

NORTH WEST NORFOLK CATCHMENT MANAGEMENT PLAN CONSULTATION REPORT



NRA

*National Rivers Authority
Anglian Region*

MARCH 1995

NATIONAL RIVERS AUTHORITY

ANGLIAN REGION

NORTH WEST NORFOLK CATCHMENT MANAGEMENT PLAN

CONSULTATION REPORT

JANUARY 1995

National Rivers Authority
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ENVIRONMENT AGENCY



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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.

Catchment management plans are a vehicle to achieve improvements in the water environment. By using public consultation they will allow input from others and provide commitment from all parties to achieving action in important issues.

Key issues in this plan are considered to be:

- Securing the protection of life and property against tidal and river flooding.
- The siltation of the Tidal River Great Ouse between Denver and the Wash
- Improvements in habitat, fishery, and recreational access to the NRA land at the Relief Channel.
- Improvements to the quality of both direct discharges to the Wash and the rivers which flow into it.
- Reviewing the water resource balance for the catchment, restating the quantities allocated to the environment and the proportion available for abstraction

This is a further such Plan produced in the Anglian Region. 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.

Grainger Davies

Regional General Manager

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THE NATIONAL RIVERS AUTHORITY

THE NRA'S MISSION:

"We will protect and improve the water environment by the effective management of water resources and by substantial reductions in pollution. We will aim to provide effective defence for people and property against flooding from rivers and the sea. In discharging our duties we will operate openly and balance the interests of all who benefit from and use rivers, groundwaters, estuaries and coastal waters. We will be businesslike, efficient and caring towards our employees".

Our aims are to:

- Achieve a continuing overall improvement in the quality of rivers, estuaries and coastal waters, through the control of pollution.
- Manage water resources to achieve the right balance between the needs of the environment and those of the abstractors.
- Provide effective defence for people and property against flooding from rivers and the sea.
- Provide adequate arrangements for flood forecasting and warning.
- Maintain, improve and develop fisheries.
- Develop the amenity and recreational potential of inland and coastal waters and associated lands.
- Conserve and enhance wildlife, landscape and archaeological features associated with inland and coastal waters of England and Wales.
- Improve and maintain inland waterways and their facilities for use by the public where the NRA is the navigation authority.
- Ensure that dischargers pay the costs of the consequences of their discharges, and, as far as possible, to recover the costs of water environment improvements from those who benefit.
- Improve public understanding of the water environment and the NRA's work.
- Improve efficiency in the exercise of the NRA's functions and to provide challenge and opportunity for employees and show concern for their welfare.

THE NRA'S VISION

NORTH WEST NORFOLK CATCHMENT

The NRA's vision is of a healthy and diverse water environment, managed in an environmentally sustainable way, balancing the needs of all users. Where significant environmental damage might occur but knowledge is incomplete, the NRA will adopt the principles of sustainable development and exercise a precautionary approach.

The North West Norfolk Catchment is predominantly rural with a population of 109,000. Much of the population depends, in different ways and degrees, upon the catchment for a living. The catchment supports a balanced ecosystem parts of which, notably the River Nar and the Wash, are of such exceptional value that they are protected as conservation sites.

Across the whole of the catchment the NRA will:

- improve its understanding of the availability of groundwater and surface water to ensure the proper use, redistribution, augmentation and conservation of the water resource.
- strive to ensure the continuing improvement in the quality of rivers in the catchment through the application of Statutory Water Quality Objectives¹. Further use related classes will be introduced for special ecosystem, water contact activity and abstraction. These would be appropriate in various parts of the catchment.
- expect to see a long term reduction in nitrate pollution of the aquifer by the implementation of nitrate sensitive areas and nitrate vulnerability zones.
- promote sustainable development through its influence on strategic land use planning.

In addition the NRA will make the following specific improvements:

- The NRA integrated management plan will protect the ecologically important Great Ouse estuary and the Wash. The effects of siltation, freshwater flows, effluent dilution and eutrophication will be established enabling the authority to conserve and further enhance this sensitive habitat.
- Schemes such as the improvement of the Tidal River training walls, King's Lynn sea frontage, beach recharge, and river bank improvements will ensure the provision of a high standard of river and tidal flood protection. To ensure this standard is met in all areas it is necessary to undertake a review of flood defence legislation and responsibilities.
- The Relief Channel is an area awaiting much improvement by increased access

¹ A glossary of terms is provided at the back of the Plan

and recreation activities, habitat enhancement and the restoration of a high quality coarse fishery.

- The River Nar is a Site of Special Scientific Interest and a Water Level Management Plan is required for the lower reaches of the river. Over the longer term water quality will meet Water Quality Objectives for River Ecosystem Class 3, and Special Ecosystem objectives to control eutrophication. The habitat of the SSSI will be enhanced and a sea trout population encouraged.
- With improvements in water quality it is expected that Water Quality Objectives for River Ecosystem Class 2 can be achieved in the River Babingley which combined with an improved outfall structure will result in a better coarse fishery and a run of sea trout.
- In the Rivers Heacham, Gaywood and Ingol the long term objective is to achieve Water Quality Objectives for River Ecosystem Class 3.

This Catchment Management Plan sets out how the NRA will move from the current state of the catchment to achieve this long-term vision for the catchment. In order to achieve the realisation of the NRA's vision, it is necessary to work with all other agencies and representative organisations in the catchment to promote and achieve an integrated approach to catchment management, particularly in areas which lie outside the direct responsibility of the Authority.

PUBLIC CONSULTATION

Input from external bodies and the general public is seen as a vital component of producing a viable plan. The publication of this Report marks the start of the public consultation period which ends on 26 June 1995. All comments, which should be in writing, should be addressed to:-

The Planning Manager
National Rivers Authority
Anglian Region, Central Area
Bromholme Lane
Brampton
Huntingdon
Cambs PE18 8NE

1. CATCHMENT MANAGEMENT PLANNING CONCEPT AND PROCESS

This chapter explains the process by which the catchment management plan is produced and the further stages following public consultation. It also identifies some of the limitations of the process.

1.1 THE NATIONAL RIVERS AUTHORITY

The National Rivers Authority (NRA) is responsible for protecting and improving the water environment within England and Wales. It has a wide range of responsibilities which include:

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

To meet these responsibilities, the NRA must work with or seek to influence central government, local government, industry, commerce, farming, environmental organisations, riparian¹ owners and the general public. Successful management of the water environment requires consideration of a wide range of interests and requirements which may sometimes be in conflict. The competing requirements and interests of users and beneficiaries must be balanced.

To assist in its work, the NRA has developed the concept of Catchment Management Plans (CMP's). These allow the full range of water management issues to be identified and considered within a relevant geographical area based on physical characteristics rather than administrative boundaries. The area covered in this catchment management plan is shown in Map 1.

1.2 SCOPE AND PROCESS OF CATCHMENT MANAGEMENT PLANNING







The process of catchment management planning within the NRA involves two stages: the Catchment Management Plan Consultation Report and the Catchment Management Final Plan.

¹ A glossary of terms is provided at the back of this Plan



National Rivers Authority
Anglian Region
Map 1

NRA

-  Regional Boundary
-  Catchment Boundary
-  Operational Boundary
-  Main River
-  Main Towns
-  NRA Offices



1.2.1 The Consultation Report

The Catchment Management Consultation Report is intended to form a basis for consultation between the NRA and all those with interests in the catchment. Consultees may wish to:

- raise additional issues not identified in the plan
- comment on the issues and options identified in the plan
- suggest alternative options for resolving identified issues

The NRA recognises that many of the options for action identified by the Consultation Report will involve organisations or individuals other than the NRA and their views will be crucial to the preparation of the Final Plan.

This plan is organised on the following basis:

Uses and Activities

The "uses" of the catchment are the principal demands upon the water resources and the environment. These fall into a series of categories relating to the basic role of the river as a conveyance of rainfall falling onto the catchment to the sea. The uses made of this resource by the environment and by human activity are managed by a set of "activities" which are the responsibility of the National Rivers Authority. These uses and activities are identified and discussed in Chapter 3. Information is normally presented in the form of a map with one or more pages of supporting text.

Objectives

Chapter 4 identifies the primary responsibilities and objectives of the NRA in relation to its activities and the management of the various uses within the catchment. Such objectives may be derived from the legislative duties and responsibilities, National and Regional policy, and specific local circumstances. For each catchment use, at any location, it is the most stringent objective which must be achieved.

State of the Catchment

Chapter 5 describes the current state of the water environment in the catchment resulting from the use made of it and the NRA's activities within it. The current state of the catchment is assessed against the NRA's objectives in managing the water environment. The shortfalls between the current state and the objectives are identified as issues which may need to be addressed in the future management of the catchment.

Issues and Options

Chapter 6 discusses the identified issues and, where possible, some options for their resolution are proposed. The options which are presented represent a range of alternative courses of action and are not generally mutually exclusive. Some options may be more feasible in one part of the catchment than others. Some options which are considered feasible will only be implemented following a full project appraisal. The section concludes with a tabulated summary of issues and options which identifies the organisation responsible and also some advantages and disadvantages of the suggested options.

1.2.2 The Final Plan

This will be produced following consultation and will have regard to the comments received. The Final Plan (to be monitored annually) will form a basis for the NRA's actions within the catchment and also provide a public document which will form a framework for the NRA's interaction with other organisations. The NRA will be seeking commitment to planned actions by others wherever possible.

1.3 LIMITATIONS OF CATCHMENT MANAGEMENT PLANS

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. This 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. In such cases the NRA may have no powers to control the necessary actions directly.
- Inevitably, 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 a major contributor to the state of that catchment and, in area terms, the largest land use is agriculture. 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 where existing legislative provision does not exist.

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 about the necessary pressure to encourage those involved to work towards their achievement.

North West Norfolk Catchment Management Plan



Infrastructure – Map 2

KEY

	Catchment Boundary		Main Road
	Coastline		Railway
	Main River		County Boundary
	IDB Watercourse		District Council Boundary
	Other Watercourse		Main Towns



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Hunstanton



KEY

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2. CATCHMENT INTRODUCTION

2.1 GENERAL DESCRIPTION

The catchment of the North West Norfolk rivers (Map 2) comprises an area of 1007 square kilometres (km²)². It contains the River Great Ouse north of the Denver Sluice, the rivers Heacham, Ingol, Babingley and Nar which flow into the estuary, and the lowlands to the west of the Ouse. The catchment area also includes those parts of the estuary of the River Great Ouse known as the Wash which are the responsibility of the NRA and are indicated as a nominal boundary on map 1. This represents an NRA administrative area as the various legislation under which the NRA operates has a variety of off-shore limits.

There are a number of other Catchment Management Plans (CMP) adjacent to the North West Norfolk Catchment Management Plan. The Stiffkey, Burn & Glaven CMP and Yare Wensum CMP lie along the eastern edge of the CMP area but do not impact upon it. The Ely Ouse CMP to the south is linked to this CMP at Denver. The planned Old Bedford CMP to the southwest will be linked to this area via the Old and New Bedford Rivers. The Lower Nene CMP to the west feeds into the area indirectly as the Wash is affected by the discharge of both the Nene and Great Ouse Rivers.

In the CMP area the River Great Ouse is tidal, and is often known as the Tidal River. Freshwater in the River Great Ouse/Tidal River is sourced from the Ely Ouse via the main Denver Sluice, from the Counter Drain/Old Bedford Ouse via the Old Bedford Sluice, and from the River Delph/Old Bedford via Welmore Lake Sluice. The Tidal River forms a continuous reach with the New Bedford/100 Foot River which provides freshwater inputs despite being tidal. The Tidal River is contained within embankments which provide flood protection to the adjacent low lying land.

The Relief Channel is a linear flood storage reservoir, constructed in the 1960s which is adjacent and parallel to the Tidal River. It is filled at the Denver Sluice complex and discharges into the Tidal River at the Tail Sluice just south of King's Lynn.

The Rivers Nar, Babingley, Ingol and Heacham originate as springs from the Chalk uplands in the east of the area. The lower reaches of these rivers flow across low-lying land in embanked channels and either discharge into the Tidal River or directly into the Wash. In their lower reaches all these rivers are, to some extent, affected by the tidal cycle of the Wash.

The area to the west of the Tidal River/Great Ouse is close to sea level. It drains to the Wash by a combination of gravity outfalls³ and pumped discharges. The southern boundary of the CMP is at Well Creek. The Middle Level Main Drain, which is crossed by Well Creek, drains the Middle Level fenland area to the south of the catchment. It flows through the western area covered by the CMP to discharge at St Germans Pumping Station on the

² A list of units is provided in the glossary at the end of the Plan.

³ A glossary is provided at the end of the Plan

Tidal River.

Most of the coastline in the CMP area is low lying, except at Hunstanton where there are cliffs. It is protected from inundation by the sea by a series of defences; comprising earth embankments, shingle ridges and concrete walls.

The catchment is almost entirely within the county of Norfolk and has a population of 108,970. Forty percent of the population is situated in the three main towns of King's Lynn (35,135), Downham Market (5,965) and part of Hunstanton (2,440). During the summer season the population numbers in the principal seaside resorts can increase considerably. An operational military air base is located at Marham. The area is served by the A10(T) north-south and A47(T), A17(T) east-west roads and a main railway line to King's Lynn from London.

2.2 GEOLOGY AND LANDSCAPE

The area covered by this plan comprises several lowland river catchments with Chalk uplands in the east and fenland to the west. The principal land classification is shown in Map 3. The maximum elevation within the catchment is 93 m above sea level (m AODN) at Brink Hill near Gayton in an area of Chalk outcrop. The geology of the region comprises a series of rock strata which dip towards the east.

Chalk is present east of a line running roughly northwards from Marham to Hunstanton. Map 4 distinguishes those areas where the Chalk is exposed or close to the surface, from those areas further to the east where the Chalk is buried beneath a substantial thickness of Glacial Till deposits. These deposits include both Chalky Boulder Clay and Glacial Sands & Gravels.

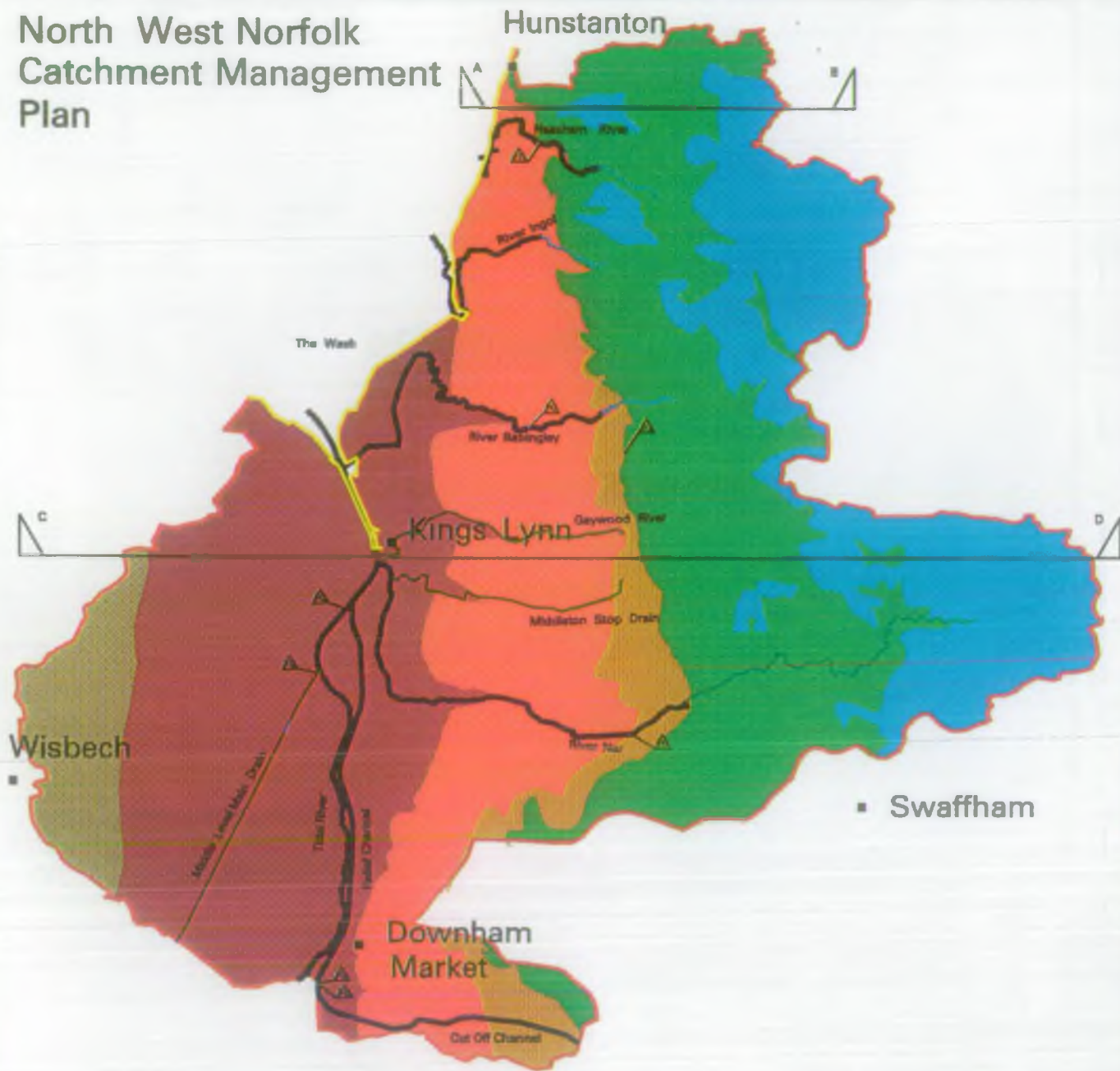
Gault Clay forms a narrow outcrop along the western boundary of the Chalk persisting northwards as far as Sandringham. North of Sandringham the Chalk rests directly on the Lower Greensand without the intervening layer of Gault Clay.

The Lower Greensand, which includes both the Sandringham Sands and Carstone, forms a wide outcrop which extends westwards as far as King's Lynn. Often the Gault Clay and Lower Greensand deposits are covered by superficial deposits. In the river valleys these are commonly alluvial deposits containing quantities of sand and gravel.

The fenland area, west of King's Lynn is covered by extensive deposits of unconsolidated clays and sands derived from river beds and flood plains, ancient beaches and estuarine saltmarshes which overlie the Kimmeridge and Ampthill Clays.

Groundwater occurs in saturated rocks known as aquifers. Water enters these aquifers as recharge during periods of high rainfall where the rocks are exposed or covered by permeable deposits. The principal aquifers in the catchment are the Chalk and Lower Greensand. Sand and Gravel deposits occur within some river valleys and form small aquifers of local importance.

North West Norfolk Catchment Management Plan



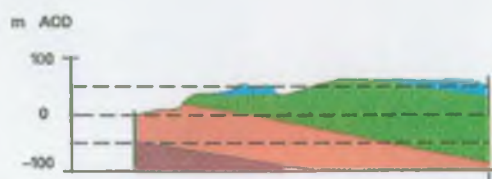
Geology – Map 4



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Cross Section A-B

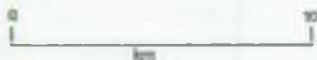


Cross Section C-D

KEY

- Catchment Boundary
- Coastline
- Main River
- Main Towns

- Boulder Clay (Overlying Chalk)
- Chalk
- Gault Clay
- Lower Greensand
- Kimmeridge Clay overlain by Alluvium
- Amphill Clay overlain by Alluvium



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North West Norfolk Catchment Management Plan



Water Quality – Map 5

1993 General Quality Assessment Classes

KEY

- Catchment Boundary
- Coastline
- Tidal River
- Main Towns



Grade

- | | | |
|--------------------------------------|---|--------|
| — | A | } Good |
| — | B | |
| — | C | } Fair |
| — | D | |
| — | E | Poor |
| — | F | Bad |



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2.3 HYDROLOGY

The flows in the rivers of the area are derived directly from rainfall as run-off over the ground, and baseflow derived from groundwater. Springflow from groundwater, in particular from the Chalk aquifer, remains relatively consistent throughout the year. High flows tend to result from heavy rainfall on saturated land and run-off from the Boulder Clay. During the winter, flows in lowland rivers also receive a contribution from pumped land drainage. In addition, the rivers receive discharges from sewage treatment works, mineral extraction sites and industry. This "return" of previously abstracted ground and river water is beneficial in terms of water resources.

2.4 WATER QUALITY

In 1993 the NRA introduced a General Quality Assessment (GQA) scheme for the periodic reporting of river quality. This scheme replaced the National Water Council schemes. The GQA scheme consists of general chemistry, nutrients, aesthetics, and biology providing four separate windows upon the quality of river stretches. The 1990 River Quality Survey (The Quality of Rivers and Canals in England and Wales (1990-92) Water Quality Series No 1) indicated that the majority of rivers are of fair or good quality. The more recent General Quality Assessment grades (derived in Appendix 1) for 1993 are shown on Map 5. This indicates a net improvement in water quality since the 1990 survey report.

The upper reaches of the River Nar, River Babingley and Heacham River support brown trout populations indicating good water quality. These rivers are generally unpolluted and support diverse aquatic communities. Major coarse fisheries are located on the Middle Level Main Drain and Relief Channel. A total of twenty-five species of fish have been recorded by the NRA within the non-tidal waters.

Estuarine water quality is assessed using the Coastal and Estuarine Working Party (CEWP) scheme which indicates fair to good quality throughout the tidal Great Ouse. The presence of fish, such as sea trout suggests that the chemical quality of the estuary is not a barrier to the passage of migrating fish. The estuary supports a flora and fauna consistent with its physical and hydrographic features.

The eastern area of the Wash supports shell fishery beds which are classified under the EC Shellfish Hygiene Directive (91/492/EC). These shell fisheries are affected by elevated concentrations of bacteria in the estuary. However, the Wash itself supports a diverse fauna indicating generally good water quality.

Two bathing beaches are designated under the EC Bathing Waters Directive at Hunstanton and Heacham. Both beaches comply with the EC Directive.

Groundwater quality is routinely monitored, however, a scheme for classification is still under development. At present the suitability for use as drinking water is the only criteria normally applied. This shows that nitrate concentrations are often higher than the limits set in the EC Drinking Water Directive.

2.5 DATA COLLECTION

The NRA requires information and data about the water environment to carry out its regulatory functions. Rainfall, river levels and flows, groundwater levels, environmental water chemistry, biology and fish populations, river habitat and river corridor surveys are all measured within the catchment.

The monitoring of water quality and river flows is undertaken either by regular site visits or by telemetry links. The telemetry system takes daily readings which are used for both operational purposes and long term data collection.

In addition much information is obtained from private individuals such as rainfall observers. It is also a requirement that abstraction licence holders are required to submit data on the amount of water taken annually.

2.6 KEY DETAILS

<i>Area</i>	1007 km ²	
<i>Population</i>	1993	Predicted 2006
	108,970	126,860
<i>Ground Levels</i>	Min Level	- 2.0 m AOD
	Max Level	93 m AOD
<i>Geology</i>	East	Chalk & Boulder Clay
	Central	Lower Greensand, fen and river deposits.
	West	Alluvial and estuarine fen deposits over Jurassic Clay
<i>County Councils</i>	Cambridgeshire	0.1 % of catchment area
	Norfolk	99.9 %
<i>District & Borough Councils</i>	Fenland	
	Breckland	
	King's Lynn and West Norfolk	
<i>NRA Organisation</i>	Anglian Region	
	Central Area	The catchment of the River Great Ouse from Brackley to the Sea
	Catchment North	The River Great Ouse downstream of Brownshill Staunch
<i>Water Companies</i>	Anglian Water Services Limited.	
<i>Major Sewage Treatment Works</i>	King's Lynn, Ingoldisthorpe, Heacham	
<i>Internal Drainage Boards</i>	Nordelph, Upwell, Hilgay Great West Fen, Northwold, West of Ouse, Southery and District, Stoke Ferry, Stringsides, Gaywood, Marshland Smeeth & Fen, Magdalen, Downham & Stow Bardolph, Churchfield & Plawfield. Middle Level Commissioners, East of Ouse Polver and Nar.	
<i>Main Towns</i>	King's Lynn	35,135
	Downham Market	5,965
	Hunstanton	2,440
<i>Length of statutory main river (maintained by NRA)</i>	138.45 km	

<i>Embanked main river</i>	56.65 km	
<i>Length of navigable river</i>	25.79 km	
<i>Length of sea defences</i>	87.3 km	Hard Defences (1.78 km) Earth Bank (66.4 km) Shingle Ridge (8.67 km) Secondary Defences (10.45 km)
<i>Water Quality - Chemical</i>		Length of river in km
	A (excellent)	0
	B (good)	18.5
	C (fair)	67
	D (fair)	31
	E (poor)	17
	F (bad)	16.5
<i>Water Quality - Biological</i>	A (Excellent)	63
	B (Good)	30
	C (Moderate)	58
	D (Poor)	4.5
<i>Quality of Estuary</i>	Class B	
<i>Designated Bathing Beaches</i>	Hunstanton, Heacham	
<i>F1 Salmonid (Game) fishery</i>	29 km	
<i>F2 Cyprinid (Coarse) fishery</i>	74 km	
<i>Sites of Special Scientific Interest (SSSIs)</i>	17	
<i>Water dependent SSSIs</i>	8	
<i>County Wildlife Sites</i>	256	
<i>Scheduled Ancient Monuments</i>	71	

3. USES AND ACTIVITIES

The "use" of the catchment relates to the principal demands upon the water resources and the environment. These fall into a series of categories relating to the basic role of the river as a conveyance of rainfall falling onto the catchment to the sea. The use made of this resource by the environment and by human activity are managed by a set of "activities" which are the responsibility of the National Rivers Authority. These uses and activities are identified and discussed in this section. Information is normally presented in the form of a map with one or more pages of supporting text.

3.1 FLOOD DEFENCES

3.1.1 General

There is a clear requirement for 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 high winds or very heavy rainfall. Flood events are described in terms of frequency at which, on average, a certain severity of flood is exceeded. This frequency is usually expressed as a return period ¹ in years eg 1 in 50 years.

A principal NRA activity within this catchment is the management, maintenance, and provision of Flood Defence. The NRA has been assigned various powers to control the activities of others. The responsibility for the maintenance of any watercourse normally rests with the riparian landowner, whose ownership as a general rule extends to the centre line of any such river. In the flood defence system certain channels are designated as Main River and certain sea and tidal defences are similarly designated. The NRA has control of the construction of any structure in or close to the statutory Main River or Sea Defence and may take a greater responsibility for the maintenance and control of the channel or structure on Main River. This and other activities likely to affect the bed or bank of the river or stability of the defence require the formal consent of the NRA.

The NRA has a flood defence operational maintenance department which deals with emergencies (flooding and some pollution control support) together with "permissive powers" to carry out river maintenance. This work is targeted at past flood and drainage schemes to ensure they function as required. In other areas maintenance work is undertaken to a standard consistent with existing land use.

The NRA also has powers in respect of consents for weirs, dams and culverts and similar obstructions on watercourses which are not designated statutory Main River. District and County Councils have powers to carry out schemes on such watercourses, but are under no legal obligation to do so. Such sites require the NRA's consent under its requirements for overall supervisory duty of drainage matters.

¹ A glossary is provided at the end of the Plan

Surface water and non-Main River flooding is likely to be more frequent than that experienced from a Main River and solutions to these rest with the District and County Authorities. The Internal Drainage Boards (IDBs) are responsible for drainage within their administrative areas and perform maintenance and flood protection duties. Coastal protection where land is above the high tide level is generally the responsibility of the various Maritime District/Borough Councils under the Coastal Protection Act 1949.

3.1.2 River Control Structures and Statutory Main River

Map 6 shows that within the Catchment significant lengths of river have been designated as Main River.

The majority of the Catchment's rivers discharge into tidal water through flapped outfall structures and are subject to tide lock periods twice per day. This tide lock effect requires there to be sufficient storage in the lower reaches and sufficient discharge capacity to evacuate the stored water during low tide periods. Another affect of tide lock is a large fluctuation in river levels for some distance upstream of the outfall structures.

In addition to a flapped, gravity discharge the Heacham River also has a pumping station at its outfall which under high flow conditions may discharge water throughout the tidal cycle. This pumping station is currently under the control of Anglian Water Services Ltd.

Flood plain is an important element of the overall river system to convey flood flows but in some cases river beds are above the level of the surrounding land and these rivers are embanked in order to prevent constant flooding.

The Relief Channel is required to convey water from the Ely Ouse System via the Denver Sluices. This includes both pumped water from the South Level system which is fed into the Ely Ouse and peak river flows transfered from the Chalk rivers into the Cut-Off Channel. The Tail Sluice controls the storage of floodwater in the Relief Channel for subsequent discharge. It also allows a greater difference in water levels each side of the sluice than possible at Denver which provides a greater discharge and erosive flow.

3.1.3 Sea/Tidal Defences

Map 7 shows that some 30% of the Catchment lies below the highest known tide level and therefore adequate tidal and sea defences are vital to the safety and economy of the area. Map 8 shows the CMP area's coastal defences along approximately 24km of coastline.

The range of coastal defences includes:

- Concrete stepped and piled sea wall between Hunstanton and Heacham.
- Flexible concrete block mattress protection at Heacham North Beach.

North West Norfolk Catchment Management Plan

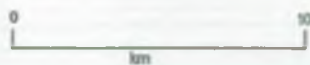


Control Structures and Weirs – Map 6

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns

- S Sluice
- O Outfall Structure
- W Weir
- GS Gauging Station
- TG Tilting Gate
- TS Tall Sluice

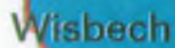


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Hunstanton.



- Swaffham

Downham Market

KEY

- 100

Land Below Highest Known Tide Level



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Sea Defences – Map 8

KEY

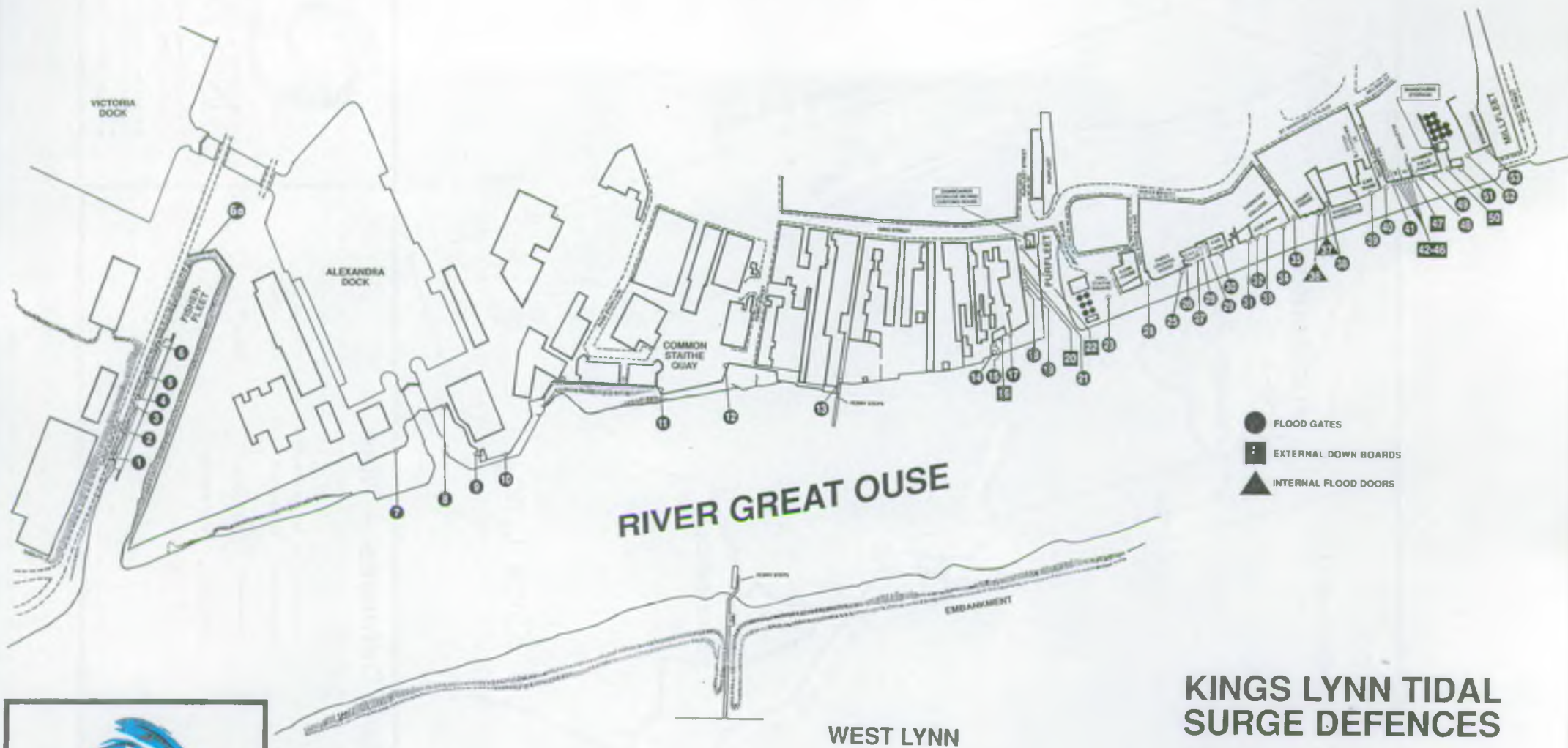
	Catchment Boundary		Borough Council Sea Wall	6.77m AOD
	Coastline		NRA Sea Wall	6.77m AOD
	Main River		Shingia Ridge	7.00m AOD
	Main Towns		Beach Recharge	



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**KINGS LYNN TIDAL
SURGE DEFENCES**
Map 9



- Shingle ridge between Heacham North and Snettisham.

Behind these first-line defences there is a second-line defence consisting of an earth bank between Hunstanton South and Wolferton Creek. This links into the main Sea Banks East tidal defences which continue along the Marsh Cut to King's Lynn.

The beach between Hunstanton and Snettisham has also been subject to a major beach recharge scheme, using imported beach material, to raise and re-profile the beach to provide a more natural sea defence or "soft option". There is a continuing maintenance commitment associated with the beach recharge scheme involving, as required, reprofiling of the beach where wave damage occurs and annual recycling. The annual recycling operation involves the redistribution of beach material from areas of deposit to areas of erosion.

On the west side of the Tidal River estuary the Tidal Banks link to the banks of the Marsh Cut which runs in a southerly direction to King's Lynn, and around the Wash to the west.

The Marsh Cut from King's Lynn northwards has stone training walls originally constructed to control siltation for both flood defence and navigation purposes.

The town of King's Lynn has a comprehensive range of tidal defences as can be seen on Map 9. These include some 1.5km of reinforced concrete surge wall much of which has been clad in brick for aesthetic and environmental reasons. Between the Fisherfleet to the north and the Millfleet in the south, King's Lynn has 54 flood gates all of which have to be closed when surge tides of above 4.6m AODN are predicted. The Alexandra Dock gates also form a part of the flood defences and these are controlled by Associated British Ports for operational reasons.

Flood barriers have been constructed across the Millfleet, the River Nar on the eastern side of the Marsh Cut, and the West Lynn Creek on the West Lynn side of the Tidal River. These barriers prevent the tide from entering the watercourses but control the discharge of water into the Tidal River through the tidal flaps.

From the River Nar outfall and the West Lynn Creek southwards the Tidal River is protected on both sides by major flood embankments.

3.1.4 Flood Warning

The NRA provides information and advice to the County Police Forces, giving them advanced warning of areas likely to be affected by fluvial or tidal flooding. Flood warnings are based on a three phase colour system: yellow for minor flooding and no public warning issued, amber for road flooding and flooding of isolated properties but no generalised public warning, and red for full flood situation, property flooding expected with a public warning issued.

The NRA is responsible for monitoring river flows and tidal conditions and predicting water levels. The responsibility for public warning currently rests with the Police. In the event of an emergency the local authorities provide a coordinating

role, support in the form of rest centres for evacuated persons, and the maintenance of infrastructure and services.

The NRA Emergency Planning Flood Warning manual outlines the catchment type and response to rainfall and tidal events, sites considered to be at special risk, data gathering points in the catchment and specific warning data. The latter item, based on calculated and observed river responses, consists of various threshold water levels (ie rates of flow) at upstream gauging stations which will be likely to result in downstream flooding. Periods of time before the flooding can be expected at each location at risk are included and this information forms the basis of any warning issued. Such procedures are re-assessed and modified as necessary in response to each flooding or near flooding event.

Tidal procedures also outlined in the NRA Emergency Planning Flood Warning manual are based on warnings from the Storm Tide Warning Service. The role of the NRA is to monitor sea conditions and surge levels and provide information to the Police and Borough Council with regard to the possibility of tidal flooding in the form of the colour phase warnings.

In addition to its monitoring role the NRA also has responsibility for the closure of the 54 floodgates located along the quayside in King's Lynn.

Associated British Ports close the Alexander Dock Gates, when required to do so for flood defence purposes, on the advice of the NRA.

3.1.5 Control and Administration

The North West Norfolk Catchment has a number of Internal Drainage Districts including the East of Ouse, Polver and Nar and a number administered by the King's Lynn Consortium of IDBs as well as part of the Middle Level which is administered by the Middle Level Commissioners.

All the IDBs have either gravity or pumped discharges into Main Rivers and are protected by sea/tidal defences which are maintained by the NRA.

The NRA is responsible for sea defences in the catchment (ie where the land behind the defence is lower than high water) whereas the King's Lynn and West Norfolk Borough Council is responsible for coastal erosion (ie those areas where the land is above high water).

Control has to be exercised over the defences to prevent development which may affect their stability or integrity and notices are served on landowners with defences on their property preventing them from altering or removing the defence without prior consent.

Whilst schemes for the protection of property can be devised there is always the possibility of an event more severe than the design standard. Thus planners of future development close to the river corridor or sea defences should be mindful of potential risks.

The area between the first and second line defences running from Hunstanton to Snettisham is subject to a planning restriction preventing occupation of premises between October 31st and Maundy Thursday or April 1st whichever occurs first, in order to minimise the risk to occupants as this period is the highest risk for storm surges.

3.1.6 Maintenance Operations

These involve a variety of activities needed to ensure the efficient use of the river and sea defence systems. These regular maintenance activities include dredging, weed control, obstruction removal, structures operation and maintenance, bank maintenance and beach recycling.

Where possible flood embankments are grazed as an alternative to mowing. Banks which are under NRA ownership are leased for grazing. Strict controls are included in the tenancy agreements to ensure damage does not occur to the banks and winter grazing is forbidden.

The annual maintenance programme takes full account of conservation recommendations identified by the Rivers Environmental Database. Identified special features are protected and the most appropriate working methods adopted to enhance river habitats, whilst maintaining flood defence objectives.

3.2 HOUSING, INDUSTRY AND COMMERCE

3.2.1 General

The control of development is the responsibility of local government under the Town and Country Planning process. The NRA's participation in the Town & Country Planning process is essentially at two advisory levels; to provide input into the production of Development Plans and to comment on specific development as proposed in planning applications.

It is the Government's intention that development will now be led by plans which set out the policies against which the Planning Authorities consider development proposals. Guidance for future development is contained in Regional Planning Guidance, County Structure Plans, Minerals and Waste Local Plans, and District Local Plans. Structure Plans set out the general framework and Local Plans provide the detail.

The NRA is a statutory consultee for some types of development under the Town & Country Planning General Development Order and advises County and Local Authorities on proposals which may have an impact on matters relevant to the NRA. The NRA's purpose in participating in the planning process is the protection of the public and the water environment from any adverse effects associated with development and land use change. The NRA will oppose development proposals which conflict with this purpose. However, the final decision on planning matters rests with the Planning Authority.

Following the granting of a planning permission, the NRA may still influence the nature of a proposed development by the necessity of the developer obtaining appropriate licences or consents.

As a consultee, the NRA will continue to seek to persuade the Local Authorities to adopt its policies. All Local Authorities have been provided with "*NRA Guidance Notes for Local Planning Authorities on the Methods of Protecting the Water Environment through Development Plans*" as part of the Structure & Local Plan procedure. This provides the basis for discussion and agreement on policies to suit individual plans. In addition, the NRA intends that Catchment Management Plans should positively influence the policies and actions of the Planning Authorities, developers, and others.

All development has an impact on the catchment to some degree. The NRA pays specific attention to proposals which may include:

- Development in the flood plain.
- Development in an area with inadequate flood defence.
- Development which concentrates surface water run-off.

- Development which might impact on groundwater or surface water quality and quantity.
- Development which might impact on water resources.
- Development in the catchment including the foreshore which might impact on flora and fauna.
- Changes in agricultural land use.
- Development which might affect the integrity or maintenance of flood defences.

3.2.2 Local Perspective

Map 2 shows that the substantial majority of the catchment is situated within the County of Norfolk, the remainder, the eastern edge of Wisbech, falling within Cambridgeshire. Apart from 14 village settlements within Breckland District Council and 1.25 square kilometres on the eastern edge of Wisbech within Fenland District Council the whole area is within the Borough of King's Lynn and West Norfolk. Their Local Plans reflect the direction of the Structure Plan in their allocation and location of housing, industry, commerce and leisure facilities up to the year 2006.

The current status of the Structure Plan and Local Plans is shown below:

STRUCTURE PLANS	CURRENT STATUS
Cambridgeshire County Council	1989 structure plan under review
Norfolk County Council	approved (March 1993)
LOCAL PLANS	CURRENT STATUS
Borough of King's Lynn & West Norfolk	draft plan on deposit (June 1994)
Breckland District Council	consultation draft (June 1994)
Cambridgeshire Minerals Local Plan	adopted (April 1991)
Norfolk Minerals Local Plan	on deposit (May 1994)
Cambridgeshire Waste Local Plan	under preparation
Norfolk Waste Local Plan	under preparation
Fenland District Council	adopted (August 1993)

King's Lynn is one of Norfolk's three largest settlements. It has a thriving port, is a centre of commerce and its industrial base, once ancillary to surrounding agriculture, is now more general manufacturing. The service sector is also a major employer. The catchment's other main employment centres are Downham Market and Hunstanton for service industries and the Wisbech fringe area for agriculture.

For the period 1993 to 2006, the requirements for the Borough of King's Lynn and West Norfolk is the provision of 3650 new dwellings, the major provision being in King's Lynn with locations such as Downham Market and Hunstanton (part in catchment) selected for intermediate development. All other settlements will have limited residential developments only.

The main location for employment will be in King's Lynn where 112 hectares (ha) of former industrial area is proposed for development; with the major areas being White House Farm, Hardwick Estate and Riverside Estate. All other areas will have limited new employment provision and then these will only be permitted when compatible with the surrounding existing uses.

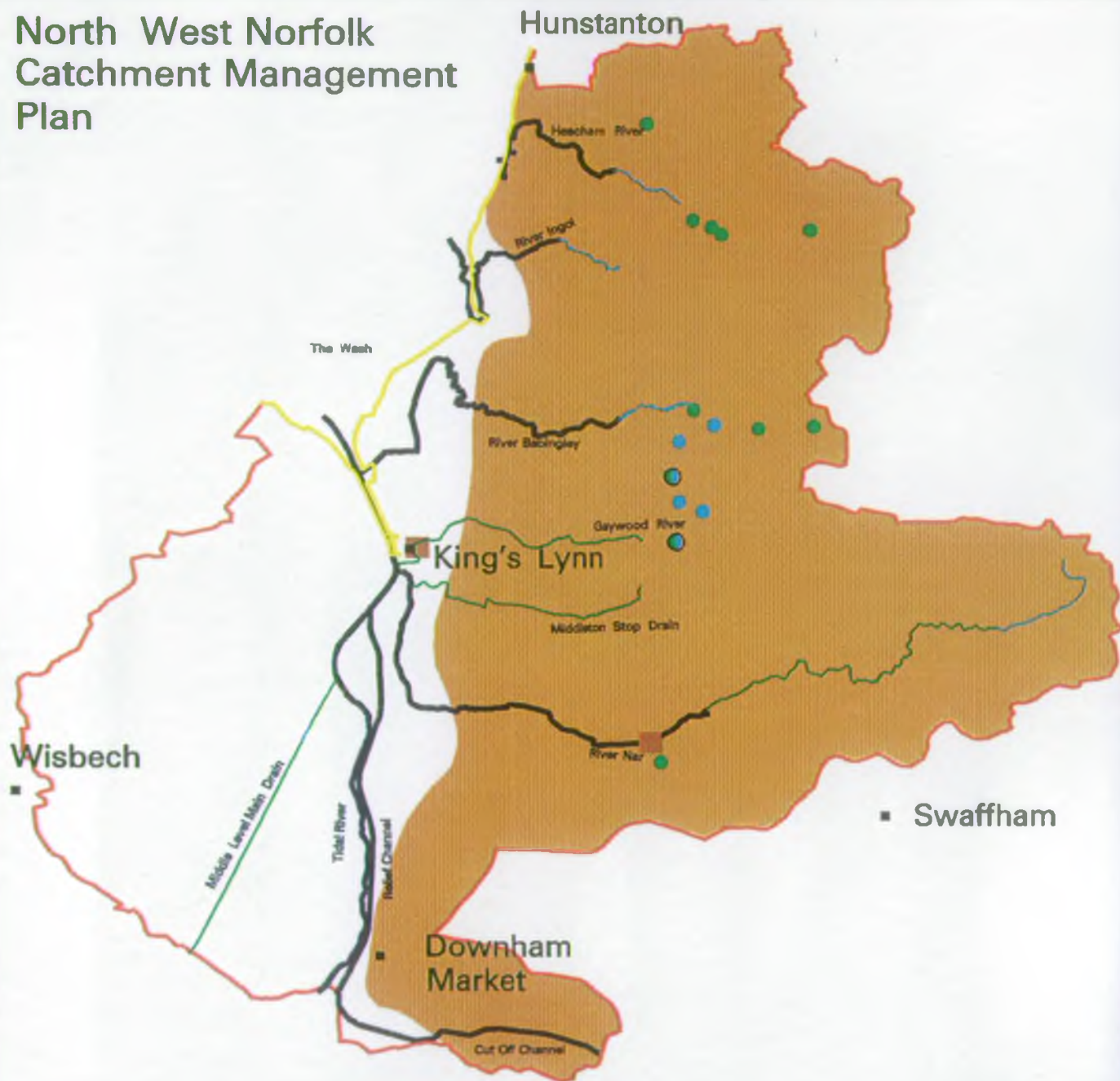
The development potential for the village settlements in the Breckland District Council area within the catchment is very limited.

Within the Fenland District Council Area in the catchment 13 hectares of residential development has been allocated with the potential for 325 dwellings.

Although no major new roads are proposed for the catchment in the foreseeable future there are currently a number of road improvement schemes in progress; such as the A47 Walpole Highway to Tilney High End. The Highway Agency Priority 2 schemes include the A47 Tilney to King's Lynn improvements and the Middleton and East Winch Bypass. Long term proposals include the A17 improvement between Sutton Bridge and King's Lynn and the Setchey - West Winch Bypass on the A10.



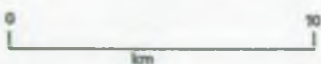
North West Norfolk Catchment Management Plan



Potable Water Supply – Map 10

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns



PUBLIC WATER SUPPLY

Ground Water Sources

- Chalk
- Lower Greensand
- Chalk and Lower Greensand

Surface Water Sources

- River Intakes

PRIVATE WATER SOURCE

- General Area Where There Are Domestic Wells or Boreholes



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3.3 POTABLE WATER SUPPLY : SURFACE WATER ABSTRACTION

3.3.1 General

This use relates to the abstraction of surface water from rivers and springs for domestic or industrial potable use.

The abstractions made by the water supply companies are controlled by abstraction licences issued by the NRA under the Water Resources Act 1991 (previously the Water Resources Act 1963). An abstraction licence is only issued by the NRA if there is sufficient water available, the need for the water is justified, all rights of existing users are protected and the water environment, e.g. rivers, springs and wetland sites, is not unacceptably affected.

Private individuals using water for their own individual domestic use are not required to have an abstraction licence unless the quantity used exceeds 20 cubic metres per day.

3.3.2 Local Perspective

Map 10 shows that Anglian Water Services Limited (AWS) is licensed to abstract surface water from both the Rivers Gaywood and Nar. Abstractions are made in order to supply the population and industry in King's Lynn and the area to the south west of the catchment.

AWS is licensed to take 827,000 cubic metres per year from the river Gaywood and 4,977,700 cubic metres per year from the River Nar. Abstraction from the River Nar is only permitted when the flow at the point of abstraction is greater than 181 cubic metres per hour. This river flow was defined in the Wisbech Water Order of 1948. The abstraction from the River Nar is used in conjunction with the abstraction made at nearby Chalk boreholes.

There are a small number of spring sources within the catchment which are used for private domestic supplies.

3.4 POTABLE WATER SUPPLY : GROUNDWATER ABSTRACTION

3.4.1 General

This relates to the use of groundwater for domestic purposes, such as drinking, cooking and washing and as well as that supplied to industry. The water is abstracted from wells and boreholes constructed into the underground aquifers.

Abstractions by water supply companies require an abstraction licence under the Water Resources Act 1991. An abstraction licence is only issued by the NRA if there is sufficient water available, the need for water is justified, all rights of existing users are protected and the water environment, e.g. rivers, springs and wetland sites, is not unacceptably affected.

Abstraction by a private individual for his domestic supply only requires a licence if the abstraction is greater than 20 cubic metres per day.

3.4.2 Local Perspective

The major sources of groundwater in this catchment are the Chalk and Lower Greensand aquifers (Map 4). Sand and gravel deposits are also locally important sources for domestic supply.

Abstractions are made by Anglian Water Services Ltd (AWS) for public water supply to the local population, temporary holiday population and industry. The main demand centres are King's Lynn, Hunstanton and Downham Market. In order to meet local demand AWS Ltd also import water into this catchment from boreholes to the south and the Stoke Ferry Intake on the River Wissey.

The 22 boreholes operated in the catchment for public water supply are shown on Map 10. Most of these have been drilled into the Chalk aquifer. As the nitrate concentration at some of the chalk boreholes can exceed the limit set for potable use, treatment or blending with low nitrate water is sometimes required before the water can be put into supply. Since 1990 the NRA has granted five temporary licences to AWS Ltd which allow abstraction of low nitrate water from the Lower Greensand. As these Lower Greensand boreholes are operated in conjunction with the previously licensed Chalk boreholes the new abstraction does not represent an overall increase in the amount licensed for abstraction for water supply. The total quantity licensed from groundwater for public water supply is 19,550,122 cubic metres per year. This represents 57 % of total water licensed for abstraction in the catchment.

A limited number of groundwater sources in the catchment are used for private domestic supply. These abstractions are principally from the Chalk aquifer and Lower Greensand aquifer, but there are also some shallow wells into local sand and gravel deposits.

There is one licensed private water undertaking of 2,795 cubic metres per year, which abstracts water from the Chalk.

Sewage Treatment Works Discharges

Anglian Water Services

DWF 100 – 999 m³/d

1. Beeston 2. Castle Acre 3. East Winch

DWF 1,000 – 9,999 m³/d

4. Downham Market 5. Watlington 6. Middleton 7. Narborough

8. Litcham 9. Grimston 10. Heacham

DWF more than 10,000 m³/d

11. Ingoldisthorpe 12. Kings Lynn

Private

A – Sandringham Estate B – Pentney C – Plum Tree Caravans Marham

D – BCKLWN Marham E – BCKLWN Smeeth Road Wisbach

F – Walpole Fruit Packers G – BCKLWN West Church Road Walpole

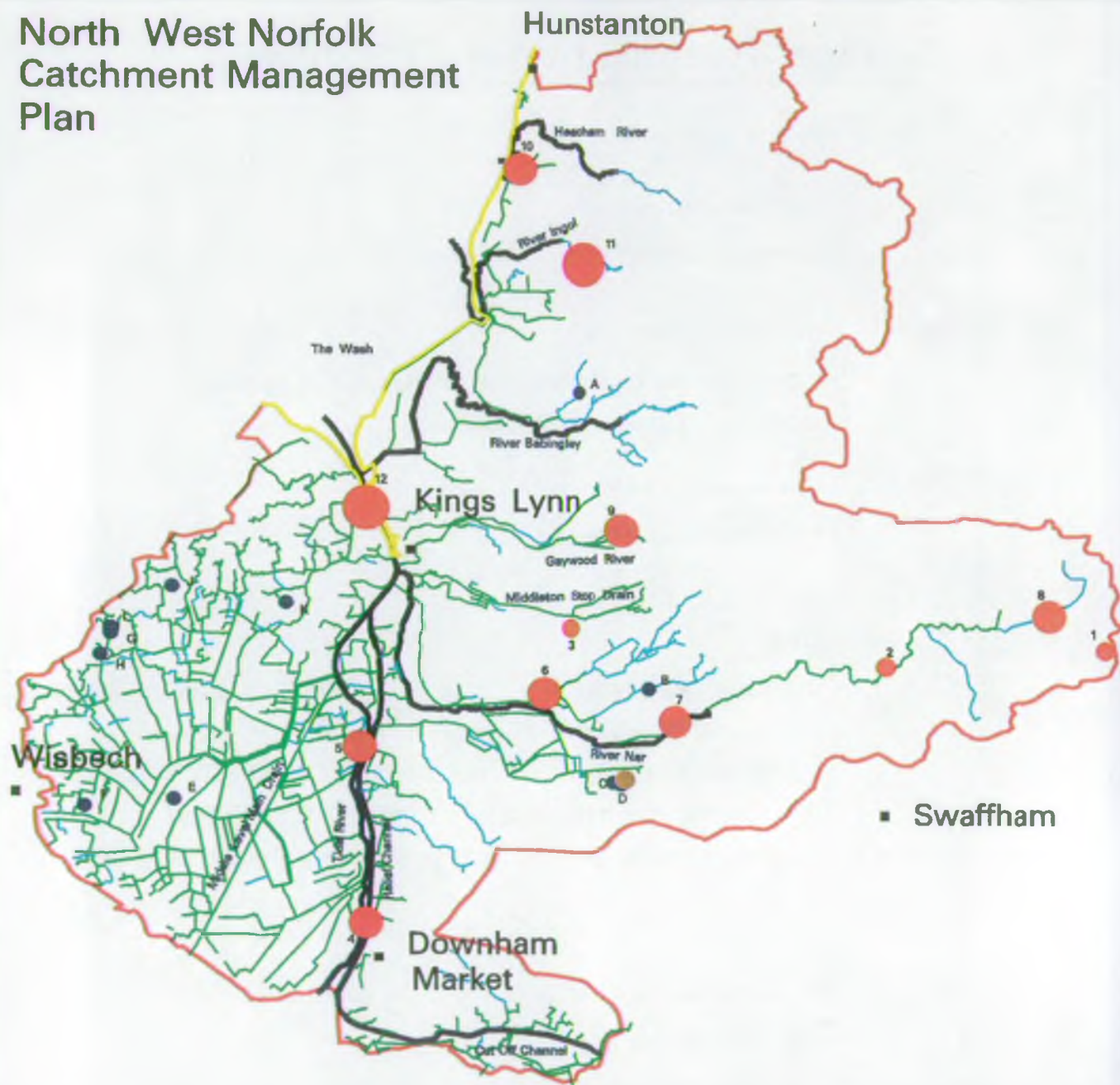
H – BCKLWN West Drove Walpole I – Walpole Parishes Trust

J – BCKLWN Hankinson Estate K – BCKLWN Glebe Estate Tilney All Saints

Ministry of Defence – RAF Marham

DWF 100 – 999 m³/d

North West Norfolk Catchment Management Plan



Sewage Treatment Works Discharges – Map 11

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns

- Anglian Water Services (1-12)
- Ministry of Defence
- Private (A-K)



For list of sites see over



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3.5 EFFLUENT DISPOSAL

3.5.1 General

This is the use of the water environment, in particular surface water, for the disposal, dispersal, and dilution of a wide variety of effluents. The quality of any effluent discharged to controlled waters must comply with criteria set out in a consent issued by the NRA under the Water Resources Act 1991. New consents are set so that the receiving water remains acceptable for its many uses. Historically, some discharges have consents which are less stringent than that required by modern standards, but are under review for future improvements.

Crown discharges are exempt under the legislation from the consenting requirements which apply to all other discharges, but the NRA does set discharge standards in Discharge Agreements which the Crown has given a commitment to comply with.

Discharges from certain activities or processes can be controlled by Her Majestys Inspectorate of Pollution (HMIP) under the Environmental Protection Act 1990 as part of the Governments policy on Integrated Pollution Control (IPC). In cases where all of the waste-water is from a prescribed process the NRA consent may be revoked and control of the site is taken over by HMIP.

In addition to consented discharges a significant amount of pollution in watercourses can be caused by surface water drainage from urban areas and also spillages from a range of domestic, commercial, agricultural and industrial activities. Many of these pollution incidents could be prevented. The NRA is pro-active in making pollution prevention site visits to identify high risk areas and offer pollution prevention advice.

The NRA has discretionary powers to issue "notices" which can set conditions for discharges of surface water to watercourses or effluent discharges to land. Where the risk of pollution is high a "notice" may be served on an individual prohibiting a discharge.

3.5.2 Local Perspective - Sewage Treatment Works

Continuous Effluents:

Map 11 shows the location of sewage treatment works. There are twelve main Sewage Treatment Works (STWs) with dry weather flows greater than 20 cubic metres per day operated by Anglian Water Services Limited (AWS) within the catchment. All sewage treatment works effluents which discharge to inland waters receive at least secondary treatment. The sewage effluents treated are predominantly of domestic origin, the consent conditions therefore primarily aim to control loads of the sanitary determinands ie suspended solids, ammonia and the biochemical oxygen demand, in the final effluent released to watercourses.

Historically discharges to tidal waters have received at best primary treatment and at worst no treatment. King's Lynn STW is the largest in the catchment; it

currently has primary treatment and discharges to the tidal River Great Ouse. Ingoldisthorpe STW which discharges into the headwaters of the River Ingol is the second largest in the catchment.

The third largest STW is Heacham which discharges indirectly to the Wash via Heacham Harbour at Heacham South Beach. The new Heacham STW was commissioned in 1990 and receives sewage from Hunstanton, Snettisham and Heacham itself. The transfer of flows from the old works at Hunstanton to Heacham new works has resulted in an improvement in bathing water quality at Hunstanton.

Many rural areas of the catchment are not served by public utility sewage treatment works. In these areas there are many, small, private STWs and septic tanks which discharge to watercourse and land respectively. Eleven private STW's are of a significant size (greater than 20 cubic metres per day), seven of which are owned by King's Lynn and West Norfolk Borough Council.

Intermittent Discharges:

Associated with the larger STWs are many sewage pumping stations, most of which have consented emergency overflows. In addition a significant number of storm overflows are found on combined sewer systems as well as at some pumping stations. These discharges are only permitted where damage to installations or property would result without the presence of the overflow.

Some areas of King's Lynn were prone to flooding problems and attempts to alleviate this resulted in many storm and emergency overflows which caused water quality problems. The problems were addressed by resewering much of the area and constructing a tunnel to transfer the storm flows to King's Lynn STW. The tunnel itself has one overflow into the tidal River Great Ouse.

3.5.3 Local Perspective - Industrial Discharges

Continuous Effluents:

Historically manufacturing industry which generated large quantities of waste-water was attracted to sites on estuaries. Partly this was because controls on discharges to estuaries were only introduced as late as 1960, and secondly, because of the lower trade effluent charges associated with estuarine and coastal sewage disposal. King's Lynn is no exception to this trend and has attracted a wide variety of industry, most notably the food processing and chemical industry. Industrial discharges to the estuary have been encouraged to connect to the public foul sewer and today most of the industry in the town discharges to the estuary via King's Lynn STW.

Map 12 shows that currently there are only three major industrial discharges directly into the estuary. Until recently the most significant in terms of volume and pollutant load was from the British Sugar site at King's Lynn. The discharge is expected to cease soon as a result of the announced closure of the site. The two other major

North West Norfolk Catchment Management Plan



Major Trade Discharges – Map 12

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns

0 10
km

For list of sites see over



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Major Trade Discharges

> 1000m³/d

- 2 – British Sugar Kings Lynn 3 – British Sugar Kings Lynn
7 – West Acre Trout Farm 9 – West Acre Trout Farm
11 – Middleton Aggreates Blackborough
14 – Hepworth Minerals Leziate 15 – Dow Chemical Company
17 – Narborough Trout Farm 18 – Narborough Trout Farm

< 1000m³/d

- 1 – Nene Fruit & Veg 4 – French Kier 5 – French Kier
6 – Cooper Roller Bearings Kings Lynn 8 – West Acre Trout Farm
10 – Middle Farm Wormegay 12 – Porvair Ltd
13 – Hepworth Minerals Middleton 16 – Beachcomber Ltd Kings Lynn
19 – Westacre Trout Farm

Marham Water Treatment Works

discharges are from chemical industry sites operated by Dow Chemical Company and Porvair, which makes plastics, at King's Lynn. The Dow discharge is covered by an authorization issued by HMIP, although the NRA continues to monitor the environmental impact of the discharge. Only part of the Porvair effluent is regulated by HMIP and the NRA still controls the final effluent discharge from the site. All of the major industrial effluents to the estuary are consented for discharge on the ebb period of the tidal cycle to ensure maximum dispersion. In addition to these discharges there are a number of smaller discharges to the estuary most of which are from shell-fish processing.

Anglian Water Services operate four nitrate removal plants which enable them to treat groundwater which exceeds the EC standard for nitrate in drinking water so that it can be used for potable supplies. The plants sited at Bexwell and Marham Water Treatment Works discharge via a combined outfall to the Tidal River at Stowbridge. The plants at Fring and Sedgeford discharge via an old sewage outfall at Hunstanton into the Wash.

There are relatively few industrial discharges to freshwaters, the most significant of these in terms of volume is the effluent from Hepworth Minerals sand workings which discharges to the Mintlyn stream. There are also three fish farms sited on the River Nar which are dealt with in Section 3.12 on Commercial Fishing and Fish Farming.

Intermittent and Diffuse Sources:

Modern agricultural techniques sometimes have detrimental effects on water quality. This applies particularly to the use of artificial fertilisers, the use of herbicides and pesticides, manufacture of silage and intensive rearing of livestock.

Agricultural effluents from silage and intensive rearing of livestock are potentially highly polluting and prohibitively expensive to treat. For these reasons discharges to watercourses of effluent from agriculture are discouraged and disposal should be in accordance with the MAFF Code of Good Agricultural Practice for the Protection of Water.

Disposal of agricultural spray rinsings has until recently often been disposed of to soakaways. This practice is discouraged and the use of treatment plants using carbon filtration is encouraged prior to the application of rinsings to land.

Accidental spillages often occur on industrial sites and farms and may cause extreme damage to controlled waters. The occurrence of spillages can be reduced by good pollution prevention measures and the NRA's programme of pollution prevention visits is intended to encourage these improvements.

Surface water run-off from industrial development may cause a significant impact on water quality. Site operators and developers are encouraged to protect surface water by providing adequate pollution prevention measures such as bunding-oil and chemical tanks and the installation of oil interceptors where appropriate.

3.6 WASTE DISPOSAL

3.6.1 General

Land within the catchment may be used for waste disposal by either landfills or by spreading wastes directly onto the ground. In recent years there has been a major change in the philosophy of landfilling waste. Previously a policy of "dilute and disperse" was applied. Providing the leachate generated would not adversely affect the use of an aquifer or watercourse natural attenuation mechanisms were considered acceptable. As a result of a number of problems with "dilute and disperse" sites the emphasis has changed to "containment" of wastes. Protection of groundwater quality is required by the EC Directive (80/68/EEC). Currently all new sites taking any potentially polluting matter must be engineered to contain and control leachate generation to protect all groundwaters.

The NRA is a statutory consultee on all activities that require a waste management licence. Licences are issued under the provision of the Environmental Protection Act 1990, in accordance with the new Waste Management Regulations that came into force in May 1994.

There is NRA involvement in waste disposal at three levels:

- On the Waste Disposal Plan which each County Council Waste Regulation Authority (WRA) is required to produce.
- On the Planning Application for individual sites; this allows consideration of the principle of a waste disposal activity at a particular location and includes aftercare considerations.
- On the Site Licence; this covers the operation of the site.

A wide range of operations require a licence; for example, transfer stations, waste storage facilities and scrap yards. All of which have the potential to pollute water.

In practice, any disposal site in use prior to 1972 could have taken virtually any type of waste as there was no control of dangerous waste and the records of what was tipped and the location of old sites are poor or non-existent.

Following the transfer of disposal responsibilities for domestic waste to the County Councils in 1974, waste disposal was concentrated in fewer large sites, and it is these that may pose a longer-term risk to water quality rather than the large number of small sites.

The spreading of sludge on land for agricultural benefit or other improvement; with some qualification, is exempt from the Waste Management Regulations. Such activities have potential for pollution where the deposition of sludge is over vulnerable aquifers, or where contamination may enter surface waters in run-off.

Operators intending to deposit exempt wastes on agricultural land have to supply

North West Norfolk Catchment Management Plan



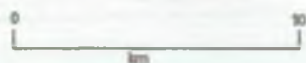
Waste Disposal Sites – Map 13

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns

■ Waste Disposal Sites

The following sites have been referred to in the text:-
Blackborough End 1, 2, 3.
Docking 4, 5



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specific details to the WRA prior to application onto land. These wastes are excluded from Waste Management Plans and there is no requirement for consultation with the NRA, although the information is placed on the WRA's public register. The WRA is obliged to ensure that proposals will not be a risk to water quality.

3.6.2 Local Perspective

Currently, the main sites for domestic waste are at Docking and Blackborough End. There is one newly licensed, but as yet non operational, site at Blackborough End.

There are relatively few major sites in the area, reflecting its predominantly rural nature. However, there are closed sites that may present a threat to local groundwater resources for example that at Wereham. Map 13 shows the waste disposal sites within the catchment.

3.7 AGRICULTURAL ABSTRACTION

3.7.1 General

This use includes water abstracted for general agricultural use (eg livestock watering, crop spraying), and overhead spray irrigation. All abstraction, except for general agricultural use of less than 20 cubic metres per day taken from surface waters, requires a licence under the Water Resources Act 1991.

An abstraction licence is only issued by the NRA if there is sufficient water available, the need is justified, all rights of existing users are protected and the water environment (e.g. rivers, springs and wetland sites) is not unacceptably affected. Abstraction from surface water sources is subject to low level or flow restrictions in order to protect the river and downstream users.

3.7.2 Local Perspective

Agricultural use represents 22 % of the total quantity of water licensed in this catchment and 203 of the total of 234 licences which have been issued. The catchment supports a mixed agricultural economy, where sugar beet, cereals, potatoes, other vegetable and salad crops are grown.

There are 77 licences for general agricultural use of water, excluding spray irrigation, in the catchment. Abstraction is mainly from Chalk boreholes. The total licensed for this use is 254,000 cubic metres per year, which is less than 1 % of total water licensed for all uses in the catchment.

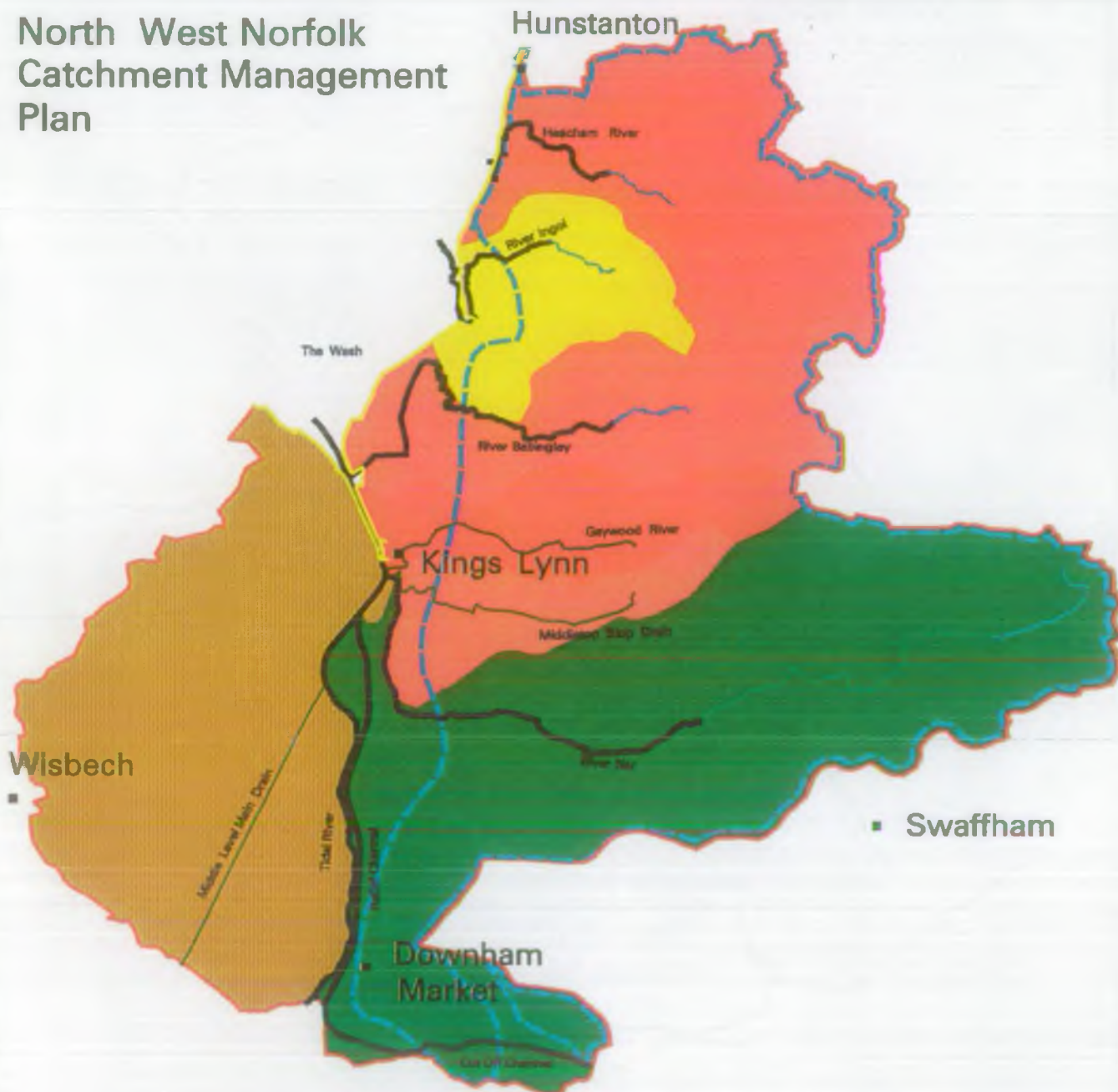
Water abstracted for spray irrigation is considered as a total loss to resources as it is not returned to the river or catchment after use. Instead, the water is taken up by the crops or evaporates. The majority of licences for spray irrigation are issued on a time limited basis, often for 10 years, so that their impact may be reviewed.

Water abstracted from surface waters is used for spray irrigation throughout the whole catchment. Groundwater for spray irrigation is abstracted from both the Chalk and Lower Greensand aquifers. Map 14 shows the majority of spray irrigation in the catchment is to the east of the Tidal River. In areas of limited summer resource, farm reservoirs may be used to store water abstracted during the previous winter for subsequent summer use. The total of 126 spray irrigation licences accounts for 7,257,000 cubic metres per year, 36% of which (2,607,000 cubic metres) is from surface water sources. Spray irrigation represents a total of 21 % of the total licensed abstraction in the catchment.

Map 14 shows the area of farm land which can benefit from spray irrigation.

Most watercourses in the catchment are used or have the potential to be used for livestock watering.

North West Norfolk Catchment Management Plan



Agricultural Abstraction – Map 14

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns

0 10
km



General Agricultural Abstraction from Ground water

- 0 - 5%
- 10 - 15%
- 15 - 20%
- 20 - 30%
- 30 - 40%

Percentage of land benefiting from
Spray Irrigation

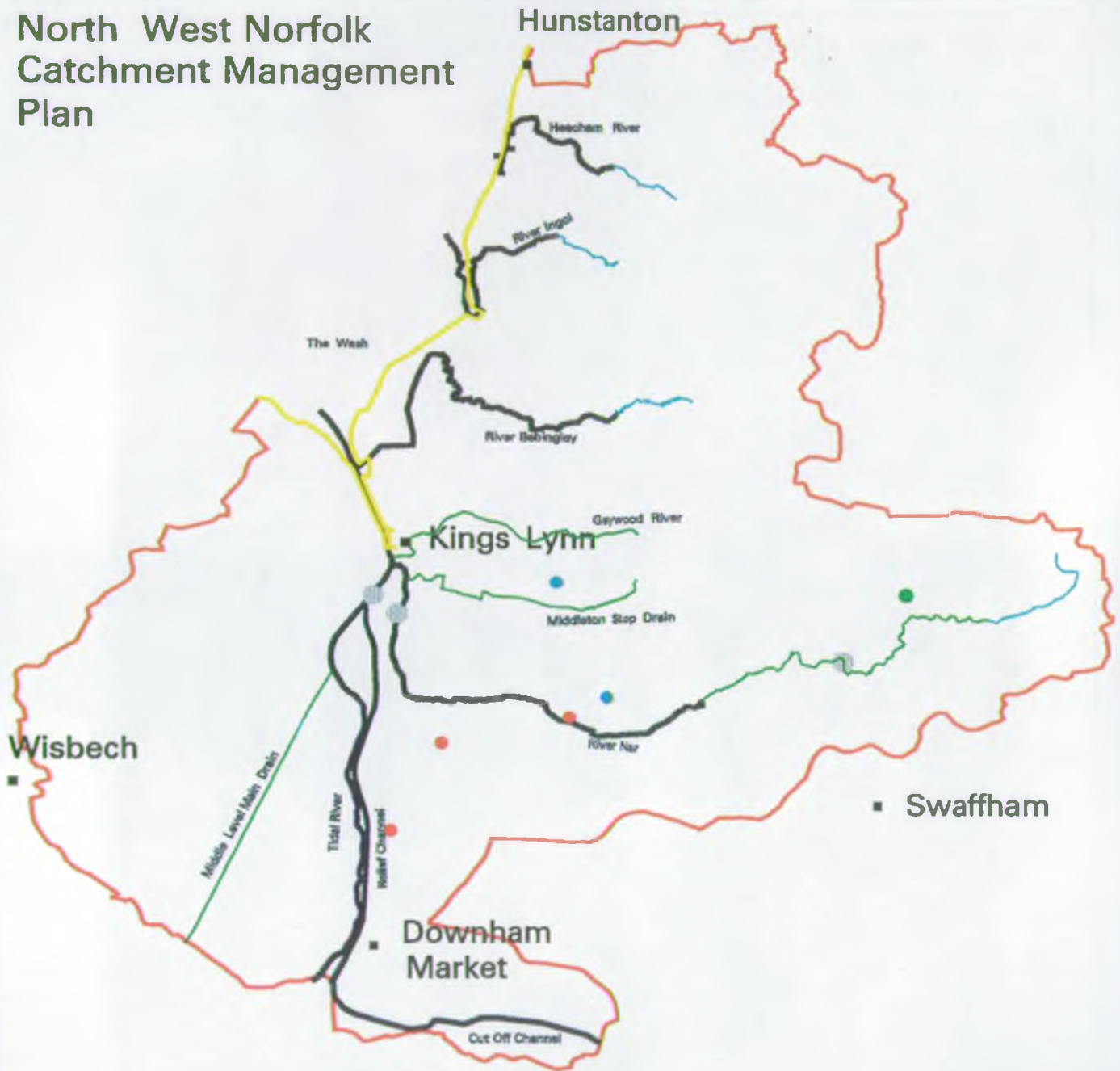


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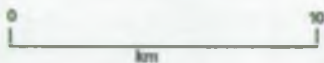
North West Norfolk Catchment Management Plan



Industrial Abstraction – Map 15

KEY

- | | | | |
|--|--------------------|--|-----------------------------|
| | Catchment Boundary | | Chalk Groundwater |
| | Coastline | | Lower Greensand Groundwater |
| | Main River | | Sand and Gravel Groundwater |
| | IDS Watercourse | | Surface Water |
| | Other Watercourse | | |
| | Main Towns | | |



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3.8 INDUSTRIAL ABSTRACTION

3.8.1 General

This use describes the abstraction of water from ground and surface waters for industrial purposes. The abstraction is made by individual companies separate from any supplies made from the public water supply company. Industrial abstractions include water used for industrial processing, cooling and sand and gravel washing.

These abstractions require an abstraction licence under the Water Resources Act 1991. An abstraction licence is only issued by the NRA if there is sufficient water available, the need for the water is justified, all rights of existing users are protected and the water environment (e.g. rivers, springs and wetland sites) is not unacceptably affected.

3.8.2 Local Perspective

The industrial need for water in this catchment is mostly met from mains water supplied by Anglian Water Services Ltd. Individual abstractions do, however, take place and at present there are two abstraction licences issued for sugar refining and cooling purposes as well as a number for mineral washing. The location of these abstractions are shown on Map 15.

The 2 licences for sugar refining and cooling at King's Lynn amount to a licensed quantity of 1,443,000 cubic metres per year. These abstractions are from surface water sources and represent 4 % of total licensed abstraction in the catchment.

The total quantity licensed for mineral washing purposes is 3,041,000 cubic metres per year which represents 9 % of the total water licensed in the catchment. Most of the water that is abstracted returns to the river or groundwater close to the point of abstraction. One abstractor obtains the water from surface water, one from the Chalk, three from the Lower Greensand and finally four from the Gravels.

3.9 RAW WATER TRANSFER

3.9.1 General

Part of the NRA's responsibilities require the redistribution and augmentation of water resources where required whilst ensuring their proper use. Therefore the NRA undertakes raw water transfers to redistribute water to areas where there are local deficits. There are raw water transfers between catchments and also within the same catchment, and where possible the schemes use existing water courses to redistribute the water.

3.9.2 Local Perspective

The NRA does not operate any raw water transfers in this catchment.

However, flows in the Tidal River and the freshwater content of the Wash are to some extent dependent upon the operation of the Ely Ouse to Essex transfer scheme at the Denver Complex. The details of this are set out in the Ely Ouse CMP. The transfer is limited by the requirement to maintain a compensation flow of 113,600 cubic metres per day from March to August and 318,200 cubic metres per day between October and February when the scheme is in operation. At times of low flow this discharge is passed into the Relief Channel rather than directly into the Tidal river downstream of Denver because the sluices which discharge into the Relief Channel are capable of finer control than the Denver main sluices.



North West Norfolk Catchment Management Plan



Mineral Extraction – Map 16

KEY

- | | | | |
|--|--------------------|--|----------------------|
| | Catchment Boundary | | Silica Sand |
| | Coastline | | Sand and Gravel |
| | Main River | | Gneiss |
| | IDB Watercourse | | Chalk |
| | Other Watercourses | | Sand & Gravel & Clay |
| | Main Towns | | |
- 0 10 km



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3.10 MINERAL EXTRACTION

3.10.1 General

This use relates to the extraction of minerals such as sands, gravels, Chalk and special clays. In order to "win" these minerals it is often necessary to pump water out of the workings (dewater). Under the Water Resources Act 1991, dewatering of mineral workings is exempt from the need to obtain an abstraction licence. However, under section 30 of the Act, the NRA can issue a "Conservation Notice" to the mineral extraction company in order to conserve water in the dewatering process, but these powers cannot be used to control the mineral extraction process.

Mineral extraction can affect both groundwater quantity and quality. Removal of minerals can physically disturb aquifers and change existing patterns of groundwater recharge, groundwater levels and groundwater flow directions. These changes can in turn affect existing water abstraction rights and the water environment. If dewatering forms part of the mineral working operation, these changes can be more pronounced. Restoration of mineral extraction sites by landfilling can pose additional threats to groundwater quantity and quality.

All County Councils within the catchment have produced Mineral Plans as required under the Town and Country Planning Act 1990, in accordance with Planning Policy Guidance Note 12. The NRA as a statutory consultee, makes representation to any Mineral Plans.

Some mineral workings also include plant for processing the mineral by washing it or some form of secondary processing. Where water is required above that taken by dewatering an abstraction licence is required under the Water Resources Act 1991. An abstraction licence is only issued by the NRA if there is sufficient water available, the need for the water is justified, all rights of existing users are protected and the water environment (e.g. rivers, springs and wetland sites) is not unacceptably affected.

3.10.2 Local Perspective

There are 10 active mineral extraction sites in this catchment as shown on Map 16.

Sand and gravel extraction is concentrated along the River Nar valley where five sites are currently being worked. At one of these five sites, clay is also extracted and used in the engineering of the nearby Blackborough End Landfill. Carstone is produced from a site situated on the higher ground to the north of the River Nar valley and a second site near Snettisham. Chalk is quarried at two sites, one near Hillington and the other near Newton. East of King's Lynn there are extensive workings which provide silica sand for industrial use.

The NRA has issued one "Conservation Notice" in this catchment and this is still in force.

3.11 ANGLING

3.11.1 General

This relates to the recreational use of the fishery.

3.11.2 Local Perspective

This catchment supports both riverine coarse and salmonid fisheries.

The coarse fishing on the Relief Channel and some of the Middle Level Main Drain is controlled by the King's Lynn Angling Association, the other part being controlled by Wisbech and District Angling Association. Roach and bream form the dominant component of catches on both of these waters although pike and zander fishing is particularly popular during the winter months. The NRA owned Relief Channel was one of the country's more prominent match fishing venues during the late 1960's and the 1970's but has declined in importance since this time, although in 1993 and 1994 its angling performance has improved considerably with the recovery of the fish population. The King's Lynn Angling Association also control the coarse fishing interests on the lower reaches of the River Babingley and River Nar.

The salmonid fisheries for brown trout on the River Nar and River Babingley are mostly controlled by fishing syndicates but some day ticket fishing is available to Salmon and Trout Association members on the River Nar between Narborough and Marham Sluice.

None of the other Norfolk rivers in this catchment have any organised angling taking place on them, although they may support a small local fishery. The major coarse and trout fisheries are shown on Map 17.

Former gravel extraction sites particularly along the River Nar valley create a diversity of angling opportunities in these stillwaters. Gravel pit complexes of note for their coarse fisheries include Nar Valley Fisheries at Middleton, Pentney Pits, Blackborough End, Tottenhill Pits and Bradmoor Lakes. Other popular sites include Wood Lakes at Stowbridge and Watlington Hall Lakes.

The most popular site for stillwater game angling is at Narborough Trout Lakes which is well stocked with large rainbow trout.

North West Norfolk Catchment Management Plan



Angling – Map 17

KEY

- | | |
|--------------------|--------------------------|
| Catchment Boundary | River Bank Fishing |
| Coastline | Coarse Fishing |
| Main River | Trout Fishing |
| IDB Watercourse | Enclosed Waters Fishing |
| Other Watercourse | Coarse Fishing |
| Main Towns | Trout Fishing |
| | Coarse and Trout Fishing |
- 0 10
km



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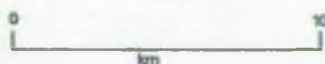
North West Norfolk Catchment Management Plan



Commercial Fisheries – Map 18

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns
- Eel Fishing Rights Leased by the NRA
- Commercial Shellfish Beds



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3.12 COMMERCIAL FISHING & FISH FARMING

3.12.1 General

This relates to the commercial exploitation of fish and shellfish stocks within the waters of the catchment as shown on Map 18.

The NRA has a responsibility to licence this fishery down to the demarcation points scheduled in the 1975 Anglian Water Authority Fishery Byelaws. The demarcation point on the Tidal River is at Stowbridge but downstream of this point the NRA has no responsibility for the regulation of the commercial eel fishery. Under the Salmon and Freshwater Fisheries Act 1975 the NRA has responsibility to regulate freshwater fish to a six mile limit from the coast. In practical terms the NRA only licences the drift fishery, however few, if any, licences are regularly issued within the area of this plan, most activity taking place on the Norfolk and Suffolk coast between Wells and Aldeburgh.

Abstraction of water for use in fish farming requires an abstraction licence under the Water Resources Act 1991. An abstraction licence is only issued by the NRA if there is sufficient water available, the need for the water is justified, all rights of existing users are protected and the water environment, eg rivers, springs and wetland sites, is not unacceptably affected.

The consent for discharge is only issued if the receiving water can assimilate the fish farm waste water without causing failure of the water quality objectives. The consent sets conditions on the change in the abstracted quality and discharge quality.

3.12.2 Local Perspective

Some commercial eel fishing takes place within the riverine section of this catchment by traditional dutch fyke netting.

All other commercial fishing in the Wash is overseen by the Eastern Sea Fisheries Joint Committee (ESFJC) who are the body responsible for policy formulation on fishing and they have the authority to regulate the fishery. They have the powers to grant licences and leases to determine the site of vessels, nets and dredges. A new Wash Fishery Order 1992 and attendant regulations came into force with effect from 4 January 1993. As well as the public fishery controlled to a three mile limit by ESFJC there is also a private fishery to the east of the Wash known as Le Strange fishery with access by permit from the owner.

The Wash area is used as a nursery ground by the juvenile fish of many species such as plaice, sole, cod, burbot and brill. Offshore fishing for fin-fish has rarely reached a viable level although small fisheries do occasionally exist for sprat, mullet, sole and skate.

The waters of the Wash form one of the most important shellfish areas in England and Wales and there are six commercial shellfish beds for mussels and cockles which are proposed as harvesting areas under the shellfish Hygiene Directive

(91/492/EEC). Commercially significant fisheries of brown and pink shrimp also exist; the latter comprising almost 100% of the total for England and Wales.

The ESFJC play an important role in the management of stocks of particularly cockles and mussels by the creation of reserves within which exploitation of stocks is prohibited thus allowing the recovery of depleted stocks.

Fish farming activities are concentrated on the River Nar. One of the factors influencing the siting of the fish farms is the consistently high quality water. There are two licences which permit water to be abstracted for fish farming purposes. The total quantity licensed is 1850 thousand cubic metres representing 5% of the total water licensed in the CMP area. Both are trout farms and abstract and return water to the River Nar. These discharges potentially contribute 50% of the total effluent discharged to the River Nar.

3.13 THE WATER ENVIRONMENT AS HABITAT

3.13.1 General

This use relates to the use of the water environment as habitat for flora and fauna both within the river corridor and in sites of conservation value which are water dependent.

These habitats support a diverse range of plants and animals ranging from those species wholly dependent on open water to species which exploit river corridors and wetlands as valuable refuges. The maintenance and enhancement of species diversity in these areas will depend on the future management regimes balancing the level and flow needed to maintain wetland sites of interest, the "in river needs", and water quality.

In terms of ecosystem conservation the "in river needs" can be defined as the velocity, level and quality of water necessary for the conservation and enhancement of aquatic and riparian communities, to maintain the requirement for effluent dilution, and provide periodic erosive flows for flushing of silt from river beds.

Wetland sites exist where the geomorphology, geology and land use allow a concentration of surface and groundwater flows and levels. The area that contributes groundwater to a wetland site is termed the wetland groundwater catchment area. The NRA is seeking to protect wetland sites of conservation interest by controlling future abstraction within these areas.

The NRA is specifically required to consult outside organisations where NRA work or consent is likely to impact on sites of high conservation value such as National Nature Reserves (NNR), County Wildlife sites (CWS), and Sites of Special Scientific Interest (SSSI).

3.13.2 Local Perspective

Freshwater Habitats

The River Nar is the most notable river in the catchment in conservation terms. The river combines the characteristics of a typical southern Chalk stream and an East Anglian fen river. Together with the adjacent terrestrial habitats, the Nar is an outstanding river system of its type and is designated a Site of Special Scientific Interest.

The upper reaches of the River Nar have a wide range of natural physical features including riffles, pools, gravel beds and meanders which support a diversity of habitats typical of upland Chalk rivers. The river below Narborough is embanked and steep sided, flowing sluggishly through a predominantly arable flood plain. This physical variety and the influence of underlying chalk supports a rich and diverse flora.

The Nar has a range of associated wetland and washland habitats. Where land

adjacent to the river is seasonally flooded and has not been reclaimed as pasture, areas of rough fen and unmanaged scrub remain. Further downstream this scrub has developed into mature wet woodland, dominated by alder carr.

The Babingley River starts its main river course west of Hillington, as a gravel bed stream with riffle-pool sequences, flowing through and adjacent to woodland. The middle reach of the river is tightly meandering, flowing through predominantly arable land, becoming a straight steep sided drain in its lower reaches. Areas of ecological interest include stands of common reed (*Phragmites australis*) and relatively extensive emergent fringes along much of the river. Valuable adjacent habitats include several adjacent ponds along the river, wooded areas and a species rich flora on the upstream floodbank.

The NRA is undertaking research to examine the methodology necessary to identify River Flow Objectives. The River Babingley was studied as part of this research. The aquatic and riparian communities were identified with reference to river flow and quality and the findings will be used to identify water resource management techniques.

The Heacham River starts its main river course west of Sedgeford, flowing through woodland with riffle-pool sequences. Ecological interest includes fringes of common reed, adjacent woodland and wet grassland. The lower reach of the river flows parallel to the coastline and may provide areas of shelter for waterfowl (waders and wildfowl).

The Ingol starts its main river course south of Snettisham with a short riffle-pool sequence, then becoming ditch-like. It flows through predominantly arable land with small woodlands and shrub lined river corridor.

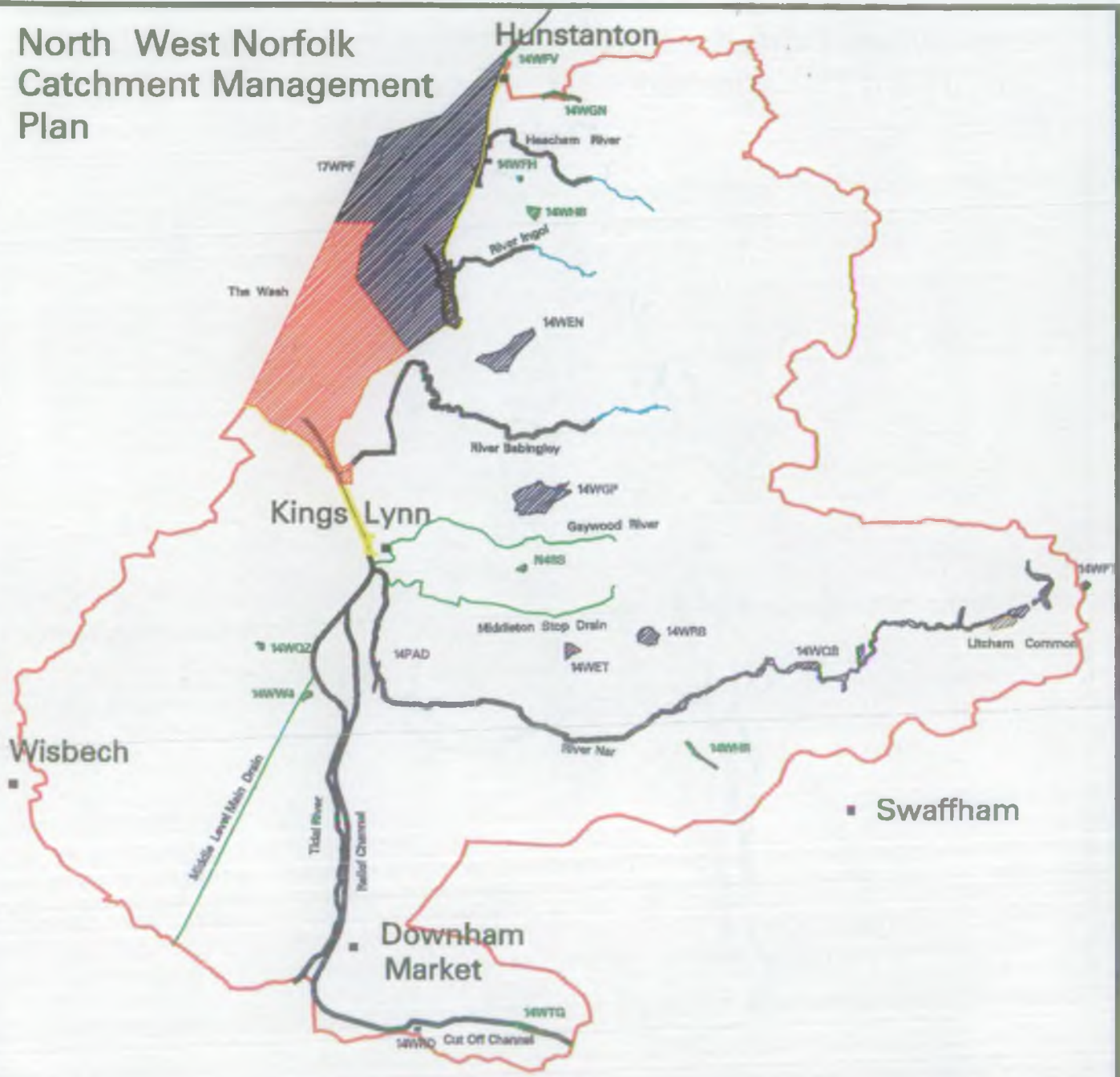
The Relief Channel, being impounded, behaves as a shallow eutrophic lake with a diverse plankton community but the littoral and benthic invertebrate communities are rather limited. The plant communities present are associated with slow flow. Although not extremely diverse, due to the uniformity of the channel, these communities are of ecological value; particularly the extensive fringes of common reed. The extensive embankments are of value, comprising unimproved grassland and areas of scrub.

The Middle Level Main Drain, which drains the entire Middle Level system is a very similar water course to the Relief Channel, in terms of the habitat type and conservation value.

The NRA undertakes fish population surveys, on a three year rolling programme, of all of the important river fisheries, as an assessment of the fish stock in its own right and as indicators of environmental quality. A total of twenty three species of fish have been recorded within the North West Norfolk rivers catchment.

The catchment contains 17 SSSIs, 8 of which are wetland dependent. The location of Statutory Conservation Sites, which include SSSIs, are shown in Map 19. Roydon Common near King's Lynn is the most important freshwater wetland site

North West Norfolk Catchment Management Plan



Statutory Conservation Sites – Map 19

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns

- Wetland SSSI
- Non-Wetland SSSI
- English Nature Reference No. 14WTG
- National Nature Reserve
- Local Nature Reserves

0 10 km



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North West Norfolk Catchment Management Plan



County Wildlife Sites – Map 20

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns
- County Wildlife Sites



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in the catchment, in addition to its SSSI status it is also designated as a RAMSAR site and Special Protection Area (SPA). There are also 256 County Wildlife Sites, one National Nature Reserve, and a Local Nature Reserve within the catchment. The location of County Wildlife Sites is shown on Map 20.

Tidal and Estuarine Habitats

The Tidal River has different plant communities to the other rivers in the catchment due to the saline intrusion. There is a marked change from freshwater plants to maritime plants in its lower reaches. The extensive embankments are of value to birds, particularly waterfowl. The bankside vegetation is well established but the instream plant communities are limited by the turbid nature of the Tidal River and the shifting nature of the sandbanks.

The Wash, from Hunstanton to Terrington Marsh in this CMP area, has been notified as a Ramsar site, a Special Protection Area and a Site of Special Scientific Interest with part of it declared a National Nature Reserve.

The waterfowl of the Wash are of international importance. In terms of the numbers of waders which feed there for all or part of the winter, the estuary is one of the two most important areas in the U.K. For most species, the vicinity of the mouth of the River Great Ouse is a favoured feeding area.

Grey seals and common seals are present in the Wash. The former, a relatively abundant species nationally, is primarily a northern species. The common seal is less abundant but the Wash population is important in international terms. Estuaries provide valuable areas for common seals and in this context the Wash and North Norfolk Coast are of very major importance, supporting, until recently, 6600 common seals (27% of the British population). Nationally, numbers have now declined owing to viral disease by 50-60%, the Wash being no exception.

There are a number of initiatives currently in progress which relate to the Wash management, all of which projects include the Wash Shoreline Management Plan, which seeks to develop a strategy for flood defence works in the Wash. There is also a continuing Wash Rivers Outfall study. This is a multi-authority project, lead by English Nature which, in effect, seeks to produce a structure plan for the Wash.

3.14 LANDSCAPE AND ARCHAEOLOGY

3.14.1 General

The NRA has a statutory duty to conserve and enhance landscape and archaeological features associated with water.

This includes specific duties with respect of areas formally designated as being of value, e.g Areas of Outstanding Natural Beauty and Scheduled Ancient Monuments. In addition, the NRA also has a general duty to protect areas which although valuable in landscape or archaeological terms are not formally protected.

3.14.2 Local Perspectives

Within the catchment there are 71 sites designated as Scheduled Ancient Monuments (SAM). In addition to scheduled sites, there are a number of other county sites which are recognised as being of archaeological value. The location of the SAMs within the catchment are shown on Map 21.

The archaeological sites most affected by the work of the NRA are those sensitive to changes in groundwater level. This is particularly important where reduced water table results in drying out at foundation level in buildings or when the shrinkage of peat results in the loss of organic artifacts by oxidation.

Part of the catchment is recognised as an Area of Outstanding Natural Beauty. The Norfolk Coast is renowned for its marsh coastlands, embracing flowing dunes, sand flats and a maze of tidal creeks, saltmarsh and lagoon. This fragile, shifting shoreline is managed as a Heritage Coast. The aesthetic as well as the ecological value of these areas is considered when assessing the impact of any NRA activity.

This catchment also includes sites of historical interest such as ruins at Castle Acre and Castle Rising as well as the remains of the priory at South Acre.

King's Lynn is the major town within the catchment and the old historical docks area of the town are of archaeological interest. The port is still used today with a fishing fleet and other ships exporting general cargo, sugar beet and grain.

North West Norfolk Catchment Management Plan



Ancient Monuments and Landscape – Map 21

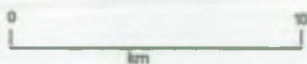
KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Town

TT



Ancient Monument
Area of Outstanding
Natural Beauty



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3.15 NAVIGATION

3.15.1 General

The legal framework under which NRA exercise its powers as navigation authority is given in the Anglian Water Authority Act 1977. Recreational Byelaws are also made under this act to regulate matters such as boat registration, boat safety and speed limits

The NRA acknowledge the Zone One Strategy Report for Water Recreation which was produced by the Eastern Council for Sport and Recreation.

3.15.2 Local Perspective

The following length of river is defined in Schedule 1, Part 3 of the Anglian Water Authority Act 1977

"The River Great Ouse from National Grid Reference TF 6028 0712 to Denver Sluice in the Parish of Denver in the District of West Norfolk in the County of Norfolk".

This is, in effect, the tidal river from Denver to Stowbridge, and is the only part of this catchment for which NRA is the navigation authority.

Within this catchment two other bodies exercise the powers of a navigation authority, the Middle Level Commissioners and King's Lynn Conservancy Board.

The Middle Level commissioners are the navigation authority for the Middle Level System, although navigation on this system does not extend to the Middle Level Main Drain included within this catchment. The King's Lynn Conservancy Board are the navigation authority on the lower tidal Great Ouse and their powers extend beyond the river mouth into the Wash.

Historically the River Great Ouse discharged to the Wash not at King's Lynn but via Upware to Wisbech. The course of the Great Ouse was diverted to King's Lynn before the end of the thirteenth century. For many years the river then became a valuable trading route to Ely, Cambridge and St Ives. Navigation was also possible on the River Nar between King's Lynn and Narborough but this use ceased in the late nineteenth century.

Today, commercial traffic inland from the Wash has all but ceased, although the river still provides an important link for recreational access between the Bedford Ouse, Ely Ouse and the open sea. The strong tidal currents between Denver and King's Lynn mean that use of the tidal river is only suited to larger boats. The Port of King's Lynn remains a busy fishing port and this use is dealt with in greater detail in the section on commercial fishing.

The tidal river provides an important link between the Ely Ouse at Denver and the west of Ouse navigations in the Well Creek and the Old Bedford River. This short

section of river is probably the busiest section of the tidal Great Ouse and is used by boat traffic on the Nene - Ouse navigation link.

Facilities for use by recreational craft are limited to lock passage moorings at Denver and Well Creek, mooring in King's Lynn is very difficult due to the large tidal range. A small number of craft do however moor to in-channel buoys at King's Lynn. Commercial fishing boats normally moor in an off river inlet in King's Lynn, known as Fisher Fleet.

North West Norfolk Catchment Management Plan



Boating and Immersion Sports – Map 22

KEY

- Catchment Boundary
- Coastline
- Main River
- IDS Watercourse
- Other Watercourse
- Main Towns

- S Sailing
- WS Wind Surfing
- B Boating
- WSG Water Skiing



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3.16 BOATING AND IMMERSION SPORTS

3.16.1 General

This use deals with water based recreational activities, such as sailing, canoeing, rowing, water skiing and swimming. The NRA acknowledges the existence of the Zone One Strategy Report for Water Recreation, prepared by the Eastern Council for Sport and Recreation.

The NRA discourages swimming in all rivers, primarily because of the risk of drowning, but also because of the possibility of contracting water borne diseases. It is also recommended that those involved in any watersport which results in contact with the water, take sensible precautions to avoid water borne diseases.

3.16.2 Local Perspective

Water based recreation within the freshwater parts of the catchment are centred primarily on former mineral workings, with the addition of some activities on the Great Ouse Relief Channel.

The Leziate/Bawsey complex of lakes near King's Lynn caters for sailing and windsurfing, similar facilities are also available at Wood Lakes, north of Downham Market. Water skiing is carried out at Abbey Road Pits near Pentney.

Sailing and water skiing takes place on the Great Ouse Relief Channel. Water skiing is controlled by a club at St Germans. Sailing is restricted to the downstream area of the channel near Saddlebow.

In addition to the formal water recreational activities, informal activities such as canoeing takes place in the navigable channels, and sometimes beyond. Sailing takes place within the Wash, with a number of private dinghy launching areas on the coast near Heacham. There are also public launch sites at Heacham and Hunstanton. The location of all principal sites for boating and immersion sports are given in Map 22.

A study commissioned by the Eastern Council for Sport and Recreation (The Supply and Demand for Water Sport on Enclosed Waters Bodies within the Eastern Region 1993) showed that participation in water based recreation in East Anglia was above the national average. The report identified potential for an increase in water recreation on the second large lake within the Leziate/Bawsey complex.

3.17 RECREATION AND AMENITY

3.17.1 General

This use deals with recreational and amenity facilities such as walking, horseriding, caravanning and camping, tourism and sites of interest within the water environment and on land owned by the NRA. Navigation, boating and freshwater angling are all major recreational activities and are covered elsewhere in this plan.

3.17.2 Local Perspective

The local authorities within this catchment promote tourism, some of which is indirectly linked to the water environment whether it be the river or coastline.

Map 23 shows that footpaths exist along the banks of the tidal River Great Ouse, the River Nar and the Middle Level Main Drain and the catchment is traversed by part of the historical Peddars Way running between Swaffham and Ringstead near Hunstanton.

Camping and caravanning sites are found close to the popular coastal holiday resort of Hunstanton with its popular tourist attractions such as the Sea Life Centre and fun fairs, bathing beach and famous cliffs. To the south of Hunstanton there are other holiday camping sites and beach huts and these are concentrated around Heacham and Snettisham. There are two bathing beaches within the catchment which are designated under European Union legislation, one at Hunstanton the other at Heacham.

A notable inland camping and recreational centre comprising sailing windsurfing boating and angling is the development at Wood Lakes in an eight hectare site near Stowbridge.

A number of the sites of historical and archeological interest (shown on Map 21) are open to the public under the management of English Heritage and the National Trust.

The catchment also contains a number of parks and open spaces for recreation, most notably Sandringham Country Park.

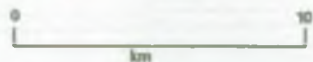
North West Norfolk Catchment Management Plan



Recreation & Amenity – Map 23

KEY

- | | | | |
|--|--------------------|--|------------------------|
| | Catchment Boundary | | Carr/Careen sites |
| | Coastline | | Footpaths & Bridleways |
| | Main River | | Bathing Beaches |
| | IDD Watercourse | | |
| | Other Watercourse | | |
| | Main Towns | | |



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4. OBJECTIVES

This section identifies the primary responsibilities and objectives of the NRA in relation to its activities and the management of the various uses within the catchment. Such objectives may be derived from the legislative duties and responsibilities, National and Regional policy, and specific local circumstances. For each catchment use, at any location, it is the most stringent objective which must be achieved.

National and Regional Objectives for the water environment have been described in a variety of publicly available documents:

Report Title	Published By	Publication Date
Water Resources in Anglia	Anglian Region NRA	September 1994
NRA Water Resources Strategy	National NRA	1993
NRA Fisheries Strategy	National NRA	1993
NRA Conservation Strategy	National NRA	1993
NRA Navigation Strategy	National NRA	1993
NRA Recreation Strategy	National NRA	1993
NRA Flood Defence Strategy	National NRA	1993
1994/95 Regional Plan - Summary	Anglian Region NRA	March 1994

This section describes how these strategic objectives are translated to objectives for the North West Norfolk CMP area at the catchment level.

4.1 SURFACE WATER QUALITY

The NRA National Aim for surface water quality is to:

- Achieve a continuing overall improvement in the quality of rivers, estuaries and coastal waters, through the control of pollution

Until recently the Anglian Region has assessed water quality using the following criteria.

- Compliance with relevant EC Directives.
- National Water Council (NWC) and Coastal and Estuarine Working Party (CEWP) target classes.
- Compliance with non-statutory River Quality Objectives (RQO).
- Biological target classes.

EC Directives set standards for relevant parameters which the directives seek to control, for example the Surface Water Directive (abstraction for drinking water), Fisheries Directive

(protection of fish) and Bathing Water Directive. The government is responsible for ensuring compliance with these standards.

In order to ensure that EC Directives are met and water quality is maintained and where necessary improved, the Department of the Environment has published proposals for a statutory scheme of Water Quality Objectives (WQO).

The WQO scheme establishes clear quality targets to provide a commonly agreed planning framework for regulatory bodies and discharges alike. The proposed WQO scheme is based on the recognised use to which a river stretch may be put. These include:

- River Ecosystem
- Special Ecosystems
- Abstraction for Potable Supply
- Agricultural/Industrial Abstraction
- Water Sports

The standards defining the five tiered River Ecosystem use classes (REC), which address the chemical quality requirements of different types of aquatic ecosystems, were introduced by The Surface Waters (River Ecosystem) (Classification) Regulations 1994. The criteria used in the RE classes are shown in Appendix 3. Although the RECs do not refer to fish, the following descriptions may be helpful to gauge target water quality:

- | | |
|------------------|---|
| Class RE1 | Water of very good quality suitable for all fish species. |
| Class RE2 | Water of good quality suitable for all fish species. |
| Class RE3 | Water of fair quality suitable for high class coarse fish populations. |
| Class RE4 | Water of fair quality suitable for coarse fish populations. |
| Class RE5 | Water of poor quality which is likely to limit coarse fish populations. |

Standards for the further uses are still under development.

For the non-tidal rivers in this plan WQO's, which have agreed quality specifications, are being used alongside EC Directives and Regional RQO's, for components of the DoE scheme which are still being developed. For each stretch of river a target RE class has been assigned. The targets have been derived by translating existing RQO's and have taken into account planned investment in the catchment. These targets are considered achievable within the short to medium term (up to ten years). Map 24 shows the water quality targets for the catchment.

North West Norfolk Catchment Management Plan



River Quality Long Term Objectives – Map 24



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However, until WQO's are formally established by legal Notice served by the Secretary of State, they will be applied on a non-statutory basis.

For the estuary locally derived quality criteria (Appendix 2) and relevant EC Directives have been used as targets.

4.2 GROUNDWATER PROTECTION

There are at present no general criteria for assessing groundwater quality. Where water is abstracted for potable supply many of the parameters in the EC Drinking Water Directive are used.

In order to ensure no deterioration in ground water quality the NRA introduced its Groundwater Protection Policy in December 1992. It provides a framework on which to build individual policies covering all types of threat to groundwater from point and diffuse sources, and by both conservative and degrading pollutants.

In particular, it sets three principal NRA National Aims:

- Ensure that all risks to groundwater resources from both point source and diffuse pollution are addressed within a common framework.
- Provide a common basis for decisions affecting groundwater resources within and between NRA regions.
- Encourage compatibility of approach between the NRA and other bodies with statutory responsibilities for the protection of groundwater.

The Groundwater Protection Policy also sets out detailed objectives which will achieve the principal aims and these cover the following aspects of groundwater protection:

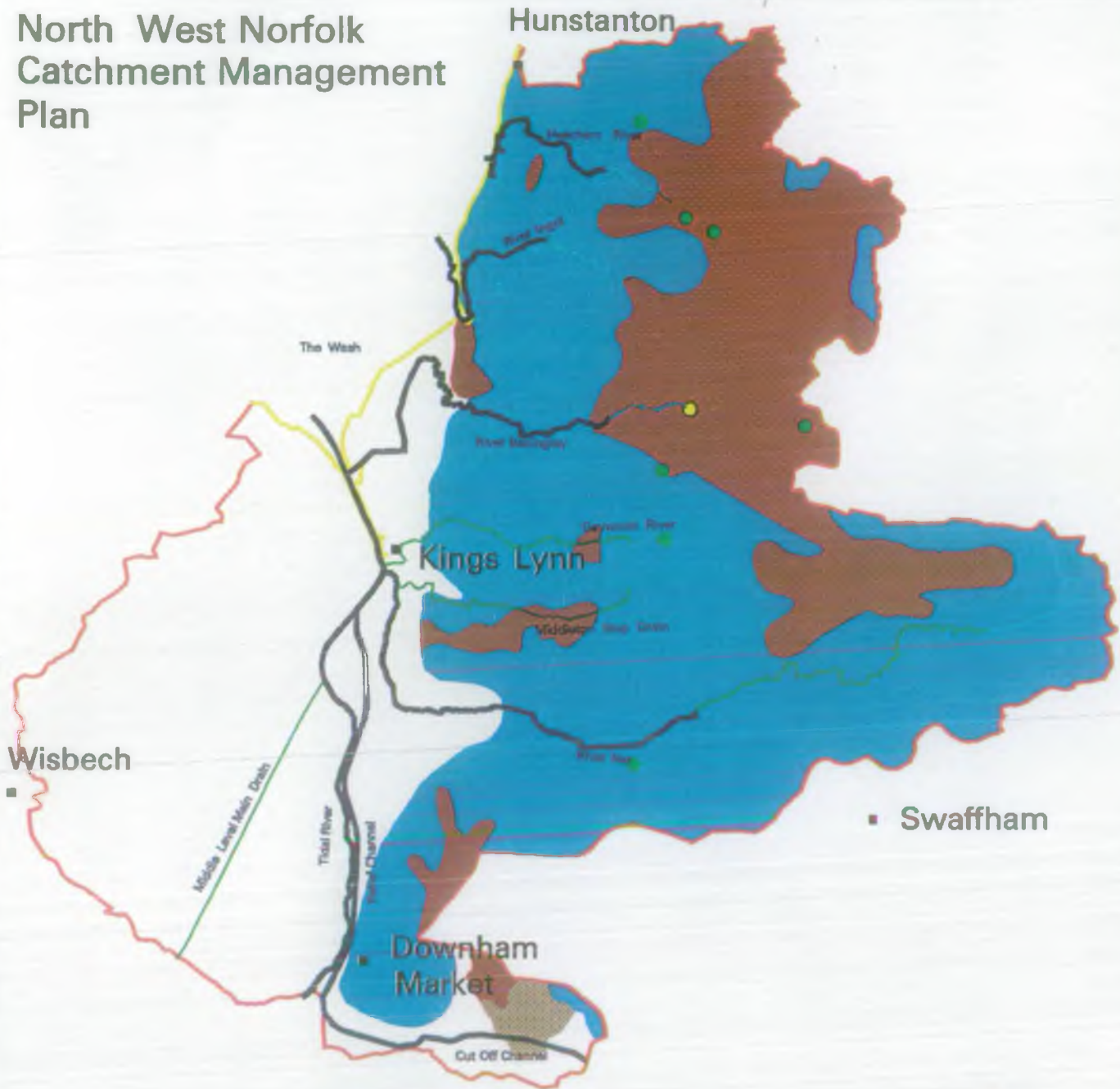
- Physical disturbance of aquifers affecting quality and quantity
- Waste disposal to land
- Contaminated land
- Disposal of sludges and slurries to land
- Discharges to underground strata
- Unacceptable activities in the inner protection zone ²
- Diffuse pollution

The various objectives are related to the risk posed by the activity at particular locations, thus maps have been prepared for the whole country identifying the vulnerability of major, minor and non-aquifers.

The aspects listed below are important considerations in terms of the identification of protection objectives in the region.

² A glossary of terms is provided at the end of the Plan

North West Norfolk Catchment Management Plan



Groundwater Vulnerability – Map 25

KEY

	Catchment Boundary		Aquifer		Soil Leaching Class
	Coastline		Major		High
	Main River		Major		Intermediate
	IDB Watercourse		Minor		Low
	Other Watercourse				
	Main Towns				

PUBLIC WATER SUPPLY:-

<u>Groundwater Sources</u>	
	Chalk
	Lower Greensand

0 10 km



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Source protection zones.

The proximity of an activity to a groundwater abstraction is one of the most important factors in assessing the risk to an existing groundwater source. At a Regional level, Source Protection Zones will be sub-divided into 3 zones of increasing risk for the aquifers and public water supply abstraction points shown on Map 25. The orientation, size and shape of these zones are determined by hydrogeology and abstraction practice.

The highest level of protection is within the Inner Source Protection Zone which is identified as all areas of land within a 50 day travel time of groundwater to the source subject to a minimum distance of not less than 50m from the source. The Groundwater Protection Policy identifies specific activities within this zone which will be opposed through the Town and Country Planning process.

Physical disturbance of aquifers.

The NRA will seek to control physical disturbance, where appropriate, through its own licenses and consents. For activities outside the NRA's legislative framework the authority seeks to influence the proposals through its role as a statutory consultee under the Town & Country Planning process.

Waste disposal to land.

The NRA is a statutory consultee of the Waste Regulation Authorities (WRA's) and therefore liaises closely with these authorities to minimise the risk of pollution from landfills throughout the life of the site. It will seek to use the planning and waste licensing processes to regulate the post-operative and aftercare of the site.

Contaminated land

The NRA will seek appropriate controls to protect the water environment from redevelopment of contaminated land by liaison with Local Planning Authorities. The NRA will also liaise with HMIP to promote Integrated Pollution Control.

Disposal of sludges and slurries to land.

The legislative framework for the control of this activity is complex and there are a number of significant exemptions. However, there are guidelines and regulations containing certain criteria that must be adhered to whilst spreading exempt sludges and slurries. There are no statutory controls other than the EC legislation covering the disposal of sewage sludge, and control of this process rests with HMIP. The NRA will seek consultation from WRA's particularly as to the quantity and timing of such disposal.

Discharges to underground strata.

Controls vary according to the nature and vulnerability of the aquifer and whether there are public water supply abstraction boreholes in the vicinity. The NRA will seek to control such discharges using its own legislative framework in conjunction with its role as a consultee to local planning authorities

Diffuse pollution.

This is pollution not attributable to a direct or point source and is therefore principally influenced by land use and land management. The EC Nitrate Directive requires the identification of groundwaters which have nitrate levels in excess of 50mg/l. Plans to control the input of nitrate will then be required; including the statutory imposition of Nitrate Sensitive Areas. The NRA will prepare and publish national and regional groundwater vulnerability maps and promote awareness of risks to groundwater amongst industry and agriculture. The NRA will also seek to have the concepts of groundwater vulnerability incorporated in the regulations and guidelines of other governmental and regulatory bodies, trade associations, and planning authorities.

4.3 WATER QUANTITY

The NRA National Aim for water resources is to:

- Manage water resources to achieve the right balance between the needs of the environment and those of the abstractors

This is implemented by adherence to the general NRA statutory objectives

- To protect aquifers and surface water from over-commitment and ensure water abstraction does not have an unacceptable effect on existing abstractors and on the environment
- To ensure the proper use of water resources
- To conserve water resources
- To augment and/or redistribute water resources, where appropriate to meet water demands to appropriate standards of reliability

At a catchment level specific objectives are listed under each of the general national objectives.

To protect aquifers and surface water from over commitment and ensure water abstraction does not have an unacceptable effect on existing abstractors and on the environment

The NRA will provide the best practicable assessments of resource availability. It will continually review and revise these in the light of new assessment methodologies and data.

The NRA will define the appropriate water levels, flows and quality required to maintain and enhance the water environment. Such "in river needs" studies will use data already available as well as further field work.

As a result of this the NRA will set River Flow Objectives for the rivers in this catchment and, where appropriate, define minimum acceptable flows.

The NRA will consider the water requirements for the washland and wetland sites of conservation interest in order to ensure that abstractions will not be authorised which would unacceptably affect such sites.

The NRA will ensure sufficient resource to maintain the water needs of the estuary.

The NRA will require the applicant for an abstraction licence to undertake an environmental assessment as part of the application procedure, where there is a possible risk of environmental damage.

To ensure the proper use of water resources

The NRA will publish best estimates of future water demand for all purposes

The NRA will define a framework within which water users can plan to meet their needs, and will advise on possible constraints.

The NRA will advise Planning Authorities on water resources aspects of their development plans, in accordance with the Regional and National Water Resource Strategy.

The NRA will promote the wise use of water and demand management

The NRA will ensure that the future requirement for water meets "reasonable needs". Water abstraction licence applications must show consideration of alternative supplies, demand management or recycling. Specific requirements according to each use, are as follows:-

- **Public Water Supply**

The licensing horizon is currently year 2011; it is not considered reasonable to allocate water for needs beyond this. The water company must have demonstrated that they have carried out effective demand management, reduced leakage to economic rates and, where water resources are under stress, considered metering of domestic use before extra water resources are allocated.

- **Spray Irrigation and Agriculture**

For spray irrigation licences the requirements of water needed with respect to the type of crops and soil conditions are taken into account. For agricultural licences the numbers and type of animals kept may be important in determining requirement.

- **Industrial**

For industrial licence applications the process is considered as well as the expected life of the plant.

To conserve water resources

The NRA will ensure that the environmental water needs are treated as a positive demand

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 will adopt the principles of sustainable development and exercise the precautionary principle when assessing the requirements for further development of the water resources of the catchment.

The NRA will encourage the storage of winter surface water in reservoirs.

The NRA will ensure the efficient management and planning of future water resources continues into the future. This includes maintaining a "watching" brief on climate change. The 1989-92 drought has served to develop better practice of water resource management

both by the NRA and the abstractors.

The NRA will set discharge consents appropriate to anticipated future flow regimes, rather than historic flow regimes and thus sustain pressure to improve river and groundwater quality.

There are benefits to water quantity (ie the impact of abstraction upon river flows will be minimised) if the discharge of water is made within the catchment and as far upstream as possible. However, water quality objectives often preclude this as an option.

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

The Authority will periodically review the need for augmentation schemes in catchments with low flows.

The NRA will support appropriate standards for each use of water as follows:-

- Public Water Supply

The NRA accepts the 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 and the risk of rota cuts or use of standpipes on average not more than once in 100 years

- Spray Irrigation

The Region's target level of service for spray irrigation is that there should be risks of shortages not more than once in 12 years on average

- Others - Industrial, Agricultural etc

There is no specific target level of service for these uses.

4.4 ENVIRONMENTAL FEATURES

The NRA National aims for environmental features are to:

- Conserve and enhance wildlife, landscape and archaeological features associated with inland and coastal waters of England and Wales.
- Maintain, improve and develop fisheries
- Develop the amenity and recreational potential of inland and coastal waters and associated lands.
- Improve and maintain inland waters and their facilities for use by the public where the NRA is the navigation authority

These broad aims are implemented as a number of specific objectives relating to the various categories of use.

Conservation

The NRA has a statutory duty to further the conservation of flora and fauna when carrying out its duties. The NRA will carry out this duty by adherence to specific conservation objectives which are:

To establish a system of classification to identify environmental condition and conservation value of river corridors, inland waters, estuaries, coastlines and wetlands. This will be carried out initially by the analysis of data collected using survey methods including the Rivers Environmental database, river corridor surveys, river habitat surveys, and the Coastal Wildlife database.

To ensure that the NRA's regulatory, operational and advisory activities take full account of the need to safeguard the water environment and further conservation, as identified within the conservation classification system and other data sources.

To sustain, and where appropriate, enhance or restore the habitat diversity within the water environment.

To provide an environmental assessment and recommendations to ensure the maintenance and enhancement of conservation interest to flood defence.

To ensure that river management does not adversely affect sites of archaeological importance.

To protect the ecology of sensitive wetland sites the NRA will, in consultation with English Nature and others, produce site specific water level management plans which will define the control water levels to be achieved.

Fisheries

Specified fisheries are designated under EC Fisheries Directives which set water quality criteria according to fishery type based upon those used in the EC Fisheries Directive:

- Game fisheries; that is the maintenance of breeding populations of salmonid fish species, namely brown trout and sea trout in this catchment.
- Coarse fisheries; that is the maintenance of breeding populations of cyprinid or coarse fish species.

These fishery types are objectives defined by their water quality and not by the species composition. However, they provide pointers to specific fisheries objectives where the water quality complies with the criteria laid down in the directive. These objectives are:

To protect and conserve Salmonid, Cyprinid, eel and Coastal fisheries

To maximise the fish biomass to the realistic potential carrying capacity for each channel, based on suitability of habitat and channel size.

To maintain appropriate species diversity by the protection and suitable enhancement of in-stream habitat, and by restocking to rehabilitate damaged fisheries.

The NRA will quantify the total extent of all fisheries, providing a detailed description of the resource to be managed and instituting a fisheries classification scheme.

Angling

With others, the NRA seeks to maintain and improve angler access, balancing the legitimate needs of all river users, and environmental sensitivity.

It also will advise anglers on methods to minimise damage to river banks caused by illegal excavation, to comply with Land Drainage Byelaws.

Navigation

The NRA will develop a suite of "model" navigation byelaws to achieve consistent, practical, legal and environmental sense on a national and regional scale.

It will maintain and improve navigation fairway, facilities and standards with a view to encouraging the use of rivers for navigation but taking into consideration the rights of land and fisheries owners and the NRA's conservation duty.

The NRA will ensure that all locks and other NRA owned navigation structures are maintained to meet the appropriate standards of Health & Safety and to the requirements of local legislation.

With District Councils, the Eastern Council for Sport and Recreation and boat users the NRA

will seek to influence the strategic development of navigation facilities.

Recreation and Amenity

The NRA will take account of recreation potential in development proposals relating to any NRA activity; for example flood banks footpaths, information boards, and access points to the waterway.

The NRA will promote and safeguard existing public access to rivers and where appropriate, on land owned by the NRA commensurate with the needs of conservation and safety.

With others the NRA will promote the appropriate recreational use of waterways by, where appropriate, the creation of new facilities and provision of information.

4.5 FLOOD DEFENCE

The National NRA aims for flood defence are to:

- Provide effective defence for people and property against flooding from rivers and the sea.
- Provide adequate arrangements for flood forecasting and warning

The NRA has commissioned a review of flood defence standards of service for Main River and Sea Defence while existing maintenance standards are based on historically determined criteria return periods and frequencies. This review will influence maintenance requirements for the future and provide a rational basis for future flood defence priorities.

The NRA has identified areas of inadequate flood protection level which will be considered for improvement subject to the recommendations covered within the 1993 Ministry of Agriculture Fisheries and Foods (MAFF) Strategy for Flood Defence in England and Wales. This strategy prescribes that improvement schemes are appraised on the criteria of technical, environmental and economic soundness. The MAFF Indicative Standards of Protection are used in conjunction with NRA Target Levels of Service to determine standards of design.

Flood defences do not provide absolute protection but alleviate flooding up to a particular level of severity. The standard of protection provided normally relates to the land use of the area concerned, where urban defence attracts a high priority.

The detailed objectives for this activity are:

To provide effective defence for people and property against flooding. The standard of protection to be appropriate to the land use, where this is economically viable.

To control development and works in or adjacent to Main River and sea defence in accordance with the NRA's Flood Defence byelaws such that the risk of flooding is not increased.

To ensure that the river topography remains suitable for the efficient passage of high flows and that control structures are adequately operated and maintained.

To ensure the correct operation of river control structures during both flood and normal flows.

To maintain and operate tidal defences to prevent, as far as possible, tidal inundation.

To provide adequate arrangements for flood forecasting and warning.

To carry out maintenance in Main River and to sea defences where necessary to protect people and property to the appropriate standard.

To carry out flood defence works with reference to the environmental needs and requirements.

To carry out monitoring of coastal cells in order to determine the effects of sea defence processes on adjacent cells both from a flood defence and environmental point of view.

4.6 DEVELOPMENT CONTROL

Development control objectives both in terms of responses to Development Plans or specific planning applications should be derived from the adaption of NRA policies, as contained in the NRA guidance notes for Local Planning Authorities, in Local Authority Development Plans.

These will aim to ensure that:

Flood Defence

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.

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.

On statutory "main river" adequate access exists for the proper maintenance of watercourses and structures and that future flood defence schemes are not precluded.

Water Quality

New development does not cause pollution of surface and groundwaters.

Developments comply with the NRA Groundwater Protection Policy.

Water Quantity

Development does not cause unacceptable effects on surface water and groundwater resources.

The existing rights of those who abstract water are protected.

Conservation and Enhancement of the Water Environment

The water environment is safeguarded from any detriment due to development.

The enhancement of the conservation, recreation and amenity value of the water environment occurs where possible in conjunction with development.

5. STATE OF THE CATCHMENT

This section describes the current state of the water environment in the catchment resulting from the use made of it and the NRA's activities within it. It is assessed against the NRA's objectives in managing the water environment. The shortfalls between the current state and the objectives are identified as issues which may need to be addressed in the future management of the catchment.

5.1 SURFACE WATER QUALITY

An assessment of current quality has been made by considering three years data (1991 - 1993 calendar years). An allowance has been made for the effects of algal BOD in some stretches. The current quality has then been compared with the existing EC Directives requirements, proposed Water Quality Objectives (WQO'S), and RQO's (for those components of the WQO scheme which are still being developed). Compliance with proposed WQO's is shown on Map 26, which identifies the stretches as compliant, marginal or significant failures. There are no reported failures for EC Directives.

5.1.2 Freshwater

Heacham River: Sedgeford to Heacham Harbour.

The majority of this stretch is of good quality and complies with the REC2 objective and is close to achieving compliance with REC 1 (Rivers Ecosystem Class 1). In the lower reaches there is a significant failure of the REC 3 objective for dissolved oxygen (DO). This failure is possibly related to the effect of partial tide-locked conditions in the lower reaches. Biological quality in the lower reaches is poor.

River Ingol: Shernborne to the Wash.

The river is of fair quality and complies with the REC 3 objective. Biological quality is moderate.

Babingley River: Flitcham Abbey to the Wash.

The upper and middle reaches are of good quality and comply with the REC 2 objective and biological quality is good. In the lower reaches there is a significant failure of the REC 2 objective for DO and biological quality is moderate to good.

Gaywood River: Gayton to the Wash.

The upper and middle reaches to the A148 roadbridge are of fair quality and comply with the REC 3 objective. Biological quality is moderate. In the lower reaches there are marginal failures for ammonia and significant DO failures. The biological quality is moderate to poor.

North West Norfolk Catchment Management Plan

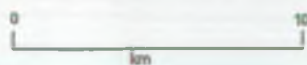


Compliance with River Quality Targets – Map 26

See map 24 for REC targets

KEY

- Catchment Boundary — Significant Failure
— Coastline — Marginal Failure
— Unserved River — Compliant
■ Main Towns



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Middleton Stop and Pierpoint Drains: Headwaters to Tidal River Nar.

The upper reaches downstream to the A149 roadbridge are of fair quality and meet the REC 3 objective and biological quality is good. The lower reach from the A149 roadbridge is of poor quality and fails to meet the target REC 3. There are significant failures for ammonia and DO, and marginal failures for Biochemical Oxygen Demand (BOD). Biological quality is moderate to poor.

River Nar: Mileham to Litcham.

This length fails to meet the REC3 objective for DO. The failures for DO are significant and occur during the summer and autumn period. These failures appear to be associated with lower flow periods in the year. Biological quality is moderate to good.

River Nar: Litcham to Lexham Hall.

This length fails to meet the REC 3 objective, there are marginal ammonia failures and significant failures for DO. Biological quality is moderate to good. The DO failures appear to be associated with the lower flow periods of the year.

River Nar: Lexham Hall to Castle Acre.

From Lexham Hall to Newton there are significant DO failures to meet the REC 2 objective. Downstream oxygen concentrations improve to give marginal failure between Newton and Castle Acre. Biological quality is good.

River Nar: Castle Acre to Narborough.

This length of river is of good quality and complies with the REC 2 objective. Biological quality is good.

River Nar: Narborough to Tidal Sluice.

This length of river is of fair quality and meets the REC3 objective. Biological quality is good.

Flood Relief Channel: Denver Sluices to Tail Sluice.

The Flood Relief Channel is of fair quality and meets the REC 3 objective. The majority of this length is of moderate biological quality, however, the lower section may be influenced by saline intrusion.

Middle Level Main Drain: Three Holes to Wighenham St Germans.

The quality of this watercourse is fair but it fails to comply with the REC 3 objective. Biological quality is moderate to good.

5.1.2 Tidal & Estuarine Waters

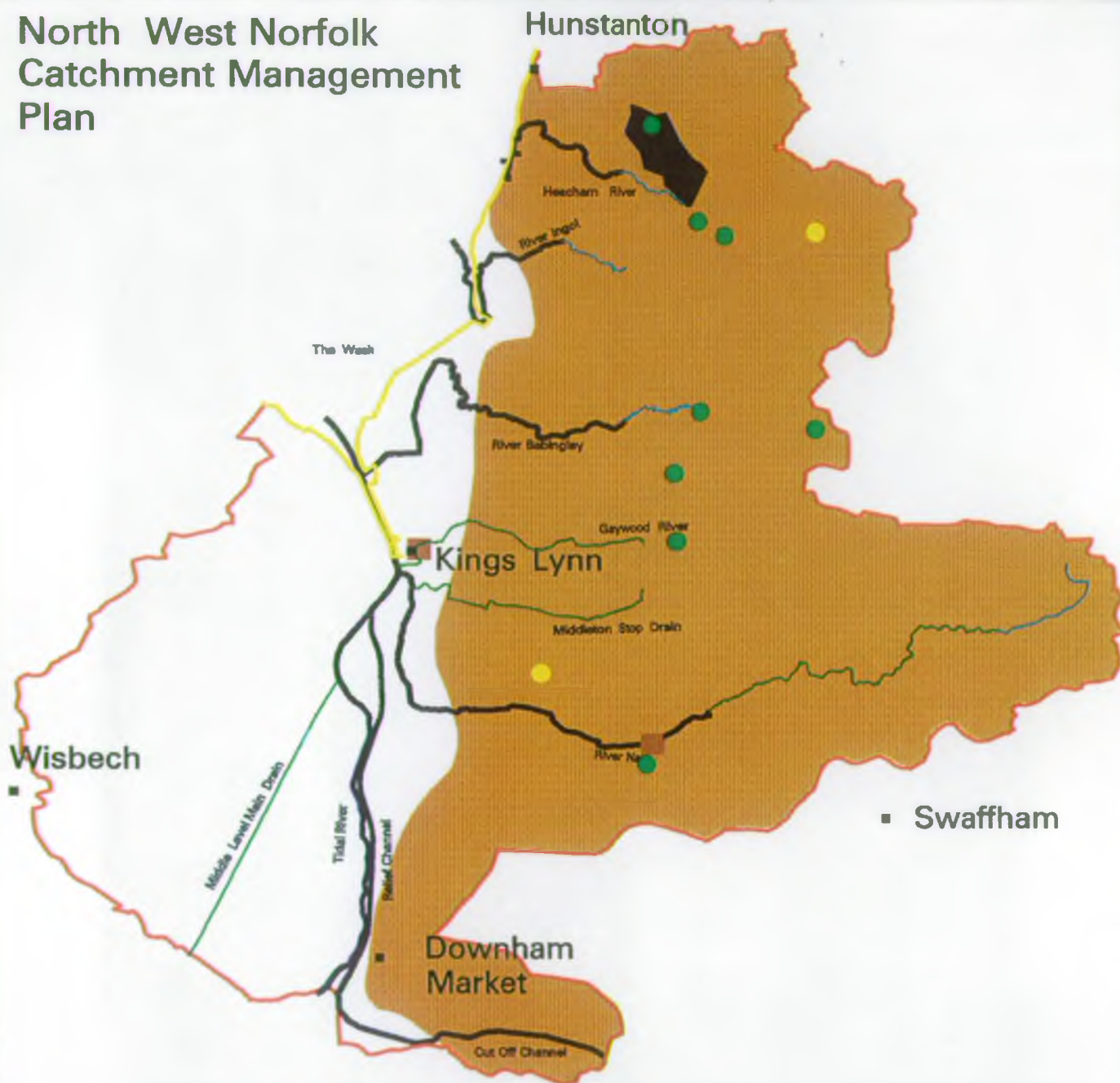
River Great Ouse Estuary & the Wash

The chemical quality of the estuary is generally good. Results show that the locally derived Environmental Quality Standards and EC Directives are met. The bacterial numbers in the estuarine water are high, especially from Stowbridge seaward into the south-east area of the Wash. The major source of bacteria in this zone is the King's Lynn STW discharge.

Bathing Water Sites.

EC Designated bathing waters at Heacham North beach and Old Hunstanton comply with the EC Directive.

North West Norfolk Catchment Management Plan



Groundwater Quality – Map 27

KEY

- | | | | |
|--|--------------------|--|--|
| | Catchment Boundary | | Public water supply boreholes with high nitrate concentrations |
| | Coastline | | Minor contamination from waste disposal site |
| | Main River | | Nitrate sensitive area |
| | IDB Watercourse | | General Area Where There Are Domestic Wells or Boreholes |
| | Other Watercourse | | |
| | Main Towns | | |
- 0 10 km



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5.2 GROUNDWATER QUALITY

Groundwater quality throughout the catchment is routinely monitored by the NRA. In addition, data collated by water companies for public supply abstractions is also used to make assessments. The Chalk provides a vital source of generally high water quality requiring only minimal treatment before use. However, it is susceptible to pollution which is very difficult to clean up.

At present groundwater protection zones (GPZ) have been defined for those sources which have high nitrate problems as shown on Map 27. Supply sites which are not subject to high nitrates are currently the subject of NRA investigations to define their GPZ's.

Physical disturbance of aquifers.

Within the catchment the major disturbance results from mineral extraction. Construction projects involving large excavation work are infrequent and limited in extent. There are several gravel extraction sites in the area as shown on Map 16. At present there are no sites in the CMP area which give rise to concern.

Waste disposal to land.

This takes place at a number of locations in the catchment as can be seen on Map 13. Waste disposal sites have the potential to contaminate both surface and groundwaters with leachate if not carefully managed. Leachate from waste sites at Blackborough End and Docking has caused contamination of the groundwater.

Contaminated land

No major problems of this nature have been identified. However, disused gas works at Downham Market, Swaffham, and Hunstanton and some industrial sites have localised contamination. This will require investigation and remediation before redevelopment at these sites.

Disposal of sludges and slurries to land.

Sludge disposal by AWS Ltd occurs close to Royden Common SSSI and at a number of other sites throughout the catchment.

Discharges to underground strata.

No significant problems with soakaways have been identified in the North Norfolk CMP area.

Diffuse pollution.

The most significant pollutant associated with agriculture is nitrate fertiliser and there are many areas within the catchment where the nitrate concentrations are above or at the EC maximum allowable concentration of 50 mg/l of nitrates. To treat high nitrate levels AWS Ltd have installed nitrate removal plants at Sedgeford, Fring, Marham and Bexwell public

water supply sources. AWS have developed alternative supplies of water from the Lower Greensand, which has a higher iron content but a generally lower nitrate concentration than the Chalk. After treatment to remove the iron this is often blended with Chalk waters to enable compliance with drinking water standards.

The NRA has been involved in the designation of Nitrate Vulnerable Zones ³ (Swaffham and Great Bircham) and Nitrate Sensitive Areas (Sedgeford) as shown on Map 27. It is hoped that compliance with the Code of Good Agricultural Practice, and more stringent controls on nitrate application are proposed by the Ministry of Agriculture Fisheries and Food (MAFF), will enable these Chalk groundwater sources to meet the requirement of the EC Nitrate Directive.

³ . A glossary of terms is provided at the end of the Plan

5.3 WATER QUANTITY

5.3.1 Surface Water Resources

The river flow in the catchment reflects rainfall, topography and surface geology.

Map 28 shows that rainfall is highest in the east of the catchment over the Chalk uplands. The long-term average for the period 1961 to 1990, recorded at Sandringham, is 683 mm which compares to 605 mm for the Great Ouse catchment as a whole. The deviation from the long-term average at Sandringham is shown on Map 28.

The Tidal River/Great Ouse has a long term average flow of 16 cubic metres per second (m^3/sec). In times of flood the need to discharge substantial quantities of water through the Denver sluices can produce peak flows of up to $190 \text{ m}^3/\text{sec}$. During drought periods it is possible for flows in the Tidal River to fall substantially which can cause siltation problems and poor water quality. Flows in the Tidal River are intimately associated with those in the Ely Ouse and Bedford Ouse CMP areas, and the operation of the various sluices.

Flows in the River Heacham, as measured at Heacham Mill, are generally low with a mean value of $0.2 \text{ m}^3/\text{sec}$ and exhibit little annual variation. In 1993 the NRA installed a flow gauging station on the Gaywood at Sugar Fen (Grid Reference TF 6940 2047) to monitor flows in the river but as yet the record is not sufficient to display any long-term data. There is no flow monitoring on the River Ingol. Flows in the Babingley are gauged at Castle Rising (Grid Reference TF 6811 2525) about half way down the river. Flows range from $1.9 \text{ m}^3/\text{sec}$ to $0.01 \text{ m}^3/\text{sec}$ with a long-term average flow of $0.48 \text{ m}^3/\text{sec}$ with little seasonal variation. Flow gauging of the River Nar occurs at Marham (TF 723 119). The long-term annual average flow is $1.15 \text{ m}^3/\text{sec}$ with an annual range of $0.14 \text{ m}^3/\text{sec}$ to $7 \text{ m}^3/\text{sec}$. There is little variation between the average summer ($1 \text{ m}^3/\text{sec}$) and winter flows ($1.2 \text{ m}^3/\text{sec}$). This pattern of flows in these rivers reflects the importance of the continual spring flow to the river.

The Fenland region to the west of the Great Ouse is crossed by numerous man-made drainage channels most of which drain into the Tidal River and estuary. Pumping from the Middle Level main drain into the Ouse estuary takes place at Wiggshall St Germans at an average rate of $3 \text{ m}^3/\text{sec}$. This is operated by the Middle Level Commissioners. Throughout the period of the drought these systems were largely self-regulating. In most IDB's the ponding levels were held higher than normal both to permit abstraction and raise 'sop' levels. This was achieved by use of stop boards within the drains. This proved particularly beneficial in the Middleton Stop and Pierpoint drain and was adopted by the West of Ouse IDB.

There are no Minimum Acceptable Flows (MAF) defined for the rivers in the North Norfolk CMP area. A Minimum Residual Flow (MRF) has been set for the abstraction by Anglian Water Services from the River Nar at Marham. Under the Wisbech Water Order 1948 an MRF of $0.0505 \text{ m}^3/\text{sec}$ (4364 cubic metres per day) was set. This MRF was not reached during the 1989-1992 drought unlike other

Public Water Supply abstraction MRFs and cessation levels.

There is also an MRF in force for the transfer of water from Denver to the Ely Ouse Essex scheme. This requires a flow through the Denver sluices, when the transfer is taking place, of 113.6 thousand cubic metres per day (tcmd) from March to August and 318.2 tcmd between October and February. At times of low flow this discharge is passed into the Relief Channel rather than directly into the Tidal River downstream of Denver. The NRA also has powers, in respect of many of the licences issued since 1992, to order the cessation of abstraction in the South Level system (Ely Ouse CMP area) under the Denver Combined Low Flows Cessation Clause. This is an exceptional measure designed to maintain some flow through the Denver Complex to the estuary.

A cessation level aims to protect low flows, in river needs and other licence holders. A cessation level for the River Nar of $0.3\text{m}^3/\text{sec}$ as measured at Marham (Map 29), takes into account both the existing MRF and other licensed abstractions. A cessation level has also been set for the River Babingley at Castle Rising Gauging Station of $0.34\text{ m}^3/\text{sec}$ and $0.04\text{m}^3/\text{sec}$ at Congham Gauging Station. There are no cessation levels set for the Rivers Ingol or Heacham. All new licences and existing licences due for renewal in the catchments of the Babingley and Nar will be subject to cessation conditions based on historic flow regimes rather than target future flows.

A recent study in the River Babingley by Loughborough University in conjunction with the NRA has led to the development of a standard method for assessing "In River Needs", formalising the environment as a positive demand. This study suggests a hierarchy of river flows dependant upon the current needs and any environmental improvements which may be required. These River Flow Objectives have yet to be incorporated in the management of any river catchment. It is hoped to repeat this methodology on other catchments in the area with a view to establishing a similar framework for them.

5.3.2 Groundwater Resources

The principal stores of groundwater reserves are the Chalk and Lower Greensand aquifers. There are several areas of Sands and Gravels which are also important locally.

An assessment has been made of the average yearly volume of water which contributes to the groundwater stores. This assessment follows NRA Anglian Region's standard practice (as outlined in the Regional Water Resources Strategy) and uses information about the rainfall distribution and the infiltration rates associated with the different types of geology. The reliable groundwater resources are divided between the environmental need for water, ie. the rivers and wetlands, and the water which may be allowed for abstraction. The table below shows the assessment for the Chalk units and the Lower Greensand unit. It is using this analysis that the groundwater abstraction licensing policy for the catchment has been derived. The final column of the table indicates how much groundwater is available for abstraction.

North West Norfolk Catchment Management Plan

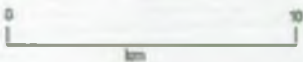


Mean Annual Rainfall (1961 – 1990) – Map 28

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourses
- Other Watercourses
- Main Towns

— 600 — Mean Annual Rainfall in mm



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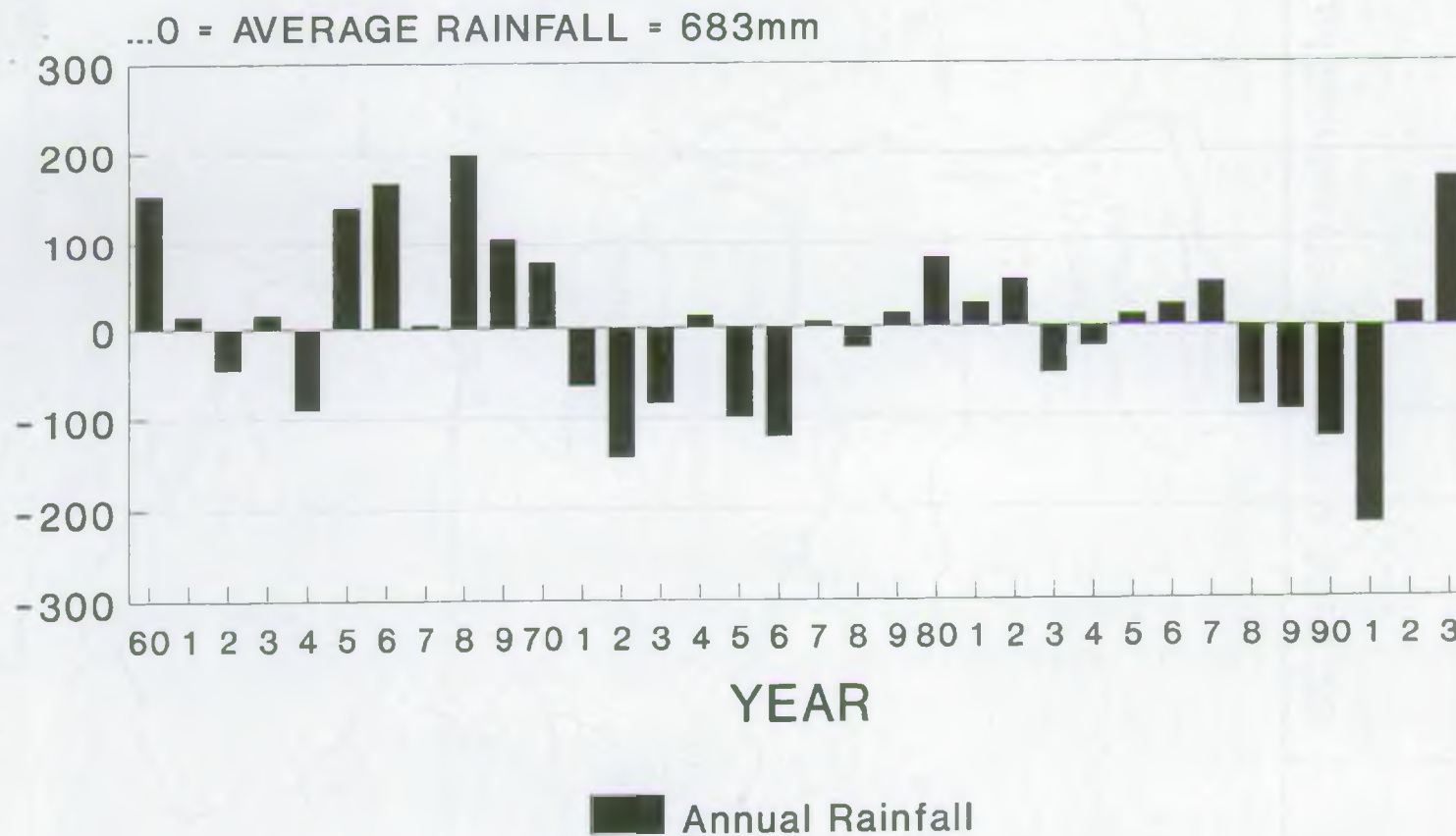
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North West Norfolk

Annual Rainfall For Sandringham

Raingauge Grid Ref TF56973289



Longterm average
1961 to 1993 = 683mm



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Groundwater Unit	Reliable Resource tcmd	Committed to Environment tcmd	Committed to Abstraction tcmd	Balance Nominally Available
North Eastern Chalk	22.3	2.1	5.3	14.9
Heacham/Ingol/Babingley/Gaywood	58.0	32.8	21.9	0.0
Nar	69.9	44.8	28.9	0.0
Lower Greensand	74.4	29.7	10.7	34.0

The NRA monitors groundwater levels using observation boreholes, however the data varies in quality. The authority is currently undertaking a review of the monitoring network with a view to resolving some of the problems.

There is a marked annual fluctuation in groundwater levels in the Chalk. The Chalk shows a rapid response to recharge with a "short" memory. This is best shown by the response of the aquifer to the 1989-1992 drought where groundwater levels reached an historical low level but within two wet winters had recovered to beyond long-term average levels. This distinct annual cycle can make the effects of seasonal abstraction difficult to identify. The annual cycle in the Lower Greensand groundwater is more gradual than that of the Chalk.

Water level changes at Dersingham Bog, Leziate, Sugar & Derby Fens and Royden Common SSSI wetland sites are due to be studied under the "Hydrological Monitoring of Wetlands" project in conjunction with English Nature. This project aims to establish to develop the understanding of the hydrology of wetland sites enabling the causes and effects of water level changes at these sites to be identified. It will concentrate, in the first instance, on those wetlands which are close to significant groundwater abstraction sites.

The NRA has not developed any river augmentation schemes in this catchment area. During the drought permission, under a Drought Order, was granted to drill and test two boreholes in the catchment of the River Nar. The yield of the scheme may have increased the flow of the Nar at Marham by around 100 l/sec. In January 1991 the decision was made not to renew the Drought Order and the scheme is not currently operational.

5.3.3 Water Abstraction

The NRA regulates the quantity of water abstracted from rivers and groundwater by the powers given under the Water Resources Act 1991. Nearly all water abstraction is controlled by a licence issued by the NRA.

The River Ouse Management Project (ROMP) is an internal study set up to enable the NRA to determine any future licence applications for increased abstractions from

the lower reaches of the Ely Ouse (such as at Denver) and the Bedford Ouse (such as at Offord).

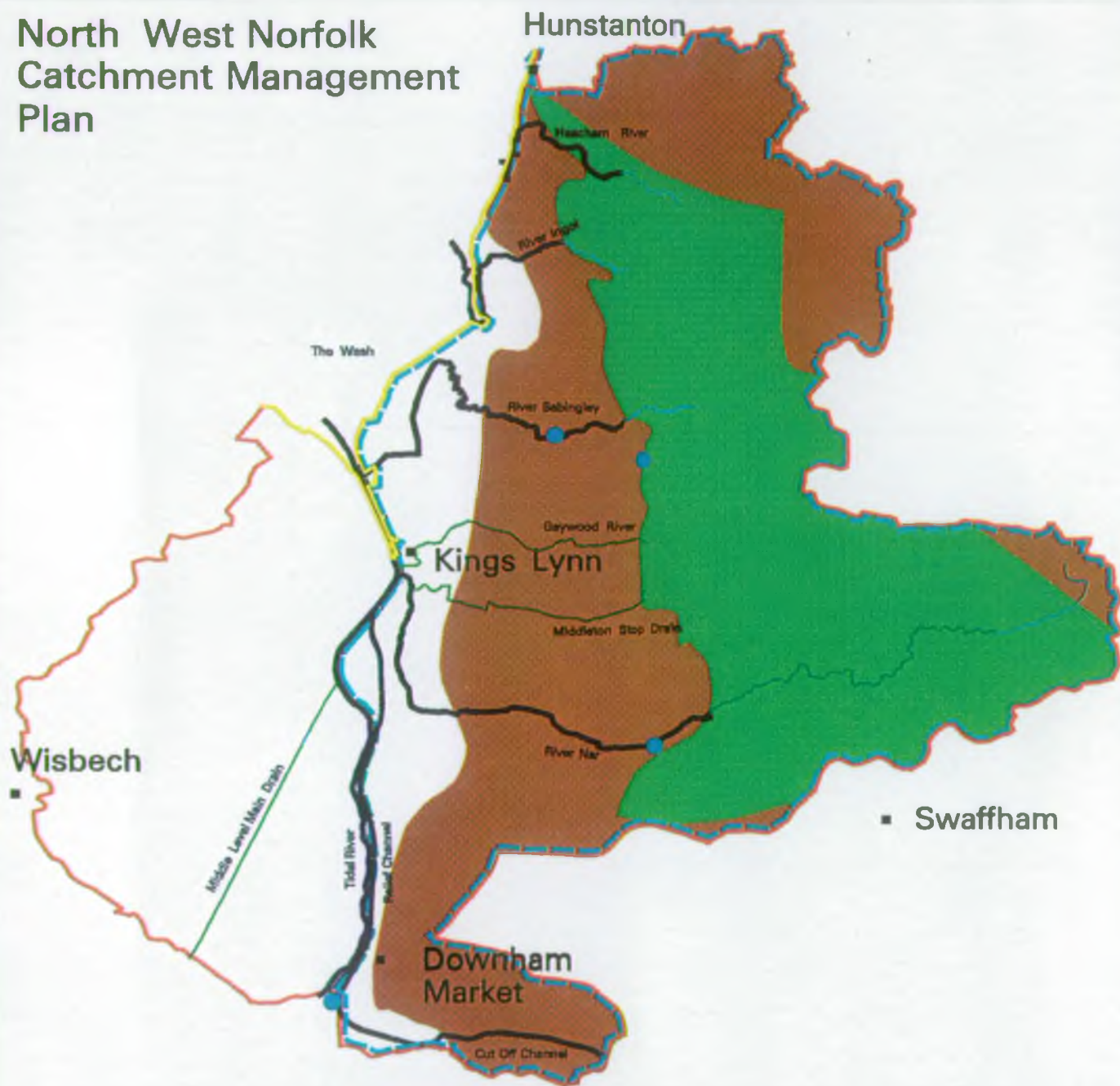
The table below summarises the currently licensed abstractions in the North Norfolk CMP area.

Use:		Potable Water Supply	Agric. - General \$	Agric. - Spray Irrigation	Industrial *	Total
Surface Water	No. of licences	3	5 (2)	67	3 (1)	78
	Quantity (m ³)	5 804	1 854 618 (1 850 000)	2 607 608	1 501 636 (59 091)	6 544 262
Groundwater - Chalk	No. of licences	9	65	31	1 (1)	106
	Quantity (m ³)	19 552 917	238 258	3 413 467	34 000 (34 000)	23 238 642
Groundwater - Lower Greensand	No. of licences	4	7	24	3 (3)	38
	Quantity (m ³)	inc in Chalk	8 702	1 045 815	1 579 400 (1 579 400)	2 633 917
Groundwater - Gravels	No. of licences	0	2	4	4 (4)	10
	Quantity (m ³)	0	2 045	190 830	1 368 550 (1 368 550)	1 561 425
Totals	No. of licences	16	79 (2)	126	11 (9)	232
	Quantity (m ³)	20 380 267	2 103 623 (1 850 000)	7 257 720	4 483 586 (3 041 041)	34 225 196

\$ Numbers in brackets refer to Fish Farming Licences included in Agricultural Category

* Numbers in brackets refer to Mineral Washing & Processing Licences included in Industrial Category

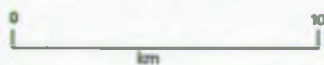
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Water Availability – Map 29

KEY

- Catchment Boundary
- Coastline
- Main River
- IDB Watercourse
- Other Watercourse
- Main Towns



Groundwater Availability

- Water Available
- Non Available
- Water Available, but area regarded as non-squaller

Surface Water Availability

- Cessation Level Control Points
- Winter Water – Available in all Catchments
- Summer Water: — None Available



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Map 29 shows current water resource availability and is summarised as:

- There is no summer water available from the rivers to the east of the Great Ouse. However, there is some available from the area to the west of the Tidal River. Winter water is available from all catchments.
- Water is available in the Lower Greensand aquifer and in the NW Norfolk Chalk.
- Water is not available in all other areas of the Chalk aquifer.

5.4 ENVIRONMENTAL FEATURES

5.4.1 Fisheries

The NRA has duties to maintain, improve and develop fisheries and to further the conservation of fish species. The fishery provides a resource for a number of catchment uses such as angling and the environment. Fish populations are affected by the quality and quantity of water as well as by the availability of suitable physical habitat features. Fish are therefore important indicators of the overall health of the river.

The extensive data collected on fish populations allows the fisheries to be classified on a scale of A to D dependent on biomass estimates. Map 30 shows the fishery classification of rivers in this catchment.

The principal coarse fisheries within this catchment are the Relief Channel and the Middle Level Main Drain. Since its creation in the 1960's the Relief Channel has supported a coarse fishery which at times has been of national renown particularly during the early to mid 1970's. Since that time, the coarse fish population has declined to a biomass category "D" fishery as described by fish population surveys from 1979 to 1991. In 1993 the biomass had improved to 16.5 grammes per square metre (gm²); a biomass category "B" fishery. This was probably as a result of an influx of fish from adjacent water courses. This survey revealed the presence of sixteen species of fish with roach and bream forming the dominant component of biomass. The Middle Level Main Drain from Mullicourt Aqueduct downstream supports a moderate biomass category "B" fishery; with roach and bream as the dominant species. Habitat enhancement techniques should be evaluated for increasing the fish holding capacity of deep lowland waterbodies such as the Relief Channel and the Middle Level Main Drain and preventing downstream displacement of juvenile fish.

Between its source near Litcham and the gauging weir at Marham, the River Nar is typified by riffle pool sequences over a gravel substrate. The fish population in this area is dominated by a breeding native brown trout population and eels. Around Narborough a rainbow trout population has also been recorded. There is some evidence of a fairly regular sea trout run into the River Nar and passage of any migratory salmonids will be made easier by the installation of a fish pass at the old King's Lynn Sluice in 1994. Below Marham, the River Nar loses its gradient and becomes embanked, showing more of the characteristics of a fenland river. In this area the fish population is dominated by coarse species, particularly roach, pike, bream and eels.

The River Babingley supports a breeding brown trout populations on its upper reaches where riffle pool sequences dominate this chalk stream. Downstream of Castle Rising the river becomes embanked down to the tidal flap at its outfall into the estuary. This area contains a limited coarse fish population and estuarine species, particularly flounder, are frequently recorded. Routine fish populations surveys with special follow up surveys as well as poor angling performance have highlighted a deficiency of cyprinids in the River Babingley in its lower reach

North West Norfolk Catchment Management Plan



Fish Biomass – Map 30

KEY

- Catchment Boundary
- Coastline
- Main Towns

Biomass Classification

- Class A > 20g/m²
- Class B 10 – 20g/m²
- Class C 5 – 10g/m²
- Class D 0 – 5g/m²
- Unsurveyed



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downstream of Castle Rising.

Evidence exists of a sea trout run in both the River Nar and the River Babingley and consideration should be given to facilitating their free passage into these rivers when re-designing tidal gates. It is also important to maintain clean gravel riffles to enhance spawning opportunities for both migratory and resident brown trout population.

The Middleton Stop Drain between East Winch and King's Lynn is a narrow embanked watercourse containing a small coarse fish population dominated by roach and pike. The Gaywood River is a small watercourse whose fish population is dominated by eels reflecting its proximity to the tidal estuary. The River Ingol is the smallest of the rivers covered in this plan and is not considered to have a significant fish population. A small breeding brown trout population has been recorded upstream of Heacham village on the Heacham River where habitat is suitable, but the downstream reaches which are ponded by the outfall at South Beach have only a small coarse fish population dominated by eels.

The following sections of river are designated under the EC Fisheries Directive and all of them comply with the requirements of the Directive.

Cyprinid Relief Channel: Head Sluice at Denver to Tail Sluice (17.0 km).

River Nar: Marham Water Works Intake to the old tidal sluice at King's Lynn (16.0 km).

Salmonid River Nar: Lexham Hall to Marham Water Works Intake (17.0 km).

River Babingley: Flitcham Abbey to A149 Roadbridge (10.0 km).

Heacham River: Lower Reaches (8.0 km).

Currently five of the six shellfish beds are adversely affected by sewage discharges to the Wash, shellfish caught from the affected beds require additional cleansing before sale for human consumption.

5.4.2 Conservation of the Water Environment

Freshwater Habitats

It is recognised that the environmental value of certain channels has been adversely affected by past land drainage activities. Fisheries and general conservation value would be improved by appropriate habitat enhancement or restoration. The Rivers Nar, Babingley, Heacham and Ingol originate as chalk streams. Morphological features such as riffle-pool sequences should be retained and restored where past land drainage activities have adversely affected them.

In rivers plant growth is an important habitat feature. Weed control for flood defence requires careful balance with environmental needs. It is therefore

appropriate to review weed control practices to ensure the correct balance is achieved to satisfy all uses. The Relief Channel comprises approximately 35km of embankment which is NRA owned. Management of these banks and the channel morphology should be assessed to maximise their conservation value while considering the needs of other users.

Analysis of the Rivers Environmental Database (REDS) determines the environmental status of the rivers of the CMP area. Conservation targets for each 500m stretch of river fall within the following three categories:

- **Conserve:** Contains rare plant or animal species and/or important plant communities and/or high plant diversity
- **Enhance:** May be poor for one element of river corridor ecology whilst maintaining good characteristics as well. Enhancement works may therefore need to improve the ecological shortfalls of a section whilst conserving the features of specific interest.
- **Restore:** Ecologically degraded - low plant and animal diversity and no rare species present.

Map 31 shows that of the 138km of statutory Main river in the catchment 7% requires conservation measures, 81% requires enhancement, and 12% requires restoration.

In addition, the habitat-based River Corridor Survey (RCS) methodology has now been developed and appears as NRA Conservation Technical Handbook No. 1. It highlights important features which need protecting and identifies opportunities to rehabilitate and enhance degraded habitats.

The NRA is also developing a National River Habitat Survey (RHS) methodology which will classify the environmental conditions of rivers with respect to the physical features of wildlife value; for example, riffles, pools, wet shelves, and cliffs.

Extensive ecological and hydrological studies are required to define the existing ecology of the river system and to establish the "In River Needs". The River Babingley has been thoroughly modelled by Loughborough University as an indicator river for low flows. Any change in the hydrogeological character of the river should therefore be considered for the continuation of this study. River Habitat Surveys have an important role in establishing the appropriate habitat features for all rivers within the CMP area.

The Chalk streams are generally unpolluted and rich in aquatic macrophytes. They support a diverse and abundant invertebrate fauna; including the key water quality taxa Plecoptera (stonefly), Ephemeroptera (mayfly) and Trichoptera (caddis fly). The slow flowing lower reaches are also noted for their Odonata (dragonfly) populations.

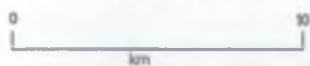
North West Norfolk Catchment Management Plan



Environmental Status – Map 31

KEY

- | | | | |
|--|--------------------|--|----------|
| | Catchment Boundary | | Conserve |
| | Coastline | | Enhance |
| | Main River | | Restore |
| | IDB Watercourse | | |
| | Other Watercourse | | |
| | Main Towns | | |



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Saline intrusion restricts the freshwater fauna in the rivers draining directly into the Wash but this is limited to the coastal areas. Tide locked conditions and slack flows also reduce invertebrate diversity in the coastal areas.

The River Nar is a Site of Special Scientific Interest, designated as an outstanding river system of its type, combining the characteristics of a southern chalk stream and an East Anglian fen river. Efforts should be made to maintain and enhance its status as a SSSI.

Tidal and Estuarine Habitats

Part of the catchment falls within the North Norfolk Coast Area of Outstanding Natural Beauty. The natural character of river corridor within this area should be retained and where possible enhanced.

The Wash estuary is an internationally important site for wildfowl and waders, as well as providing a valuable habitat for marine species. The estuary supports a fauna and flora which is broadly consistent with its physical and hydrographical features. The NRA has undertaken a Wash Zone study and a report was published in 1994.

The subtidal environment is somewhat impoverished in terms of species numbers and abundance as compared to certain other estuaries. However, this is attributable to a harsh salinity regime and severe tidal scour.

The intertidal environment is less severe because of lower flows near the banks and a less harsh salinity regime. Silt deposition is also greater leading to better productivity in the mud and sand banks of the intertidal areas. However, very high productivity and a fauna dominated by the oligochaete worm, *Tubificoides benedini*, along the West Bank training wall indicate the influence of sewage effluent in this area of the estuary.

The estuary itself supports a healthy and diverse fauna. The brown shrimp often predominates, whilst the presence of the Smelt is encouraging as this fish is regarded as being intolerant of pollution. Plankton are a very important part of the biota and of the food web in the estuary. Marked changes in the distribution of the plankton have occurred as the salinity regime has varied in recent years but the estuary has remained productive.

During the drought years of 1989-1991 marine and estuarine species came to dominate the fauna as far upstream as Denver Sluice. Higher levels of freshwater flow subsequent to this period have now returned the estuary to a balance whereby these species dominate the fauna as far upstream as King Lynn.

The Wash itself supports a diverse fauna. There is some evidence of a possible disturbance in the vicinity of the Great Ouse estuary but the hostile environment of harsh salinity regime and tidal scour are believed to be the main causes. The maintenance and improvement of sea defences should not adversely affect the conservation value of the Wash, and enhancements made where possible.

Discharges of nitrate enriched effluent into the Wash should be closely related to freshwater flows from the Tidal River so as to ensure that this highly sensitive and fragile ecosystem is not adversely affected.

5.4.3 Navigation

There is limited use of this catchment for inland navigation, that which does take place is centred on the Denver - Salters Lode crossing of the Tidal River. This can be a difficult crossing and is only possible at certain stages of the tide.

Other navigations in the catchment are controlled by the King's Lynn Conservancy Board and the Middle Level Commissioners. The Middle Level Commissioners propose to introduce new navigation byelaws and a system of boat registration.

5.4.4 Recreation & Amenity

There is an increasing demand for public access to the countryside and waterways for a variety of recreational needs. These include footpaths, bridle paths and cycleways and the NRA should seek collaboration with other bodies to enhance such access along river corridors in a sensitive manner. Site management plans should be developed for land in NRA ownership and a balance met between differing recreational needs. Such a plan should be formulated for the Great Ouse Relief Channel to accommodate the needs of all recreation and amenity users.

In any recreational plans due consideration should be given to provision of access of access for people with disabilities.

There is a paucity of general information and advice at many NRA structures.

5.5 FLOOD DEFENCE

5.5.1 Flood History

Flood defence in the catchment is dominated by tidal influences and failure of the defences could result in extreme damage and hazard to life. For centuries King's Lynn and the marshland/fenland areas have been subjected to tidal flooding when wind and sea conditions combine to produce surge tides. In recent times two major events dominate the record:

- In the 1953 East Coast Floods 46 lives were lost, 15 in King's Lynn and 31 in the Heacham/Hunstanton area.
- In the 1978 storm surge tide events no lives were lost due to improved defences and warning arrangements. However, large areas of King's Lynn and the coast were flooded with an estimated cost of the damage put at £5.5 million.

Since 1978 there has been massive investment to overhaul the Catchment's sea and tidal defences.

5.5.2 The Continuing Flood Risk

Substantially all sea and tidal defences in the Catchment satisfy the National Guidelines Standard of Protection of 1:100 years (ie a 1% chance of exceedance in any given year).

As far as fluvial defences are concerned the position is less clearly defined and less satisfactory. However, a region wide exercise to establish the Standards of Service is currently under way which, when published in early 1995, will give a clear picture of the fluvial defence situation.

The NRA is currently reviewing the whole basis of flood defence and its effect on the environment in its Shoreline Management Plans.

Map 32 shows that between Hunstanton and Snettisham the combination of "hard" and "soft" defences provides the required standard of protection to the area, however, monitoring must continue to establish the nett loss of beach material over the years so that need for a further beach recharge can be established. In the meantime an annual recycling exercise is carried out to re-distribute approximately 50,000 cubic metres of beach material along the frontage.

Annual beach recycling is a continuing requirement but beach levels appear to be stabilising and continuous monitoring of the shoreline is required to build on our understanding of the coastal process.

The many flapped outfall structures are subject to occasional problems when debris prevents the flap from sealing properly. Such Tidal outfalls have to be carefully monitored to ensure against tidal intrusion which may result in flooding or saline

intrusion. Saline water entering fresh water systems may have a detrimental impact on the flora and fauna as well as resulting in the water being unsuitable for spray irrigation and livestock watering. A system for the detection of back flow is needed which will automatically trigger closure of the upstream penstock and provide an alarm via the telemetry system.

As well as flooding of land which could result from high water levels there is a continuing problem of seepage through banks even under normal flow conditions. The effects of this may be much longer lasting than intermittent heavy rainfall flooding.

Works to improve the Tidal River banks between King's Lynn and Denver continue and are programmed to be completed in 1998. The current scheme of Tidal River bank erosion protection works (Tidal River Mattressing) is due to be completed during 1995 but there will be an indefinite need to renew and repair revetment into the future.

Probably the most significant problem to be tackled is that of Tidal River siltation which not only affects the ability of the river to discharge flood water but also both commercial and pleasure navigation interests. Siltation in the Tidal River reflects not only the deposition of sediments entrained in the river but also the inability of the river to flush sediment deposited at high tides. In the Tidal River, upstream of Downham, bank instability caused by desiccation led to the channel being widened by erosion. In places the channel has become shallow and wide which effectively prevents erosion from occurring causing shoals on the inside of bends and also in the centre of the river.

The defences throughout King's Lynn rely on manual closure of flood gates and cooperation between the NRA and Associated British Ports for the closure of the Alexander Dock Gates upon receipt of Tidal Surge Warnings. Such active systems are, to some very small degree, vulnerable to mishap.

The catchment contains 22 fluvial flood warning sites, 5 of which are linked by telemetry to the latest flood warning system. The authority also monitors 4 storm surge and tide level stations as well as meteorological data.

As far as fluvial flood risk is concerned the critical area is the River Nar where, during the November 1993 floods, a section of the river embankment failed flooding 132 hectares of agricultural land. Subsequent to the 1993 flooding, surveys have been carried out to identify the lengths of bank which are most at risk and works have been put in hand to reduce the short term risk of overtopping. At the same time studies have been commissioned to identify a strategy for the long term solution to the problem.

In order to sustain the present state of the Catchment's flood defences it is necessary to continue an established programme of maintenance works. This regime of maintenance works is kept under constant review in order to overcome possible conflicts of interest between the need to maintain a robust defence and sensitive conservation and recreational interests.

North West Norfolk Catchment Management Plan




Flood Defence – Map 32

KEY

- Catchment Boundary
 Coastline
 Main Towns

LEVELS OF SERVICE MAIN RIVERSEA DEFENCE

- Subject to Levels of Service Review
 20 - 50 years
 50 - 100 years



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5.6 DEVELOPMENT CONTROL

With some 30% of the catchment below highest tide level, comments on the development of low-lying land have always been made with reference to the standard of flood defences. With the recent completion of the major upgrading works on the tidal river defences following the 1978 tidal surge event, a satisfactory standard of flood defence has been established.

The coastal zone static caravan and chalet sites are still a concern with regard to flood protection and the integrity of the flood defences; where appropriate the NRA will still support restrictions on seasonal occupation.

At present, the majority of the River Nar embankments give protection to agricultural standards only. This matter will need addressing with regard to the proposed White House Farm development to the south-east of King's Lynn in particular.

A large proportion of the villages in the catchment are unsewered and the discharge from septic tanks can cause problems. Further development of these settlements requires careful consideration.

The concentrated run-off of surface water from development into non-maintained watercourses, often with inadequate culverts, causes many local problems. Much of the proposed major development will drain to Internal Drainage Board watercourses and they will need to decide whether they can accept this increased surface water run-off into their drainage systems and if not what upgrading works are necessary.

The upgrading of sewage disposal facilities to accommodate future development will also be a consideration.

6. ISSUES AND OPTIONS

The identified issues are discussed and where possible some options for their resolution are proposed. The options which are presented represent a range of alternative courses of action and are not generally mutually exclusive. Some options may be more feasible in one part of the catchment than others. Some options which are considered feasible will only be implemented following a full project appraisal. The section concludes with a tabulated summary of issues and options which identifies the organisation responsible and also some advantages and disadvantages of the suggested options.

6.1 CATCHMENT WIDE ISSUES

6.1.1 Water Resources Issues

There are three issues with respect to water resources and they are all linked.

- Review the Available Water Resource for the Catchment
- Review the Quantity Allocated to the Environment
- Restate the Allocation of Water Resources and the Licensing Policy

The NRA has the responsibility of allocating the available water resource between the needs of the environment and the needs of the abstractor. The current allocation is given in section 5.3 together with the relating policy for licensing water in the catchment. The NRA is reviewing and updating this analysis on a regular basis.

Issue 1 Review the Available Water Resource for the Catchment

Problem The available water resources should be reviewed in the light of additional knowledge about the aquifer systems and new analytical techniques.

Solution Collect more information about the aquifers ⁴ and rivers - record more groundwater levels from further observation boreholes and install more river flow gauging stations.

Improve conceptual model of the water balance system - for example, construct and calibrate computer models.

Examine the interaction between the Chalk and Lower Greensand aquifers

Examine groundwater and surface water interaction.

⁴ A glossary is provided at the end of the Plan

Issue 2 Review the Quantity Allocated to the Environment

Problem The water needs of the environment, i.e. rivers and wetlands, need to be reviewed and reserved from the available water resource. The NRA is currently examining new methodology in this respect.

Solution Identify methodology

Carry out methodology for each river

Identify vulnerability of individual wetland sites and define protection areas as appropriate

Identify River Flow Objectives and/or MAFs for each river

Identify the operational management of the Denver Complex during low flow periods with reference to the requirements of the estuary and the need to protect against saline intrusion

Issue 3 Restate the Allocation of Water Resources and the Licensing Policy

Problem The Water Resources Balance needs to be redefined in light of Issues 1 and 2. The Licensing policy which follows the findings of the water resources balance may also change.

Solution Identify the management strategy for water resources in the catchment based on findings of Issues 1 and 2.

Commence the management of the river system to meet defined River Flow Objectives and/or MAFs

Investigate the needs for works in the catchment, such as river support boreholes, river channel habitat works

Examine the possibility of revoking/reducing licences and the non-renewal of temporary licences, if required by the management strategy for the catchment.

6.1.2 Water Quality Issues**Issue 4 Development in Unsewered Areas**

Problem The large proportion of the villages within the catchment are unsewered, and problems with malfunctioning septic tanks are not infrequent. Proposed new development in these areas, particularly industrial development are a concern.

Particular settlements where problems have occurred include Ashwicken, Clenchwarton, East Winch, Hillington, Marham, Outwell, Shouldham, Stow Bridge, Walpole St Andrew, Walpole St Peter, Wimbolsham, Wormegay and Wretton.

Solution Investigation to identify sites where risk is highest and where restriction of development through the planning process will avoid exacerbating the problem.

The installation of first time sewerage infrastructure.

The installation of private package sewage treatment plants would be appropriate for some developments.

Issue 5 The Redevelopment of Contaminated Land

Problem A major consideration in the redevelopment of industrial land is the possible contamination of the site and its potential for polluting the water environment.

Sites exist in King's Lynn, which because of their previous use are suspected of being contaminated. The redevelopment of these sites would be of concern to the NRA.

Solution Prior to redevelopment of a site, through the planning process, the NRA will require that a detailed site investigation is carried out to assess the degree and nature of the contamination. If contamination is shown, measures to prevent the pollution of groundwater and surface water will be required.

Issue 6 Potential Pollution of Groundwater Supply

Problem Risk to groundwater supply abstractions from storage and use of industrial and agricultural chemicals and wastes. Some Groundwater Protection Zones (GPZ) have been defined for major potable supplies.

Solution Define the remaining GPZs for each major potable source

Inspect premises within these GPZs on a priority basis and recommend measures to reduce the pollution risk.

Issue 7 Nitrate Levels in Groundwater

Problem Elevated levels of nitrates in groundwater exceeding EC Directive for drinking water

Solution Public water supply companies to install nitrate removal plants for potable supplies to meet requirements of the Act.

Provision of Nitrate Sensitive Areas and Nitrate Vulnerable Zones around sources where high levels of nitrates are found. A reduction in the use of organic and inorganic fertilizers within these areas will be required.

Liaison with manufacturers, British Sugar and farmers to reduce fertilizer application rates in general and specifically within these areas

Issue 8	Contamination of Groundwater from "Dilute and Disperse" Waste Sites
<i>Problem</i>	Localised groundwater contamination from leachate from waste disposal sites at Blackborough End and Docking
<i>Solution</i>	Monitoring of plume of contaminant by Waste Regulation authority in consultation with the NRA.

6.1.3 Environment Issues

Issue 9	Restoration of Degraded Rivers and Habitats
<i>Problem</i>	Past river management activities and development have had an adverse impact on the physical characteristics and habitat diversity within many rivers. Habitat loss of this type has reduced the range of plant and animal species in the river environment.
<i>Solution</i>	The analysis of the River Environmental Database (REDS), the output of which is shown on Map 31, to identify the most severely degraded river reaches.

From this, and using other environmental data, the NRA will develop enhancement strategies for implementation by the NRA in collaboration with other bodies and landowners.

Issue 10	Water Level Management Plans
<i>Problem</i>	<p>The "Conservation Guidelines for Drainage Authorities" produced by MAFF/DOE state that plans should be produced for areas where water levels are managed and that priority should be given to Sites of Special Scientific Interest (SSSIs).</p> <p>These Water Level Management Plans provide a means by which water level requirements for a range of activities in a particular area (e.g. agriculture, flood defence & conservation) can be balanced and integrated.</p> <p>Under guidance from MAFF, English Nature and other drainage authorities the NRA is promoting Water Level Management Plans and is preparing a priority list of which the River Nar is likely to be a high priority.</p>
<i>Solution</i>	<p>To act as the co-ordinating authority for the production of Water Level Management Plans.</p> <p>To provide assistance and advice to other parties where necessary.</p> <p>To apply the plans to the day to day operational activities of the NRA.</p>

Issue 11 The Identification of Special Ecosystems

Problem Proposed Water Quality Objectives recognise the category of Special Ecosystems, within the river use classification. The objective of this use related class is to protect sensitive ecosystems from potentially damaging changes to water quality. The criteria defining special ecosystems has yet to be decided.

Solution Consultation with other conservation bodies such as English Nature and the Wildlife Trusts is required to identify potential sites as this issue requires a multi-agency solution. In this context, a site might be a sensitive Site of Special Scientific Interest or a County Wildlife Site which could be affected by discharge or a river such as the River Nar.

Issue 12 River Corridor Buffer Zones

Problem The concept of buffer zones alongside rivers has received considerable attention in recent years both within the NRA and amongst nature conservation organisations as the loss of floodplain in many areas has reduced the existence of natural buffer zones.

The concept basically involves the isolation of a suitably wide strip (10-100m) alongside rivers which is removed from intensive agricultural use and managed to provide appropriate habitat types. To realise the potential benefits a programme of habitat restoration is required.

Potential benefits of buffer zones include:

- enhances habitat diversity for nature conservation
- improved landscape appearance
- reduction of impact of soil erosion
- potential for management of weed growth by shading
- reduction of impact of farm livestock wastes
- reduction in nutrients entering rivers

Solution The NRA is currently undertaking research and development work to determine the value and efficacy of buffer zones.

The development of buffer zones requires the co-operation of riparian landowners and would need to be encouraged by grants or other financial support. Potential sources of funding would be the Countryside Stewardship Scheme (operated by the Countryside Commission) and Set Aside arrangements (if the creation of buffer zones was accepted under this scheme).

North West Norfolk Catchment Management Plan

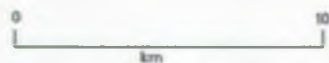


Flood Defence Issues – Map 33

KEY

- Catchment Boundary
- Coastline
- Main River
- Main Towns

- ID6 Watercourse
- Other Watercourse



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Whilst the uptake of such schemes is outside the control of the NRA, nevertheless there will be an involvement by the Authority.

6.1.4 Flood Defence Issues

Map 33 shows the locations within the catchment where particular issues have arisen, this section addresses those issues which relate to the whole catchment.

Issue 13 River Maintenance Standards

Problem The standard of protection being offered by many rivers and the value of assets at risk from flooding if the level of service is exceeded is currently unknown. Without this information it is difficult to target expenditure to the area of greatest need.

The NRA is currently undertaking a Flood Defence Standards of Service review. This review will assess "Land Use" by considering agricultural or urban content within the flood plain along lengths of river divided into 4-7 km reaches. For each element (eg road, house, grazing) a score is given, with the score measured by a single unit called a "House Equivalent" and by the score achieved, the reach is placed into one of several Land Use Bands to guide assessment of priorities when determining maintenance programmes.

Solution To apply the standards of service criteria to flood defence maintenance activities in the CMP area in order to achieve best value for money, taking fully into account environmental considerations.

Issue 14 Non Main River Flooding

Problem There is a marked escalation in the number of non main river urban flooding events due principally to lack of maintenance or extreme weather patterns overwhelming the local surface drainage system.

The Water Resources and Land Drainage Acts 1991 impose a duty upon the NRA to exercise a general supervision over land drainage matters within its area. For main river watercourses the NRA's role is set out in Chapter 3.1.1.

However, with regard to ordinary watercourses it is not practicable for the NRA to actively promote action other than through persuasion of other parties. The NRA is not empowered to require a local authority to carry out works on non-main river watercourses.

Solution To clarify the respective roles of the County Councils, local authorities, internal drainage boards and water companies. This will ensure that, as far as possible, the public receives a satisfactory service from the relevant drainage authority.

Issue 15 Section 105 (2) Survey Water Resources Act 1991

Problem The Department of the Environment Circular 30/92 requires the main input to development plan preparation to be surveys which Section 105(2) of the Water Resources Act 1991 requires the NRA to carry out. The survey, when complete, will be a definitive document on, among other things, flood plain limits (min 100 yr return period flood) on all watercourses, and will identify all flood defences, with inundation areas defined (min 200 yr return period for surge tides) for tidal defences.

The problem is the vast amount of data necessary to be collected and the subsequent modelling requirement to supply and verify information for the published survey.

Solution An implementation programme which by the year 1999 will have completed the survey for priority areas agreed with Local Planning Authorities, reference the "Memorandum of Understanding" between the NRA and the Associations of County Councils, District Councils and Metropolitan Authorities.

Issue 16 Sea Level Rise and Climate Change

Problem An allowance for sea level rise is applied to the strategic planning of all flood defence improvements. This allowance, which is currently set at 6mm per year sea level rise, takes into account the current estimates of land tilting relative to the sea and advice from the Inter-governmental Panel for Climatic Change (IPCC).

Solution As yet, advice from the IPCC indicates that there is no reason to amend these estimates for sea level rise when considering the design of current flood defence structures. However, the NRA retains a "watching" brief on climate change in relation to all of its functions.

6.1.5 Development Issues**Issue 17 Structure and Local Plans**

Problem The broad objective of catchment management planning is to conserve and enhance the total water environment through effective land and resource management. However, the NRA has very little control over the mechanisms which determine land use change on a catchment wide basis, this being the responsibility of local planning authorities through the implementation of the Town and Country Planning Acts. In its role of consultee, the NRA seeks to influence policies in statutory development plans such that they reflect the NRAs concerns and responsibilities including the statutory requirement to conserve and enhance the water environment and associated lands.

Solution As the policies in statutory development plans set out the framework for land

use change and will provide the key reference in determining development applications, it is essential that the NRA's aims for the water environment are fully represented by the planning policy statements.

The NRA has produced "*Guidance Notes for Local Planning Authorities on the Methods of Protecting the Water Environment through Development Plans*" and the aim is that the objectives will be substantially replicated in each Local Authority plan.

Issue 18 Planning Application Form

Problem None of the local planning authority's planning application forms include a question on water supply.

Solution The inclusion of such a question so that water resource implications of a development can be identified at an early stage.

Issue 19 New Roads and Bypasses

Problem The impact that road construction has on the water environment can be considerable. Such impacts include pollution potential, possible disruption to water resource availability, concentration of surface water runoff and possible obstruction to flood flows where roads cross water courses.

Solution All of the above problems associated with road construction are addressed by the NRA in its consultation role with the road promoters. It is essential, however, that the NRA is consulted at an early stage of the road design and that sufficient detail is made available to enable a meaningful response to be made.

6.2 THE WASH, ESTUARY & COASTLINE**Issue 20 Impact of King's Lynn STW on the Estuary.**

Problem Sewage discharged from King's Lynn STW receives only primary treatment prior to discharge on ebb tides. The discharge contributes a significant organic load to the estuary which reduces oxygen levels. Associated with this organic load are high levels of faecal bacteria impact on the quality of shellfish. Currently the toxicity of the effluent from the works is variable and provides some cause for concern.

Solution The installation of secondary treatment is required to comply with the EC Urban Waste Water Treatment Directive. This will result in a significant reduction of organic loading to the estuary and improved oxygen levels.

Disinfection of the effluent is required to reduce bacterial concentrations in the estuary and shellfish.

The target date for installation of secondary treatment and ultra-violet disinfection of the effluent is December 1995.

AWS Ltd to carry out trade effluent investigation to identify the source of toxicity

Impose toxicity based consent if source of toxicity is not positively identified by AWS Ltd.

Issue 21 Eutrophication in the Estuary.

Problem The concentration of nitrate, algal counts and chlorophyll-a all exceed the qualifying criteria for designating the estuary as a Sensitive Area under the EC Urban Waste Water Treatment Directive. However, there is insufficient evidence of an adverse impact on the flora and fauna, such as severe algal blooms or reduced diversity to be able to justify designation.

Solution Review of monitoring is needed to ensure adequate data is collected for reappraisal of the eutrophic status.

Collect data for 1997 review of potential Sensitive Areas.

Issue 22 Hunstanton - Snettisham Beach Access

Problem The existing access ramps to the beach for boat launching are becoming extremely congested at week-ends and there are pressures to increase the number of ramps to avoid unlawful access at undesignated entry points which may result in damage to the sea defence.

Solution Further discussion between the NRA and the King's Lynn and West Norfolk Borough Council to discuss the need and location of any further access ramps.

Issue 23 Hunstanton - Snettisham Beach Recharge

Problem An intrinsic operational feature of the Beach Recharge Scheme is the need for a major annual recycling operation as well as some localised reprofiling in order to maintain the beach's effectiveness as a sea defence.

However it is not currently known how much nett loss of beach material there is likely to be over a period of time and consequently how long it may be before a further beach recharge will be required.

Solution Continued monitoring and survey of the beach to be undertaken which will be carried out under the remit of, and feed into, the Shoreline Management Plans.

Issue 24 Loss of Beach Material at Hunstanton Boat Ramp.

Problem Loss of beach material immediately south of the Hunstanton boat ramp is a continuing problem despite the beach recharge and the annual recycling operation. Suggestions for alternative methods of protection have so far been rejected by the Town and Borough Council on the basis of their effect on recreational activities.

Solution Further discussion with the Town and Borough Council to agree on an acceptable form of protection south of the Hunstanton ramp.

Issue 25 Sea Banks East Wolferton/Snettisham

Problem Sea banks require reprofiling as per the works undertaken on the remainder of the sea banks between Wolferton and the Babingley outfall. Previous work was done using seawards borrow pit material which is now no longer an acceptable method of operation.

Solution Possible source of material available from the Ingol outfall project proposals and the creation of inland borrow pits for conservation enhancements.

Issue 26 Coastal Zone Developments

Problem The coastal zone between the front and rear line flood defences from Hunstanton in the north to Snettisham in the south, as shown on Map 34, has been traditionally used as a site for summer holiday static caravans and chalets.

The two lines of defence are complementary in that the front line protects the rear line from wave action and under certain storm conditions will be eroded and overtopped. Under these conditions the area of land between the lines of defence will be flooded, as occurred in January 1978 when flooding to a depth of 2 metres occurred and caravans were destroyed.



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Map 34



**COASTAL
ZONE
DEVELOPMENT**

Occupancy of the vast majority of holiday homes is currently restricted to the period 1 April (or Maundy Thursday if earlier) to 31st October. The problem is the continual attempt by holiday home owners to extend the period of occupancy. This would take occupation into the period, October to April, of greatest risk of storm tides, when the evacuation of the coastal zone by the Police is an action consequential to the NRA issuing a "red" tidal warning.

Solution Refusal by the local planning authority of applications to extend occupancy of holiday homes within the coastal zone beyond the current position and restrict any new development to the same occupancy. This will be strongly supported by the NRA.

Issue 27 Storm Tide Warning Service Division Boundaries

Problem The Storm Tide Warning Service have recently created new divisions by splitting the former Division Two into separate parts (Division 2N and 2S). The boundary between division 2N and 2S has been set at Hunstanton which coincides with the NRA catchment boundary. This has caused some concern to the police and Borough Council whose boundary is situated further along the coast.

Solution Further discussion between the Police, Borough Council, NRA and Storm Tide Warning Service

6.3 THE TIDAL RIVER**Issue 28 Tidal River Bank Improvements and Erosion Control**

Problem The recent major capital works which have been undertaken to provide a 1:100 year standard of protection along the Tidal River between Denver and King's Lynn are due for completion during 1998. However the extreme tidal range (5-6m) and the very high flows experienced in the channel will continue to challenge these defences.

Solution A programme of annual inspections will be required in addition to other inspections after major surge tide events in order to identify problems and take necessary action to initiate urgent remedial works.

Issue 29 Tidal River Siltation

Problem The Tidal River between Denver and King's Lynn has suffered increased siltation in the last 35 years following the completion of the Flood Protection Scheme. Silt levels are now at such a height as to affect the efficient drainage of the Great Ouse Catchment. The level of silt prevents tidal excursion rendering the Denver Sluice ineffective against high downstream water levels. Silt is also preventing efficient evacuation of water from the Ouse Washes. It is also thought that the free drainage of the Bedford Ouse River, via the New Bedford/Hundred Foot River is restricted by the level of silt in the Tidal River.

Solution A study is proposed to determine the most efficient size of river section for conveyance of both normal flows and flood waters. The strategy direction is somewhat dependent on the outcome of neighbouring strategic studies; these include the Wash Outfalls Study, the River Ouse Management Plan (ROMP), and the Ouse Washes Summer Flooding strategy.

Necessary works may include not only silt removal but also river training works to control silt levels by the normal passage of tidal ebb and flow taking fully into account all environmental considerations.

Issue 30 Tidal River Training Walls

Problem The training walls which run on both sides of the Tidal River from King's Lynn into the Wash have not been raised since their construction in 1950's. The purpose of the training walls is to provide a "self cleansing" channel for both Navigation and Flood Defence purposes. Over the years the salt marsh behind the training walls has accreted to a point where it is now above the level of the training walls. This has reduced the effectiveness of the training walls to prevent siltation of the main channel.

Solution The future strategy for dealing with siltation and the need for improvement to the training walls is to be addressed in the Wash Outfalls Strategy Study.

Issue 31 Navigation of the Salters Lode - Tidal River Crossing

Problem The Tidal River is subject to a significant tidal rise and fall at the Denver - Salters Lode crossing point. The river is also subject to strong tidal current at this point. This combination of flow and water level changes present boat users with particular difficulties when entering either the Well Creek or the Old Bedford River from Denver.

Solution To review the level of navigation facilities provided to ease this passage.

As there is nothing which can be done to influence the natural forces at this point, efforts should therefore be directed towards ensuring that the passage mooring facilities which are provided are adequate. A review should be carried out to assess the need for improvements to existing tidal moorings. This could be supported by the production of a guidance sheet which would be issued to all boats using the crossing.

Issue 32 Tidal River Outfalls

Problem Flapped outfalls are susceptible to a failure to close due to floating debris becoming caught in the flap. On these occasions tidal ingress may occur which could result in flooding and has detrimental effects on the flora and fauna of the watercourse due to saline intrusion.

A number of IDB watercourses discharge into the Tidal River via flapped outfalls. In some cases the definition of responsibility for operation and maintenance between the NRA and the IDB is unclear.

Solution Development of an automated system to detect failure of the flap to seal such that the upstream penstock will close automatically and an alarm triggered via telemetry to alert the Duty Officer.

Liaison between the NRA and the IDB's to determine responsibilities at each site and draw up agreements to be followed and used for future reference.

Issue 33 Oil pollution nuisance in Tidal River / Fisher Fleet at King's Lynn.

Problem Reports of oil pollution in the Tidal River are often traced to sources in the Fisher Fleet. Oil originates from boats and associated refuelling facilities.

Solution Liaise with the harbour authority, Associated British Ports, and boat owners to promote better practices for oil storage and handling.

Encourage the provision of facilities for the storage and handling of waste oil.

Collect evidence for potential prosecutions by the harbour authority.

Issue 34 King's Lynn Sea Defences - King's Staithe Square and The Purfleet

Problem. The main defence of King's Lynn against tidal flooding still relies on a temporary timber dam construction which borders King's Staithe Square and the Purfleet. Local planning restrictions require the dam to be removed each year between April and September.

Solution The land on which the temporary dam stands is in private ownership and is proposed for development sometime in the future. When the future of the site is known the NRA may take up negotiations with the site owners to effect a permanent defence solution which may be incorporated in any development proposed for the site.

If development of the site is not forthcoming then the construction of a more permanent defence to replace the present timber dam must be considered

Issue 35 King's Lynn Sea Defences - Common Staithe to Purfleet Quays

Problem The defences along the Common Staithe Quay to Purfleet Quay do not achieve the standard of protection afforded throughout the rest of the King's Lynn frontage.

Solution A consultants report has been prepared identifying the works required to raise the defence to the required 1 in 100 yr level of protection and a project is being prepared to put the works into effect giving full consideration to the constraints posed by the number of listed buildings along the frontage.

Issue 36 King's Lynn Sea Defences - South Quay

Problem The King's Lynn frontage along the South Quay has a number of very ancient, redundant pipes which it is thought may run from the quay edge, hidden behind the existing piling and into the town passing under the tidal defences.

The numbers, sizes and whereabouts of these pipes is unknown and it is therefore possible that under extreme surge tidal conditions some water may bypass the defences and cause flooding in the town centre.

Solution For the NRA to continue to issue a Red flood warning to the Police for levels in excess of 5.25m AOD even when the flood gates are closed offering a protection up to 6.3m AOD. This will enable the emergency services and the public to take appropriate action to relieve the effects of flooding should they occur as a result of incursion through the hidden pipes.

6.4 THE RELIEF CHANNEL

Issue 37 The Relief Channel Bank Erosion

Problem. The banks of the Relief Channel are suffering constant erosion leading to very high vertical banks which are prone to constant slumps.

Solution A study is under way as part of the Ely Ouse flood defences project which will identify problem areas and look at soft options for protection of the banks from further erosion.

Issue 38 Conservation Enhancements to the Relief Channel

Problem The NRA owns both banks of the Relief Channel and some of the adjacent land along its 17km length. The embankments consist of unimproved grassland and areas of scrub. The majority is used by tenants for livestock grazing. Other sections are mowed biannually by the NRA.

By seasonably altering mowing and grazing regimes the species composition of the grassland could be changed to increase diversity or favour rare species. Alterations in scrub management would also provide more diverse habitat.

The uniformity of the channel and banks offer an opportunity for enhancement. Increasing the diversity of bank profiles along the river provide new and different niches for further plant communities also directly benefitting invertebrate fish and bird species.

Solution The NRA will review its bank mowing and scrub management.

The NRA will liaise with tenants and the Farming and Wildlife Advisory Group, where possible, to ensure appropriate grazing management.

As part of river maintenance work opportunities will be sought to increase the variation in channel and bank morphology.

Issue 39 Fisheries Habitat Within The Relief Channel

Problem Extensive fish population surveys have highlighted that one of the major problems leading to the decline of the fishery has been the displacement of juvenile fish by high flows. This is exacerbated by the lack of instream habitat such as marginal fringes and reed beds in this smooth uniform channel which has been designed with an hydraulically efficient profile.

Measures have already been taken to minimise the disruptive effects of flow on the ecology of the fish populations by the sensitive management of levels and flow regimes where possible, especially during the early life cycle in the late summer and by the provision of a limited number of willow croys which afford shelter for fish.

Solution The number of fish refuge areas afforded by the creation of croys needs to be increased substantially in order to have a greater effect on protecting juvenile fish. Siting of the willow croys should occur preferentially in areas devoid of marginal vegetation and at locations where they will not adversely affect other uses of the Relief Channel for flood relief and recreation.

Other methods of increasing the fish holding capacity of the Channel should also be introduced in the form of structural reefs. These have multi purpose benefits of providing shelter, spawning substrates and increasing biological productivity so enhancing the fish population. Siting of reefs will require close appraisal so as not to compromise other Channel uses such as flood defence or recreation.

Issue 40 Recreational Access to the Relief Channel.

Problem The Authority has a statutory duty to promote recreational activities on and around water based sites especially where it is the landlord. The Relief Channel has already been developed to provide sailing, water skiing and angling, but an opportunity exists to further explore possible uses for the extensive floodbanks and associated owned agricultural land currently in tenancies.

Solution A survey should be undertaken to establish the potential recreational uses of land adjoining the Relief Channel and develop appropriate and desirable schemes. These schemes may range from long distance and circular footpaths to bridleways, cycle tracks, and the provision of further angling pegs. Any developments should not conflict directly with others already existing at this site. Such schemes will ensure adequate provision to all facilities for people with disabilities. Such works should form part of an all embracing plan which takes account of proposed fisheries and conservation enhancements

Issue 41 Tail Sluice Automation

Problem Having a sluice keeper living on site at the Tail sluice can no longer be sustained or justified.

Solution Works are currently underway to fully automate the Tail Sluice.

On completion of these works the operation of the sluice will need to be closely monitored for performance and reliability.

6.5 WEST OF OUSE AREA**Issue 42 Middle Level Main Drain. Failure to Meet Water Quality Objective.**

Problem This watercourse fails to meet the proposed REC 3 objective for dissolved oxygen. The ponded nature of this watercourse encourages the growth of algae and duck weed which tend to depress oxygen levels.

Solution Adopt REC 4 as long term objective.

6.6 THE RIVER NAR**Issue 43 Eutrophication of the River Nar.**

Problem Aquatic communities are sensitive to nutrient enrichment and the conservation value of the river is high. The key nutrient controlling eutrophication in freshwaters is phosphorous.

Sources of phosphorous within the Nar valley include sewage treatment works and households in un-sewered areas, fish farms and land run-off. At present Litcham and Castle Acre STW's have consents limiting the amount of phosphate which may be discharged. Limited data on phosphate concentrations, river and effluent flows suggests that current estimation methods can be improved to provide a better understanding of phosphorous sources.

Solution Review water quality monitoring programme to improve data for phosphorous load estimates.

Review flow monitoring programme to improve data for phosphorous load estimates.

Review and update phosphorous data to improve understanding of external loadings and retention of loadings under low flow conditions.

Investigate benefits of further phosphorous controls for new and existing discharges.

Issue 44 Access of Sea Trout into the River Nar

Problem The river is regulated for flood defence purposes by tidal flaps. This limits the entry of sea trout into these rivers to times when tidal flaps are open to discharge fresh water. In turn this has led to a reduction in the previously small, but locally important, run of this species.

Solution Should the gates on these outfalls be replaced due regard should be given to the passage of migratory fish.

Issue 45 Mileham to Litcham: Failure to Meet Water Quality Objective.

Problem This stretch of river fails to meet the proposed REC 3 objective for dissolved oxygen. Low oxygen levels occur during the summer and autumn when river flows are low.

Solution Investigate the relationship between low DO levels and river flow.

Maintain REC 5 as short/medium term objective.

Retain REC 3 as long term objective.

Issue 46 Litcham to Lexham Hall: Failure to Meet Water Quality Objective.

Problem This stretch of river fails to meet the proposed REC 3 objective for dissolved oxygen and ammonia. Low oxygen levels occur during the summer and autumn when river flows are low. Elevated ammonia concentrations do not follow a seasonal pattern and are influenced by the effluent from Litcham STW.

Solution Review river flow data and re-calculate River Needs Consent for Litcham STW.

Examine methods of increasing the flow available for effluent dilution during summer low flows.

Maintain REC 4 as short/medium term objective. Retain REC 3 as long term objective.

Issue 47 Lexham Hall to Castle Acre: Failure to Meet Water Quality Objective.

Problem This stretch fails to meet the proposed REC 2 objective for dissolved oxygen. Low oxygen levels occur during the summer and autumn when river flows are low.

Solution Investigate the relationship between low oxygen levels and river flows.

Maintain REC 4 as short/medium term objective.

Retain REC 2 as long term objective.

Issue 48 River Nar Bank Instability

Problem Problems have been experienced with the level and stability of the Nar Banks as well as seepage to land behind the banks providing a sub-standard level of protection.

Solution Consultants have been appointed to carry out a thorough investigation of the River Nar and a report is to be prepared outlining options to alleviate the problems along with costs and benefits for progression into a major capital project.

Issue 49 Proposed Development Dependant on Flood Defences

Problem The NRA is always concerned that the standard of flood defences both tidal and fluvial, is appropriate to the land use they protect.

The King's Lynn and West Norfolk Local Plan, Deposit Draft, identified land use for both employment and housing to the south of King's Lynn adjacent to

the River Nar. The River Nar embankments at present afford protection to agricultural land only.

Solution Where any land use change requires an enhanced standard of flood protection, the works necessary to accomplish this should be funded by the developer.

The River Nar embankments prior to development taking place will require improving to the appropriate standard; such as to cater for the 100 year return period flood. The extent of the works will be to the NRA's specification.

6.7 THE GAYWOOD RIVER**Issue 50 Failure to Meet Water Quality Objective.**

Problem The lower stretch of the Gaywood River fails to meet the proposed REC 3 objective for dissolved oxygen and ammonia.

Solution Investigate causes of elevated ammonia concentrations and depressed oxygen levels. Maintain REC 4 as short/medium term objective but retain REC 3 as long term WQO.

Issue 51 Roydon Common SSSI and Slurry Disposal to Land.

Problem Roydon Common is a SSSI and RAMSAR site. It is a prime freshwater wetland site within the catchment.

Concern has been expressed that the practice of slurry disposal to land adjacent to the site may adversely affect the conservation value of the site.

Solution Discuss with the Waste Regulation Authority how best to investigate the perceived problem. The NRA will act if a problem of water quality can be shown to have occurred.

6.8 THE MIDDLETON STOP/PIERPOINT DRAIN**Issue 52 Failure to Meet Water Quality Objective.**

Problem The lower stretch, principally the Pierpoint Drain fails to meet the proposed REC 3 objective for dissolved oxygen, ammonia and BOD.

Solution Investigate sources of pollution from industrial areas in King's Lynn and implement a programme of pollution prevention inspections.

Maintain REC 5 as short term objective. Adopt REC 4 as medium term objective. Retain REC 3 as long term objective.

Issue 53 Non Main River Flooding - West Winch

Problem West Winch is a low lying village with a history of drainage problems. A considerable amount of new development has taken place in more recent years and a number of domestic riparian owners have filled ditches through their property with undersized pipes. In many cases gardens have been extended over the piped ditches with the establishment of mature gardens, greenhouses, sheds etc. the removal of which would have a major impact on the property. Residents upstream of the pipes lengths of drain are seriously affected by flooding after heavy rains.

Solution Permissive Power rests with the Borough Council and riparian owners to agree the re-excavation of existing drains or to promote a scheme to deal with water through an alternative system.

6.9 THE RIVER BABINGLEY**Issue 54 Failure to Meet Water Quality Objective.**

Problem The lower stretch of the Babingley fails to meet the proposed REC 2 objective for dissolved oxygen.

Solution Investigate cause of low dissolved oxygen levels.

Maintenance of REC 3 as short/medium term objective, but retain REC 2 as long term WQO.

Issue 55 River Babingley Outfall

Problem The Babingley outfall is in an extremely isolated location and therefore has no power supply. Operation of the three flapped outfalls is by hand and monitoring of levels has to be done by visiting the site. Level controls are, therefore, very crude and have an effect on the environmental quality of the upstream watercourse.

Solution Investigation into the feasibility and cost of providing power to the site, the automation of the outfall, and subsequent telemetry monitoring requirement.

Investigations are already underway to carry out environmental works to relieve the effects of level fluctuation on the river habitat.

Issue 56 Improvement of the Coarse Fishery of the Lower Reaches of the River Babingley.

Problem The NRA Anglian Region system of fishery classification indicates that the River Babingley is currently below its potential carrying capacity. This has been attributed to an inability of cyprinids to maintain their position in periods of high flow which are occasionally experienced in this channel because the outfall structure may be left open in anticipation of high flows or flood events which leads to the juvenile fish being flushed out of the system.

Solution Operation of the North Wooton sluice only when absolutely necessary will minimise flushing effects.

There is limited scope for introduction of habitat shelter due to the potential risk of flooding in the lower part of the catchment. The lower flow velocities will increase the presence of species such as roach, resulting in greater sustainability of the fishery and hence increase recreational opportunities in these reaches.

Issue 57 Access of Sea Trout into the River Babingley

Problem The outfall structure limits the entry of sea trout and has led to a reduction in the previously small, but locally important, run of this species.

Solution With improvements to the outfall due regard should be given to the passage of migratory fish.

6.10 RIVER INGOL**Issue 58 River Ingol Outfall Structure**

Problem The existing Ingol outfall structure is dilapidated and has no secondary defence. Its ability to discharge is also affected by the immediately adjacent IDB pumping station during flood conditions.

Solution Consultants have been appointed to report on options for improvement or replacement of the Ingol outfall to satisfy its discharge and sea defence requirements.

Issue 59 Non Main River Flooding - Dersingham

Problem Local non-main river drainage problem in Dersingham caused by unconsented filling of ditches or installation of undersized pipes over many years.

Solution Action by the Borough Council and riparian owners to re-excavate ditches and replace undersized pipes with consented pipes of the correct size.

6.11 THE HEACHAM RIVER**Issue 60 Failure to Meet Water Quality Objective.**

Problem The lower stretch of Heacham River fails to meet the proposed REC 3 objective for dissolved oxygen.

Solution Investigate cause of low dissolved oxygen levels.

Maintenance of status as REC 4 but retain REC 3 as long term WQO.

Issue 61 Heacham River - Kalajuga Sluice

Problem The Kalajuga Sluice discharges water through the sea bank at Heacham. It has a set of pointing doors on the downstream side but no secondary defence on the upstream side.

Solution A project to be promoted to provide for the installation of a suitable penstock on the upstream face of the structure which could be closed down in the event of a failure of the pointing doors.

Issue 62 Heacham River - Pumping Station

Problem The pumping station at the Heacham River outfall was originally constructed by Anglian Water (prior to the formation of the NRA) to discharge additional flows to the river created by the new Heacham Sewage Treatment works during tide locked periods. Although the pumping station pumps river water it is still under the control and maintenance of Anglian Water Services.

Solution For a suitable agreement to be reached between AWS and the NRA for the hand over of the pumping station to the NRA along with a suitable commuted sum for its on-going maintenance.

Issue 63 Non Main River Flooding - Fring

Problem Drainage problem at Fring/Sedgeford on a non-main river section of the Heacham River due mainly to flash flood conditions and active springs which cause damage and closure to two roads.

Solution Preparation of a scheme by the Local Authorities/County Council to deal with the currently uncontrolled spring water.

6.12 SUMMARY TABLES OF CATCHMENT ISSUES AND OPTIONS

ISSUE 1: Review the Available Water Resources for the Catchment			
Options	Responsibility	Advantages	Disadvantages
Collect more information about aquifers and rivers	NRA	Obtain more knowledge about the aquifers and rivers	Cost of Data Collection, Construction of Gauging Stations etc.
Improve Conceptual Model of Water Balance System	NRA	Improved Knowledge	Cost of constructing and calibrating computer models
Determine interaction between the Chalk and Lower Greensand aquifers	NRA	Better Management/Licensing Policies	Cost of investigations
Determine interaction between groundwater and surface water	NRA	Better Management/Licensing Policies	Cost of investigations

ISSUE 2 : Review the Quantity Allocated to the Environment			
Options	Responsibility	Advantages	Disadvantages
Identify Methodology	NRA	Better approach to problem	Cost of Investigations
Carry out Methodology for each river	NRA	Better Protection of the River Ecology	Costs of applying methodology (Field Work etc.) Cost to abstractor who may be restricted
Identify protection zones for individual wetlands	NRA	Better Protection of the Wetland Ecology	Costs of investigation Cost to abstractor who may be restricted
Identify River Flow Objectives and/or MAFs	NRA	Better Management of the River System	Costs of Works needed Operational Costs to the NRA Cost to abstractor who may be restricted
Identify Operational Management of the Denver Complex during periods of low flows	NRA	Better Protection against saline intrusion into fresh water rivers Better Management Practices	Cost of investigation Operational Costs to the NRA

ISSUE 3 : Restate the Allocation of Water Resources and the Licensing Policy			
Options	Responsibility	Advantages	Disadvantages
Identify Management Strategy for water resources	NRA	Better management of water resources	Cost of producing report
Actively Manage system to meet River Flow Objectives	NRA	Better Management Practices Protection/Enhancement of River Ecology	Operational Costs to NRA
Investigate needs for works in catchment	NRA	Necessary Works are identified	Cost of investigation Future Costs of Capital Works
Examine possibility of revoking/reducing licences	NRA	Necessary revocations/reductions identified	Cost of investigation Future Costs of Compensation to Licence Holders

ISSUE 4: Development in Unsewered Areas			
Options	Responsibility	Advantages	Disadvantages
Seek to restrict development through the planning process	NRA Planning Authority	Prevents problem increasing	Does not solve existing problem
Installation of first time sewerage schemes following prioritisation	NRA Councils Householders	Improved water quality and reduction in nuisance	Cost to householder and council
Installation of private sewage treatment plants	Householder	Pollution prevention	Cost Limited Applicability Increase in NRA monitoring required

ISSUE 5: Redevelopment of Contaminated Land			
Options	Responsibility	Advantages	Disadvantages
Identify degree and nature of contamination	NRA Planning Authority Developer	Increase knowledge will enable prioritisation of affected sites	May not be possible to identify contaminant. May not be able to identify all possible sites
Agree measures to prevent pollution	NRA Planning Authority Developer	Protection of the water environment	Cost

ISSUE 6: Potential Pollution of Groundwater Supply			
Options	Responsibility	Advantages	Disadvantages
Define groundwater protection zones (GPZ) for remaining sources	NRA	Establish movement of contaminant	Theoretical model based on available data Planning blight
Prioritise inspection regime	NRA	Cost effectiveness and value for money from inspection targeting	Time delay at some sites
Offer advice and enforce pollution prevention measures	NRA	Reduction in risk to supply	Cost to site operator Much of pollution advice not enforceable but only voluntary

ISSUE 7: Nitrate Levels in Groundwater			
Options	Responsibility	Advantages	Disadvantages
Installation of Nitrate removal plants	AWS Ltd	Allows AWS to comply with legal obligations Removes nitrates from potable supply	Cost
Define Nitrate Sensitive Areas and Nitrate Vulnerable Zones	MAFF NRA	Protection of potable supplies	Planning blight and cost to farmers Reduces farming options Theoretical model based on best available data May "shift" problem to non-NSA/NSZ areas.
General Reduction in fertilizer application rates	MAFF NFU NRA Manufacturers	Reduction in nitrates in groundwater	Voluntary Agricultural productivity and profitability may be reduced.

ISSUE 8: Contamination of Groundwater from Dilute and Disperse Waste Sites			
Options	Responsibility	Advantages	Disadvantages
Monitoring of plume of contamination	NRA WRA	Assessment of risk	Theoretical model Cost
Undertake remedial measures as required	Developer Site operator NRA	Reduces pollution in aquifer	Cost

ISSUE 9: Restoration of Degraded Rivers and Habitats			
Options	Responsibility	Advantages	Disadvantages
Identify sites most in need of restoration	NRA	Allows assessment of risk and prioritises urgent action	
Develop restoration plans and implement them	NRA Landowners Conservation bodies English Nature	Improve species and habitat diversity within the river environment	Requires co-operation of landowners Cost

ISSUE 10: Water Level Management Plans			
Options	Responsibility	Advantages	Disadvantages
Assist in production of Water Level Management Plans	NRA IDBs MAFF	Improvement in water level management leading to improved species and habitat diversity	Increased control of structures required Cost
Apply WLMP in operations.	NRA IDB	As above	As above

ISSUE 11: The Identification of Special Ecosystems			
Options	Responsibility	Advantages	Disadvantages
Identify the Sites which form part of the Special Ecosystem Class of the Water Quality Objectives (SWQO)	NRA MAFF English Nature County Wildlife Trusts	Allows SEC objectives to be implemented. Highlight areas requiring River Flow Objectives	Timescale Cost

ISSUE 12: River Corridor Buffer Zones			
Options	Responsibility	Advantages	Disadvantages
Complete R & D Project	NRA (National)	Establish methodology and needs	
Develop Buffer Zones	NRA MAFF English Nature Countryside Commission	Improve species and habitat diversity within the river environment	Voluntary Requires funding external to NRA

ISSUE 13: River Maintenance Standards			
Options	Responsibility	Advantages	Disadvantages
Complete Standards of Service Review	NRA	Better able to identify criteria and targets for expenditure	Difficulty of translating standard of service to actual maintenance activities
Apply criteria to flood defence maintenance	NRA	Value for money can be identified leading to effective targeting of resources	May reduce level of service where this exceeds target level

ISSUE 14: Non Main River Flooding			
Options	Responsibility	Advantages	Disadvantages
Clarify the roles and responsibilities of the various drainage authorities.	Local authority NRA IDB's	Reduction in flooding risk Improved level of service	Availability of resources for undertaking remedial works.

Issue 15: Section 105 (2) Survey			
Options	Responsibility	Advantages	Disadvantages
Carry out survey of flood risk areas	NRA	Definitive information on flood risk areas	Cost to NRA

ISSUE 16: Sea Level Rise and Climate Change			
Options	Responsibility	Advantages	Disadvantages
To maintain a Watching Brief	NRA	Proactive works can proceed as data becomes available	No timescale

ISSUE 17: Structure and Local Plans			
Options	Responsibility	Advantages	Disadvantages
Adoption of NRA Guidance Notes in Structure and Local Plans	NRA Planning Authorities	Protection & enhancement of Water Environment	

ISSUE 18: Planning Application Forms			
Options	Responsibility	Advantages	Disadvantages
Amend planning application forms to include water supply source (ie mains/borehole)	Local Authorities	Will enable NRA to better assess planning proposals in terms of water resource availability & advise accordingly	Initial Costs of changing the forms

ISSUE 19: New Roads and Bypasses			
Options	Responsibility	Advantages	Disadvantages
Incorporate flood prevention measures into all road proposals	NRA Highway authority IDB	Avoid increased flood risk	Cost
Incorporate pollution prevention measures into all road proposals	NRA Highway authority	Avoid pollution	Cost
Ensure nature conservation interests are protected & enhanced with all road proposals	NRA Highway authority	Protection and enhancement of water environment	Cost

ISSUE 20: Impact of King's Lynn STW on the Estuary			
Options	Responsibility	Advantages	Disadvantages
Installation of secondary treatment at King's Lynn STW	AWS Ltd	Improvement in effluent quality Reduced impact on estuarine water quality	Cost
Ultra Violet disinfection of the effluent	AWS Ltd	Reduces bacterial contamination of effluent	Cost
Carry out trade effluent investigation	AWS Ltd	Enable source of pollution to be identified and remedial measures implemented	Uncertainty of a positive outcome for cost incurred
Impose toxicity based consent if source not positively identified by AWS	NRA	Places controls and monitoring on effluent toxicity.	Monitoring cost to NRA Cost to AWS Source not identified

ISSUE 21: Eutrophication in the Estuary			
Options	Responsibility	Advantages	Disadvantages
Review current monitoring of eutrophic status	NRA	Greater confidence in the data for decision making	Cost of possible increased monitoring
Collect data and undertake review of potential Sensitive Area status in 1997	NRA DOE	Confidence in classification of eutrophic status	Possible lack of positive outcome

ISSUE 22: Hunstanton - Snettisham Beach Access			
Options	Responsibility	Advantages	Disadvantages
Investigate siting of further access ramps	NRA Local Authority	Reduced pressure on existing ramps	Control of access Have to be written into Local Authority Byelaws

ISSUE 23: Hunstanton - Snettisham Beach Recharge			
Options	Responsibility	Advantages	Disadvantages
Continue monitoring of effectiveness	NRA	Better data for decision making	Long-term commitment to costs

ISSUE 24: Loss of Beach Material South of Hunstanton Boat Ramp			
Options	Responsibility	Advantages	Disadvantages
Agree able form of protection	NRA Local Authority Hunstanton Town Council	Improve level of protection Safety improvements	Safety

ISSUE 25: Sea Banks East, Wolferton - Snettisham			
Options	Responsibility	Advantages	Disadvantages
Investigate Ingol outfall project proposals as a source of material for reprofiling	NRA	Material available in close proximity to beach recharge sites	Insufficient or poor quality material may be available

ISSUE 26: Coastal Zone Development			
Options	Responsibility	Advantages	Disadvantages
To restrict occupancy of holiday homes to the summer period	Planning authority	Safeguard human life	Restricted use of holiday homes

ISSUE 27: Storm Tide Warning Service Boundaries			
Options	Responsibility	Advantages	Disadvantages
Integrate with existing police and other authority boundaries	Storm Tide Warning Service Police NRA MAFF Local Authority	Clarification of responsibility	Problem not able to be resolved as a compromise

ISSUE 28: Tidal River bank Improvements and Erosion Control			
Options	Responsibility	Advantages	Disadvantages
Undertake Annual inspections	NRA	Able to take rapid appropriate action	Long-term cost
Inspections after major storm surge events	NRA	as above	as above

ISSUE 29: Tidal River Siltation			
Options	Responsibility	Advantages	Disadvantages
Review efficiency of Tidal River	NRA	Identify issues & options for future	Cost
Further training works	NRA	Possible long term increase in self cleansing of the channel	Cost
Silt Removal	NRA	Immediate solution to the problem	Short term only Cost

ISSUE 30: Tidal River Training Walls			
Options	Responsibility	Advantages	Disadvantages
Increase height of training walls	NRA	Reduced volume of silt entering the Tidal River	Medium term solution only
Complete Wash outfalls study	NRA	Better understanding of sediment and saltmarsh accretion	

ISSUE 31: Navigation of Salters Lode - Denver Crossing			
Options	Responsibility	Advantages	Disadvantages
Review level of navigation facilities	NRA	Possible improvements to existing facilities, improved safety	Increased cost of new works and time taken to solve problem
Production of navigation guidance sheet and information board	NRA	Increased awareness of safety hazard	

ISSUE 32: Tidal River Outfalls			
Options	Responsibility	Advantages	Disadvantages
Development of automated system	NRA	Stop saline intrusion Removed flood risk	No "off the shelf" method available
Clarification of areas of responsibility followed by agreements/ working procedures	NRA IDB	More clearly defined responsibility	

ISSUE 33: Oil Pollution Nuisance, Fishers Fleet King's Lynn			
Options	Responsibility	Advantages	Disadvantages
Promote better practices for storage and handling of oil by boat owners	NRA Harbour Authority	Aesthetic improvements Reduced risk of pollution	Cost to boat owners Voluntary
Provide assistance to harbour authority in the pursuance of prosecutions	NRA	Prevents pollution occurring.	Dependent on Harbour Authority

ISSUE 34: King's Lynn Sea Defences, King's Staithe Square and the Purfleet			
Options	Responsibility	Advantages	Disadvantages
Incorporate permanent solution into any future development on the site	NRA Developer Local Authority	Permanent Resolution of flood risk problem	

ISSUE 35: King's Lynn Sea Defences, Common Staithe Square to Purfleet Quays			
Options	Responsibility	Advantages	Disadvantages
Works to increase the level of protection to 1 in 100 year standard	NRA	Reduced risk of flooding	Requires consent of owners Listed Buildings constraints

ISSUE 36: King's Lynn Sea Defences, South Quay			
Options	Responsibility	Advantages	Disadvantages
Update records and procedures as whereabouts of pipework becomes known	Land Owner Utilities Local Authority NRA	Better data for decision making	Unknown size of problem
Continue to issue "conservative" flood warnings	NRA Police Local Authority	Ensure best possible preparation against flood risk	Not a total solution to the problem

ISSUE 37: Relief Channel Bank Erosion			
Options	Responsibility	Advantages	Disadvantages
Identify problem areas and the cause.	NRA	Better data for decisions	Cost
Examine use of "soft" defences	NRA	Improvements to increase species and habitat diversity	May increase costs

ISSUE 38: Conservation Enhancements to the Relief channel			
Options	Responsibility	Advantages	Disadvantages
Review bank mowing policy	NRA	Increase species and habitat diversity	Possible risk to flood defence efficiency
Target appropriate management using data from REDS and RCS	NRA	Identify areas to be enhanced/conserved Drives subsequent actions	
Identify appropriate grazing management	NRA	Increase species and habitat diversity	Voluntary Cost to farmers

ISSUE 39: Fisheries Habitat Within the Relief channel			
Options	Responsibility	Advantages	Disadvantages
Increase fish refuges using willow croys	NRA	Increase fish biomass and improve population structure	Impact upon flood defence
Examine possible sites for artificial reefs.	NRA	as above	as above

ISSUE 40: Recreational Access to the Relief channel			
Options	Responsibility	Advantages	Disadvantages
Establish the potential demand	NRA	Target resources to achieve best value for money	May be skewed in favour of a single interest group
Increase public information and safety provision	NRA	Increased awareness of NRA role Increased public safety	Cost Impact on conservation value
Provision of more angling sites, available to anglers with disabilities.	NRA Angling Clubs	Increased availability of affordable fisheries	Impact on conservation value of site

ISSUE 41: Tail Sluice Automation			
Options	Responsibility	Advantages	Disadvantages
Complete tail sluice automation	NRA	Improved long term monitoring Cost savings	Initial high cost
Monitor for performance and reliability in all conditions	NRA	Better understanding.	

ISSUE 42: Middle Level Main Drain, Failure to Meet Proposed REC 3 WQO			
Options	Responsibility	Advantages	Disadvantages
Adopt REC 4 in the long term	NRA	Protects water quality from deterioration. Permits objective to be set on a statutory basis	Perceived relaxation of target

ISSUE 43: Eutrophication of the River Nar			
Options	Responsibility	Advantages	Disadvantages
Improve water quality monitoring program	NRA	Allow better estimates of phosphorous loads	Cost
Improve flow monitoring upstream of Marham	NRA	Allow better estimates of phosphorous loads	Cost
Review and update phosphorous data.	NRA	Potential to limit discharge	Uncertainty of effect
Investigate benefits of further controls to limit phosphorous discharges	NRA	Potential to limit discharge	Uncertainty of effect

ISSUE 44: Access of Sea Trout into River Nar			
Options	Responsibility	Advantages	Disadvantages
Examine inclusion of fish pass in any renewal of gates	NRA	Improve fishery	Cost Gates may not be replaced in the short term

ISSUE 45: River Nar, Mileham to Litcham. Failure to Meet Proposed REC 3 WQO			
Options	Responsibility	Advantages	Disadvantages
Investigate relationship between Low DO and River Flow	NRA	Provide improved information for decision making	May not be possible to establish relationship
Maintain REC 5 in short/medium term	NRA	Protects water quality from deterioration. Permits objective to be set on a statutory basis	Perceived relaxation of the target

ISSUE 46: River Nar, Litcham to Lexham Hall. Failure to Meet Proposed REC 3 WQO			
Options	Responsibility	Advantages	Disadvantages
Review flow data for the river at this point to enable limits to be confirmed.	NRA	Give confidence in the current standard and provide basis for RNC determination	
Recalculate consent limits if required	NRA	Improve water quality	No obligation on AWS Ltd to improve effluent quality
Maintain REC 4 in short/medium term	NRA	Protects water quality from deterioration. Permits objective to be set on a statutory basis	Perceived relaxation of the target
Examine methods of increasing the flow available for effluent dilution during summer low flow periods	NRA	Improve water quality	Unlikely to be additional resources available Potential cost

ISSUE 47: River Nar, Lexham Hall to Castle Acre. Failure to Meet Proposed REC 2 WQO			
Options	Responsibility	Advantages	Disadvantages
Investigate relationship between Low DO and River Flow	NRA	Provide improved information for decision making	May not be possible to establish relationship
Maintain REC 4 in short/medium term	NRA	Protects water quality from deterioration. Permits objective to be set on a statutory basis	Perceived relaxation of the target

ISSUE 48: River Nar Bank Instability			
Options	Responsibility	Advantages	Disadvantages
Completion of study outlining options and issues	NRA	Obtain best value for money solution	

ISSUE 49: Proposed Development of River Nar Flood defences			
Options	Responsibility	Advantages	Disadvantages
Improve flood defences to required standards	Developer	Allows unrestricted development	Cost

ISSUE 50: Gaywood River. Failure to Meet Proposed REC 3 WQO			
Options	Responsibility	Advantages	Disadvantages
Investigate cause of elevated ammonia and depressed oxygen levels	NRA	Better data for decision making	May not pin point the source
Maintain REC 4 in short/medium term	NRA	Protects water quality from deterioration. Permits objective to be set on a statutory basis	Perceived relaxation of target

ISSUE 51: Roydon Common & Slurry Disposal to Land			
Options	Responsibility	Advantages	Disadvantages
Investigate perceived problem	NRA Waste Regulation Authority	Protect internationally important wetland site from poor water quality	Cost of investigation

ISSUE 52: Middleton Stop/ Pierpoint Drain. Failure to Meet Proposed REC 3 WQO			
Options	Responsibility	Advantages	Disadvantages
Investigate sources of pollution from industrial areas in King's Lynn	NRA	Provide information for target	May not be able to identify a specific cause
Implement program of pollution inspection and prevention visits	NRA	Eliminate illegal discharges	Cost
Undertake remedial action	Polluter	Reduces risks	Cost
Maintain REC 5 in short term but move towards REC 4 in medium term	NRA	Protects water quality from deterioration. Permits objective to be set on a statutory basis	Perceived relaxation of target

ISSUE 53: Non Main River Flooding at West Winch			
Options	Responsibility	Advantages	Disadvantages
Re-excavation of existing drains	Local Authority Riparian Owner	Resolution of flooding problem	Effect on Landowners property
Promotion of alternative drainage scheme	Local authority Riparian Owner	Enhanced protection	May not be resolved in short term

ISSUE 54: River Babingley. Failure to Meet Proposed REC 2 WQO			
Options	Responsibility	Advantages	Disadvantages
Investigate cause of low DO	NRA	Provide indication of solution to the problem	Uncertain outcome
Maintain REC 3 in short/medium term	NRA	Protects water quality from deterioration. Permits objective to be set on a statutory basis	Perceived relaxation of target

ISSUE 55: River Babingley Outfall			
Options	Responsibility	Advantages	Disadvantages
Investigate feasibility of providing power to the site and automation of outfall	NRA	Improved control of water levels	Cost
Installation of telemetry monitoring	NRA	Improved ability to manage water levels	Cost
Carry out works to relieve the effects of water level fluctuations on habitat	NRA	Improved habitat and species diversity	Dependant on nature of water level management works

ISSUE 56: Improvement of Coarse Fishery of Lower Reaches of the River Babingley			
Options	Responsibility	Advantages	Disadvantages
Operation of sluice only when required	NRA	Stop flushing out of juvenile fish	Risk of flooding More site visits required
Investigate use of habitat shelters	NRA	Prevent flushing fish when sluice is open	Risk of flooding

ISSUE 57: Access of Sea Trout into the River Babingley			
Options	Responsibility	Advantages	Disadvantages
Consider installation of through passage when undertaking new works	NRA	Increased population	Cost

ISSUE 58: River Ingol Outfall Structure			
Options	Responsibility	Advantages	Disadvantages
Improve upstream storage and upgrade outfall	NRA IDB Landowners	No need to replace the outfall Generates material for flood bank improvements	Loss of agricultural land
Relocate the outfall upstream	NRA	Improved discharge during flood	Effect on saltmarsh cost

ISSUE 59: Non Main River Flooding at Dersingham			
Options	Responsibility	Advantages	Disadvantages
Re-excavate ditches and replace undersized culverts.	Riparian owner Local Authority	Reduce flood risk	Cost

ISSUE 60: Heacham River. Failure to Meet Proposed REC 3 WQO			
Options	Responsibility	Advantages	Disadvantages
Investigate cause of low DO	NRA	Improve data for developing solution to the problem	Uncertainty of outcome
Maintain REC 4 in short/medium term	NRA	Protects water quality from deterioration. Permits objective to be set on a statutory basis	Perceived relaxation of target

ISSUE 61: Heacham River. Kalauga Sluice Lacks a Secondary Flood Defence			
Options	Responsibility	Advantages	Disadvantages
Installation of a suitable penstock on upstream face	NRA	Increased Flood Protection	

ISSUE 62: Heacham River Pumping Station			
Options	Responsibility	Advantages	Disadvantages
Reach agreement with AWS for hand over of station to NRA	NRA/AWS	Overall control of water management will rest with a single authority	Future maintenance responsibility

ISSUE 63: Non Main River Flooding at Fring			
Options	Responsibility	Advantages	Disadvantages
Preparation of Scheme to deal with uncontrolled spring water.	Local Authority County Highways	Relieve flooding problems Reduction in road closures	

7. GLOSSARY OF TERMS AND UNITS

Items in *Italics* refer to definitions further on in the glossary:

Abstraction licence	Document issued by the authority setting out the holders entitlement to take water. A licence is required to take water for most uses as defined in the Water Resources Act 1991
Alluvial deposits	Sand, gravel and silt resulting from deposition of rivers, particularly on flood plains
Ammonia	Chemical used to characterise water quality as it is found in many effluent disposals.
Annual recycling operation	Transfer of sediment which has been eroded from beaches at one location and deposited at other sites back onto the original beaches
Aquatic	Pertaining to the water environment
Aquifers	Water bearing rock formations. Water occurs within the rock itself in the spaces between the rock granules as well as in cracks and fissures. Water contained within aquifers is known as groundwater and the level at which water occurs is the groundwater table.
Beach recharge	Import of suitable beach material from elsewhere to raise the level and/or regrade a beach for sea defence or environmental purposes
Benthic	Pertaining to the bed of a waterbody, river or the sea.
Biochemical Oxygen Demand (BOD)	Measure of the amount of oxygen in the water consumed by the breakdown of organic matter.
Biomass estimates	Measure of density usually expressed as grammes per square metre (g/m^2 or gm^{-2})
Boulder Clay	Residue deposited by glaciers as they retreated at the end of the ice ages. It consists of a mixture of rock fragments, clay, sand and gravels.
Carr	Wet woodland usually Alder or Willow which is a development stage towards mature woodland.

Carrying Capacity	Size of a channel relating to the amount of water and the flow it can contain within its banks.
Carstone	A form of <i>Lower Greensand</i> which is often more like a sandstone than a sandy deposit.
Chalk	A calcium-rich rock formed from deposition of the shells of marine creatures. Groundwater is found within the fissures of the rock.
Coastal cells	The division of the coastline into discrete units for the purposes of flood defence planning and operations.
Conservation Notice	Issued to ensure that water resources are not adversely affected by mineral, civil engineering, and other uses exempt under the Water Resources Act 1991
Controlled Waters	All surface water and groundwater bodies and channels to 3 nautical miles from the shore.
Crown	The activities and properties owned by the Crown and Central Government are often exempt from the requirements of much of the legislation pertaining to the water environment.
Cut-Off Channel	This water body is discussed in the Ely Ouse Catchment Management Plan. It links the Rivers Lark, Little Ouse and Wissey to Denver, taking storm water directly for discharge to tide and taking water from Denver for transfer to Essex for public water supply.
Cyprinid	Coarse freshwater fish such as roach, chubb and bream, but not game fish such as Trout and Salmon.
Demand centres	A generally discrete area of <i>public water supply</i> demand in which specific abstraction sites can be used to meet demand throughout that area.
Designated Main River/sea defence	River and Sea defences agreed by <i>MAFF</i> and shown on a definitive plan.
Dewatering	The abstraction of water to enable mineral extraction and civil engineering to continue below the groundwater table.

Discharge capacity	The volume of water per unit of time able to be conveyed by a channel or pipe.
Dutch fyke netting	Designed to catch eels consisting of a netting tube held up by hoops with funnels which trap the eel in the toe of the net.
Eutrophic	Nutrient rich usually resulting from high levels of organic matter but can be the result of nitrate pollution.
Fauna	Animal life forms.
Fluvial	Pertaining to rivers
Flora	All plant life.
Foreshore	That part of the shoreline above the high water tidemark.
Full project appraisal	The NRA has detailed procedures which are required before expenditure can be incurred.
Geomorphology	The study of the physical landforms of an area.
Gravity outfall	Discharge through a pipe or sluice with no pumping.
Impounded	The holding back of water behind a dam. Strictly a structure which raises water levels above their "normal" height. May need a licence and/or Land Drainage Consent from the NRA.
In river needs	The totality of requirements for the water environment and effluent dilution before abstraction is taken into account.
Integrated Pollution Control (IPC)	Set out in the <i>Environmental Protection Act 1990</i> .
Internal Drainage Boards (IDBs)	Authorities responsible for dealing with land drainage within a district. They are primarily concerned with agricultural land drainage but also may be involved with water supply to their district for agricultural purposes.
Licensing horizon	Date to which the NRA will allow demand to be forecast and will issue abstraction licences for planned demand upto this date.

Littoral	The margins of a water body, such as a lake, coastline or river. A zone of occasional submergence.
MAFF	Ministry of Agriculture, Fisheries, and Food.
m AODN	see <i>Sea Level</i>
Middle Level	Area which falls between the River Nene and Counter Drain/Old Bedford River. Much of it is below sea level and requires land drainage. It is an area of intensive farming activity. Water levels and navigation are the responsibility of the Middle Level Commissioners.
Minimum Acceptable Flow (MAF)	Required by the Water Resources Act 1991. They are a single flow below which the river should not fall.
Minimum Residual Flow (MRF)	Flow which must be maintained whilst an abstraction is occurring. They are usually set out in legislation associated with a particular abstraction.
Models	Usually theoretical frameworks, often using computers, which use mathematical formulae to describe in a simplified way the complexity of the water environment.
OFWAT	Office of Water Services. The regulator of the water companies controlling how much they can charge for their services.
Permissive powers	Powers which confer on the NRA the right to do things but not the duty to do them. See also <i>Statutory Powers</i> .
Plankton	The single celled and simple organisms which form the basic resource of the water environment food chain.
Potable Water Supply	Water of sufficient quality that it can be used for drinking water.
Primary Effluent Treatment	Physical treatment of sewage works effluent by screening and settlement.
Private water undertaking	Supply of water by an individual or company other than a <i>Water Undertaker</i> .

Public water supply	The supply of water by companies appointed as Water Undertakers by the Secretary of State for the Environment under the Water Industry Act 1991.
Ramsar Sites	Designated by the Convention on Wetlands of International Importance at Ramsar, Iran. Important particularly as wildfowl habitat.
Raw Water Transfer	The transfer of water from one resource to another in order to meet or anticipate demand. It is usually part of a scheme such as a reservoir or pipeline.
Re-profiling	Changing the shape, height or cross-section of a beach or river to prevent/correct erosion, to strengthen/enlarge or for conservation purposes.
Return period	The long term average period between occurrence of an event. Usually expressed as a probability i.e 1 in 100 yr event.
Riffle pool sequences	Reoccurring shallows and depths which form naturally in rivers. They provide habitat by having shelter and wide range of river <i>velocities</i> and food supplies.
Rights of existing users	All <i>abstraction licences</i> confer specific protection on the holder, against diminution of their ability to abstract caused by any further licences which may be granted by the NRA. Unlicensed domestic abstractions and small <i>riparian</i> agricultural abstractions are also protected.
Riparian	Owners of the land immediately adjacent to a water course.
River augmentation schemes	The use of groundwater pumped from boreholes to discharge into a river to prevent it drying out or to increase flows to prevent damage to the environment.
River Corridor Survey (RCS)	A standard map based habitat survey highlighting important plant species.
River Ecosystem Class (REC)	see <i>Statutory Water Quality Objectives</i> and Chapter 4.1

Rivers Environmental Database (REDS)	Comprehensive database based on 500m stretch surveys of <i>Statutory Main River</i> . It maps the physical and environmental information and provides a basic conservation resource.
River Flow Objectives (RFO)	A series of flows which aim to reflect the varying <i>In River Needs</i> and the seasonality of flow patterns.
River Habitat Survey (RHS)	An inventory survey of physical features of the river and adjacent habitat.
River Needs Consents (RNC)	Permissions for discharge of effluents, are based on a <i>dry weather flow</i> , and often specify limits for certain potential pollutants
Saline intrusion	Salt water is heavier than freshwater and will therefore tend sink to the bottom of a water course. Once salt water has entered a water course it is difficult to remove other than by flushing with high flows during floods. It can have profound effects on the ecology of river.
Salmonid	Game fish such as Trout, Salmon and Sea Trout.
Sea level	As defined at Newlyn. Ground levels are measured as above Ordnance Datum Newlyn (AODN). In parts of the catchment ODN is reset at 100m, the South Level datum (SLD).
Secondary Treatment	Biological degradation of sewage works effluent which may also involve some chemical and physical treatment as well.
Siltation	At low <i>velocities</i> water will deposit the material being carried with it. The slower the velocity the finer the material deposited. A deposit of clays and silt is very difficult to remove naturally as it requires turbulent and high velocities.
SLD	see <i>Sea Level</i>
Sop Level	The level of water retained in a drain in order to prevent drainage of the soil and maintain water in the soil/peat for crop growth. Also known as the Soke level.

Soft Option	Measures such as <i>beach recharge</i> which do not require walls and expansive structures to protect against flooding. They are soft because they absorb the energy of the waves and thus require continual maintenance.
South Level	This area falls between the Ely Ouse and 100 Foot/New Bedford River. Much of it is below sea level and requires land drainage. It is an area of intensive farming activity.
Statutory consultee	In both the NRA's and other agencies' legislation there are requirements for consultation. Comments and objections which are received are noted but do not usually have the power to, in themselves, prevent the controlling authority from making a decision.
Statutory powers	Powers conferred on the NRA where it has a duty to do things.
Statutory Water Quality Objective (SWQO)	Use related standards necessary to set quality targets fulfilling local needs. They are divided into use classes. At present only the River Ecosystem Class (REC) is in use. See also Chapter 4.1.
Storm Tide Warning Service	Funded by <i>MAFF</i> , a branch of the Meteorological Office with particular responsibility for predicting the size and warning of <i>tidal surges</i>
Substrate	The base material, usually a rock or deposit, upon which a habitat is formed.
Surge level	High tide level augmented by low atmospheric pressure and on-shore winds producing a higher than normal sea level.
Suspended solids	The density of undissolved matter which is held by a water body. It will vary with the turbulence and <i>velocity</i> of the water.
Sustainable	The use of a resource not exceeding the ability of that resource to fully replenish itself over a set time period.
Telemetry	The use of telephone or radio links to automatically communicate between measuring stations and a central location where the data is received.

Temporary licences	<i>Abstraction Licences</i> are now generally issued for a period of 10 years. This is to enable the NRA to continually review the allocation of resources. These licences can then be renewed but the renewal is treated as if it were a new licence application and subject to the same processes.
Terrestrial habitats	Land based habitats such as river banks which are affected or interact with the water environment.
Tide lock periods	Periods when freshwater cannot leave a river system as the outfall structure, usually a flap, is closed by the pressure of the high tide against it. This corresponds with high tide sea levels being higher than the river water level.
Velocities	The speed of movement of water past a point. Velocities relate to flows, but flow is the volume of water moving past a point and reflect the channel size. Velocities are measured in metres per second (m/sec).
Wetland	Habitats which are dependant on water. This may be either groundwater in contact with the vegetation or flow of surface water across or through the site. Washlands are often sites which are subject to periodic flooding and the habitat has developed a requirement for this.
Willow crows	Bundles of Willow stakes used to alter the <i>velocity</i> , halt bank erosion and increase upstream habitat diversity

Units used in this Report

Cubic Metres m^3 = 220 gallons

Litres l = 1.76 pints

Milligramsmg = 0.001 gm

Grammesg = 0.0353 ounces

Kilometreskm = 0.6214 miles

Metresm = 3.281 feet

Hectaresha = 2.47 acres

8.

APPENDICES

1. General Quality Assessment (GQA) Chemical Grading For Rivers and Canals.
2. Scheme for Classifying Estuaries
3. River Ecosystem Classification
4. Proposed Environmental Quality Standards
5. Directive Site Failures Reported to DOE
6. Flood Defence Standards of Service

Appendix 1

**GENERAL QUALITY ASSESSMENT (GQA)
CHEMICAL GRADING FOR RIVERS AND CANALS.**

Water Quality	Grade	Dissolved Oxygen (% saturation), 10-percentile	Biochemical Oxygen Demand (ATU)¹ (mg/l) 90-percentile	Ammonia (mgN/l) 90-percentile
Good	A	80	2.5	0.25
	B	70	4	0.6
Fair	C	60	6	1.3
	D	50	8	2.5
Poor	E	20	15	9
Bad	F ²			

¹ as suppressed by adding allyl thio-urea

² quality which does not meet the requirements of Grade E in respect of one or more determinands.

Appendix 2

SCHEME FOR CLASSIFYING ESTUARIES

DESCRIPTION		Points awarded
Biological Quality (scores under a, b, c and d to be summed)		
a.	Allows the passage to and from freshwater of all relevant species of migratory fish, when this is not prevented by physical barriers.	2
b.	Supports a residential fish population which is broadly consistent with the physical and hydrographical conditions.	2
c.	Supports benthic community which is broadly consistent with the physical and hydrographical conditions.	2
d.	Absence of substantially elevated levels in the biota of persistent toxic or tainting substances from whatever source.	4
Maximum number of points		10
a.	Estuaries or zones of estuaries that either do not receive a significant pollution input or which receive inputs that do not cause significant aesthetic pollution.	10
b.	Estuaries or zones of estuaries which receive inputs which cause a certain amount of pollution but do not seriously interfere with estuary usage.	6
c.	Estuaries or zones of estuaries which receive inputs which result in aesthetic pollution sufficiently serious to affect estuary usage.	3
d.	Estuaries or zones of estuaries which receive inputs which cause widespread public nuisance.	0
Water Quality (Score according to qualify)		
Dissolved Oxygen exceeds the following saturation values:		
60%		10
40%		6
30%		5
20%		4
10%		3
below 10%		0
The points awarded under each of the headings of biological, aesthetic and water quality are summed.		
Waters are classified on the following scale.		
Class A Good Quality 24 to 30 points Class B Fair Quality 16 to 23 points		
Class C Poor Quality 9 to 15 points Class D Bad Quality 0 to 8 points		

Appendix 3

RIVER ECOSYSTEM CLASSIFICATION

CLASS	DO % SAT 10%ile	BODA mg/l 90%ile	NH ₃ -N mgN/l 90%ile	UN-IONISED NH ₃ -N mg/N 95%ile	pH 5%ile - 95%ile	HARDNESS mg/l CaCO ₃	DISSOLVED CU µg/l 95%ile	TOTAL ZN µg/l 95%ile
RE1	80	2.5	0.25	0.021	6-9	≤ 10 > 10 and ≤ 50 > 50 and ≤ 100 > 100	5 22 40 112	30 200 300 500
RE2	70	4.0	0.6	0.021	6-9	≤ 10 > 10 and ≤ 50 > 50 and ≤ 100 > 100	5 22 40 112	30 200 300 500
RE3	60	6.0	1.3	0.021	6-9	≤ 10 > 10 and ≤ 50 > 50 and ≤ 100 > 100	5 22 40 112	300 700 1000 2000
RE4	50	8.0	2.5	-	6-9	≤ 10 > 10 and ≤ 50 > 50 and ≤ 100 > 100	5 22 40 112	300 700 1000 2000
RE5	20	15.0	9.0	-	-	-	-	-

NOTES

- a. DO Dissolved Oxygen
BODA Biochemical Oxygen Demand
- b. % SAT % Saturation
- c. %ile Percentile
- d. pH Lower limit as 5%ile, upper limit as 95%ile

Appendix 4

PROPOSED ENVIRONMENTAL QUALITY STANDARDS

(annual averages unless otherwise stated)

(Units $\mu\text{g/l}$)	Pb*	Cr*	Zn*	Cu*	Ni*	V+	B ⁽²⁾ +	As*	Cd
Fish and other life	25	15	40	5 ⁽¹⁾	30	100	7000	25	5
Shellfish	25	15	40	5 ⁽¹⁾	30	100	7000	25	5
Bathing water									

(Units $\mu\text{g/l}$)	Hg*	S ⁽³⁾	Ammonia N	Chlorpyrifos +	DO	pH Units	TC/100 ml	TTC/100 ml
Fish and other life	0.5	10	21	0.003 ⁽⁶⁾ / 0.01	6/4 ⁽⁴⁾ / 7/5 ⁽⁵⁾	6-8.5	-	-
Shellfish	0.5	10	21	0.003 ⁽⁶⁾ / 0.01	70/60 ⁽⁷⁾	7-8.5	-	2300 ⁽⁸⁾
Bathing water							10 000 ⁽⁹⁾	2000 ⁽⁹⁾

* = Dissolved

+ = Total

1. Higher units acceptable where acclimation expected or Cu present in organic complexes
2. Tentative
3. 24 h 'Maximum average' (undissociated hydrogen sulphide)
4. September-February annual average and 95 percentile (mg/l)
5. March-August annual average and 95 percentile (mg/l)
6. Upper limit
7. Percentage saturation annual average and 95 percentile
8. 75 percentile
9. 95 percentile

Source : WRC *The Great Ouse Ecological Survey* 1986

Appendix 5**EC DIRECTIVE SITE REPORTED TO DOE**

Sample Code	Site Name
R02BF51M01	Ten Mile River Denver Sluice
R02BF53M14	Middle Level Main Drain Mullicourt Priory Sluice
R02BF56M13	Flood Relief Channel Saddlebow Bridge
R02BF58M06	River Nar West Acre Road Bridge
R02BF58M08	River Nar Marham Gauging Station
R02BF58M11	River Nar By Pass Bridge Kings Lynn
R02BF59M02	Mintlyn Stream Mintlyn Farm Road Culvert
R02BF59M04	Middleton Stop Drain Middleton Towers Road Bridge
R02BF64M04	Babingley River A149 Road Bridge Castle Rising
R02BF66M04	Heacham River Beach Culvert Heacham
R02BI62M01	River Ouse The Point Kings Lynn
R02BI62M09	River Ouse Cork Hole Tide Gauge
R02BJ66M07	Hunstanton Beach
R02BJ66M11	The Wash N Beach Heacham S Sands Club

Appendix 6

FLOOD DEFENCE STANDARDS OF SERVICE

STANDARDS OF SERVICE LAND USE BANDS AND TARGETS						
LAND USE BAND	TARGET STANDARD OF PROTECTION (RETURN PERIOD)					
	FLUVIAL			SALINE		
A	1:50	-	1:100	1:100	-	1:200
B	1:25	-	1:100	1:50	-	1:200
C	1:5	-	1:50	1:10	-	1:100
D	1:1.25	-	1:10	1:2.5	-	1:20
E	< 1:2.5			< 1:5		

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 floodplain will 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, and 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 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 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.