives, including any local targets set to achieve Broads restoration objectives. (Draft Broads Plan Policy 9)
- Monitoring of effluents and controlled waters to establish compliance with EC Directives and quality standards, and take action in the event of non-compliance.

3.4.3 **Local Perspective**

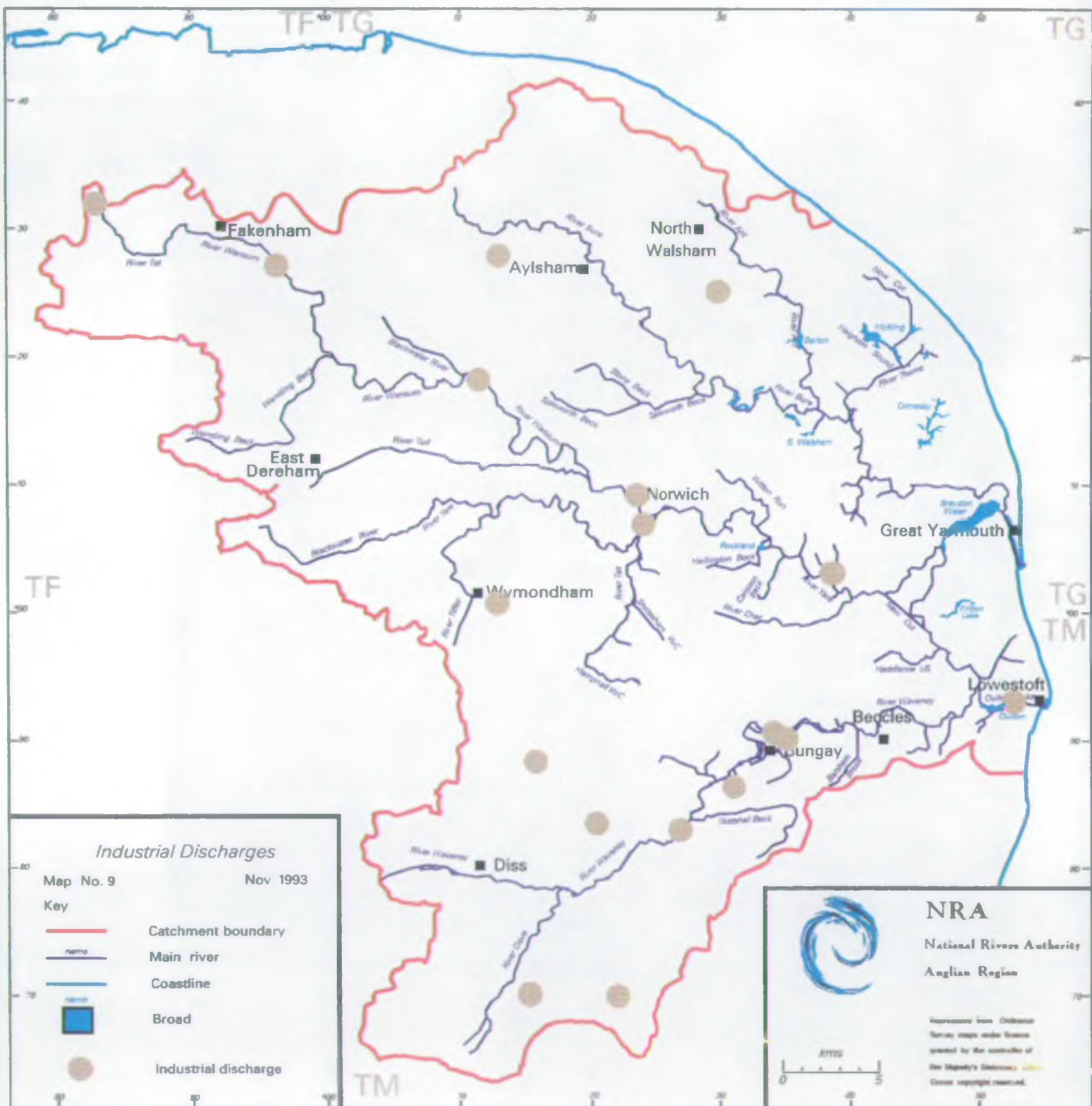
3.4.3.1 **Sewage Treatment Works** (Refer to Map No 8)

There are 159 sewage treatment works and 3 sea outfalls operated by Anglian Water Services (AWS) within the catchment area (63 in Yare/Wensum, 68 in Waveney and 31 in Bure sub-catchments).









In addition, there are a considerable number of sewage treatment works operated by commercial undertakings, local authorities and private householders. The 162 AWS and 21 larger private discharges are shown located on the attached map and are graded according to the size of the population served by the individual works or sea outfall

The largest sewage treatment works in the catchment is at Whitlingham and serves the City of Norwich and its environs, a population of over 270,000. This works has recently had considerable extensions made and currently produces a high quality effluent. Other significant sewage treatment works in this sub-catchment (serving populations in excess of 10,000) include Dereham, Wymondham, Fakenham and Strumpshaw. The effluents from these works comply with their present consent limits on quality, but these limits do not reflect river requirements and schemes are required to improve them to meet standards which are related to river quality objectives.

The two significant sewage treatment works (serving populations in excess of 10,000) in the Waveney sub-catchment are at Beccles and Diss. The effluents from these works comply with their present consent limits which are related to river quality objectives, although the Beccles consent conditions do not reflect the water quality requirements of a marsh drain which receives the effluent before being pumped to the River Waveney.

There are few sewage treatment works of significance, as regards population, that discharge to the Bure sub-catchment and they all generally comply with their consent conditions. However, in this sub-catchment there is currently a need to establish acceptable phosphorus consent conditions in the larger works to control eutrophication.

Although the tidal section of the entire Yare catchment is sensitive to excessive algal (phytoplankton) growth, the large number of lakes in the Bure sub-catchment make it particularly sensitive to enrichment and hence a priority for nutrient control. At present phosphorus is removed from sewage treatment works at Aylsham, Belagh, Briston, Horning, South Repps, Worstead, Stalham and RAF Coltishall. Discussions are currently underway to extend this to other works and establish long-term phosphorus consent conditions.

3.4.3.2 Coastal Outfalls

The main discharge to coastal waters within the catchment is at Caister (Great Yarmouth). Currently most of the Great Yarmouth sewage discharges untreated to the River Yare through many separate outfalls. A capital scheme is currently in progress to divert all the normal flows to the Caister long sea outfall. This will then leave only the storm flows discharging to the river.

The two other discharges to coastal waters are at Lowestoft and Corton. The Lowestoft sewage is subject to maceration before discharge whilst the sewage at Corton is subject to full treatment.

3.4.3.3 Industrial Discharges
(Refer to Map No. 9)

Within the catchment there are 20 significant industrial discharges, most of which are associated with the food industry. These include, four maltings, two poultry processors, two vegetable processing plants and a sugar beet factory. The locations of the 20 discharges are shown on the attached map.

In industrial areas there are on occasions some surface water pollution problems associated with unsatisfactory discharges to drainage dykes from industrial estates. These are investigated and corrected when they are identified.

3.5 Landfill Sites

3.5.1 General

The NRA is a statutory consultee of Waste Regulation Authorities (WRAs) throughout the life of any landfill site. It is also a statutory consultee of Planning Authorities under the Town and Country Planning Acts. A valid planning permission is required before a waste disposal licence may be issued. The planning permission is presently the means by which aftercare provision on closed landfill sites may be regulated. At present the waste disposal licence relates to only the operational phase of any site, but when Part 2 of the *Environmental Protection Act 1990* is implemented, it will be possible to apply aftercare provisions to the licence.

It is recognised that a wide range of waste disposal operations require a waste disposal licence. These include scrap yards, transfer stations, incinerators, waste storage facilities etc. Often the greatest threat to surface and groundwater quality is posed by landfill activities.

3.5.2 Objectives

Water Quantity

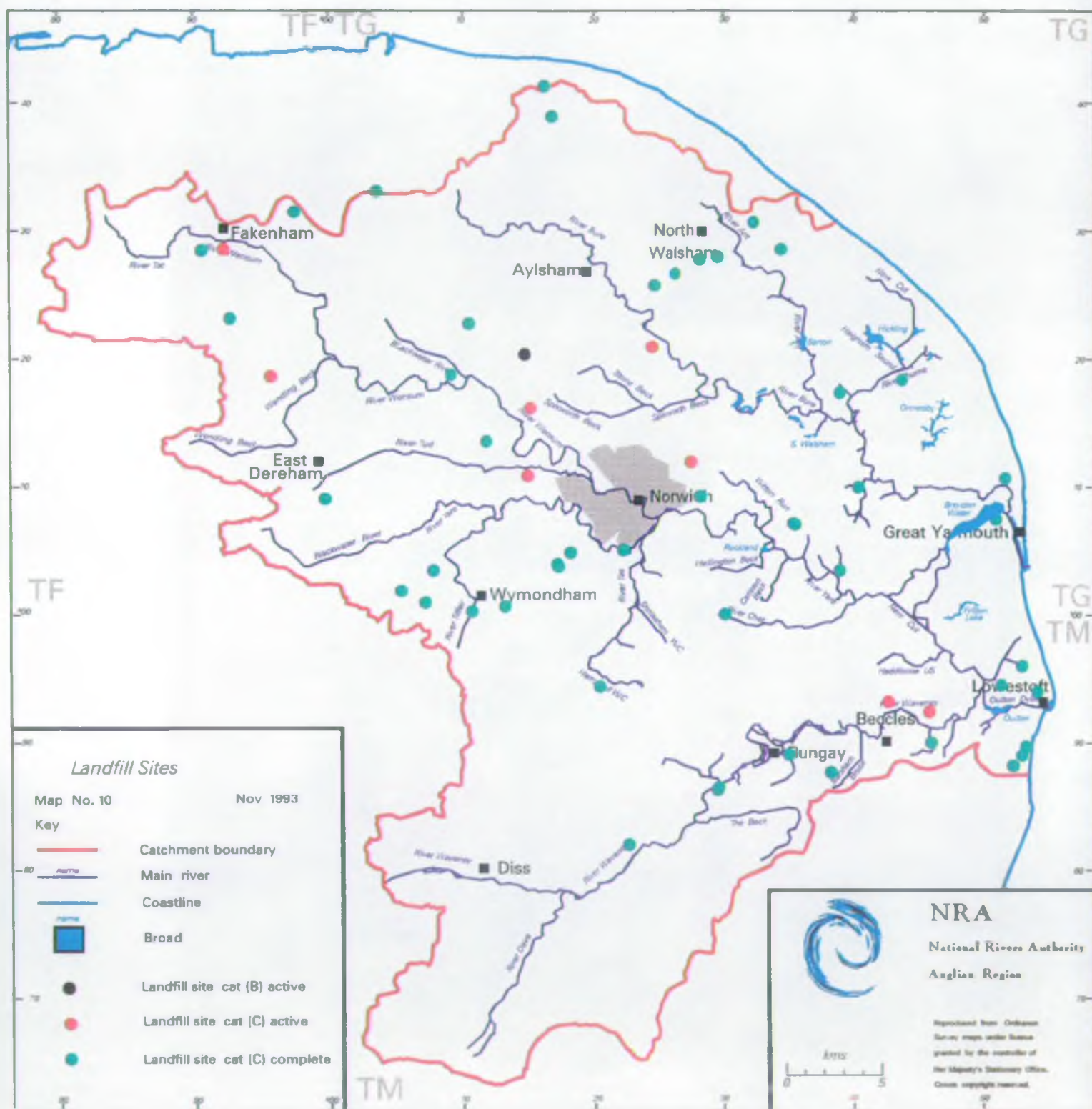
- To ensure, by liaison with the Planning Authorities, that advice is given on future development proposals which may impact on water resources.

Water Quality:

- To ensure compliance with the *EC Directive 80/68/EEC* on the *Protection of the Quality of Groundwater*.
- To Implement the NRA's National Groundwater Protection Policy.
- To prevent pollution of surface and groundwaters.
- To ensure adequate monitoring of land fill sites is undertaken to assess the effect on the quality of ground and surface waters.

3.5.3 Local Perspective (Refer to Map No. 10)

In the past, the majority of landfill sites were operated on the "dilute and disperse" principle, ie polluting liquid, known as leachate, emerging from the base of a site and into the underlying strata, was considered to be improved by natural attenuation processes and to be diluted by the general movement of groundwater passing under the site.

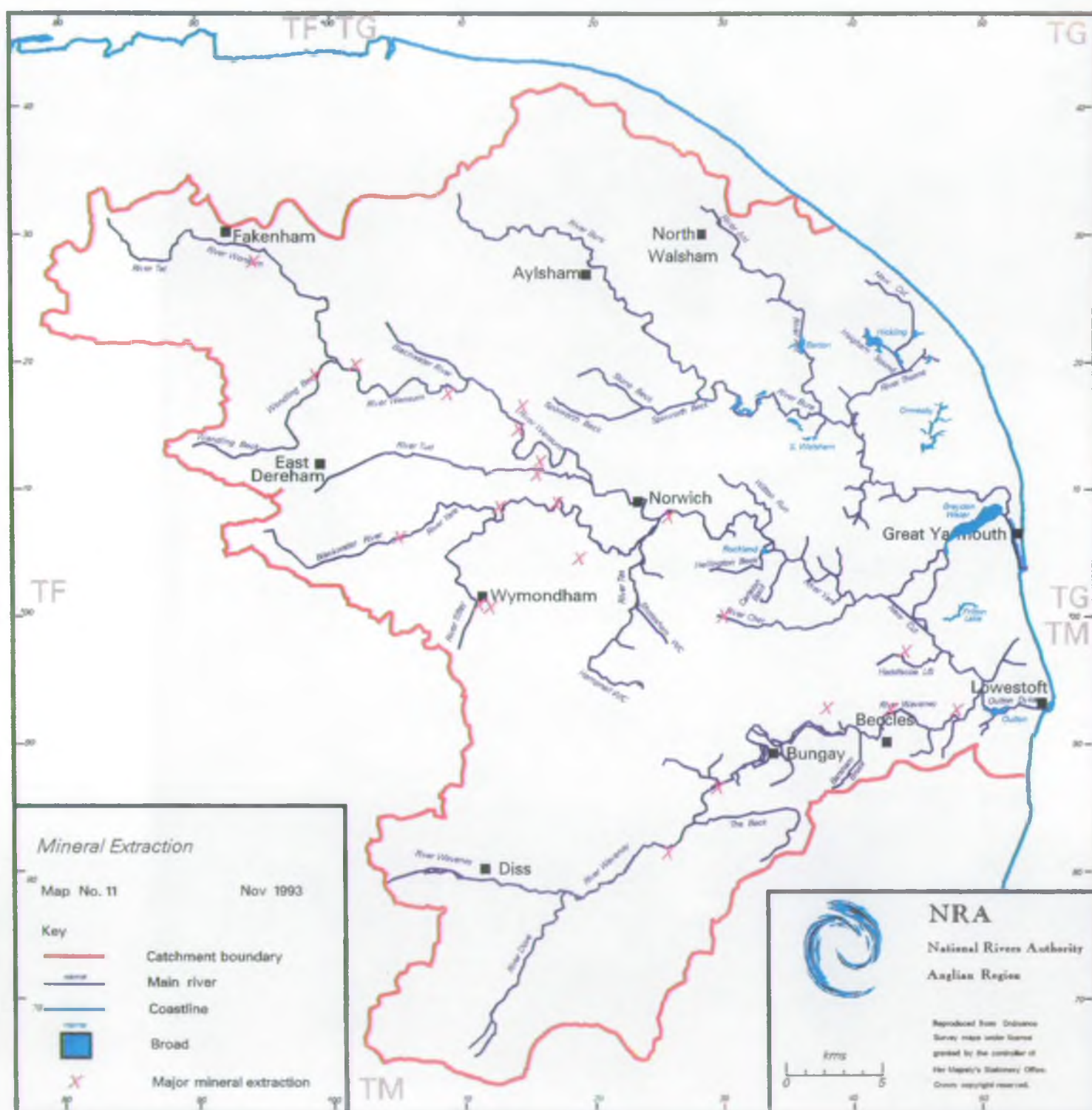


Unfortunately it is now known that in some instances the dilution and attenuation were insufficient to render the leachate innocuous. As a consequence several sites within the catchment may require remedial measures, at some time in the future, to protect the quality of the groundwater or adjacent watercourses. Such sites are presently being monitored and contingency plans are being drawn up by the site owners.

In future it is likely that the majority of landfill sites will be constructed as "containment" sites, whereby the waste disposal licence will specify the engineering measures which must be taken to minimise the escape of any leachate generated. In addition, monitoring boreholes will be required around each site in order to assess the effectiveness of these leachate containment measures.

Landfill sites are licensed to accept various categories of waste. Category 'A' waste consists of dry inert material, whereas Category 'B' and 'C' wastes contain substances which decompose. Sites which are presently operational and receiving Category 'B' and 'C' wastes are marked on the attached map. Also marked, are significant Category 'C' sites (sites which accepted domestic waste) which are now completed and closed, together with one completed hazardous waste site.

In addition to landfill sites, there are a number of areas of land in the catchment which have been contaminated by past industrial activities. Localised areas around Norwich, Lowestoft and Great Yarmouth where industrial activity has taken place in the past are examples. Identification of these sites in order to assess the implications of future development is required.



3.6 Mineral Extraction

3.6.1 General

Mineral extraction can affect both groundwater quantity and quality. Generally minerals are located in the river valleys and their removal affects the water balance of the river. Water storage for aquifer is lost and as a result of evaporation river replenishment is decreased, particularly during periods of low flow. Materials returned to the excavated area never satisfactorily replace that which has been removed.

During extraction dewatering can cause unacceptable solids discharge to rivers and the industrial nature of the activity pose other pollution risks such as oil contamination. Any lake created by the extraction can, if directly connected to the river, seed the river with algal material causing unacceptable changes in the downstream water quality.

3.6.2 Objectives

Wherever possible groundwater resources will be conserved and protected. The NRA will seek to persuade the County Councils to impose conditions in line with the NRA's Groundwater and Aquifer Protection Policy on associated planning permissions.

Water Quantity

- To ensure that dewatering and mineral extraction does not cause unacceptable effects on surface and groundwater resources
- To ensure that existing rights of those who abstract water are protected.

Water Quality

- To ensure no deterioration of groundwater or surface water quality.
- To ensure that any mineral processing water discharged is in line with consent limits and that dewatering and other activities does not cause pollution.

Physical Features

- Ensure that worked out sites are reinstated with an enhanced value to the environment.
- To minimise the loss of flood plain habitats of conservation value.

3.6.3 Local Perspective
(Refer to Map No. 11)

The counties of Norfolk and Suffolk hold significant sources of sand and gravel with East Anglian production in 1989 being in excess of 10 million tonnes which represents 8.5% of the national output. Map 12 indicates existing mineral extraction sites, but does not necessarily indicate these sites are still active, however, the map does clearly show the distribution of sites and the predominance of sites in the river valleys. Norfolk Minerals Local Plan in accordance with Planning Policy Guidance Note 12 has just completed its consultation stage. The objective of the Plan is to identify and provide for the sustainable need for minerals, and to define environmental constraints. The NRA has been consulted on the Plan and should be consulted as a statutory consultee regarding individual planning permissions which should include restoration proposals.

3.7 Flood Defence

3.7.1 General

This catchment use reflects the NRA's corporate aim for flood defence which is the protection of people and property against the risk of flooding from rivers and from the sea.

The use is divided into the following main categories:-

- Sea Defences
- Tidal Rivers - Broadland
- Non Tidal (Fluvial) Rivers
- Flood Warning

Section 105 of the *Water Resources Act 1991* requires the NRA to exercise a general supervision over all flood defence matters. For the purposes of management, certain reaches of the river are formally designated as "Statutory Main River". On Main River, the NRA have special powers to carry out works or control the actions of others. Any proposal that could interfere with the bed or banks or obstruct the flow in the river requires formal consent from the NRA. For watercourses which are not designated as main rivers, local authorities have the statutory powers, under the *Land Drainage Act 1991*, to maintain or improve existing works or construct new works, except in internal drainage districts where the powers rest with internal drainage boards. These powers are permissive and do not release riparian owners from any obligation to which they were subject by reason of "tenure, custom, prescription or otherwise", before the commencement of the *Water Resources Act 1991* or the *Land Drainage Act 1991*.

3.7.2 Objectives

Physical Features

- To provide an effective defence for people and property against flooding from rivers and from the sea. The standard of protection to be economically viable, technically sound and environmentally acceptable, (see Appendix II for Anglian Region's Interim Levels of Service).
- To implement the preferred option for the alleviation of flooding in Broadland.
- To provide adequate arrangements for flood forecasting and warning.
- To provide an emergency response to flood events.

- To maintain river channel structures and sea defences to protect people and property to the appropriate standard and take account of environmental needs and requirements. (Draft Broads Plan Policy 4)
- To ensure correct operation of barriers, washlands, sluices and other river control structures.
- To identify environmental enhancement opportunities. (Draft Broads Plan Policy 5)
- To monitor and assess coastal geomorphology.

3.7.3 **Local Perspective** (Refer to Map No. 12)

3.7.3.1 Sea Defence

The NRA maintains the lengths of sea defences shown on the map, all of which are vital to the habitation of large parts of the coastal strip. Following the East Coast Flood Disaster in January 1953, when much of the coastal strip was inundated and 10 people drowned in the Great Yarmouth area, the defences were rapidly reconstructed to improved standards. More recently certain lengths of the defences have reached the end of their useful life and the NRA has had an ongoing programme for their replacement and improvement.

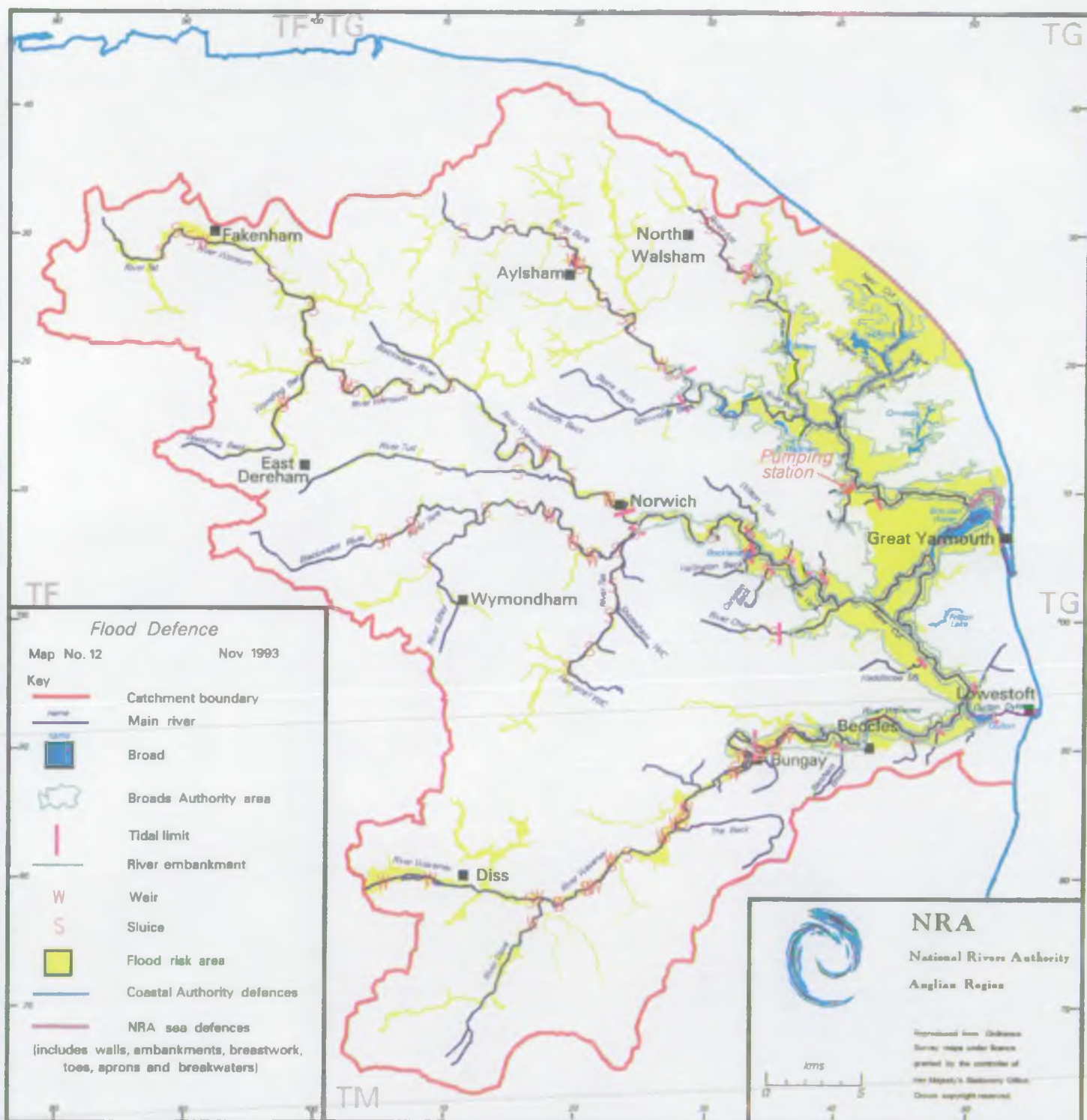
Between 1976 to 1986 a new reinforced concrete sea wall was built between Happisburgh and Winterton, to improve the standard of protection to this part of the coast and safeguard the "back door" to Broadland. Over the next 40 years the NRA will be investing circa £40 million on the implementation of a Beach Management Programme, including the construction of 16 off-shore reefs between Happisburgh and Winterton in order to maintain satisfactory beach levels.

An allowance of 7 mm per year is now built into NRA sea defence designs to accommodate projected rises in sea level over the next 50 years.

3.7.3.2 Tidal Rivers - Broadland

Flooding in Broadland is caused by high sea levels or by high river flows. The most damaging events are associated with high sea levels since much of this flooding is saline. Saltwater also penetrates further up the rivers than usual, damaging the ecology of normally freshwater reaches causing extensive fish kills.

The principal tidal rivers are flanked by some 240 km of tidal embankments which in turn defend about 21,300 ha of land. Many of these embankments have settled, by an average of about 20 mm/year, since they were last improved and over much of the area they are at risk of



being overtopped by floods with return periods of 5 years or less. Great Yarmouth is defended by flood walls which have recently been raised to levels which prevent overtopping by floods with return periods of 100 years or more.

A flood alleviation strategy study for Broadland was started in 1991. The NRA's consultants assessed six main options and ten sub-options concluding in January 1993 that the following two options should be looked at in greater detail.

Option 1

Barrier on Bure and Washland at Haddiscoe Island comprising:

- A barrier near the mouth of the Bure
- A washland at Haddiscoe Island
- Strengthening the Great Yarmouth flood walls
- Widening and strengthening the Broadland flood banks

Option 2

Yare Barrier comprising:-

- A barrier on the Yare located upstream of the Haven Bridge Great Yarmouth
- Strengthening the Great Yarmouth flood walls
- Widening and strengthening the Broadland flood banks

The schemes will require a commitment to regular raising of flood banks and flood walls to guard against settlement and sea level rise. This will be in addition to normal maintenance requirements, which include the continuing need to provide and repair erosion protection works to the existing flood banks/ronds, eg steel piling protection.

The Local Flood Defence Committee has decided that a Yare barrier option be developed. This will necessitate a public inquiry.

3.7.3.3 Non-Tidal (Fluvial) Rivers

The non-tidal (fluvial) rivers combine to form a total length of 358 km, in Norfolk and North Suffolk, and drain a total of 2320 km². On all four river systems, the water levels regularly flood out of the channels during peak flow conditions, into their flood plains. Partly due to this flood risk there has been limited development in the river valley, and the main flood risk is to agriculture and the infrastructure such as roads and communications. Schemes to improve the level of protection within the catchment have included improving channel capacities and upgrading and automating control structures. A risk nevertheless remains within the flood plain.

Maintenance of the river channel is essential, both to preserve the integrity of embankments and defences, and the flood capacity and discharge characteristics of the system. Changing agricultural practice and surface water run off has increased the silt load and deposition in the channels, whilst nutrient rich water increases aquatic weed growth during the summer, which requires removal from the channel. The Local Flood Defence Committee has agreed that maintenance frequencies should be increased where appropriate to maintain agreed standards of service.

River Yare (fluvial): The upper Yare catchment extends from Shipdham to the tidal limit at Trowse Mill on the Norwich urban fringe. A major tributary, the River Tiffey rises at Spooner Row and flows through Wymondham to join the Yare at Barford. The River Yare and its tributaries form a sub catchment to the Yare system, joining downstream of the upper tidal limit at Trowse. The fluvial Yare system is 127.4 km in length with a total catchment area of 542 km².

No major flood defence schemes have been carried out recently, the existing channel and control structures being sustained.

River Wensum (fluvial): The River Wensum has its sources at Syderstone and South Raynham, it flows to its tidal limit at New Mills in Norwich and thence downstream to its confluence with the River Yare through urban development in Norwich. River control works have been improved, together with increased channel capacity through Norwich, to protect development at risk within the flood plain.

The total length of the river system is 128 km, with the major tributaries being the Wendling Beck, the River Tud and the Whitewater River. Its total catchment is 560 km². Increased urban run off from Dereham on the Wendling Beck, and Fakenham on the Wensum, is increasing peak flood flows.

River Bure (fluvial): The upper Bure catchment extends from its source at Edgefield Street to Horstead Mill, the upstream tidal limit, 54 km in length and with a catchment area of 330 km².

One town, Aylsham, has developed into the flood plain, with some properties at risk. A former navigation existed as far upstream as Aylsham and remnants of the canal remain and form part of the flood channel. All the river control structures are in private ownership with the exception of Horstead, which is controlled by the NRA.

River Waveney (fluvial): The upper Waveney catchment extends from Redgrave Fen, the river source, to Ellingham Mill, the upstream tidal limit, 45 km in length with a catchment area of 889 km². The main tributary is the River Dove. Extensive flood alleviation works, including sluice structures, were carried out in the 1970's from Geldeston upstream to Hoxne.

3.7.3.4 Land Springs

In addition, within the Broadland system there are numerous fresh water land springs, which are frequently spring fed, that evacuate into the tidal main rivers, for example, Haddiscoe Landspring and Whitton Run. These catchwaters transfer upland water across the floodplain, and outfall through gravity sluices, as tide levels permit into tidal reaches.

3.7.3.5 Flood Warning

The NRA provides information and advice to Norfolk and Suffolk County Police Forces for the purpose of giving them sufficiently advanced warnings of areas likely to be affected by tidal and/or fluvial flooding in order that effective actions can be taken and in appropriate cases public warnings issued.

3.8 Ports, Harbours and Commercial Navigation

3.8.1 General

This use relates to the tidal River Yare through Great Yarmouth, known as the Yare Haven, the tidal River Yare upstream of Great Yarmouth and the Port of Lowestoft. There is no commercial (cargo) navigation on either the River Bure or Waveney.

3.8.2 Objectives

Physical Features

- To maintain and replace as necessary the flood defence walls and piled quay headings, subject to appropriate contributions, along the Yare Haven to protect the port and the town of Great Yarmouth.
- To ensure that the operation of the port and commercial navigation do not adversely affect water quality.

3.8.3 Local Perspective (Refer to Map No. 13)

Port of Great Yarmouth

The port is controlled by the Great Yarmouth Port Authority. It is a major local employer and sustains, directly or indirectly, a large proportion of the local industry. Originally a fishing port, its principal current activity is concerned with servicing the southern basin of the North Sea gas industry, with more than 400 companies directly related to the offshore sector, employing in excess of 5,000 people. Additionally, the port retains a significant import/export trade across Northern Europe.

The entrance to the harbour is difficult to enter or leave, but it has the advantage of being accessible at all states of the tide. It is believed that this is the main reason for it having been able to survive competition from other East Coast and Continental Ports.

During 1990 the port of Great Yarmouth's 8 kilometres of quayside saw 10,000 ship movements in and out of the port, with a further 5,000 internal ship movements, together accounting for 1.77 million tons of cargo.

Access to the port has improved in recent years with the dualling of the A11 and the A47 and this is planned to continue. Two major enhancement schemes have been proposed in recent years, a third river crossing (at a site about a third of the way up the Haven from the harbour mouth) and an outer harbour.



TG
TM

Ports, Harbours and Commercial Navigation

Map No. 13 Nov 1993

Key

- Catchment boundary
- Main river
- Coastline
- Broad
- Commercial shipping route
- Port



NRA

National Rivers Authority
Anglian Region



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Much of the quayside is headed by steel sheet piling and both sides of the Haven are provided with flood walls, some of which are located directly over the piled quay headings. Most of the piled quay headings are in private ownership and are in varying conditions. The NRA has recently improved the standard of flood protection through the Haven and it is estimated that the current defences will provide protection for up to a 1 in 100 year return period event. It is important to ensure the future defences by replacing the piled quay headings when they reach the end of their useful life.

Port of Lowestoft

Although within the Yare Catchment Plan, this port lies at the mouth of Lake Lothing and no Broadland flows discharge from the system at this point. Mutford Lock at the head of Lake Lothing has recently been reconstructed to allow small craft to pass out of the Broadland navigation system via Oulton Broad to the sea. The port has a great emphasis on fishing, whilst sharing Great Yarmouth's role in servicing the North Sea offshore sector.

Commercial Navigation

Over the years commercial navigational use of the tidal River Yare upstream of the Yare Haven at Great Yarmouth has been declining and currently there is only about one shipping movement each week, mainly to the Cantley sugar beet factory. It is unlikely that commercial navigation on the River Yare will increase.

3.9 Mill Rights

3.9.1 General

The non-tidal main rivers in Norfolk and North Suffolk are slow flowing due to minimal gradient. For at least the past 400 years, watercourses have been deepened, straightened and embanked to provide a head of water to power mill structures, constructed across, and obstructing river flows. The original function of the mills was primarily to grind corn, although New Mills at Norwich used the energy generated to pump river water around the City as a water supply.

3.9.2 Objectives

Physical Features

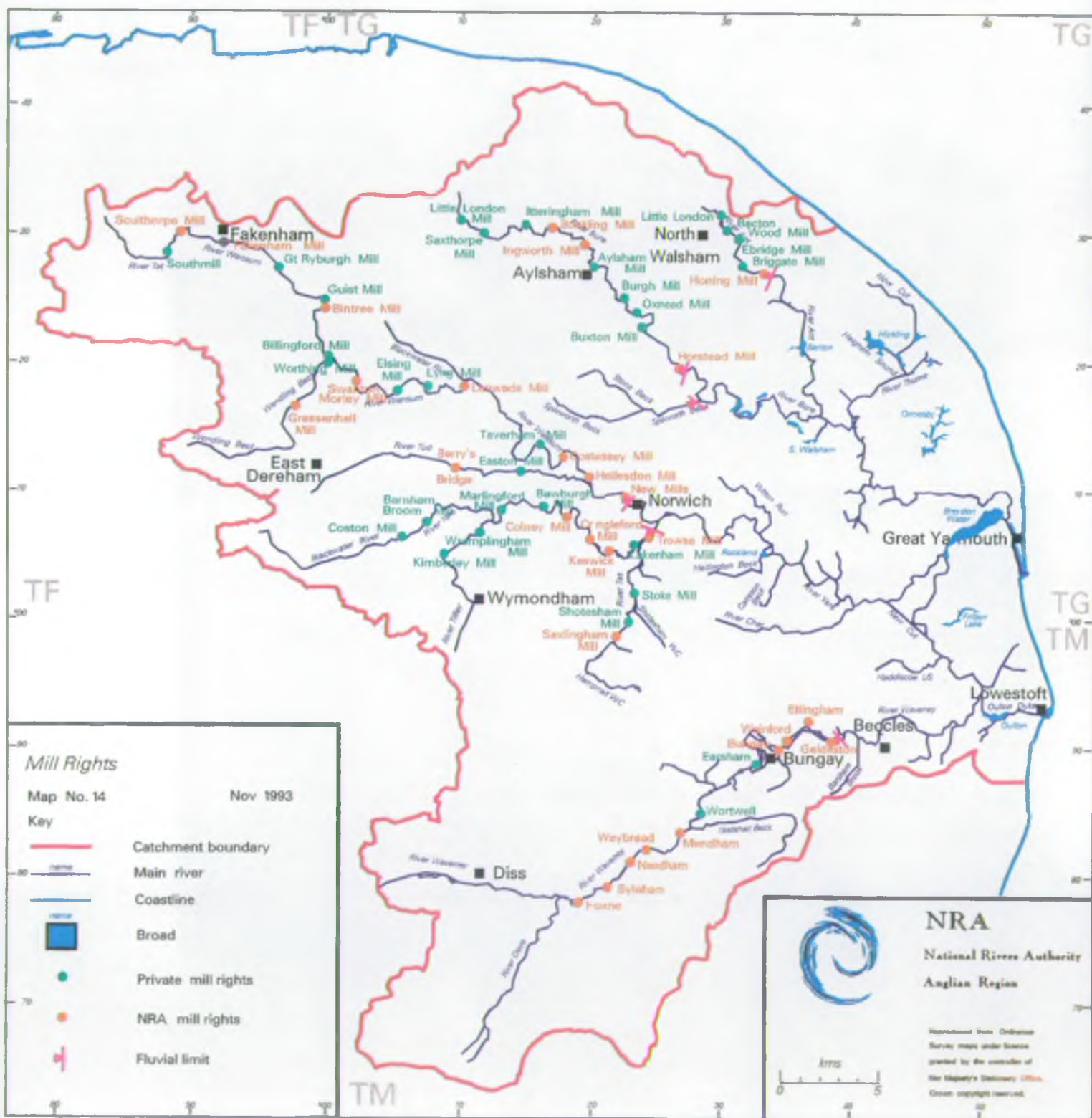
- To maintain mill pools and millstreams free of silt, obstructions and weed growth to allow continued use.
- To maintain mill structures and controls, to allow their function under all flow conditions.
- To automate manually controlled mill structures/slucices where appropriate.

3.9.3 Local Perspective (Refer to Map No. 14)

On all the major rivers systems, including the Yare, Bure, Wensum and Waveney, milling heads have been constructed to provide a means of power. The ownership of these structures, and their accompanying water rights, lies mainly with the private mill owners.

None are currently used for their original purpose, although some mills retain their undershot water wheels, such as Lenwade and Bintree. At Oxneed, the milling head is used to generate electricity, whilst at Ingworth and Sculthorpe, the water level controls have been removed, leaving a fixed broad crested weir.

The owners of the milling rights can maintain their retained levels within the old milling limits. However, the general practice nowadays is to hold the water level at its maximum height, partly for aesthetic reasons, but also because of increasing siltation of the mill pools. The fragmentary nature of mill ownerships within the Yare catchment is highlighted during flood flows. Each mill owner operates their own controls to evacuate flood waters, often without reference to owners both upstream and downstream.



Where the NRA has a series of mills on a stretch of river, such as on the Wensum through Norwich, it is possible to manage peak flows more effectively, by controlling sluice gate operations. Acquisition of all water rights within the catchment by the NRA would allow proper coordinated flood routing.

3.10 Amenity, Landscape and Recreation

3.10.1 General

Amenity relates to those aesthetic aspects and features of the water environment and its associated landscape, which contribute to users' enjoyment. It is closely linked to recreation, through issues such as access, facilities and perceived enjoyment. This section will deal with the wider issues relating to amenity and landscape. The more specific recreational activities of Angling, Boating (Navigation) and Water Contact Sports such as sailing windsurfing and canoeing, are covered in the following three sections (3.11, 3.12 & 3.13).

3.10.2 Objectives

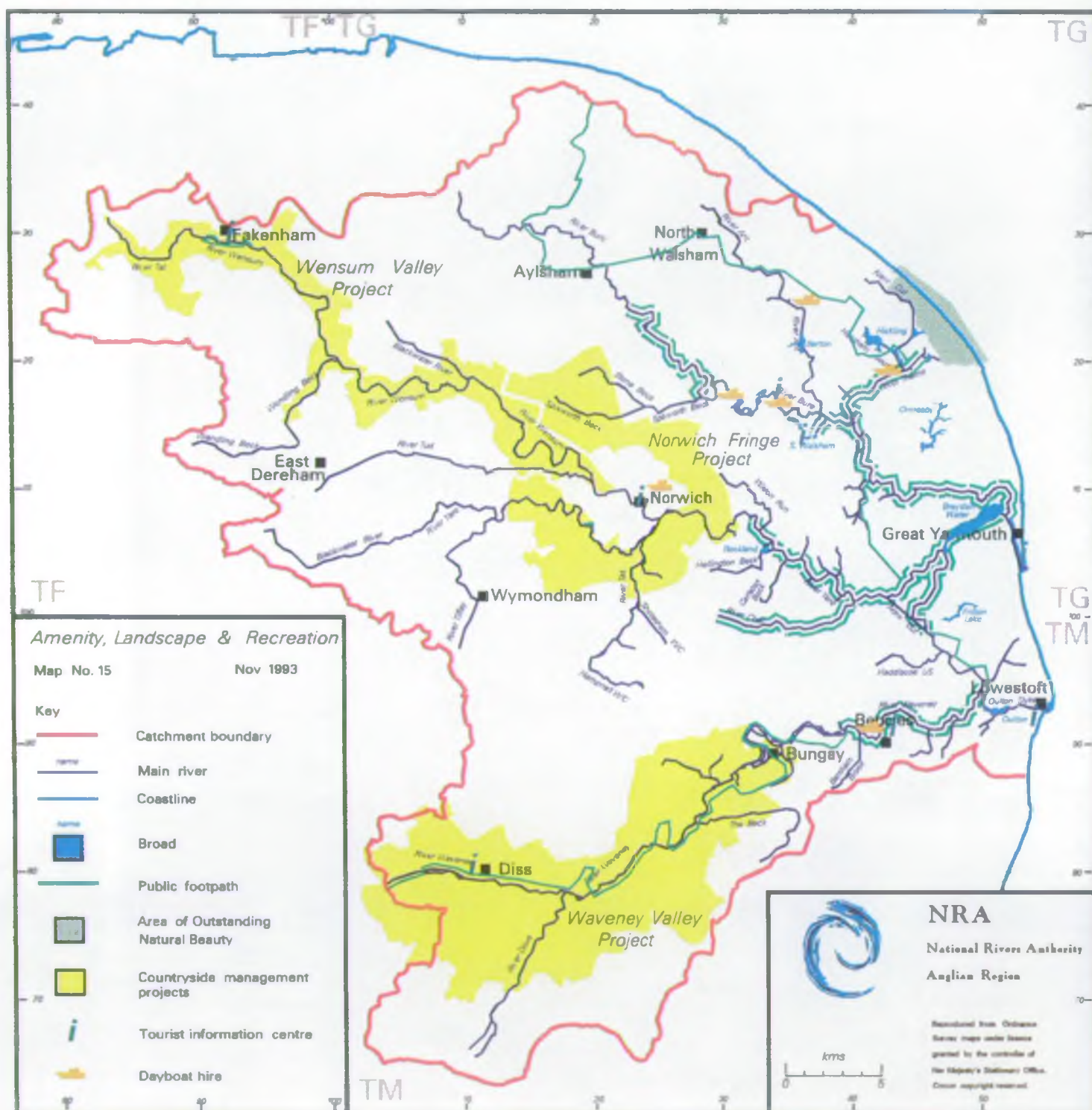
Water Quantity

- To maintain adequate flow in watercourses with an amenity use
- In the light of agricultural change (eg ESAs, extended set aside), review the NRA's standards of service in relation to flood defence to best support the changing needs of the catchment. (Draft Broads Plan Policy 5)
- Where land management agreements depend on water level, (eg Environmentally Sensitive Areas, Countryside Stewardship Scheme), ensure that surface and groundwater levels are maintained at appropriate levels. (Draft Broads Plan Policy 3)

Water Quality

- Where no specific use related water quality targets are set (eg Fisheries, Special Ecosystem¹) ensure that water quality is maintained at a level that is visually acceptable, does not give rise to offensive conditions and is appropriate to the amenity value of the stretch.
- Ensure that no deterioration of existing water quality takes place.
- As far as possible to protect dyke systems in sensitive areas from pollution, nutrient enrichment and saline intrusion. (Draft Broads Plan Policy 34)

¹At present only a proposed Statutory Quality Objective



Physical Features

- To identify the features of the channel and riparian land use that contribute to the character, economic and social interest of the catchment and ensure that these are taken into account in catchment management activities.
- To seek to explain these issues through educational and interpretation material.
- To develop objectives that take into account changes in agricultural practice that could enhance the amenity and landscape value of the catchment.
- Ensure the protection and maintenance of important landscape features while planning and undertaking flood protection or other maintenance activities.
- To promote appropriate access to river banks for all forms of recreational activity.

3.10.3 **Local Perspective** (Refer to Map No 15)

The valleys of the rivers Bure, Wensum, Yare and Waveney form a relatively natural corridor of considerable landscape and amenity value. In the upper river valleys historic, seasonal flooding has encouraged the maintenance of traditional agricultural practices, providing a wide spectrum of grassland habitats. The tidal sections of these rivers are connected to numerous shallow lakes, formed from flooded medieval peat diggings, surrounded by substantial areas of undisturbed fen and wet woodland and form the internationally important area known as the Norfolk Broads. As the rivers approach the estuary land use changes to drained grazing marsh, extensively used for stock grazing. These grazing marshes were originally drained by wind pumps and although these have now been replaced by high capacity electric pumps the original wind pumps remain, providing a characteristic landscape feature.

The Norfolk Broads are a major amenity, offering many miles of navigation and access to the water environment. The area attracts large numbers of tourists and local people which can exert a considerable impact on the environment. The centres of Great Yarmouth and Lowestoft, on the coast, are also popular tourist resorts, but the coastline also includes extensive undeveloped lengths, (eg sand dunes and slack), providing a considerable amenity with high landscape and wildlife value. The length of coast between Sea Palling and Winterton-on-Sea forms part of the Norfolk coast Area of Outstanding Natural Beauty.

During the 1960s some arable land was created from former grassland, using grant aided drainage schemes. However, initiatives such as the ESA scheme have encouraged farmers to maintain, or in some cases to revert, to less intensive stock rearing and grazing. Under the *Norfolk and Suffolk Broads Act 1988* much of the catchment has the equivalent protective status of a National Park, administered by the Broads Authority. This has provided considerable impetus to the protection of the unique nature of the Broadland landscape and its amenity value. In addition schemes such as the Norwich Fringe, Wensum Valley and the Waveney Valley Countryside Management Projects have promoted access and sympathetic management to their respective river valleys.

Access

In addition to many definitive footpaths the countryside management projects have negotiated permissive rights of way, enabling walkers to enjoy the river valleys along river bank paths. Within the City of Norwich a riverside path now exists along the River Wensum, throughout the city and upstream to Hellesdon Mill, providing a means of viewing many of the historically important parts of the city. Public footpaths follow the majority of the tidal river walls, including the only estuary in the catchment, Breydon Water. One walk, between South Walsham and Upton provides a circular route and a short boarded walkway exists along the River Bure at Horning Ferry to Cockshoot Broad that is suitable for wheelchair access. Two long distance footpaths cross the catchment and link to other long distance paths outside the catchment.

Access to the water for small craft exists via public and private slipways and day boat hire is available from a number of boat yards.

Information about the area is available from several information centres. The Norfolk Naturalist Trust, The Royal Society for the Protection of Birds and the Broads Authority have developed several of these into interpretive centres.

3.11 Navigation - Recreational

3.11.1 **General**

Throughout the tidal rivers systems in Broadland, there are over 200 miles of lock free navigable waterways. The Broads Authority have the navigation responsibilities for keeping the waterways clear, marked and safe for boating. All vessels using the system require a licence issued by the Broads Authority.

The NRA has no navigation responsibility in the Broads executive area. However, it maintains flood defences and monitors water quality. In addition under its bylaws it controls development within and adjacent to the river channel. Separate bylaws, for which the NRA are responsible, control the discharges from toilets on boats navigating within the Broads system. The primary responsibility for controlling oil spills from boats rests with the Broads Authority under the *Prevention of Oil Pollution Act 1971*.

The system is not connected to any other inland navigation, but access to the coastal waters is available at Great Yarmouth and via Mutford Lock at Oulton Broad.

There are no statutory rights of navigation outside the Broads executive area, but the British Canoe Union publishes a guide to areas where agreements have been made.

3.11.2 **Objectives**

Water Quality

- To maintain the quality of the water to provide suitable conditions for all types of boating.
- To minimise oil pollution through pollution prevention and public awareness campaigns in association with the Broads Authority.
(Draft Broads Plan Policy 8)

Physical Features

- Continue the research of alternative methods of bank protection.
(Draft Broads Plan Policy 16 & Aim 3)
- Support the research and design of more appropriate boat hulls.
(Draft Broads Plan Policy 64)

- Collaborate on dredging works for navigation purposes, to provide material for flood bank maintenance.

3.11.3 **Local Perspective** (Refer to Map No. 16)

One of the special features of Broadland is that much of it is only accessible by boat, and canoes, day boats, sailing craft and motor cruisers are able to explore these lakes using the interconnections of the main tidal rivers and their tributaries.

The most important boating centres are Wroxham, Norwich, Potter Heigham, Horning, Stalham, Oulton Broad, Great Yarmouth, Lowestoft, Beccles and Acle. Major boat yards and moorings are marked on Map No. 16, together with the navigable limits.

Earlier this century the Broads became very popular as a recreational area. Today some 20,000 powered craft and sailing vessels are available for hire throughout the year, and numerous day boats are based at the major centres. The system is also used by coastal craft and many private vessels. Speed limits are in force throughout the navigational area, and are policed by Broads Authority river inspectors.

It is generally accepted that excess boat wash has lead to serious erosion and disappearance of many of the ronds, or reed fringes fronting the flood banks. Bank erosion has been recorded at the rates of up to 1.6 metres in only 10 years. These ronds both protect the flood wall against erosion and provide a valuable conservation habitat. Norfolk reed, growing on the rond provides a sustainable commercial resource as well as absorbing naturally the harmful boatwash. (See 3.24) The Broads Authority, as well as setting and enforcing speed limits, licence the craft using Broadland, and fund research into more appropriate boat hull designs that reduce turbulence.

Loss of marginal vegetation which had been attributed to a number of factors, including boat wash and water quality, has also made the floodbanks more vulnerable to erosion, as the marginal plant life is disappearing and no longer naturally provides a protection against erosion. The common solution by the NRA has been to protect its floodwalls against failure by installing sheet steel piling along the toe. This is both unsightly and expensive. However, on deep sections of the tidal rivers where erosion and the tidal range is greatest it remains the only viable current option.

The NRA has been experimenting with alternative, and environmentally acceptable, methods of softer bank protection techniques in Broadland. New materials, such as asphalt filled matting, and open-cell blockwork,

are being installed and monitored, where conditions are favourable. These are designed to encourage the growth of reeds, sedge and water plants along the marginal fringe.

This corridor of vegetation helps protect the bank from erosion, as well as being a softer and aesthetically pleasing frontage. It also provides a valuable refuge for wildlife.

3.12 Water Contact Sports

3.12.1 General

This use includes swimming, water skiing, dinghy sailing, sailboarding, scuba diving and jet skiing. At the present time, the only mandatory water quality requirement is in respect of EC Bathing Water sites, which are restricted to the coastal waters. No other specific water quality requirements related to these uses in inland or coastal waters currently exist.

Swimming, mainly by children during hot weather, takes place at various localities particularly on the outskirts of Norwich. The NRA discourages swimming in freshwater rivers because of the inherent risks due to strong currents, physical structures such as sluices, and weed growth. The bacterial quality of water used for swimming can never be guaranteed to be suitable due to many factors including water flowing off agricultural land and urban areas, either of which may have become contaminated by animals. It is therefore not NRA policy to actively encourage sites for swimming in fresh water rivers.

3.12.2 Objectives

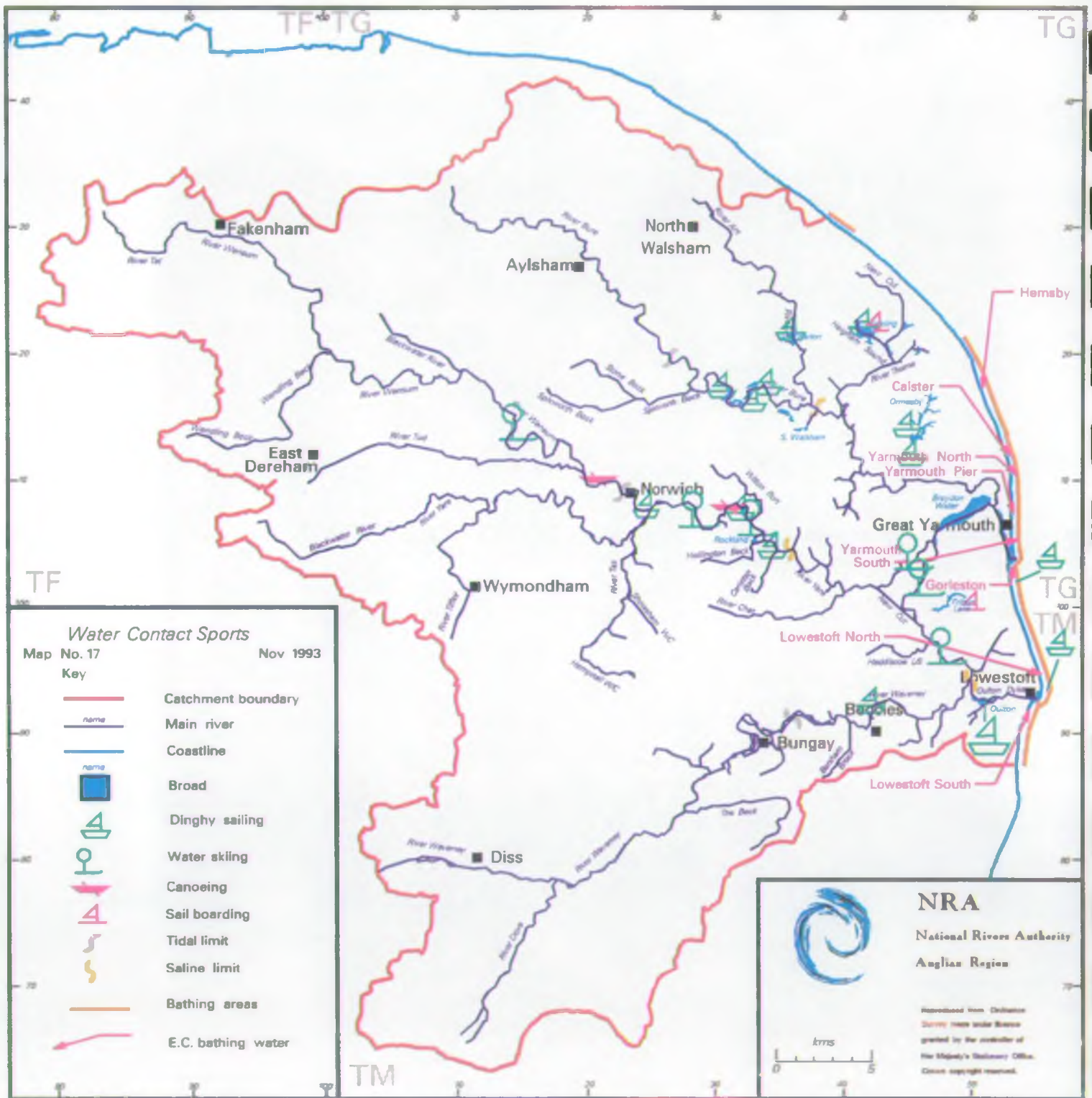
Water Quality

- To maintain the water quality at the EC designated bathing waters so that the quality requirements of the *EC Bathing Waters Directive (76/160/EC)* are met.
- At non-designated bathing waters and waters used for other immersion activities, the water quality will be maintained or improved, where necessary, to meet future statutory quality objectives.

3.12.2 Local Perspective (Refer to Map No 17)

Estuary and Coastal:

Popular coastal bathing beaches exist in this catchment, with 7 EC designated sites, one at Hemsby, three at Great Yarmouth, one at Gorleston and two at Lowestoft. Water quality is monitored throughout the bathing season for bacteriological compliance with EC standards. All but one of the EC designated beaches met the mandatory standard in 1992. The exception was Great Yarmouth South Beach, which failed due to the proximity of existing discharges of untreated sewage into the Haven area.



Compliance with the Directive standards is expected at this beach in 1997 on completion of the major sewage works being undertaken in Great Yarmouth. Other beaches along the coastline are used by smaller numbers of people and at present the NRA only undertakes additional monitoring at Sea Palling, Scratby, Hopton and California.

Other water contact sports take place along the coastline and in the estuary. These include sail boarding, jet skiing and dinghy sailing. Water skiing is occasionally practised along the coastline but in the estuary it is permitted between Reedham Ferry and Breydon Water, above Burgh Castle and between St Olaves and Oulton Broad. No water skiing is permitted on the tidal River Bure.

Inland

Yare/Wensum: Dinghy sailing takes place throughout the tidal River Yare above and below the saline limit at Cantley. The major centres however are, Crown Point, Brundall and Buckenham. Water-skiing is permitted, under certain conditions, on the River Yare at Bramerton, Brundall and Cantley and a ski club operates on Costessey Pits. A canoeing club is in existence at Norwich although canoeing activity extends throughout the River Yare below Norwich.

Bure: Dinghy sailing takes place throughout the tidal River Bure above and below the saline limit at St Benets Abbey. However, the major centres for dinghy sailing are Wroxham Broad, Decoy Broad, Horning, Barton Broad and Hickling Broad. In addition dinghy sailing is undertaken on Filby and Rollesby Broads. Sailboarding takes place at Hickling Broad, but no sailboarding of significance takes place above the tidal limit.

Waveney: The freshwater Waveney below Geldeston is used throughout for dinghy sailing, but the main centre is based upon Beccles. Fritton Lake attracts water activity interest and is used for sailboarding.

3.13 Freshwater Fisheries and Angling

3.13.1 General

This section refers firstly to NRA's aims to maintain, improve and develop fisheries, and secondly to the use of the catchment for angling.

NRA has a range of duties and powers associated with the regulation and control of fisheries and angling (fishing).

3.13.2 Objectives

Water Quantity

- Ensure that fisheries and angling interests are included in the establishment of "minimum flow" objectives.
- Ensure that water resource abstraction and augmentation schemes fully consider impacts on fisheries and angling.

Water Quality

- Ensure that all stretches of river which are currently designated as salmonid or coarse fisheries under the *EC Freshwater Fisheries Directive 78/659/EC* meet the required quality.
- Ensure that quality requirements of appropriate SWQO are achieved.
- Ensure that current measures used to mitigate against the effects of saline intrusion in the River Thurne are maintained and, where possible, enhanced.

Physical Features

- Identify and promote an understanding of the influence of physical factors on fisheries and angling.
- Ensure that fisheries and angling interests are fully considered during the operation of river control structures.
- Ensure that the operational works carried out by NRA take account of the need to maintain, enhance and develop physical factors of importance to fisheries and angling.
- Where appropriate, promote the development of natural or artificial habitat features to enhance fisheries.

- Ensure that the provision of facilities and/or development of access for angling is appropriate to fisheries and land use considerations (Draft Broads Plan Policy 66).

3.13.3 Local Perspective

Fisheries (Refer to Map 18)

Most rivers within the catchment have been impounded by mills and sluices in their middle and upper reaches. This can lead to some separation of fish populations within rivers. The lower reaches are mostly tidal and become increasingly brackish downstream.

Yare/Wensum (including Tiffey, Tud and Tas)

The River Wensum supports a salmonid (brown trout) fishery upstream from Bintry. The River Tat and the Whitewater and Blackwater Tributaries also support salmonid fisheries as do the Rivers Tas and Tud in their upper reaches. These rivers together with the River Tiffey also contain good populations of dace and club.

Good populations of dace, chub and roach occur in the middle reaches of the River Wensum. Barbel have been introduced to the Wensum between Lyng and Norwich and grayling occur between Lyng and Attlebridge. The Rivers Yare, Tas, Tud and Tiffey also contain good populations of mixed species of coarse fish.

The Rivers Wensum, Tud and Tas merge with the River Yare near Norwich and the River Yare is tidal below Norwich. Here, the fishery is dominated by roach, common bream, perch and ruffe. Several broads are linked to the river and fish are able to move freely between the river and some broads. In the lower reaches and in Breydon water estuarine species such as flounder and smelt occur.

Bure

A salmonid (brown trout) fishery occurs upstream from Aylsham. Brown trout also occur in the Scarrow Beck. The upper reaches of the River Ant support a mixed coarse fishery.

The River Bure between Aylsham and Coltishall contain a mixed coarse fishery which includes roach, dace, chub and pike. The River Ant between Horning and Wayford Bridge also supports a coarse fishery which includes roach, bream and pike.

The tidal Rivers Bure, Ant and Thurne and their associated broads also contain coarse fisheries dominated by roach, bream, pike and ruffe.

Shoals of large bream occur in all rivers and specimen pike and bream occur particularly in the River Thurne Broads (Hickling Broad, Horsey Mere, Heigham Sound and Martham Broads).

Waveney

The Rivers Waveney and Dove support good mixed coarse fisheries. The Frenze River, however, supports fewer coarse fish.

Good mixed coarse fisheries occur throughout the area and in Broome Beck. Species present include roach, dace, chub, common bream, tench, pike, perch and common carp.

The River Waveney is tidal from Ellingham Mill downstream where it supports a good fishery dominated by roach and bream. In the lower reaches and in Breydon Water brackish water species such as flounder and smelt occur in increasing numbers.

Angling

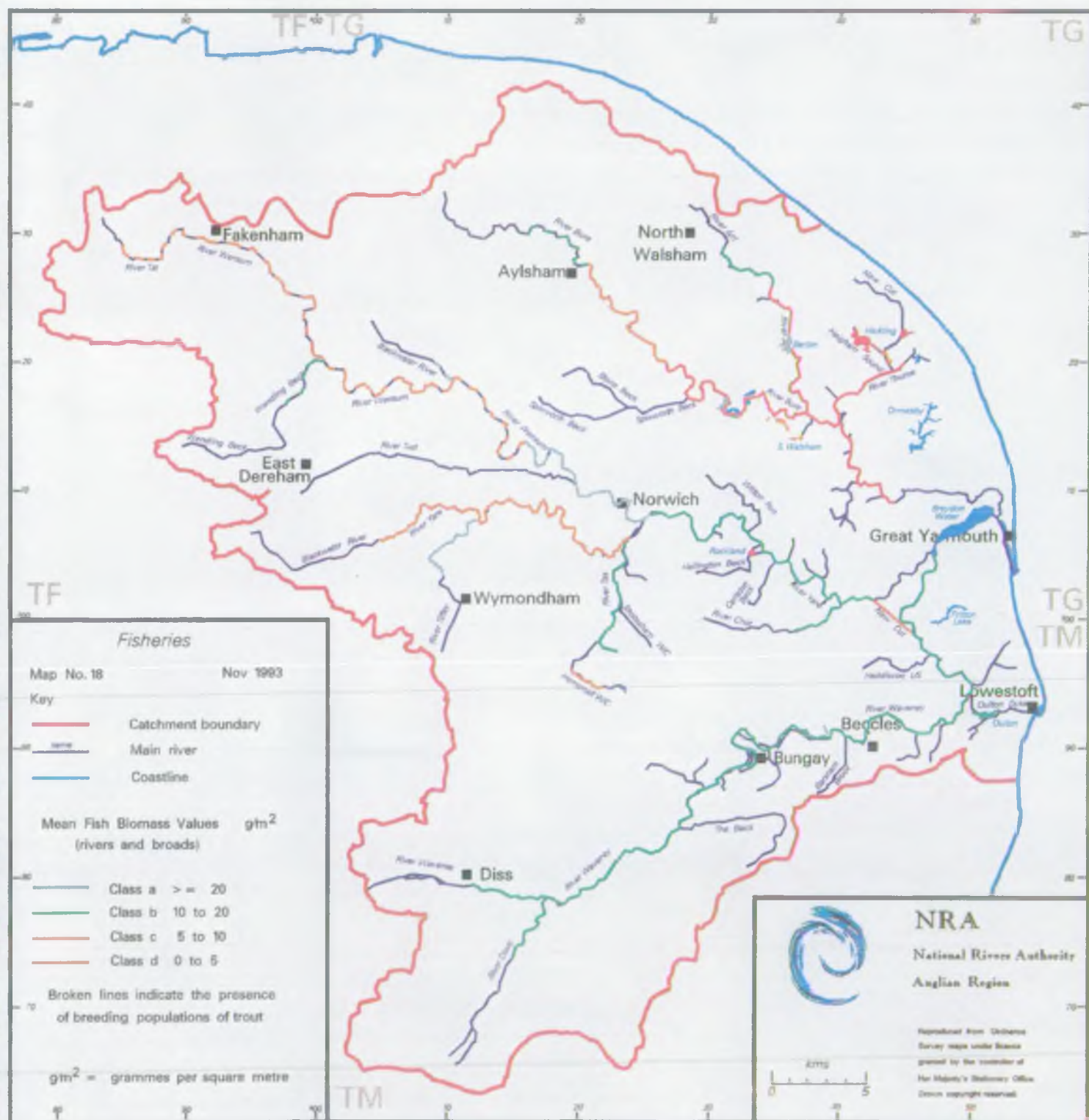
(Refer to Map 19)

Fishing is free in the tidal waters of Broadland and angling from boats is extremely popular. Free fishing is also available from those banks controlled by the NRA, but access to other banks is controlled by the riparian owners. Fishing on non-tidal waters is controlled by riparian owners and many stretches of non-tidal river, lakes and ponds support organised or casual angling. The NRA publish a guide listing the principal angling locations and clubs.

Yare/Wensum

The Lower Yare valley is a popular match angling venue, and supports good populations of roach and bream. The river is increasingly saline downstream of Buckenham which is reflected in the abundance of saline tolerant smelt and flounder. The Upper and middle Yare contain a medium quality coarse fishery which is dominated by dace, chub, and roach. A commercial trout lake exists in the upper valley.

The lower Wensum, above and through Norwich, is a good roach fishery. Access for angling is good within the city, but has potential for improvement above Hellesdon to Costessey. Sand and gravel extraction along the valley has led to several off river fisheries (including commercial trout fisheries), especially between Fakenham and Costessey. This reach also contains a barbel fishery at the lower end (Taverham-Drayton) and a grayling population between Lenwade and Attlebridge.





Further barbel were introduced during 1990 and 1991 at Bylaugh. The Upper River Wensum is used for fly fishing for the native and introduced brown trout.

The Rivers Tas, Tiffey and Tud are fished by specialist river anglers, but has little or no organised angling. The Tas supports a coarse fishery lake complex at Tasburgh.

Bure: (Includes Thurne and Ant sub-catchments, also many Broads).

There are many stretches of good coarse fishery throughout the middle and lower Bure, Thurne and Ant which are dominated by roach and bream. Pike fishing is popular on the Thurne Broads, Trinity Broads (Ormesby, Filby, Rollesby) and others. The Bure, above Coltishall (tidal limit) also supports a good coarse fishery, and upstream of Aylsham there is a fly fishery for the native brown trout.

Waveney

The Waveney is intensively used as a match angling venue in the lower reaches downstream of Bungay to Oulton Broad where it supports a good roach/bream fishery. Gravel workings have created numerous still water coarse fisheries in the middle reaches between Hoxne and Bungay. The lakes support general coarse fishing and are of particular interest to carp anglers. The angling interest of the river includes dace and chub downstream of mills, as well as carp, pike, tench and bream fishing.

3.14 **Commercial Fisheries - Eel, Sea Trout, Shellfish**

3.14.1 **General**

This use refers to the use of the catchment for commercial fishing, particularly eels, and its regulation by the NRA under the requirements of the *Salmon and Freshwater Fisheries Act (1975)*, and the Regional Fisheries Byelaws.

3.14.2 **Objectives**

To promote the understanding of integrated usage of the catchment amongst parties engaged in and regulating eel fisheries and support the investigation of the life history of eels within the catchment, to understand the impact and sustainability of the commercial eel fishery.

Water Quantity

- Identify, and promote understanding of, 'adequate' and 'minimum' flow levels necessary to maintain life cycles stages of eels within the sub-catchments.
- Ensure where possible 'adequate' surface water provision throughout the catchment, to comply with the above recommendations, or those otherwise designated in relation to eel fisheries.

Water Quality

- Ensure that surface waters, throughout the catchment, comply with the *EC Fisheries Directive (78/659/EC)* that groundwater does not deteriorate in quality to an extent which adversely affects waters remote from channels that may be used by eels.
- Ensure that marine, surface and groundwater complies with proposed SWQO for this catchment, in relation to coarse fisheries.

Physical Features

- Identify, and promote understanding of, channel and riparian features which will potentially enhance the age structure and productivity of eel populations, which ensure the commercial viability of the fishery.
- Ensure that river control structures throughout the catchment are reviewed, and if possible, improved to permit natural migratory behaviour of all life stages of eels.



Commercial Fisheries

Map No. 20

Nov 1993

Key

- Catchment boundary
- Main river
- Coastline
- Broad
- Drift net fishery for sea trout
- ✕ Current downstream limit of the NRA's jurisdiction over oel fisheries



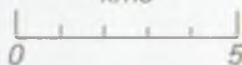
NRA

National Rivers Authority

Anglian Region

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3.14.3 Local Perspective
(Refer to Map No 20)

Commercial eel fishing remains a significant activity on all sub-catchment rivers. It is viewed as a traditional activity of the catchment, and being typical of the region, is of interest to visitors from various backgrounds. Licences are issued for each 'fyke' net or other instrument operated and details of the numbers of licences issued are retained by the NRA Enforcement Department.

Yare/Wensum (Including Tas. Tiffey. Tud)

The Yare has some netting activity between Reedham and Norwich, and to a lesser degree upstream to Marlingford. The lower Wensum has a small amount of netting between Costessey and Hellesdon.

Bure

The Rivers Thurne, Ant and Bure, including their associated Broads, and the Trinity Broads, are the most intensively netted waters in the catchment. A specialised entrapment, of some historical interest, is operated on the Thurne at Candle Dyke known as an eelset, this trap is attended whilst in use. Netting takes place throughout the River Thurne, also the River Ant in the vicinity of Barton Broad and in the River Bure upstream to Burgh near Aylsham.

Waveney

Netting may occur upstream as far as Stuston but is mainly concentrated in the middle and lower reaches downstream of Mendham. Potential conflict exists arising from accidental entrapment of other species, notably otters, coarse fish and birds. The re-introduction programme operated by the Otter Trust at Earsham, involves releases of otters within the catchment. Efforts by the NRA to promote the use of otter guards on fyke nets will continue to be essential.

Coastal

A significant sea trout fishery exists along the catchment coastline, and its integrity may influence fish populations in catchments to the north as this coastline is a migratory corridor. Impacts upon this population are from its commercial fishery concentrated at Caistor, and potentially from coastal management which may affect food sources and migratory behaviour via physical alteration or water quality.

Commercial exploitation of shellfish, herring, cod, skate and other species takes place from boats based on this coastline, particularly from Caistor and out of Great Yarmouth.

3.15 Surface Water Drainage

3.15.1 **General**

This concerns the provision for the passage and disposal of surface water from the catchment via watercourses and sewers to the tidal estuary at Great Yarmouth.

3.15.2 **Objectives**

Water Quality

- To ensure that adequate precautions are taken to prevent contamination of surface water from roads, urban and industrial areas.
- To ensure that education and enforcement are used to control organic and chemical contamination of surface waters by oil, agricultural slurries and chemicals. (Draft Broads Plan Policy 7)
- To explore with other agencies techniques for controlling diffuse nutrient sources (nitrogen and phosphorus), particularly in the northern Rivers Ant and Bure. (Draft Broads Plan Policy 6 & 7)

Physical Features

- To ensure adequate controlled discharge to watercourses exist wherever new development can cause surface water flooding problems.
- To maintain the land drainage effectiveness of watercourses to meet flood defence requirements and take account of nature conservation interests.

3.15.3 **Local Perspective**

Rural

The rivers covered in this management plan have a total catchment area of 3180 km², which drains both naturally and via pumped systems into 579.7 km of main river. Local Internal Drainage Boards are mainly responsible for the secondary systems which are pumped or gravitate into main rivers.

The downstream fluvial limits of the component rivers are controlled by sluice structures; on the Yare at Trowse, on the Wensum at New Mills, Norwich, on the Bure at Horstead and on the Waveney at Ellingham. There are currently no control structures on the tidal sections of main river. The NRA operates one pumping station at Acle, which discharges the Acle Landspring into the tidal River Bure.

A growing problem of surface water drainage is erosion of sediment and deposition in the upper reaches of the rivers. This is particularly marked in the River Waveney, the Rivers Tas and Tud and to an extent in the River Bure. This problem reflects local soil conditions and topography, but is exacerbated by changing land management policies, the loss of bankside vegetation and the general increased velocity of surface water run off.

Surface water draining from rural areas is also a potential source of pollution involving organic material from agricultural activity, agrochemicals and nutrients. Although the control of organic effluents and agrochemicals is being carried out through farm pollution prevention campaigns, the issue of nutrients remains largely unresolved.

Drainage of land in the River Thurne catchment due to the ploughing of grasslands has resulted in increases of salinity and substantial inputs of iron hydroxide complexes (ochre). This is due to the oxidation of acid sulphate rich soils and penetration of drainage into the saline water table. Similar problems of ochre occur in the Scarrow Beck, the upper River Yare, Rivers Waveney and Dove and their tributaries. In all these instances this has resulted from lowered water tables, often as a result of agricultural drainage.

Urban

In these catchments urban drainage is via surface water sewers with many outfalls to water courses, rivers and estuaries. There are intermittent problems in centres of urban development, such as Dereham and Fakenham and particularly Norwich, where storm sewage and blocked foul sewers can give rise to localised water quality deterioration. In many areas of Norwich the sewers are combined foul and surface drainage and during severe storms this has put the storm tank facility under pressure, giving rise to occasional large volume storm discharges into the River Yare at Trowse.

It is not practical to detail the precise location of all the surface water discharges. In Norwich alone 80 outfalls exist ranging in size from 150 to 1500 mm in diameter.

Some surface water sewers become contaminated with industrial material. This is a particular problem in Great Yarmouth, where industrial estates have proliferated in recent years and insufficient attention has been given to the control of activities on these sites. Of particular concern are the estates on North River Road, Gapton Hall and Harfreys.

3.16 Conservation - Ecology

3.16.1 **General**

This use specifically relates to the promotion, protection, maintenance and enhancement of flora, fauna and physical features of conservation and ecological importance.

3.16.2 **Objectives**

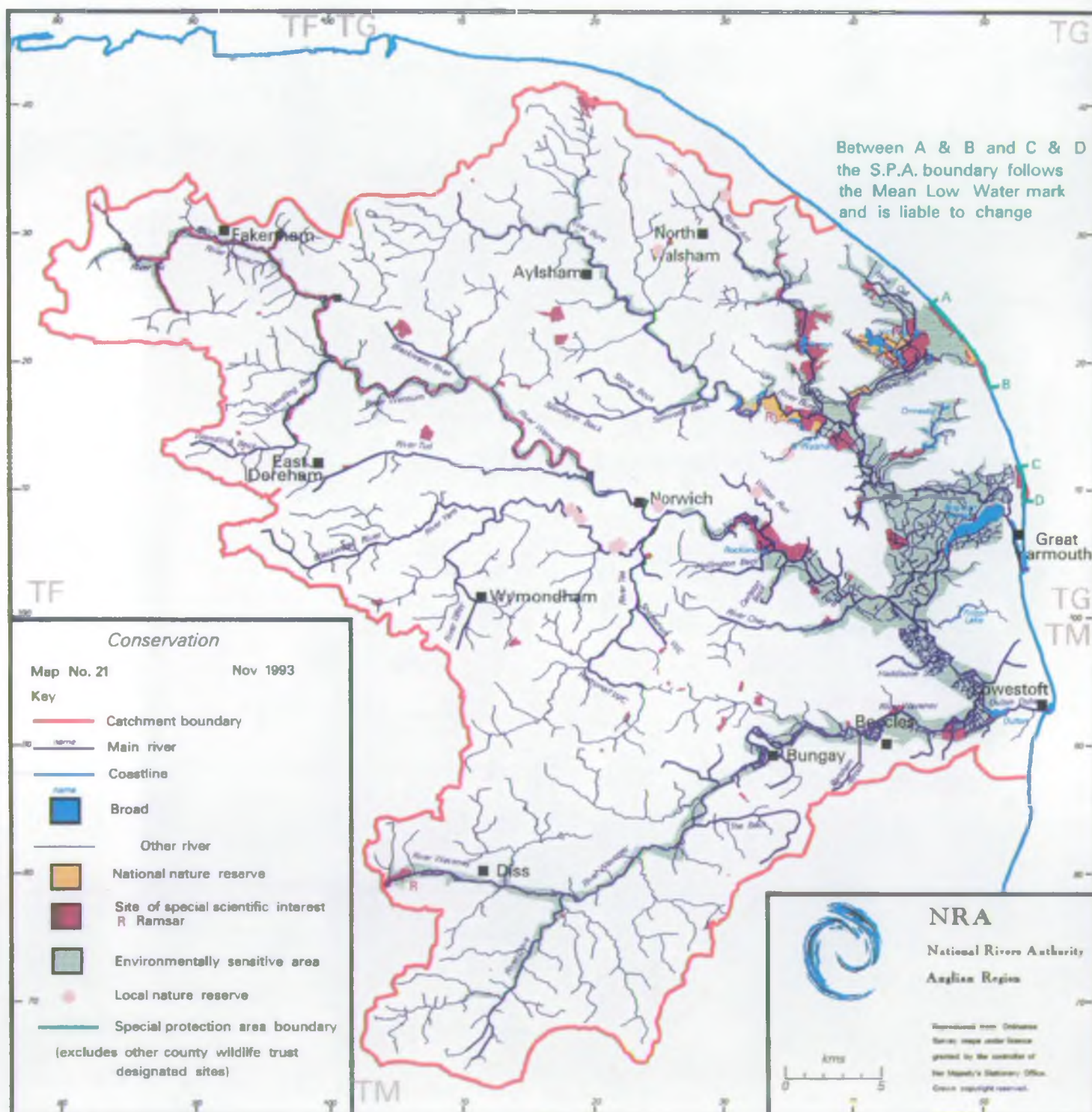
The NRA has a duty to further the conservation and enhancement of natural beauty and the conservation of flora, fauna and geological or physiographical features of special interest, whilst carrying out its functions, including commenting on proposals by others. To achieve this it needs to identify the factors that influence the conservation value of rivers and their corridors and ensure that these factors are taken into consideration when planning or undertaking the NRAs duties. Where possible the NRA will cooperate actively with other organisations to co-ordinate policy and promote the use of novel techniques (eg biomanipulation, habitat enhancement) to benefit conservation. (Draft Broads Plan Policy 2)

Water Quantity

- Identify and promote understanding of flows necessary to sustain conservation and ecological interest throughout the catchment. (Draft Broads Plan Policy 1)
- Ensure where appropriate environmental assessment of abstraction and supplementation schemes. (Draft Broads Plan Policy 2)

Water Quality

- Ensure that surface waters meet the appropriate proposed SWQO where a watercourse directly or indirectly affects the conservation or ecological interest. ie proposed SWQO for Special Ecosystems and Fisheries.
- Ensure that coastal waters meet the appropriate proposed SWQO to safeguard foreshore, near shore and estuarine habitats.
- Work with other agencies to promote and maintain freshwater dykes in Environmentally Sensitive Areas. (Draft Broads Plan Policy 3 & 34)



Physical Features

- Identify and promote the understanding of natural and man-made features which provide conservation and ecological interest. (Draft Broads Plan Policy 125 & Aim 15)
- Ensure the maintenance, enhancement and re-instatement of those features which provide conservation and ecological interest.
- Ensure the protection, enhancement and re-instatement of habitat features during the design and implementation of flood defence schemes. (Draft Broads Plan Policy 5)
- Ensure that where appropriate river management promotes the achievement of ESA and Countryside Stewardship schemes within the catchment.

3.16.3 Local Perspective (Refer to Map No 21)

Refer to Appendix III for a listing of SSSI's and other statutory protected conservation locations. The map also shows their locations and the extent of the Broads ESA. Many nationally rare species, including Swallowtail Butterfly, Norfolk Hawker Dragonfly, Bittern, Marsh Harrier, Natterjack Toad, and plants such as Water Soldier and Royal Fern are present in the catchment.

Yare/Wensum

The River Wensum valley has outstanding ecology and water quality, and has recently been designated a river SSSI. Its upper reaches, at Syderstone Common, hold an important colony of Natterjack Toads, and there is widespread evidence of otters.

The rivers Tud, Tas and Tiffey all support important semi-improved tracts of grazing meadow and high quality fluvial environments.

The middle and upper Yare valley includes numerous tracts of semi-improved grazing meadow and dyke systems. In its tidal Broadland reaches the valley also has several tidal broads with a range of wetlands habitats. The lower Yare marshes and the Halvergate marshes contain important dyke flora and together with Breydon Water support internationally important bird populations.

Bure

This catchment contains internationally recognised wetland habitats and national rarities occur within the flora and fauna of fens, dykes and grazing marshes throughout the Ant, Thurne and Bure systems (refer to Appendix). All broads with the exception of Upton and Martham Broad have suffered from eutrophication and/or boat usage. Major broads restoration projects by the Broads Authority and the NRA are planned at Barton and Ranworth Broad, are underway at Alderfen, Belaugh, Hoveton Great and Little Broads; and partially completed at Cockshoot Broad.

Grazing marsh and dyke systems throughout the Bure sub-catchment have a notable flora and fauna, and will attract grant aid for conservation measures dependent upon water level management.

Waveney

The River Waveney rises within Redgrave and Lopham Fen SSSI, a RAMSAR site of particular note for the presence of the Fen Raft Spider. The NRA in conjunction with Suffolk Wildlife Trust and Suffolk Water Company are currently addressing major rehabilitation options for the site and the Upper Waveney involving the relocation of public water supply boreholes and the raising of river levels.

Throughout its length, the wide valley floor has extensive tracts of semi-improved grazing marsh and dyke systems, holding a variety of wetland flora and fauna.

The Earsham based Otter Trust, is a national centre engaged in breeding otters for re-introduction which relies upon the river at this location to supply its enclosures. Marshes in the middle and lower valley are significant for wintering wildfowl.

Ronds

Ronds are narrow strips of land between the river and the river wall. They occur in the lower tidal reaches of all three main rivers and Breydon Water, comprising an area of 54 ha of salt marsh, 165 ha of brackish reed and 75 ha of fen. The ronds are important in that they provide protection to flood banks from boat wash and valuable habitat for wildlife. Some of the ronds are also cut commercially for reed although there is evidence that this is in decline. The major threats to the ronds are loss by erosion, dumping of spoil from dredging and the cessation of reed cutting due to deterioration of the reed. There is a need for the NRA and the Broads Authority to develop a code of practice for spoil dumping of navigational dredgings. (Draft Broads Plan Policy 15)

Coastal

The coastline between Happisburgh to Kessingland is of high conservation value. The stretch from Happisburgh to Winterton is protected by a sea wall which is maintained by the NRA. Its effect upon the foreshore environment is currently being addressed with the construction of 16 offshore reefs. The area behind the seawall is characterised over much of the length by dune systems, with associated rare fauna and flora.

3.17 Archaeology

3.17.1 General

This use covers the protection of physical and structural features designated as of outstanding or national value as landscapes or archaeological significance and those of interest that have not been formally designated. The NRA has a duty to protect and conserve sites of archaeological interest.

3.17.2 Objectives

Water Quantity

- To ensure that activities take account of the requirements of archaeological sites.

**3.17.3 Local Perspective
(Refer to Map No 22)**

Yare/Wensum

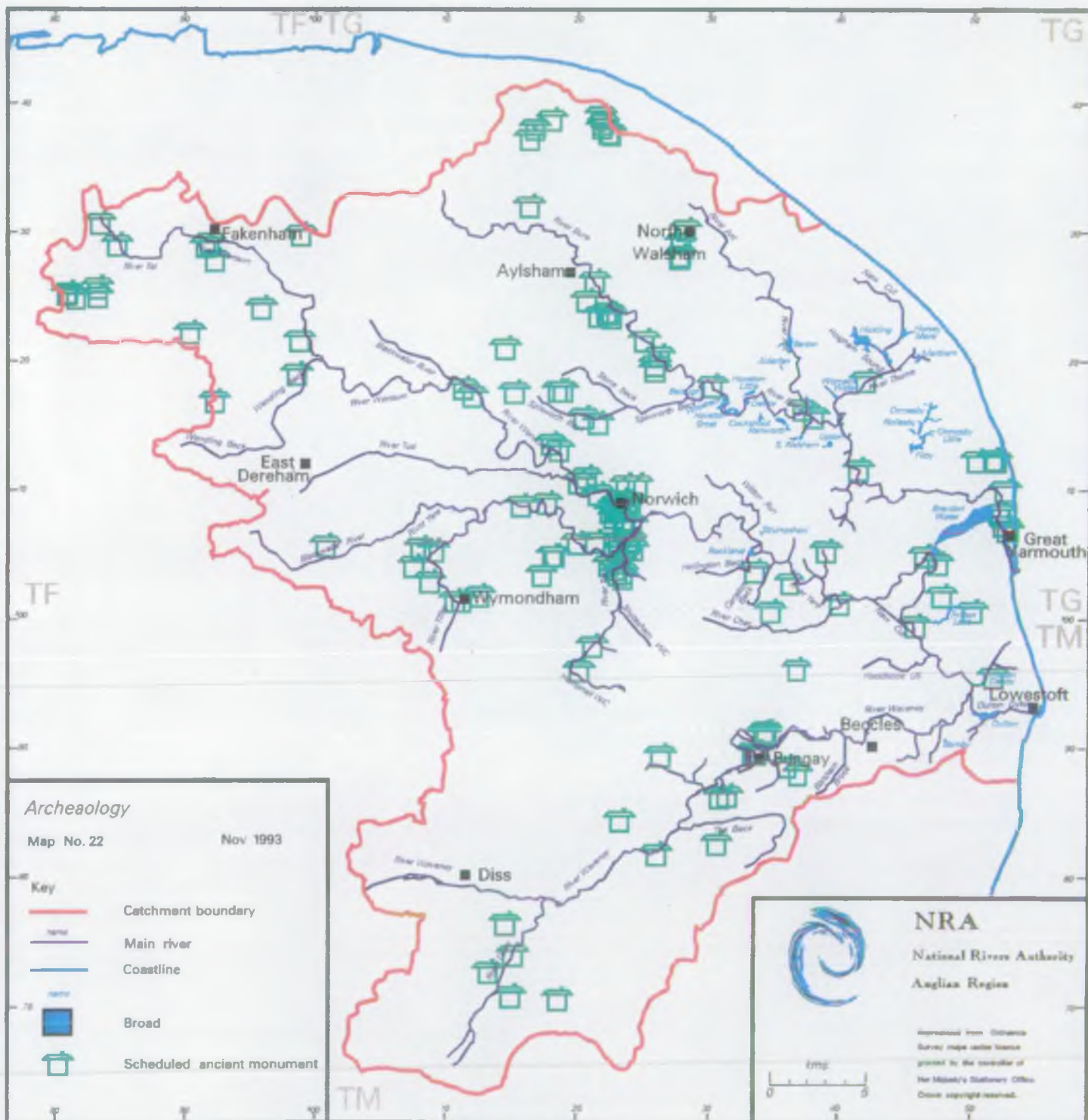
The lower Tas valley has a dense concentration of prehistoric remains and major Romano-British and Saxon sites at Caister St. Edmund. The City of Norwich has important structures dating from many periods along its river frontage. The lower Yare valley has yielded evidence of the origin of broads from several locations and is the site of a major Romano-British site at Burgh Castle, overlooking Breydon Water.

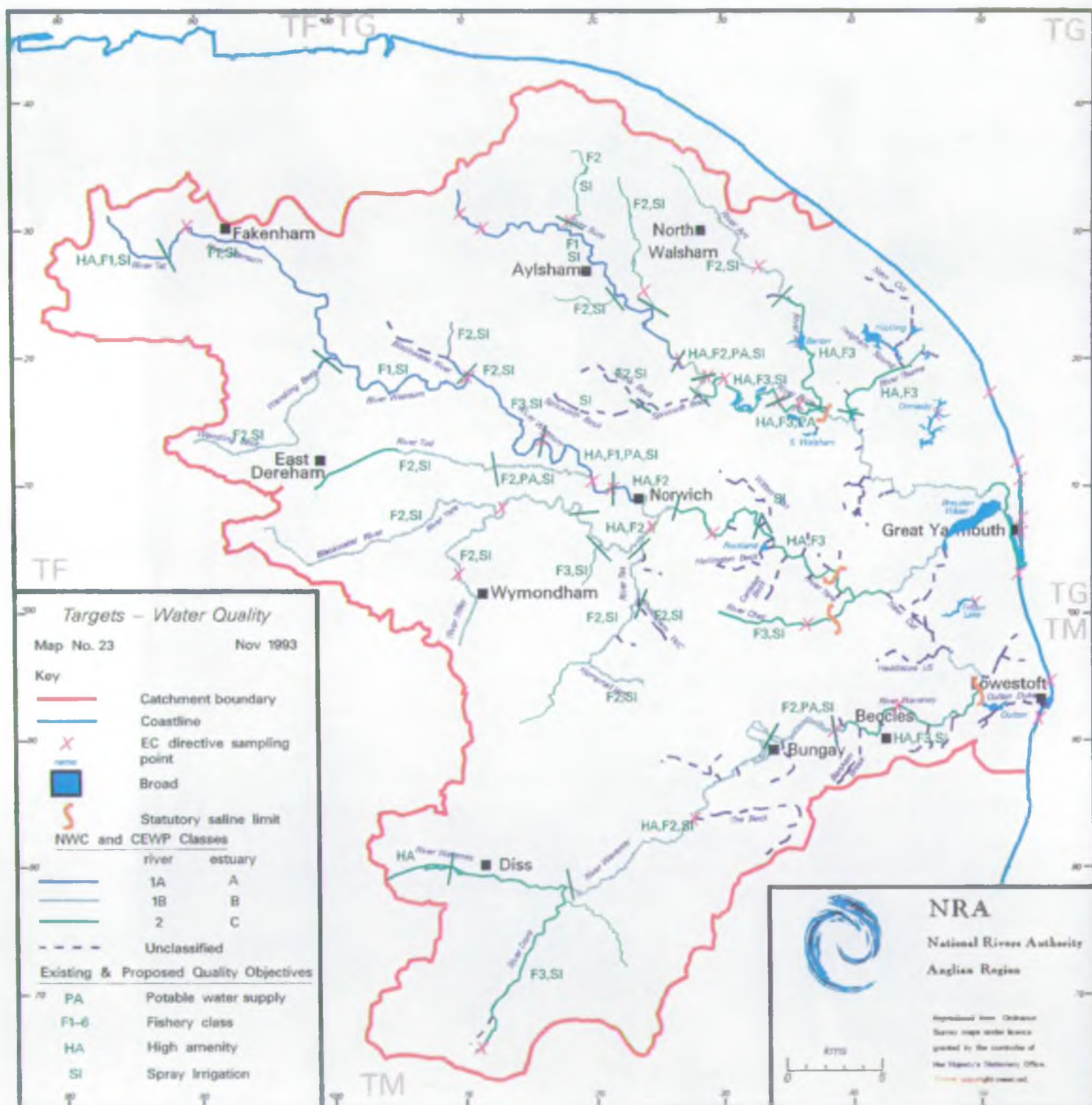
Bure

The upper reaches have a number of prehistoric sites, whilst the major historical remains are the Abbey of St Benets near Horning and the Romano British fort at Caister near Great Yarmouth. A notable medieval bridge remains at Potter Heigham.

Waveney

The Waveney sub-catchment has a significant number of prehistoric remains. There are several medieval towns and villages associated with the river ie Diss, Bungay and Beccles.





4.0 CATCHMENT TARGETS

4.1 Catchment Targets - Water Quality

4.1.1 General

This section considers the overall water quality requirements of the catchment.

Water quality in the Anglian Region is currently assessed by reference to a number of control measures. These are:-

- Compliance with River Quality Objectives (RQOs)
- National Water Council (NWC) target classes
- Biological target classes
- Compliance with relevant EC Directives

The general aim of the NRA is to achieve compliance with EC Directives, use related objectives (which have generally incorporated relevant EC Directives) and to ensure that general water quality, as measured by the NWC class, does not deteriorate from that measured in 1984. Biological target classes are used to assist in this process and will form part of the proposed NRA general classification of controlled waters.

4.1.2 River Quality Objectives (Refer to Map No 23)

At present the Anglian Region of the NRA has non-statutory River Quality Objectives which relate given water quality standards to river use. However, the DoE is producing a series of Statutory Water Quality Objectives (SWQO), which will replace the RQO and provide a clear indication of the desired water quality in a given length of watercourse. Each river stretch will be accorded uses which have their own requirements for water quality. These include potable water supply (PA), fisheries ecosystem, industrial/ agricultural abstraction (IR), water contact activity, special ecosystem and commercial harvesting of marine fish/shellfish. The fishery ecosystem is sub-divided into 6 classes (F1-6).

For this catchment plan only those SWQOs which have agreed quality specifications (Potable Abstraction & Fisheries) are being used to set targets and determine compliance. In the absence of an agreed SWQO then existing RQO compliance has been used. For example as the "Special Ecosystem" SWQO has yet to be resolved by the DOE the existing "High Amenity" RQO has been used.

4.1.3 National Water Council Target Classes (Refer to Map No 23)

When the SWQOs are adopted, it is proposed to replace the NWC classification system by a 'General Classification Scheme'. However the NWC target classes have been retained for this plan. They are based upon a limited range of criteria, for example, Biochemical Oxygen Demand, Dissolved Oxygen and ammonia, and are ranked in order of decreasing water quality as 1A, 1B, 2, 3, 4.

Historically the NWC classification and RQO have been primarily related to rivers. In this catchment lakes are particularly important and the use of these systems does not provide a satisfactory system of control. Important water quality changes, such as eutrophication, are not adequately measured. However, the General Classification Scheme will be developed for each water type (river, lake, estuary, etc) and should overcome the problems associated with the existing system.

4.1.4 Broadlands Restoration Targets.

Although SWQOs may eventually be applied to lakes and waters other than rivers plans are not sufficiently far advanced to include this within this plan. Similarly the General Classification Scheme relating to lakes is still to be determined. Thus in this plan the special needs of the Broadland lakes are addressed in the light of current research being undertaken in the catchment. The following local targets have been established.

- To safeguard, in good ecological condition, those broads that still support an abundance of aquatic plants and animals. (Draft Broadlands Plan Aim 1)
- To seek to ensure that other broads are restored to a state conducive to the re-establishment of a variety of aquatic plants and animals. (Draft Broadlands Plan Aim 2)
- To encourage the adoption of SWQOs which fully meet the needs of the restoration objectives of the Broadlands. (Draft Broadlands Plan Policy 10)

4.1.5 Biological Target Classes

Biological classification, by reference to the presence and abundance of species, provides an alternative indication of water quality to sampling and analysis for some chemical parameters. Biological Sampling is undertaken regularly at 87 points on rivers throughout the catchment and the results are assessed against a prediction for the particular watercourse.

4.1.6 EC Directives

EC Directives stipulate standards for relevant parameters which the directives seek to control, for example the Dangerous Substances Directive and the Surface Water Directive.

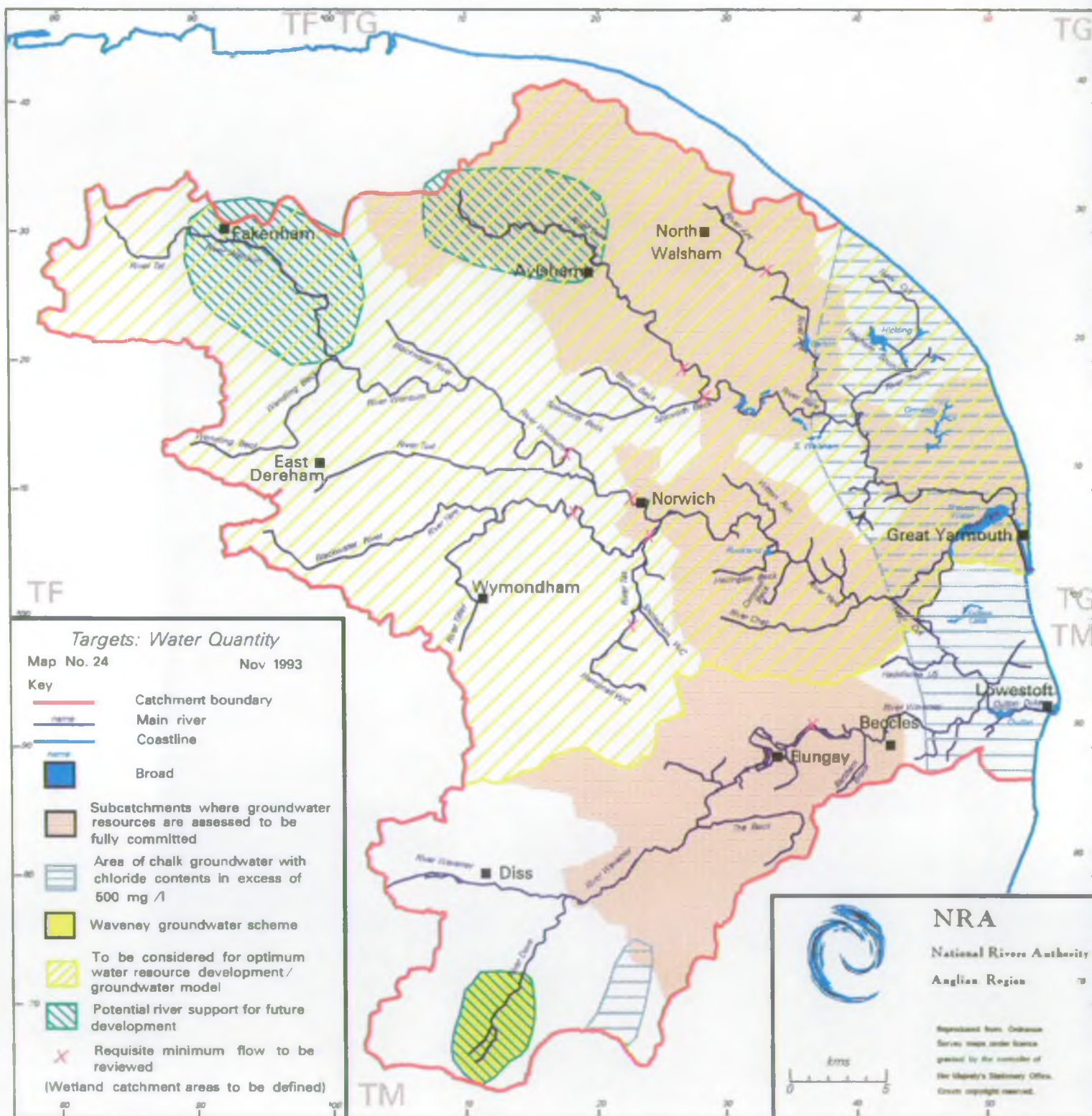
4.1.7 Groundwater Protection

In November 1991 the NRA issued for public consultation its Groundwater Protection Policy. Groundwater is a vital natural resource and under particular threat from the effects of human activity. Once polluted, groundwater is often difficult and very expensive to remediate. Therefore preventing groundwater contamination is a major objective for the NRA. The Authority would like this policy to be viewed by all those whose activities may compromise groundwater quality, as a guide to assist and influence future planning and strategy decisions.

The document outlines the concept of vulnerability, that is the designation of areas of land where certain activities can have an appreciable affect on groundwater quality in an aquifer system and where pollution could quickly enter groundwater. It deals in particular with:-

- waste disposal to land
- disposal of slurries and sludge to land
- physical disturbance of aquifers affecting quality and quantity
- contaminated land
- diffuse pollution and unacceptable activities in high risk areas.

It is important to note that the definition of "controlled water" provided by the *Water Resources Act 1991* included groundwater.



4.2 Catchment Targets - Water Quantity

4.2.1 General (Refer to Map 24)

This section considers the requirement to manage ground and surface water resources to achieve the right balance between the needs of the environment and those of the abstractors.

This is achieved through the NRA's statutory duties.

- To manage water resources where possible in such a way as to meet all reasonable demands, including those of the environment, having due regard to overall costs.
- To ensure the proper use of water.
- To conserve water resources, for example by encouraging efficient water use and leakage control.
- To augment and/or redistribute water resources, where appropriate, to meet water demands to appropriate standards of reliability.

The NRA Anglian Region plans to produce a Water Resource Development Strategy during 1994 to describe how future demands will be met in the Region. A consultation draft was presented in April 1993. The key options relevant to this catchment include:

- demand management,
- further groundwater abstraction in Norfolk to meet local needs,
- transferring water into the catchment (this option has not been recommended).

These options are currently under consideration, and any outcome will have an effect on the future allocation and management of water resources in this catchment.

The future targets for this region and this catchment have been listed for each duty.

4.2.2 To manage water resources to achieve the right balance between the needs of the environment and those of the abstractors.

To ensure adequate protection to the environment the NRA needs to:

- Set minimum residual flows (MRF) and minimum water control levels. (Draft Broads Plan Policy 1)
- Ensure compliance with future and existing MRF.
- Maintain and protect as far as possible the hydrology of sensitive wetland sites. (Draft Broads Plan Policy 2)

NRA Anglian Region is actively reviewing the methodology used for the allocation of water resources between human and environmental uses. Of particular concern is the amount of groundwater allocated to the river as baseflow in the Bure Catchment. Depending on this, resources could either be assessed as balanced or in surplus. In addition, resource calculations are being reviewed in light of the 1989-1992 drought statistics.

The Authority aims to carry out ecological and hydrological studies to examine the existing ecology of the river system and to define the minimum water level, flow and quality required to maintain the system. Such "in river needs" studies will use data already available as well as further field work.

The NRA is to carry out a National Research and Development study on the "Determination of Minimum Acceptable Flows". This study, in its initial stages, is due to end in 1996 and will better define in-river needs in association with low flows.

Currently, the University of East Anglia are collating and reviewing data for NRA in a three year research investigation programme due for completion in June 1994, to better understand the relationship between water resources management and the hydrology and ecology of North Norfolk rivers. The study is in its second year and concentrates on the non-tidal stretches of the rivers Bure, Nar and Wensum.

As demand continues to rise plans are established for optimum water resource development. These are produced in collaboration with others; essentially water companies, abstractors of significant quantities and conservation bodies, etc. Groundwater simulation models are useful management tools for the allocation of water resources. Currently no such model exists for this catchment which could be effectively used to simulate groundwater levels and impacts within the catchment based on various abstraction regimes at a variety of locations.

There is a need to identify the water catchment areas of the wetland sites of conservation interest in order to better regularise their protection. NRA have recently let a Research and Development contract "The Protection of East Anglian Wetlands" due for completion in July 1994. This will provide a standard method for assessing catchment areas, estimates of the effects of groundwater abstraction and the amount of groundwater required by wetlands based on investigations carried out at representative sites. There will still be a need for more site specific investigations where an individual wetland's hydrology is of particular concern. (Draft Broads Plan Policy 2)

All these studies, together with local information will assist the NRA to identify Minimum Residual Flows (MRF) and minimum control levels for rivers within the catchments. (Draft Broads Plan Policy 1)

It is NRA policy not to allocate resources for abstraction in excess of the renewable resource. Planning horizons for these allocations of up to 20 years means that in many instances full licensed potentials are not realised for some time. It could be argued that this apparent surplus (paper water in the bank) could be utilised in the short term to meet other abstractive needs. Administratively this could be achieved through the issue of phased stepped increased licences addressing the longer term plan. Meanwhile, time limited licences could be issued to other abstractors to take up these apparent surpluses. Holders of the immediate short term time licences, however, would need to be fully aware of the potential risks and consequences associated with time limited licences and the potential likelihood of non-renewal after expiry.

4.2.3 To ensure the proper use of water resources

The NRA will give prior (and equal) priority to existing protected rights to abstract and to established environmental needs before allocating any further water for abstraction.

The NRA must decide on whether the future requirement for water meets "reasonable needs". The consideration of alternative supplies or demand management must be shown as well as consideration of recycling. In areas where water resources are shown to be over exploited and/or affecting existing users rights, including the environmental, licence revocation will be considered. In such cases compensation payments would normally be incurred by the NRA. Specific requirements according to each use, are as follows:

Public Water Supply

The planning horizon for the allocation of licences is currently the year 2011. It is not considered reasonable at this time to allocate additional water for needs beyond this.

The water companies must have demonstrated that they have carried out effective demand management, controlled leakage and, where water resources are under stress, at least considered metering of domestic use before extra water resources are allocated.

Spray Irrigation and Agriculture

The requirements of water needed with respect to the type of crops, soil conditions, stock types and numbers are taken into account.

Industrial

The industrial process is considered as well as the expected life of the plant.

4.2.4 To conserve water resources.

The NRA encourages the storage of winter surface water in reservoirs. It is accepted however, that this is likely to be an expensive option in this catchment due to limited availability of natural construction materials and the general unsuitability of the local geology.

The NRA will encourage groundwater abstraction in preference to summer surface water abstraction, other than at or near the tidal limit of the river.

Efficient water use is encouraged and where possible re-use promoted for purposes appropriate to the quality of the resource. The 1989-1992 drought has served to develop better practice of water resource management both by the NRA and abstractor. The promotion of efficient water use will continue in the future.

The NRA aims to resolve issues where historic allocation of groundwater has caused unacceptable stress on the water environment, ie river flows and wetland sites of conservation value. The NRA has a programme of locations for investigation under the heading of "Alleviation of Low Flow Schemes" (ALF). Redgrave and Lopham and East Ruston Fens are of particular relevance in this catchment.

The NRA will set discharge consents appropriate to anticipated future flow regimes, rather than historic flow regimes.

There are benefits to water resources (ie the impact of abstraction upon river flows can be minimised) if discharge of water is made within the catchment as far upstream as possible. Water quality objectives however, will need to be satisfied.

4.2.5 To augment and/or redistribute water resources, where appropriate to meet water demands to appropriate standards of reliability.

The NRA already operates river support in this catchment supporting the Waveney with groundwater using the Waveney Groundwater Scheme. This type of river support is well proven in the Anglian Region and will continue to be considered as a development option.

Future abstractions likely to cause unacceptable effects on river flows or levels will not be authorised without appropriate river support or associated ameliorative works.

The NRA intends to ensure compliance with existing minimum residual flows and minimum control levels and to set these to protect other environmental interests, eg RAMSAR and wetland SSSI.

4.3 Catchment Targets -Flood Defence and Physical Features (Refer to Maps No 25 and 26)

4.3.1 General

This section relates to the need to maintain and develop the natural physical features of the catchment, which are important to the environment and its enjoyment, while providing adequate maintenance and structures to control flooding, ensure access and generally manage the water environment.

The NRA's flood defence aim is to provide effective defence for people and property against the risk of flooding from rivers and the sea and to provide adequate arrangements for flood forecasting and warning.

The targets in relation to physical features of this catchment thus have to take into consideration both the NRA's statutory obligation to protect and enhance the geological and physiographic features and its duty to provide effective defence for people and property against the risk of flooding from rivers and the sea.

4.3.2 Target Standards of Service for Flood Defence.

Flood defence levels of service are well established and minimum standards of flood protection adopted by the Anglian Region are shown in the table opposite. Standards of flood protection are normally expressed as the level of protection afforded against the risk of a particular flood return period in years, eg 1 in 50 years. The standards applied are related to land use and need to be shown to be economically viable, technically sound and environmentally acceptable. The standards of service for the tidal section of the catchment are shown in map no 28.

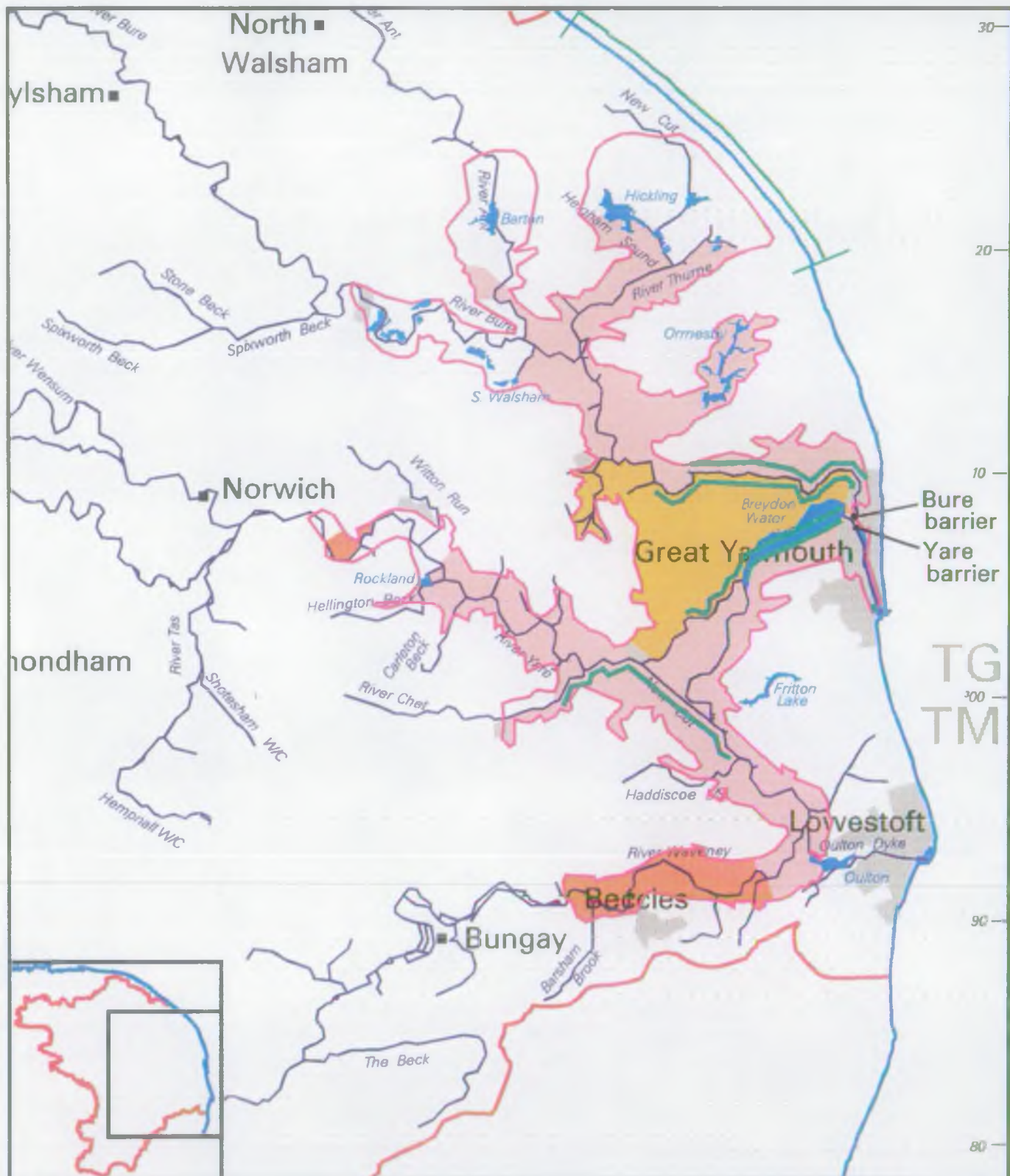
Other targets for the catchment are set out below .

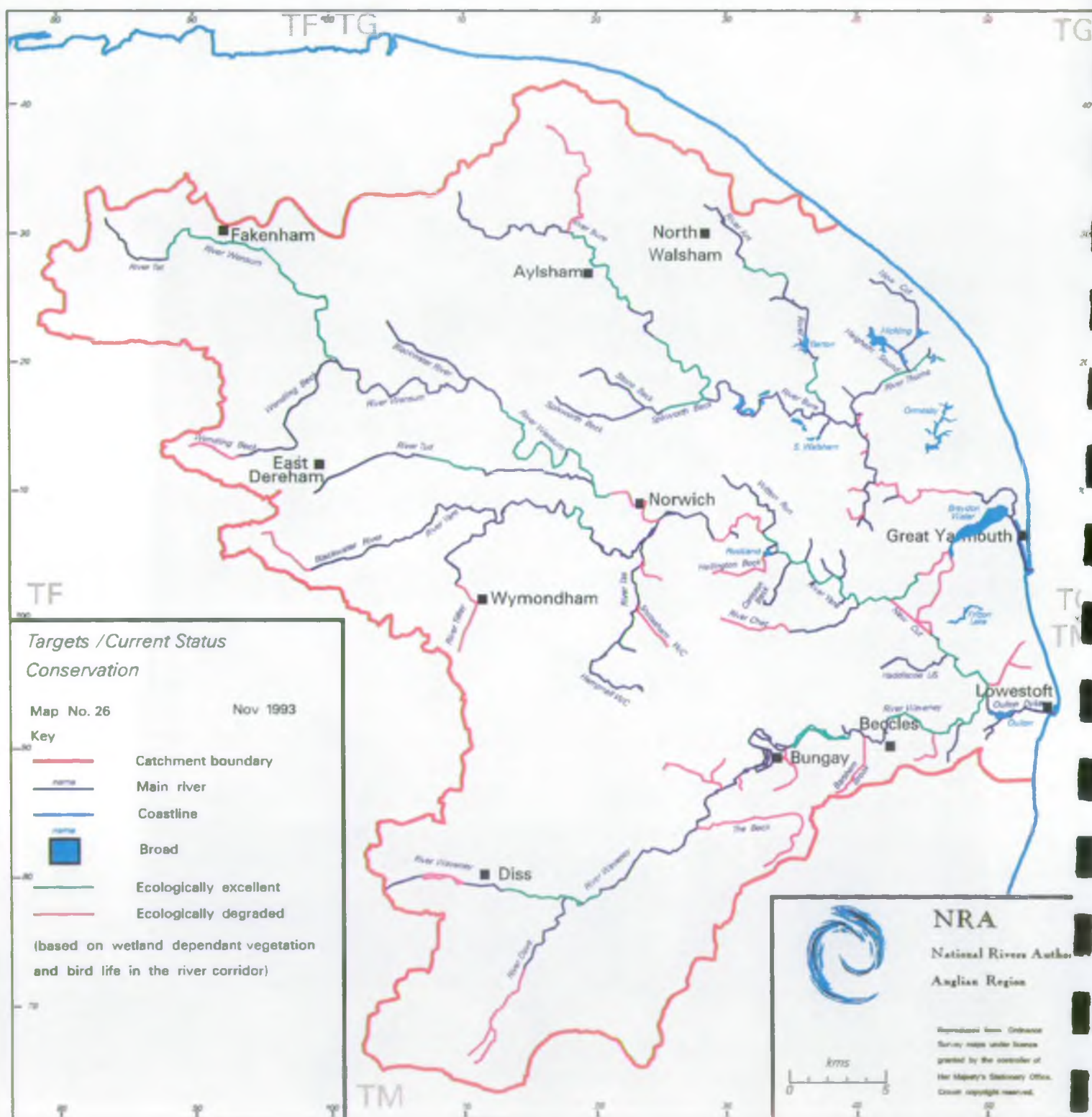
4.3.3 Infrastructure and Information

The provision of an effective flood defence requires:

- Continuation of a systematic approach to assess capital and maintenance requirements to ensure the integrity of all flood defences and promotion of medium and long term plans for those defences owned or maintained by the NRA.

- Development of strategies for warning, and responding to emergencies. (eg information technology improvement)





- Support research and development which will identify future flood defence needs arising from climatic change, improvements in best practices for operating methodology, increasing and enhancing efficiency and value for money.

Review and develop the hydrometric network to ensure the continued adequacy of data to meet all requirements.

4.3.4 Development

- To discourage development within flood risk areas and minimise the loss of flood plain habitat of conservation value.

4.3.5 Coastal

To participate in coastal zone management groups and continue an integrated approach to sea defence management, in particular:-

- utilise natural coastal processes.
- maintain and enhance beach profiles, dune systems and sea defences.
- to ensure minimum disturbance to sensitive habitats during maintenance or works.

4.3.6 Non-tidal Rivers

- To maintain the essential flood carrying capacity of river channels through regular maintenance, (eg weed cutting and dredging) while ensuring that where practical physical features such as bankside trees, marginal vegetation are maintained by carrying out ecological surveys in advance of all maintenance work.
- To review the channel capacity of non-tidal rivers in the catchment to assess the potential for incorporating features that can enhance the environmental value of the river.
- To identify areas where artificial habitat creation would benefit fish populations and investigate how these can be carried out within existing economic constraints.
- To identify river stretches which could be protected, enhanced or restored.
- To identify the need for artificial off-river fish nursery areas.

- To ensure as far as possible that river control structures (weirs, sluices) are operated in such a way as to minimise flooding, to maintain water levels appropriate for a diversity of users.
- Identify options for automation of river control structures.
- Where practical, to ensure that the operation and design of river structures does not impede the passage of migratory species and takes account of the needs of all users.
- To minimise the loss of flood plain habitat of conservation value.
- To resist the connection of gravel pits/lakes to fluvial rivers where water quality problems may develop as a result (eg excess algal growth)
- To explore with other agencies the potential for buffer zones to minimise nutrient, soil and sediment import to river.

4.3.7 Tidal Rivers

- To develop and implement a flood defence strategy for Broadland that provides effective flood protection while having regard to its effects on ecology, navigation, recreation, aesthetic and economic aspects of the area (Draft Broads Plan Policy 4)
- To maintain existing flood defences to meet target standards of service.
- To explore with other agencies alternatives to traditional steel and timber piling that will resist erosion, enhance ecological value, and meet navigational, aesthetic and cost criteria. (Draft Broads Plan Aim 3, Policy 16)
- To work with other agencies to re-create habitat for fish and other fauna through the re-establishment of a diversity of aquatic vegetation in selected broads (Draft Broads Plan Aim 2).
- To work with other agencies to ensure adequate bankside access for anglers and other users while minimising environmental damage. (Draft Broads Plan Policy 66)
- To determine features that influence the Broadland fisheries and develop an integrated approach to habitat and fisheries management

5.0 CURRENT SHORTFALLS AND IDENTIFICATION OF ISSUES

5.1 Current Shortfalls and Identification of Issues - Water Quality (Refer to Map No 27)

5.1.1 General

Having set water quality targets it is possible to assess the state of the catchment against these targets. Data from routine water sampling and biological surveys have been used to facilitate this comparison.

The map identifies failures to meet the use related targets, relevant EC Directives and the NWC river classification.

5.1.2 Shortfalls Identified

Yare/Wensum

1. River Wensum - Taverham to Mile Cross Bridge (Norwich)
River Tud - Honingham to River Wensum

Rivers fail to meet nitrate level laid down in EC Surface Water Directive.

2. Wendling Beck

Agricultural and urban run-off cause a failure to achieve target class and predicted biological score. Dereham Sewage Treatment Works also influences the failure of target class in the lower stretches of river.

3. River Tud - Headwaters to Mattishall

Agricultural and urban run-off, together with the effluent from Mattishall Sewage Treatment works cause a failure to meet the target class, fishery classification and predicted biological score.

4. River Tiffey - Wymondham to River Yare

Effluent from the sewage treatment works at Wymondham causes failure to meet target class and predicted biological score.

5. Intwood Stream - Headwaters to River Yare

Effluent from Swardeston sewage treatment works causes failure to meet the target class.



6. River Tas - Headwaters to Fornsett St Mary

Low river flows coupled with agricultural run-offs has led to a failure to meet the target class and fishery classification.

7. River Chet - Loddon Bypass

Failure to meet predicted biological score.

8. River Tat. Tatterford Common

Failure to meet target class and predicted biological score.

9. River Wensum - A1065 Road Bridge
King's Beck - Kings Bridge

Failure to meet predicted biological score due to adverse effect on habitat by river maintenance works.

10. River Yare (tidal) - Brundall to Rockland Broad

Concern that bacteriological requirements for water contact sports may not be met in this area.

11. River Wensum - Attlebridge

Concern over risk to quality of River Wensum by Attlebridge waste disposal site.

12. River Wensum - Norwich

Concern over possible health risk to swimmers and participants in water sports in Rivers Yare and Wensum.

13. River Yare (tidal) - Thorpe to Rockland Broad

Contamination of the river sediments by mercury from past discharges to the foul sewer in Norwich.

14. Rivers Yare and Waveney (tidal)

Concern over the nutrient enrichment of these rivers and their associated broads.

Bure

15. River Bure (Tidal) - Horning to Ant Mouth
River Ant (Tidal) - Barton to Ant Mouth

Eutrophication causes a failure to meet predicted biological score and fishery classification.

16. River Thurne - Headwaters to Thurne Mouth

Eutrophication and naturally high levels of ammonia causes a failure to meet fishery classification.

17. River Bure (tidal) - Horning to Thurne Mouth

Concern over increasing salinity levels in the river above Thurne mouth and increased frequency of fish kills caused by saline intrusion.

18. Rivers Bure, Ant and Thurne (tidal)

Water quality of these rivers and broads needs to be of an appropriate quality to allow Broad restoration objectives to be met.

19. Thurne Broad - Control of Prymnesium

Concern over the intermittent blooms of algae in the Broad and adjacent rivers which result in large fish mortalities due to the release of algal toxins.

20. Halvergate Marshes

The concentration of salt within the marsh dyke system should be maintained at levels appropriate to the various requirements within the Halvergate system.

Waveney

21. River Waveney - Roydon to Billingford

Low river flows and low oxygen levels have caused failure to meet the target class, fishery classification and predicted biological score.

22. River Dove - Stoke Ash to Eye

Low river flows and lack of dilution for sewage and trade effluents has led to failure of fishery classification.

23. River Waveney - Bungay to Beccles

River fails to meet nitrate level required under EC Surface Water Directive.

24. River Dove, Thorndon Watercourse - Cat Bridge

Low river dilution of sewage and industrial effluents causes failure to meet predicted biological score.

25. Marsh Dyke Downstream of Beccles STW

Failure to meet predicted biological score.

26. Starston Beck - Harleston to River Waveney

Local quality objectives for ammonia are not achieved due to the effluent from Harleston Sewage Treatment works.

Coastal

27. South Beach, Great Yarmouth

Existing discharges of sewage into Haven area of River Yare cause non-compliance with the quality requirements of the E.C. Bathing Waters Directive.

28. Great Yarmouth - Industrial Estates

There is concern over pollution generally from surface water discharges serving industrial estates.

Groundwater

29. Trowse, Norwich - Groundwater

Groundwater in this area has been found to be contaminated with organic solvents.

30. Thorpe, Norwich - Groundwater

Groundwater contaminated by historic disposal of solvents onto ground.

31. Harford Waste Disposal Site, Norwich - Groundwater and River Yare

Groundwater and adjacent River Yare are at risk by pollution from an old waste disposal site.

General

32. **Lakes/Parks**

There is concern that occasional blooms of toxic blue/green algae affect recreational and amenity lakes and enclosed waters across the area. High levels of algae are also a problem to the water abstracted by the Water Companies.

33. **Tributaries of Catchment River Waveney**

Concern that low flows are causing inadequate dilution of effluents.

34. **Broads Area - Oil Pollution**

There is concern over boat related oil pollution in Broadland.

5.2 **Current Shortfalls and Identification of Issues - Water Quantity**
(Refer to Map No 28)

5.2.1 **General**

This section details the water quantity shortfalls compared with future targets, as described in Section 4.

5.2.2 **Shortfalls Identified**

35. **In-river needs are not quantified and minimum acceptable flows are not defined.**

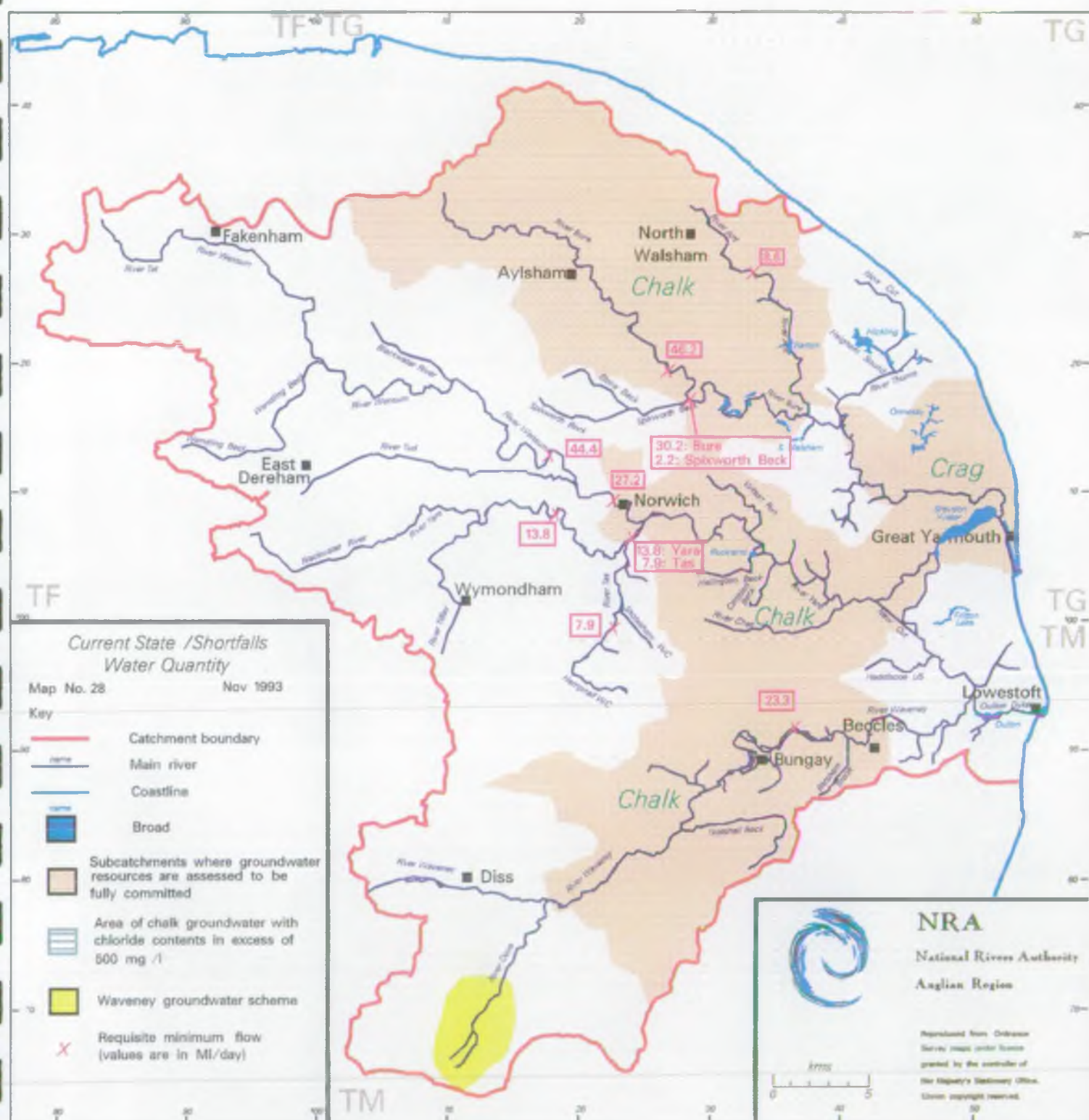
Extensive ecological and hydrological studies are required to establish the minimum acceptable water level, flow and quality (ie in-river needs) required to maintain the ecosystem. This is also essential for quantifying environmental demands to be used in groundwater balances for assessing water resources.

The *Water Resources Act 1991* empowered the NRA to set Minimum Acceptable Flows (MAF) on rivers. To date none have been set Regionally or Nationally. However, the Anglian Region NRA have set Minimum Residual Flow (MRF) targets at a number of points on rivers in the catchment. In essence these are similar to the concept of MAF but without the legal status. MRF are used for river management and to guide decisions on licence applications to protect other existing uses and users of the rivers within the catchment.

There is a need to review the methodology used for assessing water resource availability in the light of perceived environmental demands. In particular, the amount of groundwater allocated to the river as base flow component in the Bure catchment.

Traditionally, groundwater resource estimates comprise the long term average recharge into the underlying storage rocks called aquifers, which sustains base flows to the rivers, together with surface run-off which occurs after periods of heavy rainfall.

The environmental demand for water is currently represented by an allowance of total groundwater resource, provisionally set at the natural 95 percentile flow (the flow that would be exceeded naturally 95 percent of the time), less the reliable contribution of effluent discharges.



36. Groundwater resources in the Bure catchment are fully committed to existing demands compared against current resource assessments

This issue will be influenced by any subsequent developments in issue 35 above.

Future demands for water in the Anglian Region are progressively rising. Demand for public water supply is assessed by reference to forecast changes in population and consumption habits as well as considering the potential for demand management practices such as leakage control and metering policies. Demand for industrial and agricultural growth are also allowed for.

37. Catchment Areas for wetland sites of conservation value need to be defined.

Wetland sites exist where the geomorphology, geology and land use allow a concentration of surface and groundwater flows and levels. The proportions of these contributing factors will vary for each site adding to the complexity of the study of wetlands. The area of groundwater contributing to the wetland site can be defined as the wetland catchment area. Once defined this will identify areas of the catchment where future abstraction boreholes can be sited. The NRA will discourage any future abstractions that will cause unacceptable effects to a wetland site of conservation interest.

Redgrave and Lopham and East Ruston Fens are already identified as wetland sites suffering from nearby groundwater abstraction. Options to ameliorate this are currently being investigated.

38. There is a requirement to develop plans for optimum water resource management and development within the catchment.

This requires a better understanding of aquifer responses to varying development/abstraction scenarios, eg groundwater simulation models. Future plans may identify the need for river support schemes.

This is particularly relevant in the Bure for maintaining flows into Broadland and the consequent depletion of flows from groundwater development in the catchment.

Future river support required as a direct consequence of abstraction is likely to be promoted and operated by the abstractor as a licence condition under the "polluter pays principle", ie the abstractor will be liable for any remedial works as a consequence of water resource developments where they are the sole instigator and beneficiary.

39. Opportunity exists to consider more flexible methods of allocating longer term resources

A significant proportion of water resources are effectively tied up as "paper water" and subsequently under-utilised until longer term demands materialise (essentially public water supply licences to meet demands up to current planning horizon 2011). This apparent surplus could be temporarily re-allocated to meet other shorter term demands.

40. Inability to guarantee maintenance of Covenant Level at Costessey Mill

Abstraction at Costessey from the Wensum by Anglian Water Services is controlled by the requirement to provide a minimum flow to pass downstream of Costessey Mill gauging station. In addition, the NRA have a requirement to maintain a covenant level upstream of the Mill. These two aspects are inconsistent. The licence condition and design of the gauging structure at Costessey Mill does not always guarantee that the covenant level can be maintained.

41. Gauging at Ellingham Mill is inadequate to provide accurate data.

The River Waveney is currently gauged at 4 sites. Flow measurements at Ellingham Mill are derived from a complex structure of weirs and adjustable sluice gates. Derivation of flow data is time consuming and of dubious accuracy.

Flow data at this site is required for a number of uses - in particular, assessment of water resources and management of the river and its associated groundwater scheme.

42. Hydrometric Network

All technical aspects of the management of the catchment depends to some extent on the availability of accurate and timely hydrometric data. In response to changing requirement, it is necessary to periodically review hydrometric networks.

The recently completed "Performance Review of Hydrometry" recommends that a review of baseline networks be carried out for rainfall, river flow, groundwater levels and meteorological data.

5.3 **Current Shortfalls and Identification of Issues - Flood Defence and Physical Features** (Refer to Maps No 29 and 30)

5.3.1. **General**

Having set Flood Defence target standards of service (see map no) the issues identified below detail areas where there is a current shortfall. Similar shortfalls in those physical features related to Fisheries, Recreation and Conservation are separately identified.

5.3.2 **Issues Identified**

43. **Development of a Broadland Flood Alleviation Strategy**

The most damaging flooding in Broadland is that associated with high sea levels, resulting in saline inundation. Broadland contains some 240 km of flood embankments, defending about 21,300 ha of land. Many of these embankments have settled, by an average of 20 mm/year and the current standard of protection is no more than 1 in 5 years and in places as low as 1 in 1 year. Great Yarmouth is defended by flood walls which prevent overtopping by floods with a return period of more than 1 in 100 years. **Without a comprehensive strategy for flood alleviation, much of Broadland and the economy it supports will cease to exist.**

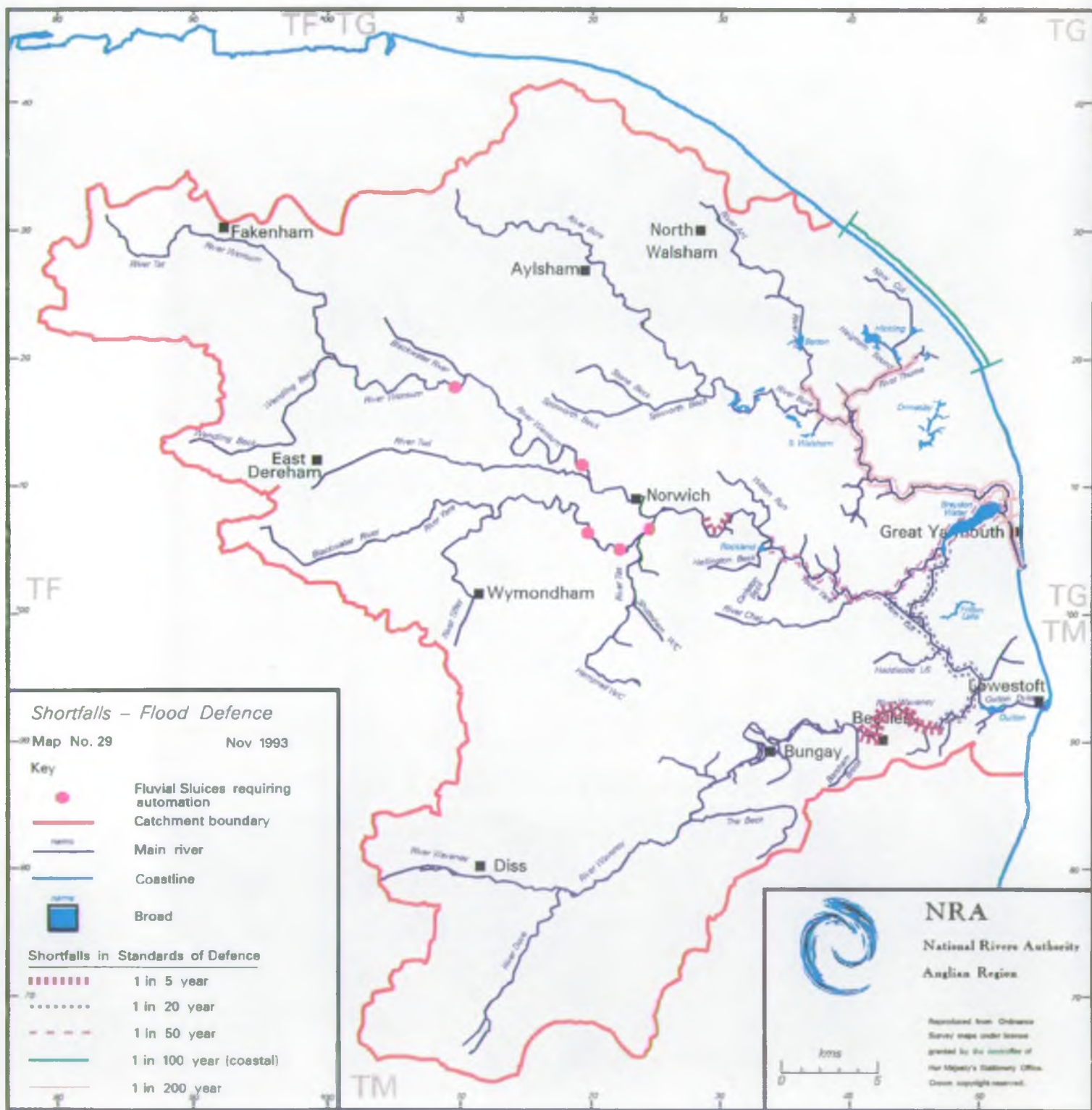
44. **Requirement for integrated Sea Defence Management**

Tidal flooding on the coastal frontage of the catchment is an ever present threat, due to wind and wave action. The diverse coast is geomorphologically and geologically complex and there is an ongoing need for major flood defence investment. It is important to continue with the integrated management of the whole coast rather than a piecemeal approach.

45. **Sea Level Rise and Managed Retreat**

The future planning of sea defences needs to take account of possible sea level rise. Currently, an allowance of 7 mm per year is built into all sea defence designs to allow for future sea level rise.

The NRA does not have a policy either in favour or against managed retreat. This is a potential issue along the coastal frontage but would only be implemented should it prove uneconomic to maintain the current defences.



46. Standards of Service/10 Year Needs

The NRA set target standards of service (Appendix II) against which existing flood defences are compared and the need for improvement schemes identified.

Proposed schemes are regularly reviewed, costed and prioritised, and set out in a 10 year needs programme. The annual capital expenditure is subject to rigorous cost benefit and environmental analysis and requires approval from MAFF for grant in aid contributions.

The needs programme for the Yare CMP is given in Appendix IV.

47. Development Control

The NRA discourage development in any flood risk area, both tidal and fluvial. Existing development within a flood plain is at risk of flooding. Within Broadland NRA would not object to development that is within defended areas which meet the NRA's target standards.

48. Undefended Properties

Within Broadland there are a number of riverside villages with undefended properties, ie, property which has been built between the flood defence embankment and the river, eg Brundall, Reedham, Potter Heigham. The policy of the NRA is to object to inappropriate development in undefended areas.

49. River Control Structures (Weirs and Sluices) and Mill Rights

Throughout the fluvial river systems control structures regulate and maintain water levels. The majority of the structures are old, manually operated and some are operationally unsound. They are in need of regular repair and many need major investment to counter deterioration, upgrade their flood flow capacity and automate their monitoring and control systems.

The management of water levels to meet the needs of a diversity of users should be addressed. The ownership and operation of river control structures is vested either with the NRA, or is under private control. Where private mill rights exist, the NRA have no powers to influence their operational regime and retention levels. This can lead to conflict with riparian owners both upstream and downstream of the structure and may conflict with any proposed NRA integrated river management policy.

50. Need for Fish Passes

Many existing river structures are impassable to migrating fish and eels.

There is a requirement to address this whenever major improvement works are undertaken on river control structures. The structure at New Mills at the tidal limits of the River Wensum is impassable to sea trout which are known to ascend the River Yare.

51. River Rehabilitation Schemes

Features associated with channel meanders, e.g. pools and shallows on bends, variations in flow velocity, slack water areas have reduced over the previous decades. There has also been a reduction in the ratio of marginal vegetation to open water on the fluvial channels.

A number of rivers have stretches which are deficient in physical features such as riffles, pools and meanders. These stretches will need to be included in river rehabilitation programmes designed to restore habitat diversity and ecological value whilst addressing the requirement for flood defence. Three such stretches have been identified on the River Waveney.

52. Lack of spawning sites

Within the upper and middle reaches of the rivers there is a lack of gravel riffles which are important sites for providing feeding and spawning sites for fish.

53. Lack of Shallow Margins:

These are a natural feature on meandering channels and provide warmer water and security from predators for fish fry.

54. River maintenance frequencies

Although recommended frequencies (Appendix V) have been established, they are not mandatory and are influenced by the following factors:-

1. Need
2. Finance
3. Conservation and Recreational requirements
4. Landowner requirements.



55. Management of Bankside Trees and Bushes

There is a need to work collaboratively with riparian owners, Countryside Management Projects and conservation organisations to improve the status and management of riparian trees and bushes.

56. Concern over Increasing Sediment and Nutrient Levels from Land Run Off

There is a requirement to investigate the value of river buffer zones could do much to improve the river environment by preventing pollution and silt reaching rivers. They may also have a role in reducing diffuse nutrient input to rivers, particularly important in the River Bure and its tributaries.

57. Erosion Protection

The tidal sections are subject to intensive boat usage for much of the year. As a consequence, marginal vegetation and banks have been eroded, water turbidity is high, and there is little structure within the rivers to provide shelter and cover for invertebrates and fish.

Many of the tidal flood banks in Broadland are protected against further erosion by various types of bank protection. This erosion, which is caused by a combination of boat wash and the deterioration of marginal vegetation can affect the integrity of the flood bank, if left unchecked. Traditional steel and timber piling is currently being supplemented where appropriate by softer methods of bank protection involving geotextiles and rond creation. However constraints include depth of water, navigation requirements, costs, aesthetics and durability.

The NRA are continuing their investigation into alternative methods of bank protection, by installing and monitoring trial sections using new materials and techniques.

58. Bio-manipulation in Broadland - Impact on Angling

Within most of the Broad, the loss of aquatic vegetation has resulted in loss of aquatic invertebrates and continued loss of water clarity due to phytoplankton, despite control of nutrients. This has markedly reduced the biological diversity of these lakes including the numbers of larger, older fish which are of value in recreational fisheries.

Isolation and temporary removal of fish (biomanipulation) can encourage the re-colonisation of aquatic vegetation. However this may compromise existing angling use of some broads.

59. Provision of bankside facilities for anglers in Broadland

Bankside angling, including competition fishing is a very popular recreation on broadland rivers. There is a need to work with the Broads Authority to enhance appropriate facilities including access for anglers.

60. Limited Access to Riverbanks:

There is a need to work with riparian owners and other agencies to promote appropriate access to and along river banks.

61. Lack of Habitat diversity for fish

In areas where there is little prospect of restoration of vegetation, eg tidal rivers, artificial habitats may be needed. (Broadland rivers).

62. Insufficient knowledge of factors limiting Broadland fish populations.

There is a requirement to improve the understanding of factors limiting fish population in Broadland.

6.0 ISSUES AND OPTIONS

6.1 General

This section of the plan considers options to address the issues that have been raised in the preceding sections. The options as presented are the initial thoughts of the Anglian Region of the NRA and do not constitute policy statements. It must be re-emphasised that at this stage, it is not the objective to present a detailed programme of action or to prioritise the issues and options identified. It is recognised that considerable consultation and negotiation will be necessary before an acceptable and practicable action plan can be drawn up. This will be the next stage. Comments on the issues and options are therefore requested together with any new ideas/ suggestions.

Wherever possible the body responsible for carrying out each option has been identified. In some cases this is identified as someone other than the NRA. However, the options as presented are intended as a plan to facilitate improvements to the water environment for the benefit of all users. Obviously this will entail many bodies and individuals working together to fulfil the aims and objectives as detailed in this Catchment Management Plan.

6.2 Issues and Options

Issue No. 1: R Wensum - Taverham to Mile Cross Bridge (Norwich)
R Tud - Honingham to R Wensum
Failure to meet nitrate levels laid down in EC Surface Water Directive

Options	Responsibility	Advantages	Disadvantages
Derive a nitrogen "budget" for these rivers	NRA	Identifies significant nitrogen sources for targeting action.	i) Cost to NRA. ii) Potential cost to AWS Ltd and agriculture
Application of nutrient removal requirements, under E.C. Urban Waste Water Directive, to appropriate sewage treatment works	NRA/AWS	Reduction in nitrogen loading on rivers.	i) Cost to AWS ii) No guarantee of improvement
Use of EC Nitrate Directive for limiting nitrogen application by farmers in designated areas	NRA	Reduction in river nitrogen levels	i) Cost to farmers ii) Possible difficulty in enforcement iii) No guarantee of improvement

Issue No. 2: Wendling Beck
Failure to achieve target class and predicted biological score

Options	Responsibility	Advantages	Disadvantages
Survey in upper catchment to identify polluting sources	NRA	Action can be targeted.	i) Cost ii) Potential cost to dischargers
Improvements to Dereham STW to meet River Needs consent limits	AWS	Compliance with class objectives	Cost

Issue No. 3: R Tud - Headwaters to Mattishall
Failure to meet target class, fishery classification and predicted biological score.

Options	Responsibility	Advantages	Disadvantages
Monitor effluent from Mattishall STW to assess improvements resulting from recent extensions to the works	NRA	Identifies source of problem	Cost
Pollution survey upstream of Mattishall STW	NRA	Identifies possible problem sources and targets action	i) Cost ii) Potential cost to dischargers

Issue No. 4: R Tiffey - Wymondham to River Yare
Failure to meet target class and predicted biological score.

Options	Responsibility	Advantages	Disadvantages
Assess improvements to water quality in 1996 after completion of planned improvements to Wymondham STW	NRA	Identifies whether present problem has been resolved	Cost
Ensure best compliance with river needs consent limits, set on Wymondham STW, until completion of planned improvements	AWS	No further deterioration in water quality	Cost

Issue No. 5: Intwood Stream Failure to meet target class

Options	Responsibility	Advantages	Disadvantages
Improvements to Swardeston STW to meet River Needs consent limits	AWS	Compliance with target levels	Cost

Issue No. 6: R Tas Headwaters to Forncett St Mary. Failure to meet target class and fishery classification

Options	Responsibility	Advantages	Disadvantages
Survey to identify polluting sources.	NRA	Targets action	i) Cost ii) Potential cost to discharge

Issue No.7: River Chet - Loddon By Pass. Failure to meet predicted biological score.

Options	Responsibility	Advantages	Disadvantages
Pollution survey	NRA	Identifies source of problem	Cost and staff resource

Issue No 8 River Tat, Tatterford Common - Failure to meet predicted biological score.

Options	Responsibility	Advantages	Disadvantages
Pollution survey	NRA	Identifies source of problem	Cost and staff resource

Issue No 9 River Wensum - A1065 Road Bridge. Kings Beck - Kings Bridge Failure to meet predicted biological score.

Options	Responsibility	Advantages	Disadvantages
Liaise with IDBs over possible adverse affects of their works programme	NRA/IDB	Improved habitat	Resource costs

Issue No. 10: Concern that bacteriological requirements for water contact sports are not met in tidal R Yare

Options	Responsibility	Advantages	Disadvantages
Derivation and application of statutory quality objective, related to water contact sports, in River Yare from Brundall to Rockland Broad	DoE/NRA AWS	Target level identified Achievement of target levels	- Possible additional costs of sewage treatment in area

Issue No. 11: Concern over risk to R Wensum by Attlebridge waste disposal site

Options	Responsibility	Advantages	Disadvantages
Monitoring to assess changes in groundwater quality away from site.	NRA/WRA/Site Operator	Identifies need for action.	Cost
Implementation of contingency plan if required.	Site Operator	Safeguards River Wensum	Cost

Issue No. 12: Possible risk to participants in water sports, including swimming in rivers particularly in Norwich area in the catchment.

Options	Responsibility	Advantages	Disadvantages
Ban all water contact sports in Norwich including swimming	NRA/Norwich City Council	No risk to health	1) Difficult to enforce 2) Some participants are willing to accept a slight risk
Achieve a bacteriological quality in the river which presents no risk to swimmers etc.	NRA/City Council/AWS	No risk to health	Impossible to achieve due to urban nature of area.
Management policy to be derived to cover water contact sports within Norwich	NRA/City Council	Clear objectives	Cost
Mount public awareness campaign of the physical and health dangers	NRA/Local Authorities	Clear statement of risks	Cost

Issue No. 13: Mercury in tidal River Yare from past discharges to foul sewer in Norwich.

Options	Responsibility	Advantages	Disadvantages
Do nothing apart from navigational dredging	NRA	No cost	Increased capacity for methyl mercury production
Removal of contaminated sediments	NRA	Reduced level of mercury in river	i) Unlikely to be successful ii) Disturbance likely to temporarily increase methyl mercury production
Planned programme of management with Broads Authority to include navigational dredging	NRA/Broads Authority	Reduced capacity for methyl mercury production	Additional costs to routine dredging programme

Issue No. 14 and 18: Water Quality in the Broads area is required to be of an appropriate quality to allow Broads restoration objectives to be met

Options	Responsibility	Advantages	Disadvantages
Setting of appropriate non-statutory quality targets for specific areas in Broadland	NRA/Broads Authority	Enables long term ecological targets to be met	Not legally enforceable
Setting of statutory quality objectives when available in Broadland	NRA/Broads Authority	i) Enables meaningful long term ecological targets to be met ii) legally enforceable	Could result in long term non compliance or the need to set short term interim limits

Issue No 15: R Bure - Horning to Ant Mouth
R Ant - Barton to Ant Mouth
Failure to meet predicted biological score and fishery classification due to eutrophication.

Options	Responsibility	Advantages	Disadvantages
Continuation of R&D programme, in conjunction with Broads Authority, to lead to eventual restoration of water quality.	NRA and Broads Authority	Achievement of Broads restoration objectives.	Cost

Issue No. 16: R Thurne
Failure to meet fishery classification due to enrichment and elevated ammonia levels.

Options	Responsibility	Advantages	Disadvantages
Continue to participate in R&D programme with Broads Authority and continue active participation in Thurne Broads Management Group.	NRA and Broads Authority	Achievement of Thurne Broads restoration objectives.	Cost

Issue No. 17: Increased salinity in River Bure above Thurne mouth

Options	Responsibility	Advantages	Disadvantages
Investigate fresh water flow requirement and set appropriate MAFs	NRA	Ability to plan for increased fresh water flow	Cost and potential cost for increasing fresh water flow
Allow further upstream movement of saline water to new agreed limits	NRA/Broads Authority	No direct costs	1) Possible inability to restore South Walsham Broad 2) Possible adverse effects on Suffolk Water Company intake at Horning 3) Adverse effects on fisheries

Issue No. 19: Production of intermittent algal toxins in Hickling Broad which result in extensive fish mortalities

Options	Responsibility	Advantages	Disadvantages
Enhancement of existing fish refuge	NRA	Reduction in number of fish killed	1) Inadequate water resource 2) Only of local benefit
Long term improvements within the catchment to decrease the salinity which encourages toxin release	NRA/Broads Authority	Reduction in number of fish killed	Potential cost to farmer/IDB?

Issue No 20: Maintenance of acceptable levels of salinity in Halvergate Marshes system.

Options	Responsibility	Advantages	Disadvantages
Do nothing	MAFF/NRA/IDB /Broads Authority	No cost	Continues present unacceptable situation
Appropriate management strategy to be adopted by farmers in the area	MAFF/NRA/IDB /Broads Authority	Agreed chloride levels achieved	Conflicting interests by farmers in the area.

Issue No. 21: R Waveney - Roydon to Billingford. Failure to meet target class, fishery classification predicted biological score.

Options	Responsibility	Advantages	Disadvantages
MAF to be assessed to take account of effluent dilution and environmental requirements	NRA	Derived river flow figure can be used to plan action.	Cost
River flow to be maintained above assessed MAF.	NRA/Abstractors	Compliance with target levels	i) Possible flow augmentation costs for NRA ii) Possible costs for NRA in compensation for licence revocations.

Issue No. 22: R Dove - Stoke Ash to Eye. Failure to meet fisheries classification

Options	Responsibility	Advantages	Disadvantages
MAF to be derived to take account of effluent dilution and river flow to be maintained above derived MAF	NRA/Abstractors	i) Compliance with target levels ii) Derived river flow figure can be used to plan action.	i) Possible flow augmentation costs for NRA ii) Possible compensation costs for NRA in revoking abstraction licences.
Improved effluent quality from sewage treatment works & industry	AWS/Industry	River quality meets RQO's	High cost in order to meet stringent effluent standards

**Issue No. 23: R Waveney - Bungay to Beccles
Exceedance of nitrate level required under E.C. Surface Water Directive**

Options	Responsibility	Advantages	Disadvantages
Nitrogen "budget" required for Waveney	NRA	Identifies significant nitrogen sources for targeting action	Cost to NRA
Application of nutrient removal requirements, under EC Urban Waste Water Directive, to appropriate STWs	NRA/AWS	Reduction in river nitrate levels	Cost to AWS
Use of EC Nitrate Directive for limiting nitrogen application by farmers in designated areas	NRA	Reduction in river nitrogen levels	1) Cost to farmers 2) Possible difficulty in enforcement

Issue No 24 **River Dove, Thorndon Watercourse - Cat Bridge**
Low river dilution of sewage and industrial effluents causes failure to meet predicted biological score.

Options	Responsibility	Advantages	Disadvantages
MAF to be derived to take account of effluent dilution and river flow to be maintained above derived MAF	NRA/Abstractors	Improved biological quality	1) Possible flow augmentation cost for NRA 2) Possible compensation costs
Enhanced quality limits on discharge consents	NRA/Dischargers	Improved biological quality	1) Cost to dischargers 2) Doubt whether objective would be achieved as present limits are stringent.

Issue No 25 **Marsh dyke downstream of Beccles STW - Failure to meet predicted biological score.**

Options	Responsibility	Advantages	Disadvantages
Enhanced quality of effluent from Beccles STW	AWS Limited	Improved quality of marsh dyke	Cost

Issue No. 26: **Starston Beck - Harleston to Waveney. Local quality objectives for ammonia not achieved**

Options	Responsibility	Advantages	Disadvantages
Improvements to Harleston STW to meet River Needs consent limits	AWS	Compliance with objective levels	Cost

Issue No. 27: Non compliance with E C Directive on the Quality of Bathing Waters at South Beach, Great Yarmouth

Options	Responsibility	Advantages	Disadvantages
Monitor affects of diversion of existing phased programme of sewage outfalls to new Caister sea outfall by 1997	NRA	Confirms compliance with EC limits or identifies need for further action	i) Cost ii) Potential cost to AWS

Issue No. 28: Concern over pollution by surface water discharges from industrial estates in Great Yarmouth

Options	Responsibility	Advantages	Disadvantages
Prosecution when sources are proven	NRA	May effect an improvement	Action is taken after pollution has occurred.
Controlling discharges by means of consents when justifiable	NRA	May effect an improvement	Possible cost to dischargers for improvements
Diversion of "risk areas" to foul sewer when available	NRA/G.Y.B.C./AWS	Reduction in pollution	Cost to dischargers
Planned strategy for future industrial areas to ensure that effective drainage systems are in place at the beginning of the development	NRA/G.Y.B.C/AWS	Reduction in pollution	Costs to dischargers

Issue No. 29: Groundwater contamination - Trowse, Norwich

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	No Cost	Risk to present and future abstractors
Investigation to determine source of pollution and remedial action to clean up groundwater	NRA/Polluters	Returns groundwater to suitable quality for future users	1) Cost to NRA 2) Potential cost to owner of polluting source 3) Original owner of polluting source untraceable

Issue No. 30: Groundwater contamination by solvents - Thorpe, Norwich

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	No Cost	Risk to present and future abstractors
Continue to monitor extent of contamination and warn groundwater users if required.	NRA	Enables appropriate action to be taken	1) Cost 2) No improvement to Groundwater
Remedial action to recover solvents and clean up the groundwater	NRA/Polluter	Groundwater suitable for use as required	1) Historical pollution and sources are unidentified 2) Difficult, costly and unlikely to be wholly successful

Issue No. 31: Groundwater pollution and potential pollution of River Yare from old waste disposal site at Harford, Norwich

Options	Responsibility	Advantages	Disadvantages
Investigation and monitoring to assess extent of groundwater contamination	NRA/Norwich City Council	Enable appropriate action to be taken	Cost
Remedial measures on site.	Norwich City Council	Reduced risk of pollution to groundwater and river	Cost

Issue No. 32: Concern regarding blue/green algae in a number of recreational and amenity lakes or adversely affecting public drinking water supply sources

Options	Responsibility	Advantages	Disadvantages
Develop an "Action Plan" for each lake, in a priority order, which will identify practical remedial measures	NRA	Identifies options leading to reduction in problem	Cost of "Plan" and potential cost to owners of the lakes

Issue No. 33: General concern over dilution for effluents in tributaries of Catchment.

Options	Responsibility	Advantages	Disadvantages
Derive MAFs	NRA	Derived MAF to be used to plan action	Cost
River flows to be maintained above MAF	NRA/Abstractors	Improved water quality to meet environmental requirements	1. Possible flow augmentation costs for NRA. 2. Possible compensation costs for NRA in revoking abstraction licences
Enhanced treatment of effluents from sewage treatment works and industry	AWS/Industry	River quality meets RQO's	High cost to meet stringent effluent standards

Issue No. 34: Broads Area - Oil Pollution

Options	Responsibility	Advantages	Disadvantages
Joint initiative with Broads Authority to assess best means of managing problem	NRA/Broads Authority	Defines extent of problem and best means for resolution	Potential cost to boating activities
Education campaign	NRA/Broads Authority	Heightens public awareness	Potential cost to boating activities
Prosecution of offenders	NRA/Broads Authority	Publicity leading to reduced pollution	Often difficult to prove
Production of bye-laws enforcing oil handling and storage procedures	Broads Authority	Reduces risk of pollution	i) Cost to boating industry ii) Need for enforcement

Issue No. 35 Minimum acceptable flows are not defined.

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	Saving of staff resource	Inability to adequately assess water resources availability - particularly critical in the Bure catchment. Need to rely on existing MRF which may be inappropriate.
Carry out extensive ecological and in-river needs studies	NRA	Improved resource management. Enables better protection and understanding of river ecology. Verification of water resources availability.	Cost and timescale. Reduction in current MRF may impact on water quality. Increase would impact on water resource availability.
Await outcome of National R&D Study on defining MAF's	NRA	Better understanding of in-river needs. National standardised approach identified for setting MAF's.	Timescale - study not due for completion until 1996. Local issues could be "masked" by National approach.
Set MAF's based on review of existing MRF's and experience	NRA	Quicker implementation	Possible lack of National consistent approach. Subjective.

Issue No. 36: Groundwater resources in the Bure catchment are inadequate to meet future demands compared against current resource assessments.

Options	Responsibility	Advantages	Disadvantages
Review environmental/river needs and reassess ground water availability	NRA	Potential for further development of groundwater resources linked to issue no 35.	Potential impact on river system. Relies on Issue 35 being addressed.
Demand Management	NRA (Raw Water allocation). WCo's (PWS)	Reduces demand and delays major expenditure	Possibly expensive to Water Companies. Impact on local users.
Groundwater support to augment low flows in rivers	NRA/WCo's/ Abstractors	Satisfies environmental requirement. Would enable greater groundwater exploitation	Cost Resource limitations
Revocation of underused licences	NRA	Make more water resources available for reallocation to other potential users	Cost Public Relations
Re-use of sewage effluents	NRA/WCo's	Better utilisation of water resources	Emotive. Water quality implications for Broadland. eg eutrophication if discharged to river first.
Encourage aquifer recharge	NRA	Re-establishment of groundwater levels. Better utilisation of water resources	Cost. Unproven techniques. Limited yield. Pollution risk. Requires suitable geological conditions.

Issue No. 37: Groundwater Catchment Areas for wetland sites of conservation value need to be identified.

Options	Responsibility	Advantages	Disadvantages
Environmental studies at sites of particular concern	NRA/W Co's/ conservation bodies	Better hydrological understanding of wetland behaviour. Provide effective protection to wetlands. Improved management	Timescale and cost. Possible lack of National consistency in approach
Await outcome of R&D Study on wetlands	NRA	Consistent approach. Cheaper than site specific studies.	May not be appropriate for local issues - site specific investigations may still be necessary.
Use empirical assessments	NRA	Quick	Potential to be inaccurate. Subjective.

Issue No. 38 There is a requirement to develop plans for optimum water resource management and development within catchments

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	Cost and saving in staff resources	Water resources would be inadequately managed.
Detailed investigation and modelling of system	NRA	Better understanding of how the catchment aquifers respond to water resource development	Cost and timescale

Issue No. 39: Opportunity exists to consider more flexible methods of allocating long term resources

Options	Responsibility	Advantages	Disadvantages
Temporary allocation of committed, unused, licensed amounts to other applicants in the short term	NRA	More efficient utilisation of water resource allocation	Suitable for short term requirements only. High risk of non renewal. Requires cooperation of existing licence holders. Difficult to administer and police. Removes flexibility of operation for existing longer term licence holders.
Issue stepped incremental licence quantities to new longer term issues	NRA	More efficient utilisation of water resource allocation	As above - except does not require cooperation of longer term licence holder.

Issue No. 40: Inability to guarantee maintenance of agreed water level at Costessey Mill

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	Cost	NRA open to legal action
Vary AWS's surface water abstraction licence to reflect level requirement as well as flow	NRA	Agreed level could be maintained.	Depends on cooperation of Water Company.
Modify gauging structure at Costessey Mill	NRA	Ensure consistency between level and flow control with regard to abstraction	Cost. Still requires variation of AWS licence to regularise
Operating agreement with Water Company	NRA/AWS	Easier to implement	Not legally binding
Renegotiate agreed level	NRA	Agreed level could be maintained	Possible cost implication of environmental effects

Issue No. 41: Gauging at Ellingham Mill

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	Short term cost savings to NRA	Continuing inefficient processing and inaccurate data.
Random flow gauging at Ellingham	NRA	No capital cost processing time saved	No flow data available for this important site.
Build new gauging station	NRA	Accurate data some processing time saved	Capital Cost

Issue No. 42: Hydrometric Network

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	No Capital Cost	Network may not meet requirements
Await Regional Review	NRA	Regional consistency Network tailored to present day requirements. Economy of scale.	Cost Time
Review for this catchment		Possible time saving. Network tailored to present day requirements.	Cost No economy of scale No Regional consistency.

Issue No. 43 Broadland Flood Alleviation Strategy

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	Short term cost savings to NRA	Increased tidal flooding with up to 90% of the currently defended land permanently flooded.
Sustain present level of defences	NRA	Secures existing standard of protection	(i) Existing standard of protection is not up to NRA target standard. (ii) Annual flooding will occur in certain areas. (iii) A major flood event would cause wide spread damage.
Raise existing flood embankments	NRA	Provides a consistent standard of protection throughout Broadland	(i) Could be serious technical difficulties due to poor ground conditions. (ii) Flooding of currently unprotected areas will increase. (iii) Visually intrusive.
Construct a barrier across the Yare upstream of the Haven Bridge Gt. Yarmouth	NRA	(i) Provides a 1 in 200 year standard of protection throughout Broadland (ii) Technically sound.	(i) Not the cheapest option to provide NRA target standards. (ii) May impact on the port detrimentally. (iii) Environmental concerns.
Construct a barrier across the Bure with washland storage at Haddiscoe	NRA	(i) Meets the NRA targets standards of protection. (ii) economically viable (iii) Technically sound (iv) Environmentally acceptable	(i) Split level of protection (1 in 200 yrs to Bure and 1 in 20 to Yare/Waveney)

NB. Bank raising of the tidal rivers is common to both the Bure and Yare Barrier options.

Issue No. 44 Requirement for Integrated Sea Defence Management

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA/ Maritime Local Authorities	Short term cost savings	(i) Fragmented approach to coastal management (ii) General decline in standard of protection (iii) No accumulated coastal data
Maintain policy of sea defence management	NRA/ Maritime Local Authorities	(i) Integrated approach to coastal management (ii) Availability of coastal management information (iii) Enables prioritising of standards of protection	Cost

Issue No 45: Sea Level Rise and Managed Retreat

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	Short term cost savings	(i) Increased frequency of flooding (ii) Increased risk to life and property
Sustain existing defences	NRA	Short term cost savings	(i) Standard of protection will decrease (ii) Increased maintenance requirement.
Managed Retreat	NRA	(i) Medium to long term cost savings (ii) Development of salt marsh as soft defence/protection. (iii) Environmental enhancement opportunities	(i) Loss of land to the sea. (ii) Loss of coastal frontage protection to Broadland.
Sustain existing defences	NRA	Short term cost savings	(i) Standard of protection will decrease (ii) Increased maintenance requirement.
Take account of sea level rise	NRA	Maintains target standards of protection	Cost

Issue No. 46: Standards of Service and 10 Year Needs

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	Short term cost saving	(i) Fragmented approach to flood defence needs. (ii) Lack of priority
Produce target standards of service	NRA	(i) Integrated approach to defence needs of catchment. (ii) Aids feasibility studies. (iii) Will provide data for performance measures. (iv) Improved planning efficiency.	Needs continually updating hence cost implications.
Provide 10 year needs programme	NRA	(i) Integrated approach to defence needs of catchment. (ii) Known priorities and costs (iii) Aids capital investment (iv) Utilises resource economically	None.

Issue No. 47 Development Control in Flood Risk Areas
Development often increases risks to the water environment but NRA
has only limited powers to impose conditions on development.

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	None other than staff saving	Uncontrolled development in flood risk areas
To gain a direct influence in the planning process using existing legislation and adoption of NRA Anglian Region model policies/ guidance notes (Appendix 1)	Local Authorities/ NRA/ Developers/ Landowners	Ensure matters the NRA are responsible for are fully taken into account in all development proposals	Implications on LA control. Possible cost implications to landowners/ developers.

Issue No. 48: Undefended Properties

Options	Responsibility	Advantages	Disadvantages
Do nothing	Planning Authority	Cost	Existing property and life at risk to flooding
Provide protection	Landowner	Reduction in frequency of flooding	(i) Likely to be uneconomic (ii) May encourage further development

NB: NRA have permissive powers to carry out flood protection works where economic viability can be demonstrated.

Issue No. 49: River control structures and mill rights

Options	Responsibility	Advantages	Disadvantages
Do nothing	Private owner /NRA	Cost	i) Loss of water levels. ii) Loss of amenity. iii) Possible flood defence problem. iv) Environmental concerns
Rebuild structures to NRA requirements	Private owner/ NRA	i) Co-ordinated approach. ii) Retains structures and associated benefits to river users. iii) Allows the introduction of more automation into river level control - and improved flood flow management.	i) Cost ii) Possible conflict between requirements and apportionment of costs.
Investigation into overall management policy of river system related to structures	NRA	i) Identifies real needs and environmental impact. ii) Includes co-ordinated approach	Cost

Issue No. 50: Requirement for fish passes access through mills and control structures.

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	No cost	Impacts upon salmonid, coarse fish and eel populations. Cost of remedial work to fish populations.
Provide fish passes through mills, sluices etc., where appropriate eg New Mills at Norwich	NRA/ Fishery owners	Ensure the natural migration of fish species, particularly trout and eels.	Negotiating consent of landowners. Cost of installation
Provide underwater tunnels for migration, through or around existing structures	NRA/ Fishery owners	As above. Possible lower cost than conventional fish pass. Appraisal of alternative design solution	Requires R + D assessment.

Issue No. 51: River Rehabilitation Schemes

Options	Responsibility	Advantages	Disadvantages
Do nothing		No cost	Continued impoverished status of fauna and flora of many reaches.
Minimise interruption of the progression towards natural channel characteristics when undertaking channel and vegetation management. Particularly in the upper reaches.	NRA/ Landowner	Improves habitat and holding capacity for river corridor fauna and flora. Improvement in fishery classification. Alleviation of low flow problems. Reduction in major disturbance. High benefit: cost ratio.	Requires pre-operational channel design. Cost. Will require landowners agreements.
Assist progression towards meander development within existing embankments, when undertaking channel and vegetation management.	NRA/ Landowner	As above. May be integral with E.S.A. or Countryside Stewardship schemes.	As above.
Modify bank gradient to create shallower profile and wider aquatic margin.	NRA/ Landowner	As above.	As above.
Design and implement restored channel configuration at suitable locations. eg River Waveney	NRA/ Landowner	As above. Maximises enhancement of ecological features whilst incorporating existing flood defence requirements.	As above.

Issue No. 52: Lack of spawning sites.

Options	Responsibility	Advantages	Disadvantages
Do nothing		Retains status quo	Possible impact upon fisheries biomass and holding capacity for invertebrates.
Allow greater encroachment of marginal vegetation to constrict and accelerate flow, thus cleaning channel.	NRA/ Fishery Owners	Gravel exposure where 'natural' flow regime dictates. Reduced frequency and cost of dredging. Increase in marginal habitat and its interface with the channel. No requirement for machinery movement.	Requires forward planned projections of channel response and necessary vegetation management. Possible flood defence implications
Reinstate gravel runs and riffles where appropriate	NRA/ Fishery owners	Creates immediate spawning sites for fish and habitat for invertebrates. Can be integrated with current flood defence schemes.	Cost of implementation. Possible flood defence implications

Issue No. 53: Lack of Shallow Margins

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	No cost	Has a negative impact upon the survival and recruitment of juvenile fish.
Create shallows in appropriate marginal areas of rivers and adjacent dykes.	NRA/ Fishery owners	Creates survival and feeding zone for juvenile fish. Ensures good recruitment of fish. Creates access to water for stock.	May involve disposing of spoil onto existing banks, and cutting into or moving existing banks. Need land owners permission.
Allow existing margins to encroach outwards into the existing channel.	NRA/ Fishery owners	As above	Possible flood defence implication

Issue No. 54 River maintenance frequencies

Options	Responsibility	Advantages	Disadvantages
Do nothing (no maintenance)	NRA	Short term cost savings	Increased flooding risk.
Continue with current practice	NRA	No increase in current costs. Minimum environmental disturbance	Deteriorating channel capacity, structure and flood banks. Standards of flood defence protection will deteriorate.
Meet recommended frequencies	NRA	Target standards of maintenance reached. Maximise flood defence standards. Some routine maintenance costs reduced. Potential for environmental enhancement works.	Increase over current costs. Environmental disturbance and conflict with fisheries and conservation interests

Issue No. 55: Management policy for bankside trees and bushes

Options	Responsibility	Advantages	Disadvantages
Adjust current management techniques, and introduce planting schemes	Landowner Countryside Management Projects/NRA	Improvement in the holding capacity for fish by providing cover (particularly encourages trout). Loss of important riverside habitat. Improved husbandry will reduce future management requirements.	Requires corridor planning via REDS to integrate planting schemes. Requires landowner participation to protect trees from stock. Reduction in future management requirements
Maintain current level of management and safeguard existing trees. Provide training in conservation aspects of riverside management e.g. coppicing, pollarding etc.	Landowners/Countryside Management Project/NRA	Maintains the current level of cover on many stretches. No extra training or subsequent maintenance considerations.	No improvement in fishery and river corridor habitat. Future costs of remedial works to improve fishery by less appropriate means i.e. stocking.
Maintain current management	Landowners/Countryside Management Project/NRA	No additional cost	Continued lack of adequate tree management

Issue No. 56: Concern over increasing sediment and nutrient levels from land runoff.

Options	Responsibility	Advantages	Disadvantages
The formation of buffer zones adjacent to rivers	NRA/MAFF	Provides more effective protection to surface waters. Could be developed in conjunction with ESA's	i) Cost. Timescale. Conflict of interest ie. production of land or set aside. ii) May not address the problem.

Issue No. 57 Erosion Protection

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA	Cost	(i) Integrity of flood embankment in jeopardy. (ii) Loss of sands/marginal vegetation
Traditional steel/timber piling	NRA	(i) Maintain integrity of flood embankments (ii) Reduces erosion (iii) Only option in deeper water	(i) can be unsightly (ii) Relatively expensive (iii) Little environmental benefit
'Soft' protection	NRA	(i) less expensive than piling (ii) Environmentally more acceptable (iii) Visually more pleasing	(i) Provides lower level of protection (ii) Shorter life expectancy (iii) Only suitable in shallow water
Reduction of navigation speed limit.	Broads Authority	Reduced boat wash Environmentally more acceptable.	Needs enforcing
Improved boat hull design	Boat construction industry boat owners	Reduced wash Environmentally more acceptable	(i) Cost (ii) Long terms solution

Issue No. 58: Bio-manipulation in Broadland - Impact on Angling.

Options	Responsibility	Advantages	Disadvantages
Improve understanding and liaison with angling representatives and promote awareness of future enhanced angling opportunities. Limited area/time.	NRA/ Broads Authority	Create understanding and co-operation.	Staff time.
Fish removal for limited time, and/or limited area.	NRA/ Broads Authority	Minimal disruption to angling.	May be insufficient time to effect improvements.

Issue No. 59: Provision of bankside facilities for anglers in Broadland

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA/Broads/ Landowners	No cost	Continued piecemeal pressure upon sensitive locations. Loss of public relations initiative.
Carry out feasibility study to assess extent of requirement and suitability of locations	NRA/ Broads Authority/ Landowners	Low cost. Provides framework for consultation and implementation	Cost
Feasibility study and implementation of recommendations.	NRA/ Broads Authority/ Landowners	As above. May result in enhanced facilities for angling. Control user impact and activity within the catchment. May minimise negative impact upon sensitive locations.	Cost. Planning permission required.

Issue No. 60: Limited access to riverbanks

Options	Responsibility	Advantages	Disadvantages
Do nothing	NRA/ Landowners/ Local Authorities/ Countryside Management Projects	No cost	Loss of public relations initiative
Negotiate access to riverside in order to provide riverside walks and appropriate recreation	NRA/ Landowners/ Local Authorities/ Countryside Management Projects	Provides basis with which to plan access, and amenity walks. Enhancement of NRA recreational profile. Low cost: benefit ratio.	Cost. Requirement for additional staff.
Negotiate access to riverside and assist with access creation and maintenance	NRA/ Landowners/ Local Authorities/ Countryside Management Projects	As above. Provision of advice upon the planning, design and implementation of access. Enhances working relationship with the River Valley Projects.	As above.

Issue No. 61: Lack of Habitat Diversity for Fish.

Options	Responsibility	Advantages	Disadvantages
Do nothing		No cost	Continuing inadequacy of fish habitat.
Provide artificial habitat structures in areas where natural habitat restoration cannot be achieved.	NRA/Fishery owners	Improve and holding capacity for fish; improve fishery.	Cost of installation and maintenance.

Issue No. 62: Insufficient Knowledge of Factors Limiting Fish Populations in Broadland

Options	Responsibility	Advantages	Disadvantages
Do nothing		No cost	Fragmented approach to fisheries work in Broadland
Review all existing fisheries work in Broadland and produce a strategy for future work.	NRA	Better understanding of existing data and factors limiting Broadland fisheries. Strategic approach to future fisheries requirements to address existing Broads Authority work.	Cost Staff resources.
Extend existing routine fisheries work in Broadland	NRA	More general data on existing status of fisheries	No analysis of long term trends; no strategic approach; costs; staff resources.

GLOSSARY

Alder Carr - Shrub or woodland habitat which develops in wetland areas.

AODN - Relates to height of sea level above Ordnance Datum Newlyn.

AONB - Area of Outstanding Natural Beauty.

Aquifer - A water-bearing stratum situated below ground level. The water contained in aquifers is known as groundwater.

Barrier - A structure intended to close a channel or waterway temporarily.

Base flow - The proportion of river flow that is provided by groundwater discharge from an aquifer.

Bio-manipulation - Isolation and temporary removal of fish.

Broad - Environmentally important water bodies; originally man-made peat diggings.

Buffer Zones - zones of land of variable width alongside rivers for controlling water quality.

Catchment Area - The area of land that collects the rainwater flowing into a given length of a stream, lake, or reservoir.

Coastal and Estuarine Working Party Classification - A summary of the quality of estuarine waters based on points awarded for biological, aesthetic and water quality.

Consent - A legally binding statutory document issued by the NRA to indicate any limits and conditions on the discharge of an effluent to a controlled water.

Controlled waters - All rivers, canals, lakes, groundwaters, estuaries and coastal waters to three nautical miles from the shore.

Countryside Management Project - A project funded by the Countryside Commission and Local Authorities to promote enhanced countryside management.

Countryside Stewardship - A scheme of grant aiding the retention and restoration of traditional countryside management practices supported by the Countryside Commission.

Coarse Fish - eg. Roach, Dace and Bream - Cyprinid.

Environmentally Sensitive Area (ESA) - An area where traditional farming methods may be supported by grant aid from the Ministry of Agriculture, Fisheries and Food (MAFF) to support distinctive landscape, wildlife habitats or historic features.

Eutrophic - A description of water which is rich in nutrients. At worst, such waters are sometimes beset with unsightly growths of algae.

Fen - Area of waterlogged peat-based land that supports reeds and other aquatic vegetation.

Flood Defences - Anything natural or artificial that protects against flooding, to a designed return period.

Fyke Net - A conical net used to trap eels.

Flood Embankment - A raised earth bank intended to protect against flooding to a designed return period.

Groundwater - Water which saturates a porous soil or rock substratum (or aquifer).

Main River - Statutory length of river or watercourse over which NRA have permissive powers.

Minimum Acceptable Flow (MAF) - Legally defined minimum flow.

Minimum Residual Flow (MRF) - target flow set locally and not legally defined.

National Nature Reserve (NNR) - An area of national importance for nature conservation.

National Water Council Class (NWC Class) - A summary of the quality of river water based largely on the measured chemical quality for the purposes of classification and reporting, originally devised by the National Water Council.

OFWAT - Office of the Water Industry's Regulator.

RAMSAR - Wetland site of international importance which is designated under the RAMSAR convention.

Rond (or Rand) - A narrow strip of land between a flood embankment and the adjacent river channel.

Riffle - A shallow area in a river where the bed is composed of gravel and the flow is faster.

River Corridor - The continuous area of river, river banks and immediately adjacent land alongside a river and its tributaries.

River Quality Objectives (RQO) - Locally derived levels of water quality that a river should achieve, in order to be suitable for its agreed use.

Salmonid (Game) Fish - Trout and salmon.

Saltings - An area of salt marsh.

Site of Special Scientific Interest (SSSI) - A site given a statutory designation by English Nature on account of its nature conservation value.

Special Protection Area - Statutorily protected habitats for wild birds under EC Regulations.

Statutory Water Quality Objectives (SWQO) - A quality objective given a statutory basis by Regulations made under the Water Act of 1989.

Surface Water - Water collecting on and running off the surface of the ground.

Surge Tide - Change in sea level caused by meteorological conditions. Surges can either raise or lower sea levels relative to the levels that would be caused by the tide.

Telemetry - A means of directly collecting data from remote sites.

Tide - The rise and fall of the sea occurring with a period of just over 12 hours and caused by the gravitational effect of the sun and the moon.

Washland - An area of land allowed to flood so that water levels in the adjacent river do not rise as much as they otherwise would.

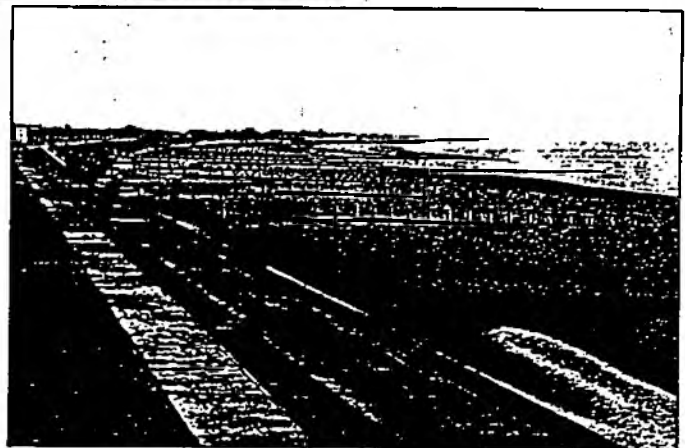
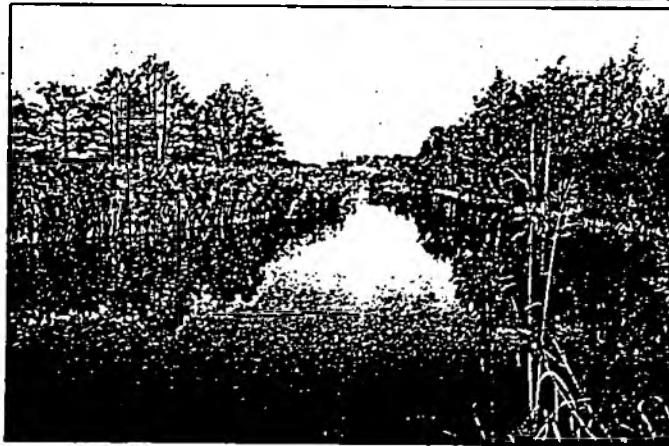
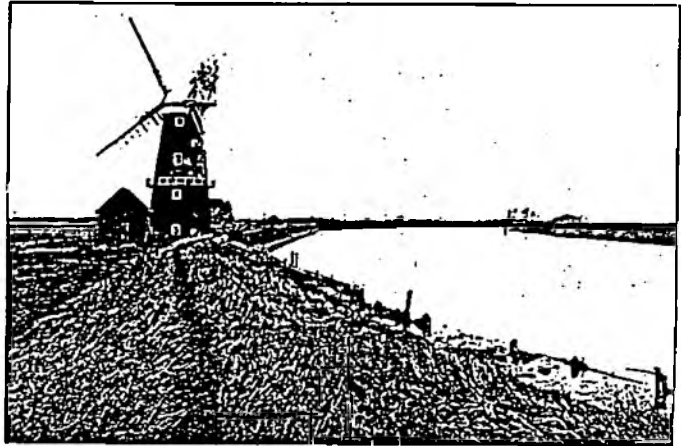
ABBREVIATIONS

mm	millimetre
m	metre
km	kilometre
ha	hectare
tcmd	thousand cubic metres/day
tcm	thousand cubic metres/annum
ml	million litres

APPENDIX 1

PROTECTING AND IMPROVING THE WATER ENVIRONMENT

MODEL POLICIES



NRA

*National Rivers Authority
Anglian Region*

MODEL POLICIES FOR THE PROTECTION AND IMPROVEMENT OF THE WATER ENVIRONMENT

INTRODUCTION

The NRA, Anglian Region welcomes consultation with planning authorities during the development of Structure and Local Plans.

At this strategic level, liaison is a two way process with the NRA having input into structure and other plans and seeking input by the planning authorities into NRA's plans. The NRA will make recommendations to the local planning authorities for the inclusion of policy statements in their plans to protect the public interest and NRA assets in the longer term.

At local plan level, development of particular sites begins to be identified. This stage is possibly the most vital part of the planning process. The NRA will offer critical advice as to which areas suggested for development are subject to constraints such as flood plains, flooding problems, aquifers and sensitive catchments. The technical constraints will be clearly spelt out for each individual development whenever possible.

These model policies and explanatory notes are intended to assist Chief Planning Officers and their staff by explaining the reasons why it is necessary to include policy statements to protect and improve the water environment. NRA planning liaison staff will make further recommendations where appropriate during the consultation stage.

The policies are grouped under the following headings:

- 1 Flood protection
- 2 Conservation and enhancement of the water environment, including recreation, navigation and fisheries
- 3 Water quality and water resources



1. FLOOD PROTECTION

AIMS

To ensure new development is not at risk from flooding and does not put other areas at risk of flooding which could endanger life and damage property.

To ensure any work which is needed to reduce the risk of flooding created by a new development is paid for by the developer and not the public.

SUMMARY POLICY STATEMENT

Flood Protection

Policy 1/1 There will be a presumption against development (including the raising of land) where, in the opinion of the Local Planning Authority after consultation with the NRA, such development would be likely to impede materially the flow of flood water, or increase the risk of flooding elsewhere, or increase the number of people or properties at risk.

KEY ISSUES AND POLICIES

Protection of the Flood Plain and Washlands

The floodplain is generally the area of low lying land adjacent to a watercourse which, by its very nature, is liable to flood under certain conditions. The floodplains are defined on maps held by the NRA. In addition some washlands, areas designed and maintained to provide storage of flood water, are defined in the NRA Anglian Region's Land Drainage and Sea Defence Byelaws. For a variety of reasons, some development has taken place on the floodplains of the region's rivers. Consequently people and property in these areas are at risk from flooding. These developments also reduce the capacity of the available floodplain and impede the flow of water, thereby increasing the risk of flooding elsewhere.

The Land Drainage and Sea Defence Byelaws specify a number of activities in the floodplain that require the prior consent of the NRA and inter alia give the NRA powers to protect an undeveloped strip of land along each main river bank.



Policy 1/2 In areas at risk from flooding (as defined by the NRA) there will be a general presumption against new development or the intensification of existing development. These areas will include defined washlands, natural floodplains and other areas adjacent to rivers to which access is required for maintenance purposes.

Policy 1/3 Appropriate flood protection will be required where the redevelopment of existing developed areas is permitted in areas presently having an unacceptable risk of flooding. The flood protection requirements for such redevelopments will be defined by the local planning authority in consultation with the NRA and funded by the developer.

Surface Water Run-Off

Unless carefully sited and designed, new development or the redevelopment of existing urban areas can exacerbate the problems of flooding in areas downstream through an increase in run-off from additional impermeable surfaces, such as roofs and paved surfaces. It is quite often the case that the effects of development in the upper parts of a river catchment are not apparent in the area within which such development occurs but have a significant effect in areas downstream.

Policy 1/4 Planning permission will not normally be granted for new development or redevelopment of existing urban areas if such development would result in an increased flood risk in areas downstream due to additional surface water run-off.

Policy 1/5 Where development is permitted which is likely to increase the risk of flooding, it must include appropriate attenuation or mitigating measures defined by the local planning authority in consultation with the NRA and funded by the developer. Works could be required at substantial distances from the development and the impact on conservation and recreation aspects will be considered.

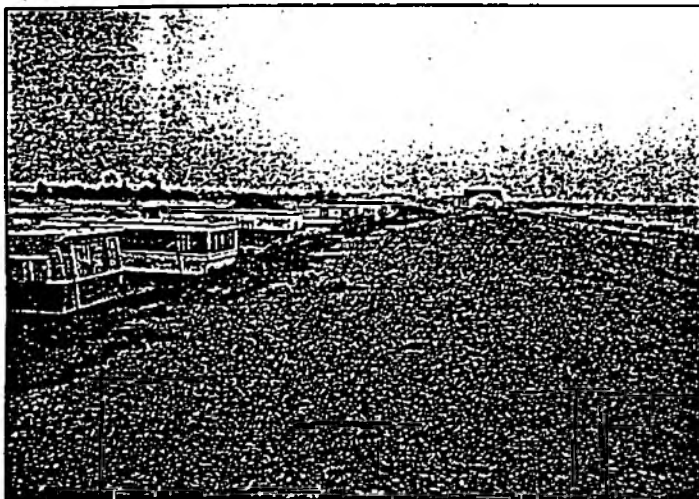
Coastal and Estuarial Defences and Embanked Watercourses

A breach in the defences along an embanked watercourse, or coastal or estuarial defence can lead to significant flooding in areas of low lying land often well away from the location of the breach. In order to protect people and property from the effects of inundation, it is essential that the integrity of the defences and embankments is maintained. This should be determined in consultation with appropriate bodies, including the NRA. It is impracticable to prevent all flooding in extreme climatic

conditions. The NRA's aim is to protect people, property and land to standards which are practical and appropriate. A 'residual flooding hazard' is left after completion of any flood alleviation scheme.

The NRA Anglian Region Land Drainage and Sea Defence Byelaws specify a number of activities on sea defences that require the prior consent of the NRA and inter alia give the NRA powers to protect the sea defences from interference or damage.

Policy 1/6 Planning permission will not be granted for development which would adversely affect the integrity of tidal or fluvial defences.



Policy 1/7 In order to minimise the effects of tidal flooding, there will be a presumption against development on land to the seaward side of sea defences, including the siting of temporary holiday chalets and caravans. On land between a first line sea defence and the main defence, the siting of holiday chalets, caravans and camping sites may be permitted following consultation with the NRA. Time-limited occupancy conditions will be imposed and enforced preventing occupation during the period from November - March inclusive when the risk of tidal inundation is greatest.

Policy 1/8 On the landward side of sea defences and behind embanked watercourses, there will be a presumption against development in areas liable to flood unless the standard of defence is appropriate to the development proposed.

Policy 1/9 Where development is permitted in areas having substandard protection, appropriate increased protection must be provided in advance of the development as defined by the local planning authority in consultation with the NRA and funded by the developer.

Funding of Works

Lack of money means the NRA can only undertake flood defence schemes which are of the highest priority, those designed to protect life and property. Others, such as projects which would enable new development to take place, have the lowest priority and will not be carried out unless the developer pays for them. The NRA strongly recommends that if any work is needed to reduce the risk of flooding, the developer enters into a formal agreement with it or the local planning authority to provide the necessary flood protection work.

Policy 1/10 Developers will meet the cost of the physical infrastructure and facilities within the sites and the off site costs occurring as a direct result of the development. Developers and landowners will normally be expected to enter into a legally binding agreement with the NRA or local planning authority to provide the necessary flood protection work.

2. CONSERVATION AND ENHANCEMENT OF THE WATER ENVIRONMENT

AIM

To protect the water environment from any detriment due to development.

To enhance the water environment in conjunction with development.

SUMMARY POLICY STATEMENT

Conservation of the Water Environment

Policy 2/1 The conservation and enhancement of wildlife, landscape and archaeological features associated with rivers, ponds, lakes, estuaries etc will be encouraged.

KEY ISSUES AND POLICIES

Water Environment

The NRA has a statutory responsibility under Section 16 of the Water Resources Act 1991 to manage the water environment so as to:

- further the conservation and enhancement of the natural environment;
- promote facilities for sport and other forms of recreation, including public access;
- Further the conservation of buildings, sites and objects of archaeological, architectural or historic interest.

The NRA also has a duty under the Water Resources Act 1991 to maintain, improve and develop fisheries.

Policy 2/2 The Planning Authority, in consultation with the NRA, will seek to promote river corridors as important areas of open land by

- conserving existing areas of value within river corridors and, wherever possible, seeking to restore and enhance the natural elements of the river environment;
 - supporting initiatives which will result in improvements to water quality;
 - where appropriate promoting public access in river corridors;
- and
- identifying appropriate locations for water related recreation along river corridors.



Policy 2/3 There will be a general presumption against any development which will have an adverse environmental impact on the water environment, particularly in relation to rivers, ponds, wetlands, public access in river corridors, and appropriate water-related recreation.

Environmental Assessment

All types of works in, under, over and adjacent to watercourses and sea defences need to be properly evaluated since uncontrolled works may lead to effects such as an increased risk of flooding, erosion of the watercourse or defence, increased danger to the public, restricted access for maintenance purposes, and damage to the water environment. The particular sensitivity of watercourses to drainage works is recognised by Statutory Instrument No. 1217 'The Land Drainage Improvement Works (Assessment of Environmental Effects) Regulations 1988'. This SI states that the drainage authority — NRA on main river and the District Council on non-main river — should not carry out any improvement works unless they have first completed the procedure prescribed by these regulations.

Policy 2/4 The planning authority, in consultation with the NRA, will seek to ensure that all works in, under, over and adjacent to watercourses and sea defences are appropriately designed and implemented. There will be a general presumption against the culverting of watercourses except those to enable reasonable access over a watercourse. When acting as the drainage authority, the planning authority, in consultation with the NRA, will consider the likely impacts of drainage proposals in accordance with the provisions of Statutory Instrument No. 1217 'The Land Drainage Improvement Works (Assessment of Environmental Effects) Regulations 1988'. Where works are proposed by an interested party which is not the drainage authority, the planning authority consultation with the interested party, will consider the likely impacts of drainage proposals in accordance with the same regulations.

3. WATER QUALITY AND WATER RESOURCES

AIM

To protect inland, coastal and groundwaters from pollution and derogation arising from development.

SUMMARY POLICY STATEMENT

Water Resources/Water Quality

Policy 3/1 There will be a presumption against development, including changes in land-use which in the opinion of the local planning authority after consultation with the NRA pose an unacceptable risk to the quality of ground or surface water.

KEY ISSUES AND POLICIES

Sewerage and Sewage Treatment Infrastructure

With increasing population and water use in the region, many sewerage systems and sewage treatment works are becoming overloaded. Where development continues despite overloading, pollution of watercourses will occur if additional infrastructure is not provided.

Policy 3/2 New development will only be permitted in locations where mains foul sewers, sewage treatment and surface water drainage of adequate capacity and design are available or can be provided in time to serve the development. Infill development where septic tanks are proposed will only be permitted where ground conditions are satisfactory and the plot is of adequate size to provide an adequate subsoil drainage system.

Surface Water Protection

The NRA has a duty to protect the quality and hence uses of inland and coastal waters. Currently recognised river uses are abstraction for potable supply, industrial water supply, fisheries, livestock watering, spray irrigation, and amenity and conservation. Statutory water quality objectives (use-related standards) are being introduced and the NRA will have a duty to ensure these are met. Discharge consents will not be granted where a proposed discharge is likely to cause a breach of the relevant standards.

Aquifer Protection

The groundwater reserves of the Anglian Region are an invaluable source for public water supply, industry and agriculture as well as sustaining base flows in the rivers. The clean up of contaminated groundwater is difficult, expensive and sometimes impossible. It is therefore better to prevent or reduce the risk of groundwater contamination, rather than deal with its consequences.

The NRA has published an aquifer protection policy which contains a statement of the policy adopted to minimise the risks of contamination of underground water resources from the effects of development or land use policy.

Policy 3/3 Development will not be permitted within areas around potable groundwater sources or over vulnerable areas of aquifers which, in the opinion of the local planning authority after consultation with the NRA, pose an unacceptable risk to the quality of the underlying groundwater.

Availability of Water Resources

The development of water resources for water supply is becoming increasingly difficult in the Anglian Region. The NRA has a duty to ensure that provision of water for new development does not have a detrimental impact on existing users, nature conservation or recreation. Abstraction licences will not be granted in areas where water resources are fully developed and further abstraction would affect existing users or damage the environment. Consequently there is a growing need to transport water over long distances.

Policy 3/4 The provision of water resources will be coordinated with development plans to prevent a detrimental impact on existing users, nature conservation and recreation.

Mineral Abstraction and Waste Disposal

Mineral abstraction and waste disposal activities can affect the water resources and the environment if appropriate measures are not taken. The NRA may specify measures which will help to preserve the water resources in the area, including ensuring protection to adjacent licensed sources, and preserve sites of conservation interest.

Policy 3/5 New mineral workings or waste disposal sites will not be permitted where, after consultation with the NRA, it is considered there would be adverse effects on water resources or rivers and other waters.

Large Coniferous Forests

Large coniferous forests situated on aquifer outcrops significantly reduce the amount of aquifer recharge. The result is a reduction in the available groundwater resource. The NRA discourages the planting of new large forests in such locations in order to protect and ensure maximum groundwater recharge.

Policy 3/6 The planting of new large coniferous forests on aquifer outcrops will be discouraged.

APPENDIX II

ANGLIAN REGION FLOOD DEFENCE TARGET STANDARDS OF SERVICE

Land Classification Band	Minimum target standard of flood protection expressed as flood return period (years)	
	Fluvial	Tidal & Sea Defence
A	100	200
B	50	100
C	20	50
D	10	20
E	-	-

Band A

Areas of dense conurbations where widespread flooding would cause serious infrastructure failure and endanger life. Major trunk roads and/or motorways and railways may be included in this band.

Band B

Predominantly urban areas, including housing, industry and commerce. The flood plain include 'A' and 'B' class roads. Little agricultural land is likely to be present.

Band C

High grade agricultural land suitable for cereal and cash crops. Residential and industrial property, as well as roads, amenity and/or navigation interests may also be prominent.

Band D

Typical land use incorporating average gross-margin crops, permanent pasture. little residential or industrial property will be present. Conservation and water ecology interests may significantly influence the standard of service to be applied.

Band E

This covers areas which are generally of low grade land use. Residential or industrial property is unlikely to be present. Agricultural use is likely to be limited to horse paddocks, forestry and scrubby grazing land. Land within this category may have a high conservation value requiring a lower standard of service than would be expected otherwise. Flood storage washlands or land which is deliberately allowed to flood may fall into this band.

YARE CATCHMENT SSSI'S

ENTRY	SITE NAME	FEATURES	GRID REF.
1	Tindall Woods, Ditchingham	Ancient woodland, with communities associated with impeded drainage.	TM327935
3	Upper Thurne Broads and Marshes N.N.R. Ramsar Norfolk Nats. Reserve. Part of proposed 'Broads' S.P.A.	Internationally important wetland. Broads, fen, carr, dykes, grazing marshes. Numerous nationally rare fauna and flora.	TG430210
4	Yare Broads and Marshes R.S.P.B. Sites Part of proposed 'Broads' S.P.A.	Internationally important wetland. Broads, fen, carr, dyke and grazing marshes. Numerous nationally rare fauna and flora.	TG330063
5	Shelfanger Meadows	Spring fed unimproved tributary meadows.	TM110828
6	Decoy Carr, Acle	Spring fed, isolated fen and carr. Several rare arctic/alpine mosses.	TG405090
7	Lower Wood, Ashwellthorpe	Ancient woodland with communities associated with impeded drainage.	TM140980
8	Badley Moor, Dereham	Extensive spring fed valley fen. Finest tufa formations in Britain, and exceptional calcareous fen community.	TG013117
10	Beetley and Hoe Meadows Norfolk Nats. Reserve.	Spring fed species rich meadows, with communities dependent upon soil moisture variation.	TF982174 TF949169 TF949169
11	Booton Common	Wet calcareous fen/grassland adjacent stream, and wet acidic heath.	TG113230
12	Bramerton Pits	River valley geological.	TG295060 TG298061 TG298061
13	Breydon Water Local Nature Reserve	Internationally important estuary. Supports internationally important populations of passage and wintering wildfowl and waders.	TG500075
15	Bryants Heath, Felmingham	Dry and wet heath, calcareous springs and fen.	TG259294
16	Burgh Common and Muckfleet Marshes	Fen, dykes and grazing marshes with numerous nationally rare fauna and flora.	TG440117
17	Buxton Heath	Dry acidic heathland with acidic flushes grading into calcareous fen. Stream on site.	TG175218
18	Caister St. Edmund Chalk Pit	Geological site.	TG239048
19	Alderfen Broad	Broad, fen and carr, with extensive range of wetland habitats. An important past and current research site.	TG355195
20	Stanley and Alder Carrs, Aldeby	Alder carr woodland. Conservation area for otters.	TM434928
21	Alderford Common	Only example of chalk grassland in east Norfolk. Also woodland, heath, wet grassland and ponds.	TG129184
22	Aslacton Parish Land	Unimproved spring line meadow.	TM156918

ENTRY	SITE NAME	FEATURES	GRID REF.
23	Calthorpe Broad	Broad, fen, carr and dykes. Research site.	TG412258
24	Catton Grove Chalk Pit	Geological site.	TG229109
25	Cawston and Marsham Heath	Largest heather community in east Norfolk. Soil moisture and damp hollows critical for diversity.	TG170235
26	Ducan's Marsh, Claxton	Spring fed grassland and calcareous fen community.	TG339027
29	Crostown Marsh	Spring fed unimproved meadow and fen. Neutral with calcareous flushes.	TG263165
30	Broad Fen, Dilham	Open water, fen, dykes and carr. Fauna and flora contains national rarities.	TG343255
31	Eaton Chalk Pit	Geological site.	TG209064
32	Edgefield Little Wood	Ancient Oak coppiced woodland. Soil moisture critical.	TG107342
33	Felbrigg Woods National Trust Site.	Ancient Beech wood. Soil moisture levels critical.	TG196401
34	Flordon Common	Spring fed calcareous fen with localised acidic communities.	TM183971
35	Fornsett Meadows	Unimproved wet meadows	TM166926
36	Foxley Wood Norfolk Nats. Reserve.	Norfolk's most extensive ancient woodland. Soil moisture and impeded drainage critical.	TG056227
37	Geldeston Meadows	Wet meadow communities	TM396916
38	Dillington Carr, Gressenhall	Open water and carr. Nationally rare Bird Cherry and Alder woodland.	TF971158
39	Gunton Park Lake	Open water, reedswamp, fen, carr. Nationally important wintering Gadwall flock.	TG221345
40	Halvergate Marshes Part R.S.P.B. site, S.P.A. to be considered.	Internationally important grazing marsh and dyke complex.	TG435060
41	Happisburgh Cliffs	Unique geological exposures.	TG379314 TG383311 TG383311
42	Hardley Flood Norfolk Nats. Reserve.	Tidal open water, reedswamp. Nationally important breeding bird populations.	TM380997
43	Gawdy Hall Big Wood	Ancient woodland with critical dependence on impeded drainage	TM250850
44	Sexton Wood, Hedenham	Ancient woodland. Soil moisture critical.	TM299916
45	Hall Farm Fen, Hemsby	Unimproved meadow and dyke systems. Calcareous and acidic communities.	TG481170
46	Priory Meadows, Hickling	Wet meadow and dyke system. Acidic plant communities.	TG417254
47	Sea Mere, Hingham	Open water, fen, meadow, woodland	TG035012

ENTRY	SITE NAME	FEATURES	GRID REF.
49	Holt Lowes	Wet acidic heathland with calcareous fen.	TG088374
50	Hockering Wood	Ancient Oak-Lime woodlands. Soil moisture critical. Woodland ponds support nationally rare Great Crested Newts.	TG073144
51	Honeypot Wood, Wendling Norfolk Nats. Reserve	Ancient Ash-Maple wood. Soil moisture critical.	TF932144
52	Horningtoft Wood	Ancient woodland. Soil moisture critical.	TF948238
54	Poplar Farm Meadows	Spring fed calcareous fen and dyke complex.	TG370021
55	Limpenhoe Meadows	Unimproved meadows and dyke complex. Nationally rare aquatic plants.	TG399031
56	Fritton Common, Morningthorpe	Damp acidic grassland with ponds. Important invertebrate fauna.	TM224921
60	Sweet Briar Road Meadows	Unimproved wet meadows, permanently waterlogged.	TG208097
61	Pulham Market Big Wood	Ancient woodland. Soil moisture critical.	TM205896
62	Redgrave and Lopham Fens Ramsar. Suffolk W.T. Reserve	Spring fed valley fen, holding internationally important invertebrate species i.e. Fen Raft Spider, Research site.	TM050797
63	East Ruston Common	Acidic heathland and grassland. Mixed acidic and base rich fen.	TG340280
68	Potter and Scarning Fen Norfolk Nats. Reserve	Calcareous fen with nationally important invertebrate species.	TF982120
69	Shotesham and Woodton Hornbeam Woods	Ancient Hornbeam woodlands. Soil moisture critical.	TM253975 TM258948 TM249978 TM268944
70	Shotesham Common	Unimproved wet meadows, with a range of grassland types.	TM241998
71	Smallburgh Fen	Spring fed valley fen, with calcareous flushes.	TG327246
72	Shallam Dyke Marshes, Thurne	Grazing marsh and dyke complex. Nationally important site for breeding waders and ducks.	TG399165
73	Upton Broad and Marshes Norfolk Nats. Reserve	Outstanding broad, fen, grazing marsh and dyke complex. Numerous nationally rare fauna and flora.	TG390137
74	Swannington Upgate Common	Dry and wet acidic heathland, fen, grassland and ponds.	TG148181
75	Syderstone Common Norfolk Nats. Reserve	Acidic heathland and grassland with ponds. Nationally important for Natterjack Toads.	TF834315
79	Westwick Lakes	Acidic and neutral waters, spring fed. Important bird and invertebrate site.	TG273274
80	Whitwell Common	Unimproved wet grassland and alder wood.	TG088206
81	Holly Farm Meadow, Wendling	Unimproved spring fed calcareous meadow. Range of wet-dry grassland types.	TF936131

ENTRY	SITE NAME	FEATURES	GRID REF.
86	Winterton to Horsey Dunes N.N.R. S.P.A. proposed.	Outstanding dune system, foreshore and heathland. Nationally important Natterjack Toad colony, and Little Tern colony.	TG490210
87	Ant Broads and Marshes. Part Norfolk Nats. Reserve. Part of proposed 'broads' S.P.A.	Internationally important wetland complex. Broads, reedswamp, fen, carr and dykes. Numerous national rarities amongst the flora and fauna. Important research and restoration site.	TG362213
89	Horsewood, Mileham	Ancient woodland. Wet Ash-Maple wood and rare plateau Alder wood. Soil moisture critical.	TF922186
91	Dereham Rush Meadow	Unimproved wet meadows and alder carr.	TF976140
93	Ludham and Potter Heigham Marshes. Part N.N.R. Norfolk Nats. Reserve.	Nationally important grazing marsh and dyke complex. Exceptional aquatic flora.	TG410178
94	Barnby Broads and Marshes	Nationally important broad, grazing marsh and dyke complex.	TM480910
98	Southrepps Common Local Nature Reserve	Unimproved wet grassland and calcareous fen.	TG261350
99	Worthing Ling	Dry heath and acidic grassland, with damp hollows critical for species diversity.	TM093795
103	Coston Fen, Runhall	Spring fed calcareous valley fen, and unimproved grassland.	TG062066
104	Bure Broads and Marshes, N.N.R. Part of proposed 'Broads' S.P.A.	Internationally important wetland complex. Broads, reedswamp, fen, carr and dykes. Numerous national rarities amongst the flora and fauna. Important research location.	TG337166
105	Great Yarmouth North Denes S.P.A. proposed R.S.P.B. site.	Internationally important nesting site for Little Terns. Extensive accreting foreshore and dune system.	TG533100
106	Hedenham Wood	Ancient woodland. Soil moisture critical.	TM314946
810	Major Farm, Braiseworth	Unimproved wet meadow.	TM122723
813	Sprats Water and Marshes	Open water, reedswamp, fen, carr and dykes. Spring fed.	TM507921
830	Hoxne Brick Pit	World famous geological exposure.	TM174766
835	Metfield Meadow	Unimproved meadow.	TM303799
853	Gypsy Camp Meadows, Thrandeston	Wet meadows and dyke complex.	TM115773
	River Wensum	Enriched, calcareous lowland river.	TF942246 TG250078

APPENDIX IV

NRA Medium Term Plan - River Yare Catchment
Proposed Capital Grant-Aided Flood Defence Improvement Schemes

Submission Data July 1993

Total shown in M.T.P.
(Proposed for August)

<u>Scheme</u> <u>Eligible</u>	<u>Ref</u>	<u>Timing</u>	<u>G r a n t</u> <u>Expenditure</u> <u>(£000)</u>
Broadland Compartment 11 Halvergate	9140400	07/1994-03/2004	4,500
Broadland Compartment 11 Halvergate phase 2/6	9140402	04/1994-01/1996	1,500
Broadland Compartment 11 Halvergate phase 5	9140405	04/1993-07/1993	50
Broadland Compartment 11 Halvergate phase 7	9140407	01/1993-09/1993	800
Broadland Compartment 11 Halvergate phase 8 R Yare	9140408	02/1993-09/1993	450
Broadland Compartment 11 Halvergate phase 9 R Bure	9140809	03/1993-06/1993	150
Broadland Compartment 22 Burgh/Norton	9140500	05/1994-03/2004	5,000
Broadland Compartment 22 Burgh/Norton Phase 3	9140503	03/1993-07/1993	250
Broadland Compartment 36 South Breydon	9140600	06/1993-03/2004	3,300
Broadland Compartment 9/10 North Bure	9140800	06/1993-03/2004	3,650
Happisburgh Breakwaters	9141300	01/1996-03/2004	24,500
Happisburgh Breakwaters	9141302	12/1992-03/1993	6,000
Happisburgh Breakwaters Beach Monitoring	9141307	05/1992-03/2004	330

<u>Scheme</u>	<u>Ref</u>	<u>Timing</u>	<u>Grant Eligible Expenditure</u>
Happisburgh/Winterton Groynes remedial work	9141320	05/1993-03/2004	550
Great Yarmouth Flood Defences remedial works	9141400	03/1993-03/2004	13,550
Broadland Flood Alleviation Study	9141900	12/1991-09/1993	533
Broadland F.A.S. Erosion Protection	9141901	06/1994-03/3004	21,100
Broadland F.A.S Embankments/Structures	9141950	05/1994-03/2004	30,000

RECOMMENDED FLOOD DEFENCE MAINTENANCE FREQUENCIES

The following frequencies are those recommended by the Norfolk and Suffolk local Flood Defence Committee to be applied to all sea, estuary and tidal reaches; and to those fluvial reaches and features identified as requiring regular maintenance attention.

ACTIVITY	TASK
<u>Sea Defences:</u>	<ul style="list-style-type: none"> - Inspect twice a year - Maintenance as required
<u>Tidal/Estuary Banks and Embankments:</u>	<ul style="list-style-type: none"> - Inspect once a year and following a major surge/meteorological event - Maintenance as required
<u>Structures:</u>	<ul style="list-style-type: none"> - Health and Safety inspection once a year - Mechanical and Electrical inspection twice a year - Civils inspection once every five years
<u>Pumping Stations:</u>	<ul style="list-style-type: none"> - Health and Safety inspection once a year - Mechanical and Electrical inspection twice a year - Civils inspection once every five years
<u>Dredging:</u>	<ul style="list-style-type: none"> - Tidal/Estuary, as required - Fluvial (Large Rivers), every 10 - 12 years - Fluvial (Small Rivers), every 6 - 8 years
<u>Banks and Embankments</u>	<p>A. Grass Cutting</p> <ul style="list-style-type: none"> - Sea, Estuary, Tidal, once a year - Fluvial, Flood storage reservoirs and Urban areas, twice a year - Fluvial, Rural areas, once a year <p>B. Vermin Control</p> <ul style="list-style-type: none"> - Sea, Estuary, Tidal embankments, twice a year - Fluvial embankments, twice a year
<u>Weed Control:</u>	<ul style="list-style-type: none"> - Rivers and watercourses through urban and sensitive areas, twice a year. - Rivers and watercourses through rural areas, once a year
<u>Obstructions:</u>	<ul style="list-style-type: none"> - Inspect/Clear channels, once a year - Additional clearance in sensitive Urban areas, as required

