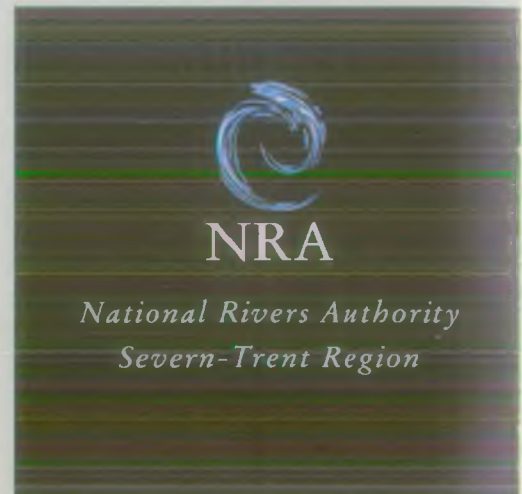


RIVER SEVERN LOWER REACHES CATCHMENT MANAGEMENT PLAN CONSULTATION REPORT MAY 1995



YOUR VIEWS

This report is intended to form the basis for consultation between the NRA and all those with interests in the catchment. Consultees may wish to:

- * comment on the Vision for the Catchment
- * comment on the issues and options identified in the report
- * suggest alternative options for resolving identified issues
- * raise additional issues not identified in the report

Following the consultation period all comments received on the Consultation Report will be considered in preparing the next phase, the Action Plan. This Consultation Report will not be rewritten as part of the Action Plan process.

The NRA intends that the Plan should influence the policies and actions of developers and planning authorities as well as assisting in the day to day management of the catchment.

A pre-consultation Forum was held on the 18 January 1995 to discuss the issues. Representatives from Local Authorities, National Organisations, other interested parties and representatives of the NRA Statutory Committees were in attendance. These external Statutory Committees advise the NRA on all aspects of its work. Comments arising from the Forum have been incorporated into this document where possible. A list of organisations attending the Forum is given in Appendix 3. The NRA is grateful for the useful suggestions received.

Comments on the Consultation Report should be sent to:

Dr Richard A Bailey, Area Manager
NRA Lower Severn Area
Riversmeet House
Newtown Industrial Estate
Northway Lane
Tewkesbury
Glos GL20 8JG

All contributions should be made in writing by: Friday 28 July 1995

If you or your organisation need further information, please contact Dr J K Everard at the above address or by telephone on (01684) 850951.

May 1995

FOREWORD

The National Rivers Authority was created in 1989 to preserve and enhance the natural water environment and to protect people and property from flooding. In its role as 'Guardian of the Water Environment', the NRA is committed to preparing a sound plan for the future management of the region's river catchments.

This Consultation Report is the first stage in the catchment management planning process for the River Severn - Lower Reaches Catchment. It provides a framework for consultation and also a means of seeking commitment from those involved to realise the full environmental potential of the catchment.

We look forward to receiving comments and contributions from interested organisations and individuals. These will enable a final Plan to be produced, balancing the conflicting demands placed upon the natural water environment.

Dr Richard Bailey
Area Manager
Lower Severn Area

VISION STATEMENT

This vision for the catchment describes what the NRA would wish the catchment to be and how it might work toward that vision. This vision is long term and while it may only be partly achieved in the next five years, it is something we can all work towards.

The NRA aims

- * To ensure that water quality is appropriate for the current and future uses of the catchment. This includes:
 - * Seeking additional safeguards to protect water supplies by submission of proposals to the Department of Environment that the River Severn and Gloucester - Sharpness Canal should be designated as Water Protection Zones.
 - * Working in conjunction with other authorities to control mining activities in the Forest of Dean.
 - * Ensuring that development or use of contaminated land in Cheltenham, Gloucester, the Forest of Dean and Avonmouth is accompanied by responsible remedial measures.
 - * Upgrading the quality of the Rivers Chelt and Frome by sewage treatment works' improvements and enhancing the quality of the major tributary of the Severn - the Warwickshire Avon, by actions detailed in the Avon's Catchment Management Plan.
 - * Seeking adequate rural sewerage systems to serve areas where pollution is evident. Support will be given to local schemes which will employ sensitive and sustainable methods of treatment.
 - * Reduction of diffuse nitrate and phosphate pollution by assisting the Ministry of Agriculture in managing Nitrate Vulnerable Zones and proposing to the Department of the Environment that the Gloucester-Sharpness Canal and the Rivers Severn and Leadon be designated as Eutrophic Sensitive Areas.
- * To protect ground and surface water resources. Particular aims are to:
 - * Manage the residual flow in the Severn at Gloucester to meet requirements for water supply, navigation and fish migration.
 - * Restore flow in the Glynch Brook in dry summers.
- * To provide flood defences to reduce the risk to people and property from flooding where this is cost effective and environmentally acceptable, to improve the system of flood warning in non-tidal rivers and to establish a warning system on the tidal River Severn. Particular aims are to:

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- * Establish a strategy with Gloucester City using a combination of new roadworks, redevelopment of flood plain fringes, removal of redundant structures and installation of new flood defences.
- * Provide flood alleviation works in Cheltenham in co-operation with Cheltenham Borough Council to give increased flood protection to more than 700 properties.
- * To reinstate degraded sections of river corridor to their full potential especially on the Rivers Cam and Frome and the Hatherley, Norman and Horsebere Brooks.
- * To support and develop recreational activities including restoration of the Stroudwater, Thames and Severn and Herefordshire & Gloucestershire Canals where this does not adversely affect other uses.
- * To seek the return of otters to the catchment and protect native stocks of brown trout, especially in the Forest of Dean, and crayfish in the Little Avon, from introduced species.
- * To improve and protect the fisheries in the catchment, in particular the elver fishery, via fisheries management, habitat and environmental quality improvements.
- * To support the development of small scale hydropower schemes where it can be demonstrated that they do not adversely affect other uses of the River Frome or other Cotswold streams.
- * To ensure that development at Avonmouth does not reduce the present flood storage capacity or adversely affect wetland ecology by co-operation with Bristol and Northavon Councils, the South Gloucestershire Internal Drainage Board and English Nature.
- * To forward the principles of sustainability and environmental protection and enhancement by consultation with local authorities, agencies and developers within the planning process. This includes participation in the formal planning system and via Water Level Management Plans, Coastal and Catchment Management Planning.

The final overall aim encompassing all of these aspects is a sustainable water environment.

RIVER SEVERN LOWER REACHES CATCHMENT MANAGEMENT PLAN

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PART I

THE CONSULTATION REPORT

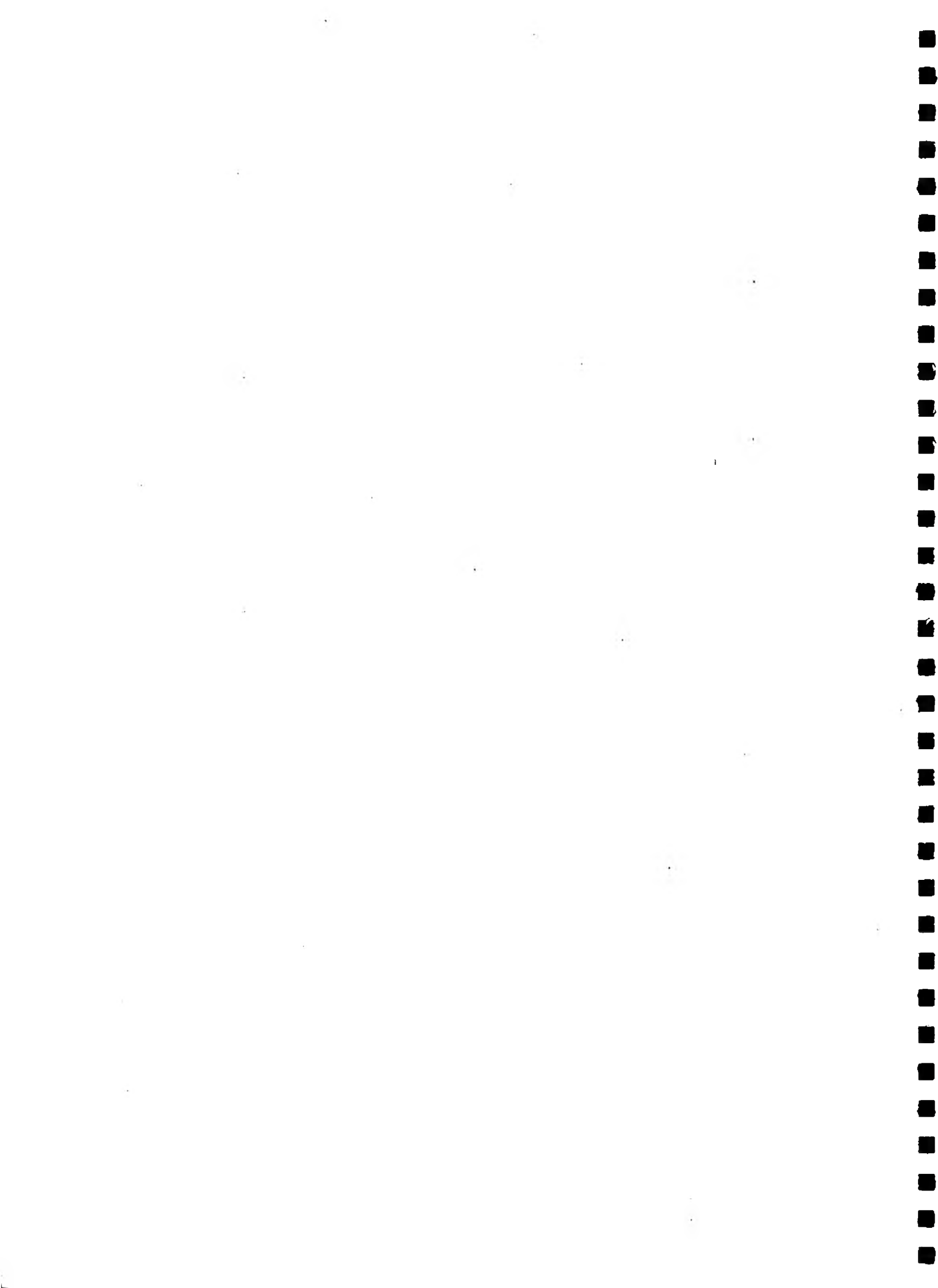


NRA Severn-Trent Region

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River Severn - Lower Reaches CMP



SECTION 1.0

THE CATCHMENT MANAGEMENT PLAN PROCESS

1.1 THE NATIONAL RIVERS AUTHORITY (NRA)

1.1.1 Status

The NRA was created in 1989 as an independent environmental agency. Its prime purpose is to protect and improve the water environment in England and Wales and to regulate the use of water by industry, agriculture and the private water and sewerage companies.

The NRA's responsibilities cover rivers, lakes, canals and underground waters. It has statutory responsibilities for water quality, water resources, flood defence, salmon and freshwater fisheries, conservation, navigation and recreation. It also has a duty to protect people and property from flooding caused by rivers and the sea. The responsibilities for water quality and fisheries extend into coastal waters.

The NRA is the UK competent authority for approximately 20 European Union (EU) Directives. It is a non-departmental public body, sponsored by the Department of the Environment (DoE). The Ministry of Agriculture, Fisheries and Food (MAFF) has important policy and funding responsibilities in relation to flood defence and fisheries. The Welsh Office has important responsibilities in relation to the NRA's work in Wales.

Statutory Committees

In each NRA region there are three statutory Regional Committees covering rivers, flood defence and fisheries. The Rivers Advisory Committees cover the broadest range of NRA functions, namely water quality, water resources, conservation, navigation and recreation. Each committee is consulted on a wide range of matters not just its areas of interest.

Each committee is made up of between 15-20 members drawn from the NRA's main customer groups. The Committees meet four times a year in public session. They advise the NRA on how to carry out its functions and are involved in corporate and regional plans and in CMPs. In addition Flood Defence Committees have executive powers in relation to flood defence activities.

1.1.2 Mission Statement

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.

1.1.3 Aims

- * 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 waters 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 environmental 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.

1.1.4 The Operational Activities of the NRA

The NRA meets its responsibilities through day to day operations. These activities do not form part of the Catchment Management Plan.

For pollution control, the most important task is to monitor the aquatic environment and any discharges to it. Water quality is continuously assessed against the aim of achieving compliance with national and European legislation. The pollution of water is a criminal offence and the NRA will prosecute when necessary.

The responsibilities for water resources include licensing, covering licence determination, charging, policing and enforcement. Through these responsibilities an integrated approach is taken that aims to strike a balance between the needs of abstractors and the environment.

Flood Defence activities cover regulation and enforcement, maintenance and emergency response. Regulatory activities include the issuing of land drainage consents. Routine maintenance includes the clearance of debris from watercourses and the maintenance of channels and flood defences. Emergency response involves the continuous monitoring of weather and river levels to forecast where and when flooding is likely to occur and issuing appropriate warnings. During flood events, defences are monitored and operated.

The NRA works closely with Local Planning Authorities (LPAs) through its planning liaison function. Planning applications are considered in relation to their impact on the water environment and a response is made which reflects any concerns of the NRA. Local, Structure and Regional Plans are all carefully considered.

The NRA is responsible for maintaining, developing and improving fisheries. These duties include fish rescues, stocking, general advice to the public and the scientific monitoring of fisheries. Fishery bailiffs check licences and ensure that anglers and others abide by the relevant legislation.

To ensure conservation and recreation duties are fulfilled, staff collaborate with numerous external bodies. The NRA also manages many recreation sites. Environmental Assessment procedures are followed to ensure consistent high quality control over the NRA's construction works.

1.2 THE CATCHMENT MANAGEMENT PLAN

The NRA's vision for the future is a healthy and diverse water environment managed in an environmentally sustainable way balancing the needs of all users of water. Sustainable development is at the heart of international and UK policy and must embrace environmental, social and economic concerns for it to be a workable concept. The NRA's approach is through an integrated approach to river catchment management.

Catchment Management Plans (CMPs) allow the NRA to balance the competing requirements and interests of all users. The process allows the environmental potential of a catchment to be realised in terms of water quality, water quantity and physical features. In the future, CMPs will provide the framework within which the NRA can implement the new system of Water Quality Objectives (WQOs). These objectives are use-related and may be given a statutory status following public consultation and agreement by the Secretary of State. Section 5.2 gives further details of the WQO scheme.

The CMPs set out the NRA's vision for the future of individual river catchments. A river catchment is a discrete geographical area which is drained by a single surface water system. The 21,600 square kilometres covered by the Severn-Trent Region of the NRA consists of only two principal catchments, the River Severn and the River Trent. Owing to their large surface area, they have been divided for catchment management purposes into 17 plans.

The Catchment Management Plan contains an analysis of the issues affecting each catchment, with suggested actions to resolve them. Many of the issues can only be addressed with the co-operation or assistance of other bodies, organisations or industries, so the preparation of CMPs must involve consultation with local communities and other interested parties.

CMP STAGES

The first stage in the CMP process is this Consultation Report, which is laid out as follows:

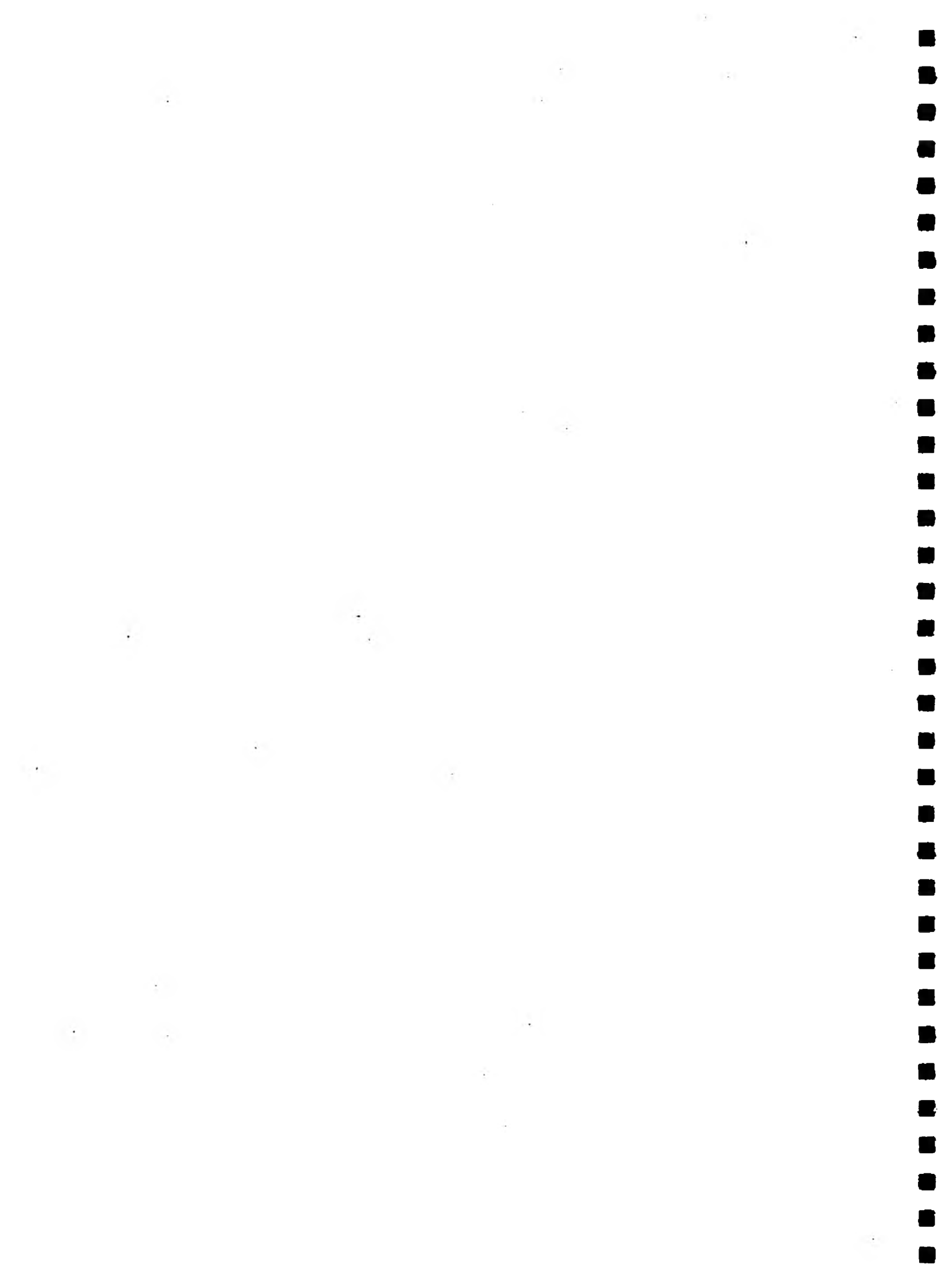
- PART I The Consultation Report:** This section gives a brief description of the Catchment and presents a range of management issues with suggested options for solution. The bodies responsible for the suggested actions are identified.
- PART II Supporting Information:** This section provides background information to Part I. A description of each use of the water environment and its impact in the catchment is included. Targets are given for water quality, water quantity and physical features. These are assessed against the current state of the Catchment

The second stage of the CMP process is the production of the Action Plan. The Action Plan details areas of work and investment proposed by the NRA and others. It will explain how comments from the Consultation process have affected the issues and options in the CMP. Further consultation will be held with those involved in the actions to seek their commitment prior to publication of the Action Plan. Timescales, targets and estimated costs will be added at this stage.

The **third** stage of the **CMP** process is the implementation of the Action Plan. Progress will be monitored and an Annual Review produced. These reviews will examine the need to update the **CMP**. The period between major revisions will normally be 5 years.

SECTION 2.0

AN OVERVIEW OF THE CATCHMENT



2.1 CATCHMENT DESCRIPTION

The NRA has divided the River Severn into three sections for the purposes of Catchment Planning and is producing separate plans for three of its main tributary rivers during 1993-1997:

	<u>Consultation Period</u>	<u>Final Plan</u>
River Severn - Upper Reaches	Nov 1994 - Jan 1995	May 1995
River Severn - Middle Reaches	May 1997 - July 1997	Nov 1997
River Severn - Lower Reaches	May 1995- July 1995	Nov 1995
Stour	Dec 1992 - Feb 1993	Dec 1993
Warwickshire Avon	Mar 1994 - Jun 1994	Oct 1994
Teme	Aug 1995 - Oct 1995	Feb 1996

In addition a collaborative project between 3 NRA regions to produce a Severn Estuary Catchment Management Plan will take place during 1996.

Introduction

This River Severn - Lower Reaches CMP covers the River Severn Corridor from its confluence with the River Teme, just south of Worcester, to just below its tidal limit at Gloucester plus the Avonmouth and Severnside areas. The latter have been included in this plan as NRA Severn-Trent Region have Flood Defence responsibilities and associated conservation activities and fisheries duties there. Other functions relating to water quality and water resources are administered by NRA South Western Region. The actual boundary between these regions is the Cam/Little Avon and Frome sub-catchment boundary. The total area of the catchment is shown in Map 1. Issues relating to the estuary itself will be covered in the Estuary CMP noted above. Inland water issues are addressed in this plan.

For the purposes of this CMP and because of its characteristics, the catchment has been split into 6 sub-catchments as detailed below and as shown on Map 1:

1. River Severn Corridor.
2. River Leadon.
3. Forest of Dean.
4. River Frome.
5. River Cam and Little Avon.
6. Avonmouth Area.

The River Severn Corridor includes the Malvern Hills and the main towns of Malvern, Cheltenham, Gloucester and at the confluence with the Warwickshire Avon, Tewkesbury. Historically, the River Severn has featured highly in the landscape characteristics of this area and is a focal point for many recreational activities. It is an historic navigation and now provides water supplies to over 1.5 million people. Malvern is world famous for its bottled water source, and "Regency" Cheltenham has some of the finest architecture in the country.

**River Severn Lower Reaches
Catchment Management Plan**

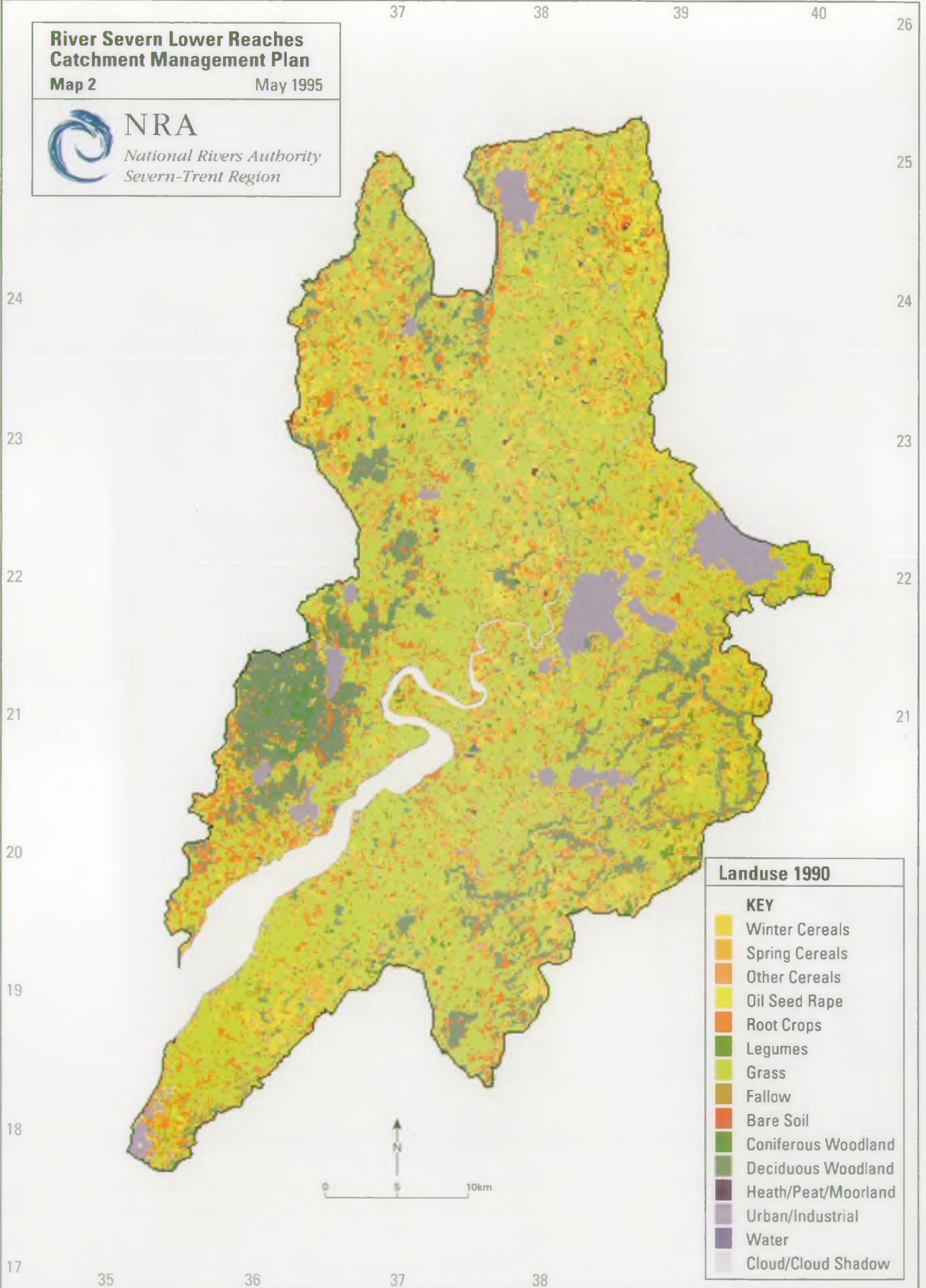
Map 2

May 1995



NRA

National Rivers Authority
Severn-Trent Region



CATCHMENT OVERVIEW

Gloucester old docks have in recent years been renovated with the river now a feature again. Perhaps the most characteristic feature of the area is the Severn Bore which occurs at times of high tide, attracting many sightseers.

The River Leadon is a rural catchment and traditionally an area for hop-growing. The main issues in this catchment relate to water resources and diffuse sources of pollution as a result of agricultural activity.

The Forest of Dean is a popular area for visitors, but has historic and potential problems related to opencast and deep mining.

The River Frome is characterised by its shape. The steep-sided profile of the river valley with its resultant fast flows has been exploited for wool milling and is currently under scrutiny for its potential for hydropower generation. There is also considerable interest in canal restoration. The Gloucester-Sharpness Canal is not only of interest as a recreational feature, but also, along with the River Severn, supplies drinking water to Bristol and towns in this catchment.

The south west sub-catchments of the Cam, Little Avon and Avonmouth are areas where coastal defence predominates to protect from flooding. Avonmouth is criss-crossed by small drainage channels or "Rhines" which have been culverted in many cases to act as discharge channels from the extensive chemical works in Avonmouth. The main issues in this area are pollution, waste disposal, land drainage and sea defences. Significant changes in land use are anticipated in this area which will impact on all of these aspects.

Land Use

The catchment is predominantly rural, with the population centred on the main urban areas of Avonmouth, Cheltenham, Cinderford, Gloucester, Great Malvern, Lydney, Stroud, and Thornbury. The total population within the catchment is approximately 512,000, of which 41% is located around Gloucester and Cheltenham.

The majority of development is concentrated around the existing urban areas. Future development within the catchment is to be led by the Statutory Development Plans of the local Planning Authorities.

Map 2 illustrates that a large proportion of the total area is under grass cover. The Forest of Dean and areas of the Leadon, Frome and Cam sub-catchments contribute to 11.6% of the catchment being forested. There is also a significant area of arable farmland. Although a proportion of the Avonmouth sub-catchment is rural, the impact of the Avonmouth chemical industries is highly significant.

Geology

The characteristics of the Severn in its south-westerly course is governed by two main geological features. The Welsh border hills to the west are formed of old Palaeozoic rocks and are resistant to erosion, while to the south east, the Cotswold ridge is composed of limestone. In between, the low lying areas of Severn Vale are made of softer clays which

CATCHMENT OVERVIEW

make up the main Severn Valley. 70% of the catchment is dominated by clays and mudstones which lie in a broad central band from Worcester southwards to Dursley. Owing to their low permeability these strata are classified as Non-Aquifers. The Jurassic Limestones (Inferior Oolite Series) forming the Cotswold escarpment are Major Aquifers and owing to their fissured nature are highly vulnerable to surface derived pollution. Triassic Sandstones outcrop in a narrow, fault bounded block north of Newent. The Triassic Sandstone is a Major Aquifer which produces high yields and good quality water.(Map 3).

Along the south-western boundary of the catchment in the Forest of Dean are a series of Carboniferous strata consisting of limestones and cyclic sequences of shale, coal seams, sandstone and clays. The limestones are classified as Major Aquifers which produce variable yields and support surface water. These limestones are highly vulnerable to pollution from, amongst other sources, the mine workings in this area. Devonian Old Red Sandstone and Silurian limestones and shales exist as a narrow band along the western boundary between Ledbury and Ross-on-Wye, and are classified as Minor Aquifers. The Malvern Hills form a prominent ridge of Pre-Cambrian volcanic rocks forming the north-western boundary of the catchment.

Quaternary deposits occur throughout the region and include glacial and fluvioglacial clays and gravels, terrace gravels and river deposits. These superficial deposits are thin and variable in nature, and produce small quantities of groundwater on a local scale. In most cases these deposits are in hydraulic continuity with adjacent surface watercourses, and are classified as Minor Aquifers.

Hydrology

The range in topography of the River Severn Lower Reaches area gives a slight variation in hydrology. The Cotswolds, rising to over 400m in places, have an average higher mean rainfall than the Severn River valley and Leadon Catchment to the west - the rainfall varies from 655 mm/year at Ledbury to 900 mm/year at Miserden. The average catchment rainfall is 720 mm/year and average July soil moisture deficit is about 100mm. The River Severn is supported by the Clywedog reservoir in Mid Wales and in times of low flow the Shropshire Groundwater Scheme. Flows, rainfall and groundwater levels are gauged as shown in Map 4. The minimum and maximum mean flows of the catchment's rivers (megalitres/day) are summarised in Table 1.

**River Severn Lower Reaches
Catchment Management Plan**

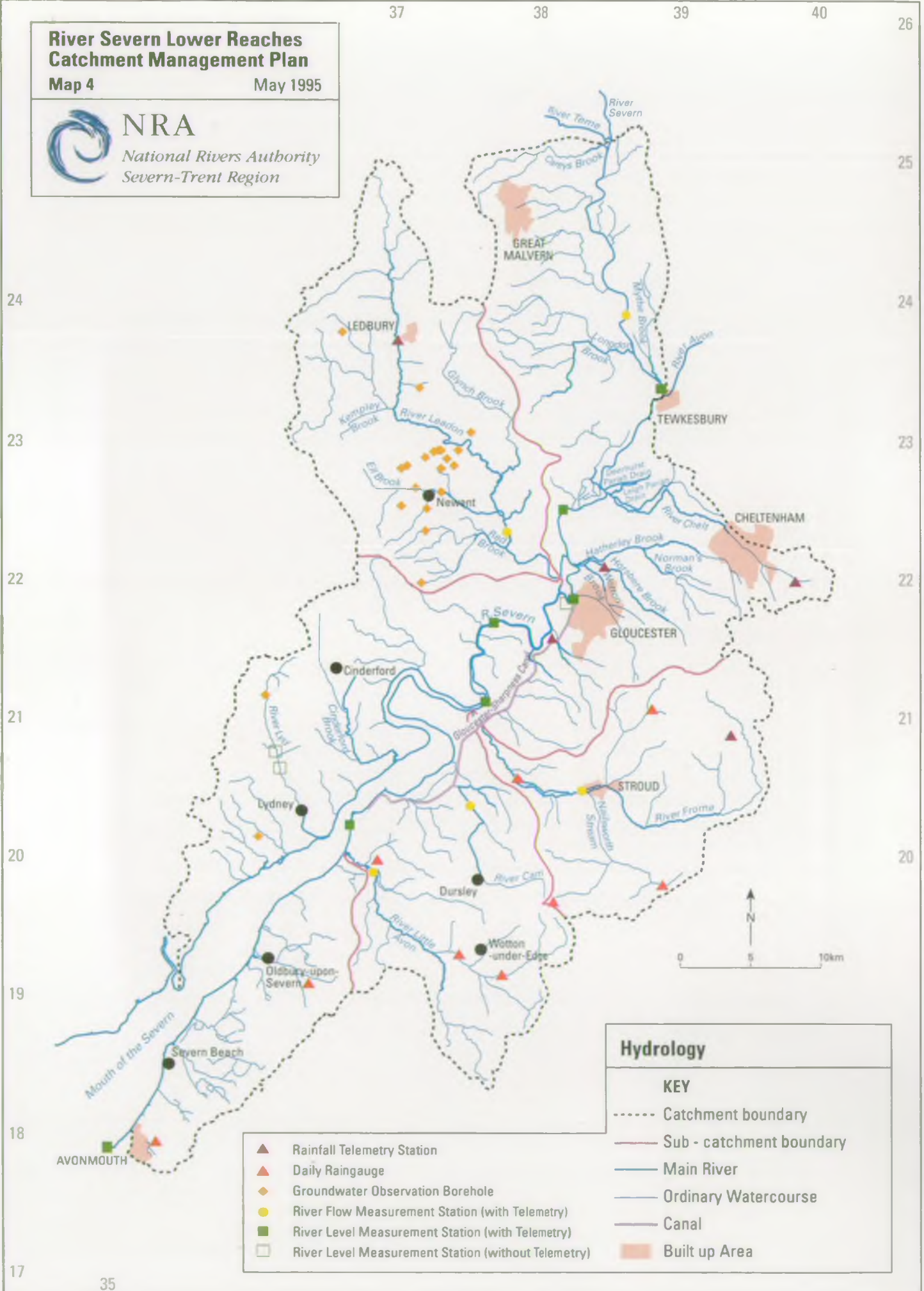
Map 4

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Hydrology

KEY

- Catchment boundary
- Sub-catchment boundary
- Main River
- Ordinary Watercourse
- Canal
- Built up Area
- Rainfall Telemetry Station
- Daily Raingauge
- Groundwater Observation Borehole
- River Flow Measurement Station (with Telemetry)
- River Level Measurement Station (with Telemetry)
- River Level Measurement Station (without Telemetry)

TABLE 1 CATCHMENT RIVER FLOWS

River (Gauging Station)	Monthly Mean Flows (Ml/d)		Catchment Area to gauging stations (km ²)	Dry Weather Flow (Ml/d)
	Min	Max		
R Severn (Saxons Lode)	2160	14,500	6850	1380
R Severn (Haw Bridge)	2765	18,130	9895	1712
Leadon (Wedderburn)	51	364	293	28
Frome (Ebley Mill)	105	371	198	78
Chelt (State Mill)	38	73	34.5	26
Cannop Brook (Parkend)	7.3	67	31.5	5.0
Cannop Brook (Cannop Cross) a.k.a. R. Lyd	2.6	23	10.5	2.0
Little Avon (Berkeley)	14.3	302	134	20.2

Low flows are influenced greatly by the type of soil cover and underlying geology. The River Severn Lower Reaches area varies in this respect in that the dry weather flow per unit area is much greater in the limestone region of the Frome catchment (>0.4 Ml/d/sq km) than the mudstones of the Leadon and Chelt catchment (0.01-0.1 Ml/d/sq km). The flows also reflect the location of urban areas where there are discharges from sewage treatment plant and urban run-off.

Water Resources

The Severn below Worcester provides the water supply for around 1.5 million people. Cities and towns supplied include Bristol, Coventry, Gloucester and Cheltenham. The Rivers Frome and Cam, via the Gloucester-Sharpness Canal, are also major water supply rivers as they provide a significant proportion of the supply to Bristol in winter months.

The main uses of surface and ground water as a percent of total water quantity are as follows; Public Water Supply (64%), Power Production (21%), Fish Farming (5.5%) Cooling Water (2%) Industrial Use (2%), Transfer of Water (1.5%), Spray Irrigation (1%), Miscellaneous (3%).

The catchment area is subdivided into five catchments for water abstraction licensing purposes, Lower Mid Severn, Severnside below Tewkesbury, Leadon, the Frome and the Little Avon. There are a total of 627 abstraction licences within these subcatchments allowing for a maximum 20,715 Ml/a (megalitres per annum) to be abstracted from groundwater and 286,324 Ml/a from surface water sources.

There are major abstractions for public water supply from the River Severn at Upton-on-Severn for Coventry, at Tewkesbury for Gloucestershire and from the Gloucester-Sharpness

Canal for Bristol.

The majority of licences (405) are for agricultural purposes and spray irrigation, giving a total potential abstraction of 3,414 Ml/a, of which 1,087 Ml/a is from groundwater and 2,327 Ml/a from surface water for these purposes.

The catchment has two main areas for groundwater abstraction. These are Oxenhall and Bromsberrow units, both in the Newent area. The NRA has a duty to protect this resource which is vulnerable to over abstraction and is important in supporting surface waters through springs and base flows to rivers. The Bromsberrow Unit is considered to be over licensed and over abstracted with evidence of low flows, for example in the Glynch Brook. The drilling of new boreholes in the area by Severn Trent Water may lead to compensation water being added to the Glynch Brook at times of low flow. Some water resource development can be considered still for the Oxenhall Unit. There are also other limited groundwater abstractions such as in the Cotswold area where an increasing number of licences has prompted the need for further monitoring.

Water Quality

The watercourses of the lower Severn reaches include a wide variety of rivers and streams, from shallow upland brooks draining the Cotswold Escarpment, to deep lowland rivers such as the Severn itself and drainage rhines which are in effect linear ponds. Quality similarly varies from totally unpolluted streams, to nutrient rich rivers suffering oxygen depletion in summer and to streams whose quality is dominated by sewage and trade effluents.

The majority of rivers within this catchment, including the Gloucester-Sharpness Canal, fall into the categories "Good"(A-B) and "Fair"(C-D) under the NRA General Quality Assessment Scheme. This means that they can support game and coarse fisheries respectively. Section 5 gives further details of the scheme.

Some tributaries of the Leadon and a stretch of the Chelt downstream of Cheltenham fall into the "Poor" category, owing mainly to sewage inputs. The Avonmouth rhines can be considered in a practical sense to be drainage channels or, as on industrial sites, culverts for effluent disposal. As such they are not classified under this scheme. 40% of current classified reaches fall into the highest GQA Chemical Grades A & B, 53% into GQA Grades C & D and 7% into Grades E & F.

As the River Severn enters the catchment below Worcester, it is subject to opposing influences, i.e. the polluting effect of Worcester sewage works and the diluting effect of the clean River Teme. Quality remains good throughout the stretch to Tewkesbury and the Avon confluence. Although of lower chemical quality than the Severn, the Avon has limited immediate impact because of the much greater flow in the Severn. However, the disproportionate nutrient load from the Avon contributes to the periodic incidence of algal blooms in the Severn from this point on. The next influence is from the River Chelt, containing the treated effluent from Cheltenham Sewage Works. This also adds to the eutrophic effects from nutrient enrichment.

CATCHMENT OVERVIEW

Below the tidal limit at Maisemore the Severn ceases to be an inland water and becomes a tidal river, with unstable bed and physical conditions which change violently during tide cycles. Vast quantities of silt are re-suspended and subsequently deposited with the passage of the tidal bore, which brings saline estuary water up to Gloucester. The discharge from Gloucester Sewage Works into this stretch has been an important influence on quality, now much improved as installation of full treatment proceeds.

The Leadon Catchment is predominantly agricultural. Its quality is affected by pollution incidents from farms, including run-off of pesticides. At Ledbury it receives effluent from the sewage works, plus urban and industrial drainage, which promotes evidence of eutrophication, exacerbated by slow flowing conditions. Quality improves as it nears the River Severn.

Streams in the Forest of Dean are mostly fast flowing and uncontaminated, except where they receive minewaters from abandoned coal mines, e.g. Cannop Brook/River Lyd. There are also a number of continuing industrial influences.

The Frome starts as an excellent quality river, but urban influences and historic industrial use throughout the Stroud valleys lead to a lowering of quality. At Stanley Downton, it receives the treated effluent from Stroud Sewage Works but recovers its quality before reaching Whitminster, where it flows partly into the Gloucester-Sharpness Canal and partly into the Severn Estuary.

The Cam is also of excellent quality in its upper reaches, but is affected by the discharge from Coaley Sewage Works. Quality improves again by the time it enters the Gloucester-Sharpness Canal.

The Little Avon is mostly of good quality. However, there are some stretches of fair quality owing to localised problems.

Flood Defence

In the Severn valley from Worcester to Tewkesbury there are a total of 28 km of flood defence embankments protecting 4,600 ha of flood plain to a nominal 1 in 5 year standard. The remaining flood plain areas at Kempsey, Upton and Longdon Marsh still flood annually. All these flood plain areas provide essential protection or relief from flooding for property both in this reach and downstream. Impoundment for navigation purposes (e.g. weirs) can impede drainage of low lying areas.

In the Severn valley from Tewkesbury to Gloucester there are 34 km of embankments protecting 5,000 ha of flood plain to an annual standard. Unprotected areas around Tewkesbury and the Avon confluence flood more frequently.

The Estuary lowlands, from Gloucester to Beachley on the west and Avonmouth on the east, are protected by 100km of sea/tidal defences, with 15,600 ha of land lying below high tide level. This area contains around 2000 properties. Drainage of these areas is a problem owing to low levels, tide-lock, slack gradients and "foreign water" drainage from the extensive uplands which back them. Defences in the tidal reach have to cope with the second largest

CATCHMENT OVERVIEW

tidal range in the world - the mean spring tidal range at Avonmouth is 12.3m.

There are of course a host of other tributaries and lesser watercourses on which the drainage of the farthestmost parts of the catchment depends. Many of these are "ordinary watercourses" and as such primarily the concern of District Councils. Over the winters of 1992-93 and 1993-94 there was extensive local flooding on these minor drainage systems which caused much alarm and distress to the property owners involved.

Lowland Drainage:

The lowlands of the Severn comprise the flood plain above Gloucester and the coastal lowlands below. Both lie below river or tide flood levels and have local drainage problems. This problem is illustrated by the fact that all four Internal Drainage Boards (IDBs) which lie within Lower Severn area are located along this part of the Severn.

The Boards are: Longdon & Eldersfield IDB, North Gloucestershire IDB, West Gloucestershire IDB and South Gloucestershire IDB.

These are all sovereign authorities wholly responsible for the internal drainage within their own areas.

Flood Warning Service:

A full flood warning service to NRA national standards is operated on three reaches of the Severn:

<i>Reach</i>	<i>Location</i>
S10	Powick to Mythe Bridge
S11	Mythe Bridge to Ashleworth Quay
S12	Ashleworth Quay to Minsterworth.

A storm tide warning service, limited to the immediate area of the settlement, is provided for Severn Beach near Avonmouth to the national standard.

A limited flood warning service is provided on the Frome below Stroud. This does not cover the main urban areas but is targeted primarily at the Gloucester-Sharpness Canal to enable flood control sluices to be operated for the protection of the Canal. At present there are no flood warnings in operation in the estuary.

Fisheries

A broad variety of fish species are present in the catchment. Both coarse(cyprinid) and game(salmonid - salmon and trout) fish are fished by anglers. In addition, there are commercial fisheries for eels and elvers as well as salmon in the estuary. Stretches of the Rivers Leadon, Frome and Little Avon are designated as salmon fisheries under the EC Fisheries Directive. Stretches of the Rivers Severn, Leadon, Longdon Brook, Cannop Brook and the Gloucester-Sharpness Canal are designated cyprinid fisheries under this Directive.

Conservation, Landscape and Heritage

The lower reaches of the Severn contain a wide variety of habitats and landscape features as well as being a popular tourist area. There are historic settlements, small towns such as Ledbury and Stroud and larger towns with a wider range of cultural interest such as Tewkesbury, Gloucester and Cheltenham. The attractive upland landscape of Areas of Outstanding Natural Beauty (AONBs) such as the Malvern Hills contrasts with the broad expansive floodplain of the Severn. However, there are a number of watercourses which, owing to past maintenance practices are in need of renovation and improvement.

In the Forest of Dean, both the quality and landscape value of the environment are affected by mining activities. In the urban areas the rivers have in the past been canalised or culverted for various reasons which has degraded the river habitat. The Avonmouth sub-catchment is characterised by the rhine system which, in itself, is of habitat interest. It does, however, carry a legacy of industrial land usage. In addition to renovation or restoration, riverside amenity development is a feature in the lower Severn area. The integrated management of aquatic habitats via 'Water Level Management Plans' will be an important aspect of equating land drainage and conservation needs.

Recreation and Navigation

The catchment area varies greatly in actual or potential recreational opportunities depending upon the locality and the mix of natural and man-made resources.

The Forest of Dean has possibly the greatest identity and individual character as a recreational and tourist area, with other highlights being the Wildfowl Trust at Slimbridge and the restored Gloucester Docks. Some recreational activities are land based, but by their nature attract people to the river environment, eg. walking, picnicking and bird watching. Angling is prevalent throughout the area. There is a steadily increasing demand for water sport activities and various forms of boating and sailing. The 'Severn Way' long distance footpath follows the river throughout Gloucestershire and is currently being extended.

The River Severn is navigable from Stourport in the north (outside of this CMP area) to Gloucester in the south ie. above the Gloucester Weirs and links via the River Avon and various canals into the inland waterway system. British Waterways are the Navigation Authority. Navigation of the river below Gloucester is possible but hazardous. The navigable waterway below Gloucester Docks, therefore, is the Gloucester-Sharpness Canal which gives access via Sharpness Docks to the Bristol Channel and the open sea.

Infrastructure

There are 3 County Councils and 10 Borough/District/City Councils in the Catchment (Map 5 shows the County Boundaries).

Three motorways cross the catchment, the principal motorway is the M5, which conveys traffic north and southwards. Two motorway arteries radiate from the M5, the M50 which joins north of Tewkesbury and the M4 joins north of Bristol. These motorways are served by an extensive network of A and B roads.

**River Severn Lower Reaches
Catchment Management Plan**

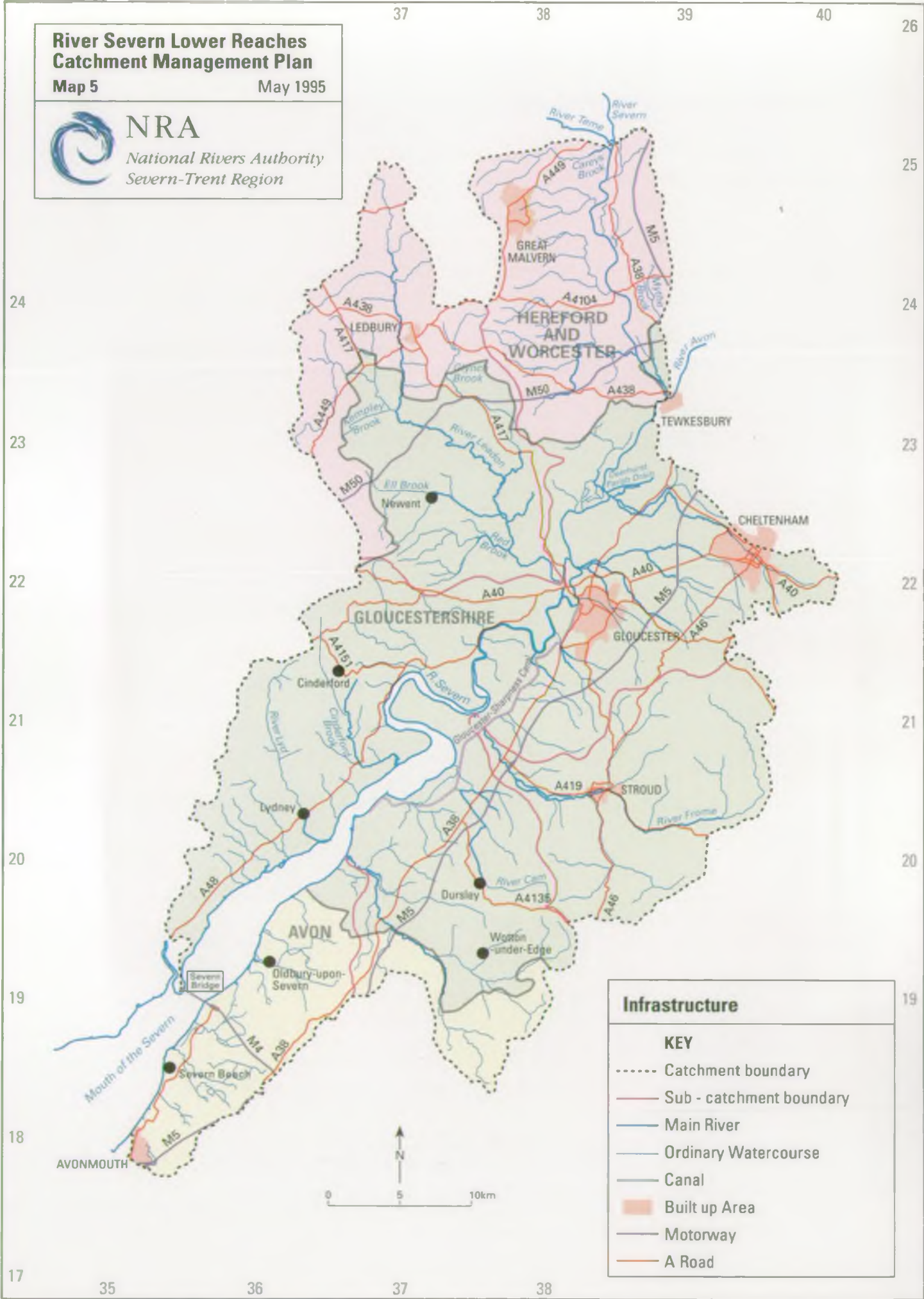
Map 5

May 1995



NRA

National Rivers Authority
Severn-Trent Region



Infrastructure

KEY

- Catchment boundary
- Sub-catchment boundary
- Main River
- Ordinary Watercourse
- Canal
- Built up Area
- Motorway
- A Road

CATCHMENT OVERVIEW

Major new infrastructure for the catchment includes the Second Severn Crossing at English Stones which is currently under construction.

Rail transport consists of main lines to Bristol and Birmingham, Gloucester to Swindon via Stroud, Gloucester to South Wales via the Severn Tunnel, Filton to Avonmouth and the predominantly industrial link to Severn Beach.

2.2 KEY DETAILS

Catchment Details	Area	2022km ²
	Population	512,200
Topography	Minimum Level	<10m Above Ordnance Datum
	Maximum Level	425m Above Ordnance Datum
Tidal Range (Avonmouth)	Mean Spring Tides	12.3m
Administrative Details		
County Councils	Avon County Council Gloucester County Council Hereford & Worcester County Council	
District Councils	Northavon District Council Cheltenham Borough Council Cotswold District Council Forest of Dean District Council Gloucester City Council Stroud District Council Tewkesbury Borough Council Malvern Hills District Council South Herefordshire District Council Wychavon District Council	
NRA	Severn-Trent Region, Lower Severn Area South Western Region, North Wessex Area	
Water Companies	Severn Trent Water plc Bristol Water Co plc Welsh Water plc Thames Water plc Wessex Water plc	
Internal Drainage Boards	Longdon & Eldersfield IDB North Gloucestershire IDB West Gloucestershire IDB South Gloucestershire IDB	
British Waterways	Gloucestershire-Sharpness Canal River Severn	

CATCHMENT OVERVIEW

Main Towns and Land Use

The total population of the catchment is approximately 540,000. Main towns and settlements in the catchment are Gloucester, Cheltenham, Malvern, Avonmouth and Thornbury, Stroud, Ledbury, Cinderford, Lydney and Newent. The main land uses in the catchment are grass 40%, arable 33%, woodland 12% and the urban area 7%.

Water Quality

Total classified length 363.8 km

Lengths of classified watercourse in each GQA Grade (km.)

Grade A	6.2
Grade B	137.5
Grade C	154.6
Grade D	39.4
Grade E	23.6
Grade F	2.5

Water Resources

Average annual rainfall	790mm/a
Mean flow of Severn at Haw Bridge)	8,980 MI/d
Total licensed abstraction	307,039 MI/a
Number of licensed abstractions	605
Comprising	
ground water	283
surface water	322

Flood Defence

Length of main river in catchment	349.7 km
Length of raised flood defences	162km
Area of land at risk from tidal flooding	25,200 ha
Number of properties at risk	2000

Fisheries

Length of watercourses designated under EC Directive for Freshwater Fisheries (78/659/EEC).

Salmonid	40.6 km
Cyprinid	
- Rivers	51.3 km
- Canals	25.0 km

Conservation

Number of Sites of Special Scientific Interest (SSSIs)	105(42 water based)
Number of Scheduled Ancient Monuments (SAMs)	148

2.3 CATCHMENT MONITORING

The NRA manages an extensive monitoring network to survey and gather data on water quality, biological quality, fisheries, nature conservation and water resources (surface and groundwater). The information gained underpins all of the NRA's activities.

Water Quality

The chemical quality of surface and groundwater is monitored for a variety of purposes - protection of supplies, compliance with consents to discharge sewage or industrial effluents and compliance with EC Directive requirements. In addition to these, the NRA uses long-term quality information to classify river quality thus monitoring whether it is improving or worsening. This assessment - the General Quality Assessment Scheme (GQA) is described in more detail in Section 5 (Targets and State of the Catchment).

The NRA maintains an extensive monitoring network, taking some 3,000 river water samples in the catchment each year. 60% of these samples provide strategic quality information for the General Quality Assessment and to monitor compliance with EC Directives, while the remainder are for local operational monitoring purposes.

Biological Quality

The overall quality of watercourses is also assessed using the biology of the riverbed as an indicator. On a scoring system (known as the "BMWP" score - see glossary for more details) high scores are given to animals found which are known to be intolerant to pollution - their presence indicates good water quality. Low scores indicate a predominance of pollutant tolerant species and hence poor water quality.

The NRA maintains a biological monitoring network to complement the chemical network, with invertebrate fauna being sampled three times annually at some 120 sites.

Fisheries

Information on the current status of fisheries in the catchment is known, in the main, from:

1. Survey work carried out for this purpose by the NRA Fisheries department using electric fishing techniques, scientific echo-sounding equipment and netting techniques.
2. Returns provided on a voluntary basis by anglers fishing in the area. These are principally match fishing results used in the Angler Census Programme and by rod and commercial salmon anglers, eel and elver fishermen as a condition of the issue of their licence.
3. The monitoring, by fisheries staff, of fish killed in pollution incidents or other circumstances.

CATCHMENT OVERVIEW

In the future information will also be available from the counters at proposed salmon, eel and elver and shad passes to be installed on the Upper Lode Weir in the Severn at Tewkesbury.

Though some survey data is available for earlier years, a catchment wide fishery survey programme was started in the late 1970's by fishery staff of the former Severn Trent Water Authority prior to transfer to the National Rivers Authority in 1989. All major rivers and brooks in the catchment together with a number of the minor ones have been surveyed during this period, the larger ones on a 3 to 5 year return time. Consequently fishery data is available for over 200 sites including:

- 10 sites on the River Cam and its tributaries
- 10 sites on the River Chelt and its tributaries
- 25 sites on the River Frome and its tributaries
- 32 sites on the River Leadon and its tributaries
- 16 sites on the River Little Avon and its tributaries
- 18 sites on the Longdon Brook and its tributaries
- 9 sites on the Longhope/Westbury Brook and its tributaries
- 10 sites on the River Lyd
- and sites on the main River Severn and Gloucester Sharpness Canals.

Nature Conservation

The conservation value of river corridors is assessed using surveys which give comprehensive information on areas and features requiring protection or improvement. Virtually all of the main rivers in the catchment (bar a few small streams) have been surveyed in this way. In addition to this method the NRA is currently developing a River Habitat Survey Methodology which will be used to identify particular types of river habitat present and what one should expect to find there. The NRA also has a method for Landscape Assessment which it uses not only for its own works but also where programmes of improvement are planned. For NRA operational works, Environmental Assessments are conducted to assess impacts on nature conservation, landscape, etc. These are produced, where appropriate, for consultation as Environmental Statements.

Hydrometry

Area Hydrometric staff maintain within the catchment:

- 5 flow measurement stations with telemetry
- 9 level measurement stations with telemetry
- 3 level measurement stations without telemetry
- 15 rainfall stations

The telemetred stations, noted above, provide continuous data which is used to help the flood warning system. Data from Ebley Mill on the Frome are also used by British Waterways to prevent flooding in the Gloucester-Sharpness Canal. In addition to the continuous data, records from the non-telemetred sites are used to check historic water levels and in the design and appraisal of Flood Defence schemes.

Flood Defence

All flood defences are or will shortly be monitored on an asset survey programme which will maintain up to date records of their condition and adequacy and trigger any necessary works and improvements.

A system for measuring the effectiveness of the whole network of "main river" channels will also be introduced to ensure that optimum levels of maintenance are employed, appropriate to the frequency and severity of flood risk.

Water Resources

Hydrometric data from rainfall and flow stations are also used for water resources planning and regulation. Flow measurement stations control the extent of abstraction possible on the Rivers Leadon, Frome, Cam and Little Avon. Flows on the Severn are monitored closely to ensure that water releases from reservoirs in mid-Wales and the Shropshire Groundwater Scheme are providing the correct level of support to meet requirements.

There are also 21 groundwater observation bore holes which are used to monitor levels in aquifers to assess the effect of groundwater abstractions.

Abstraction

The control of abstraction licences is undertaken by water resources officers and office based technical services officers. Returns on quantities abstracted are required from holders of licences deemed to have significant impact on resources to monitor the quantity of water abstracted and these are checked by undertaking enforcement work on site. A regular monitoring system is in operation on all licences whereby 33.5% of licences are visited every 5 years, 45% every 3 years, 21% every year and 0.5% more than once a year.

SECTION 3.0

ISSUES AND OPTIONS

This section of the plan details specific issues in the catchment. The issues have been identified by:

- * comparing Targets with the Current State of the Catchment (Section 5).
- * informal consultation with selected organisations in the catchment.
- * considering pollution incidents and flooding complaints.
- * utilising the local knowledge of NRA staff.

The options as presented are the initial views of the Lower Severn Area, Severn-Trent Region and North Wessex Area, South Western Region of the NRA and do not constitute policy statements. The issues and options that follow are not in a priority order.

Comments on the issues and options are requested together with any new ideas/suggestions.

Wherever possible those responsible for carrying out each option have been identified. The options presented are intended to facilitate improvements to the water environment for the benefit of all users. Their implementation will require the cooperation of many organisations and individuals.

Catchment location for the Issues identified in this section are summarised in Map 6.

**River Severn Lower Reaches
Catchment Management Plan**

Map 6

May 1995



NRA

National Rivers Authority
Severn-Trent Region

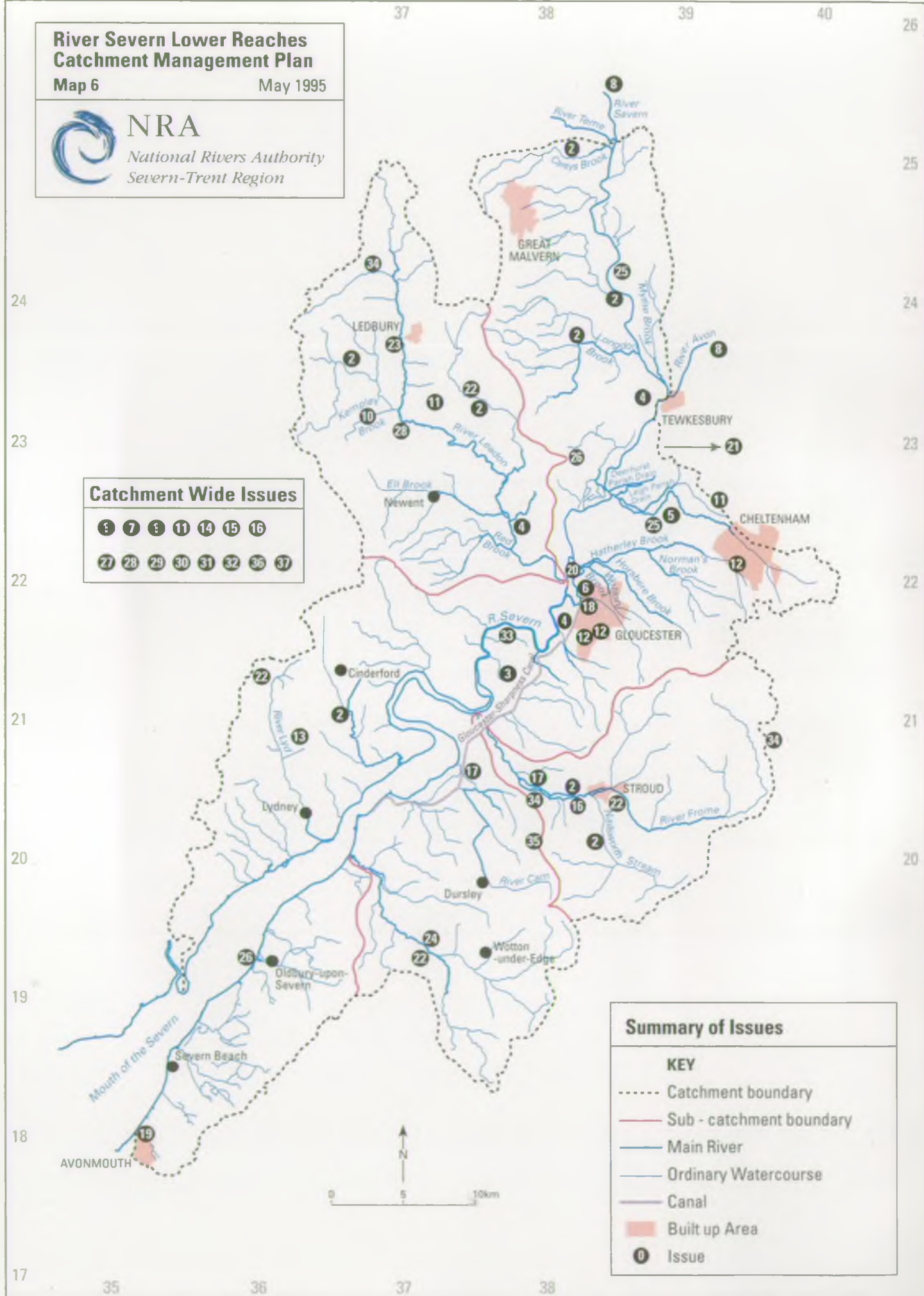
Catchment Wide Issues

- | | | | | | | | |
|----|----|----|----|----|----|----|----|
| 1 | 7 | 9 | 11 | 14 | 15 | 16 | |
| 27 | 28 | 29 | 30 | 31 | 32 | 36 | 37 |

Summary of Issues

KEY

- Catchment boundary
- Sub-catchment boundary
- Main River
- Ordinary Watercourse
- Canal
- Built up Area
- ⊙ Issue



3.1 ISSUES IDENTIFIED

Whilst many issues cover all the NRA's functions they have been grouped under four main headings:

Issues 1-19 Water Quality

Issues 20-23 Water Quantity

Issues 24-35 Physical Features (Conservation, Fisheries, Flood Defence)

Issues 36-37 Planning

Issue	Title
1.	Achievement of River Water Quality Objectives.
2.	Extension of designated fishery reaches.
3.	Protection of Water Supplies from the River Severn and Gloucester-Sharpness Canal and designation as Water Protection Zone.
4.	Impacts of the Urban Wastewater Treatment Directive and Designation of Eutrophic Sensitive Areas.
5.	The impact of the River Chelt on the water quality of the River Severn.
6.	Impact of investments and improvements at Gloucester Sewage Works on the tidal River Severn.
7.	Sewage and industrial discharges.
8.	Upstream impacts on water quality in the River Severn.
9.	Pollution from inadequate rural sewerage.
10.	The impact of pesticides on water quality.
11.	Farm pollution including the effects of ammonia and nitrate.
12.	Pollution risks from contaminated land.
13.	Pollution from mining and quarrying in the Forest of Dean.
14.	Water contact sports and relevant quality standards.
15.	Impacts of marinas and oil pollution from boats on water quality.
16.	River Litter.
17.	Seasonal effects of blue-green algae on the Stroudwater Canal and Frampton Lakes
18.	Pollution risks associated with Hempstead Tip Gloucester.
19.	Impacts of large industrial plant.
20.	Maintenance of river flows at Gloucester for abstraction to the Gloucester-Sharpness canal and other environmental uses.
21.	Potential effects of a Severn Thames Transfer scheme.
22.	Impact of low flows in the Leadon, Forest of Dean, Frome and Cam/Little Avon.
23.	Severn Exempt Area Order.
24.	Local issues relating to Fish Farms in the Little Avon Catchment.
25.	Major flooding from the River Severn and Chelt.

ISSUES AND OPTIONS

26. Flood Warning.
27. Flood Plain management.
28. Rehabilitation of river corridors.
29. Competing requirements of river engineering and other uses.
30. Reconciliation of competing requirements between recreational users and conservation interests.
31. Development of recreational access.
32. Protection of rare species.
33. The elver fishery - associated problems.
34. Canal Restoration.
35. Hydropower Development.
36. Development Issues.
37. Water Level Management Plans.

3.2 A DESCRIPTION OF THE ISSUES FACING THE CATCHMENT

ISSUE 1 ACHIEVEMENT OF RIVER WATER QUALITY OBJECTIVES

River Quality Objectives have been used since the 1970's as yardsticks to measure water quality, but it was not until the Water Act 1989 that the concept of statutory Water Quality Objectives was introduced. No statutory orders defining WQOs have yet been made, but one of the prime purposes of this Catchment Management Plan is to consult on proposals for such Objectives within the area of the Plan. River stretches and detailed proposals for quality objectives are presented in Table 13.

The River Ecosystem Classification (Cf. Section 5.1) is used to define the objectives as short and long term quality targets for each river stretch. In 75% of cases the long term target (or better) is already achieved and the short and long term objectives are therefore the same. Where current quality fails only marginally to meet the long term objective the short term objective is set at the higher quality, provided this can be justified statistically. In other cases the short term objective is defined as the quality which is achieved now or which can be predicted with confidence to be achieved within the period of the Plan. Each short term objective consists of a quality target and date for achievement.

The RE classification system has replaced the previous NWC classification and the translation from one to the other produces a number of anomalies. Several river stretches, particularly in the flatter parts of the catchment, are subject to low dissolved oxygen levels, placing them in a lower quality class than other parameters would allow. This is, in part, owing to the strict statistical methodology of the new system, which bases the classification on the "worst case" parameter. Many of these stretches are deep, slow-flowing water with poor re-aeration characteristics. Low summer dissolved oxygen levels are a natural feature of such waters, made worse by the eutrophic effects produced by increasing nutrient levels.

Setting lower short-term objectives in these cases does not imply acceptance of lower quality standards for the other class-determining parameters, i.e. Biochemical Oxygen Demand and Ammonia. Further investigations are to be carried out to confirm the reasons for low oxygen levels.

Many of the issues in this Catchment Plan are generated by the drive to achieve Water Quality Objectives.

Options for action are shown on Page 61

ISSUE 2 EXTENSION OF DESIGNATED FISHERY REACHES

Fishery Reaches were first designated under the EC Fisheries Directive in the late 1970s. A comprehensive review has recently been completed and further stretches are now proposed for designation. Formal comments are invited on these proposals. Following adoption of the Catchment Management Plan an application will be made to the Secretary of State for

determination. Following a comprehensive review, further stretches are now proposed for designation. The proposals are shown in Table 13 with the corresponding water quality classification.

Re-classification will provide extra protection to these watercourses by setting quality standards for a wider range of parameters.

All new proposals represent the current situation - i.e. cyprinid or salmonid fish are present in the stretches indicated. However, in some cases actual fishery status is better than the water quality classification would indicate e.g. in the Leadon catchment (see Table 13). These anomalies will need further study to support an application for designation.

Options for action are shown on Page 61

ISSUE 3 PROTECTION OF WATER SUPPLIES FROM THE RIVER SEVERN AND GLOUCESTER-SHARPNESS CANAL AND DESIGNATION AS A WATER PROTECTION ZONE

The River Severn below Worcester is the source of drinking water supply for 1.5 million people, in Coventry and Warwickshire, Worcestershire, Cheltenham, Gloucestershire and Bristol. The protection of these supplies and their water quality is a duty of the NRA.

This duty, defined in Section 15 of the Water Resources Act 1991, requires the NRA to have particular regard to the duty imposed on water undertakers by the Water Industry Act 1991 to supply "wholesome" drinking water (Section 68, Water Industries Act 1991).

There are three points of abstraction for public supply within the area of this catchment plan - from the River Severn itself at Upton on Severn and Mythe, Tewkesbury (Severn Trent Water Ltd) and from the Gloucester-Sharpness Canal (which is fed from the River Severn) at Purton (Bristol Water plc). All waterworks have significant demands to supply. There is no bankside storage of raw water at these sites.

Regulations were enacted in 1991 giving the Authority additional powers to control farm pollution and the authority is now pressing for similar regulations to be enacted to cover storage of industrial chemicals and oil.

In addition to the power to make regulations to forestall pollution, the Secretary of State for the Environment may designate a river as a "Water Protection Zone" under the provisions of Section 93 of the Water Resources Act 1991. Designation would empower the Authority to introduce additional safeguards to protect water quality, prohibiting or restricting certain activities in order to reduce the risk of pollution affecting water quality.

A Water Protection Zone Order may specify, for example, obligations on users of land to

- * register the use of specified materials and quantities stored
- * inform the NRA of any loss or spillage of specified materials
- * inform the NRA of changes of land use and processes involving specified materials

ISSUES AND OPTIONS

- * undertake specified preventive work to forestall pollution
- * undertake risk analysis for materials used and potential impact on water supply sources

The River Severn incident of April 1994 (when chemical contamination of the effluent from a sewage treatment plant operated by Severn Trent Water Ltd polluted the water supplied to some 100,000 households in the River Severn corridor) highlighted the threat of unregulated chemical use in the catchment and the need for information on materials used and stored which could prejudice the safety of water supplies.

The NRA intends to pursue the possibility of establishing a Water Protection Zone Order covering vulnerable sections of the River Severn and the Gloucester-Sharpness Canal during the period of this Catchment Management Plan. However, the decision on designation and timescale for introduction rests with the Secretary of State.

The main risks to water supply abstractions from the River Severn at Upton upon Severn and Mythe are from boat-derived oil pollution, pollution from Worcester and Malvern and occasional traces of pesticides. It is rare for incidents in the upper and middle reaches of the River Severn to affect the intakes, but in the 1994 incident, solvents were detected at both Upton and Mythe. Boat-derived oil pollution is the most common event and Severn Trent Water is equipped to disperse oil from the intakes when necessary. Ammonia from Worcester Sewage Works has reduced recently with the commissioning of new nitrifying plant. The most common pesticide found is lindane (gamma-BHC).

The scale of the River Severn means that, once pollution has occurred, remediation may be impossible and the only action available is to track its movement and ensure intakes are closed while the polluted water passes. Times of travel are predicted from river flow rates and appropriate warnings issued, which will include private abstractors where necessary.

The Gloucester-Sharpness Canal is fed from the River Severn at Gloucester in times of low flow, with additions from a number of small streams, plus the rivers Frome and Cam. Although catchment control procedures are carried out to protect the Purton supply, there is always a risk from discharges entering the canal via the Frome and Cam, from industrial activity in the Gloucester area and from any contamination in the River Severn itself. The water can occasionally contain traces of pesticides and nitrates above permitted levels. The greatest acute threat is probably from industrial use of toxic materials in Gloucester, particularly from timber treatment, oil and chemical plants.

The canal is a navigation as well as a conduit for water supply and this limits possible action to remedy pollution. The Frome can be diverted to the tidal River Severn and the feed from the River Severn at Gloucester can be stopped, but only for limited periods. The Cam cannot be diverted. Floating matter such as oil can be removed and solids allowed to settle, but it may be impossible to remove dissolved material without isolating and pumping out a section of canal.

Options for action are shown on Page 62

ISSUE 4 IMPACTS OF THE URBAN WASTEWATER TREATMENT DIRECTIVE AND DESIGNATION OF EUTROPHIC SENSITIVE AREAS

Capital spending programmes of the water companies on sewage works improvements are subject to price control under the financial regulator OFWAT. The programmes for the period 1995-2005 were agreed in July 1994. The NRA submitted a number of proposals for capital spending, not all of which were accepted. However, the first priority scheme for the catchment area, namely upgrading the River Chelt by improvement at Cheltenham, Hayden Sewage Treatment Plant (STP) has been accepted and will proceed in the next five years.

Apart from growth in demand and asset renewal, the Urban Wastewater Treatment Directive (UWWTD) will be the main driver for investment over the period of the Plan. Work is also planned or currently underway under existing programmes (including the asset Management Plan (AMP2) submission agreed by OFWAT in July 1994 for price regulation) at other sewage treatment plants. Treatment works in the catchment which will benefit from this investment are shown in Table 2 below.

TABLE 2 : SEWAGE TREATMENT PLANT UNDERGOING IMPROVEMENTS UNDER THE UWWTD/AMP2

STP	Receiving Watercourse	Nature of Work
Gloucester, Longford	Hatherley Brook	Improve BOD removal
Gloucester, Netheridge	Upper Estuary	Provide secondary treatment
Stroud, Stanley Downton	River Frome	Increased hydraulic capacity
Castlemorton	Longford/Bushley Brook	Ammonia removal
Innsworth	Hatherley Brook	Improve effluent quality
Cheltenham, Hayden	River Chelt	Improve effluent quality
Wotton-under-Edge	Little Avon	Capital improvements

Investment is also planned or currently underway under existing programmes (including the Asset Management Plan (AMP2) submission agreed by OFWAT in July 1994 for price regulation) at other sewage treatment plants:

A number of discharge consents for Severn Trent Water sewage discharges are currently under Appeal, i.e. the company does not accept the conditions set by the NRA. The Appeals will be decided by the Secretary of State unless agreement can be reached with the company.

In some cases, determination of the Appeal in the company's favour (i.e. with the relaxed conditions they request) may impact on water quality affecting compliance with quality targets. These are listed below (Table 3) with details of the watercourse affected and likely impact.

TABLE 3 : DISCHARGE CONSENTS UNDER APPEAL

STP	Watercourse affected	Impact
Avening	Nailsworth Stream	Organic / Ammonia/ Failure of River Class
Kempsey	River Severn	Organic
Gloucester, Longford	Hatherley Brook	Metals
Gloucester, Netheridge	Severn Estuary	Metals
Madresfield, Waterloo	Madresfield Brook	Ammonia

Eutrophic sensitive areas

Eutrophication means the enrichment of water by nutrients, especially nitrogen and phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to water quality.

The UWWTD requires member states to identify waters which receive discharges from urban wastewater treatment plants as "sensitive areas" if they are eutrophic as a result of the discharges, or may become eutrophic if protective action is not taken.

Three stretches of water in the area are currently being investigated during 1994-6 with a view to obtaining evidence for a submission to the Department of the Environment for designation as sensitive areas. These are shown in Table 4.

TABLE 4 : CANDIDATES FOR DESIGNATION AS EUTROPHIC SENSITIVE AREAS

Candidate Sensitive Area	Extent	Qualifying Discharges
Gloucester-Sharpness Canal	Gloucester Docks - Sharpness Canal	Coaley Stroud, Stanley Downton
River Leadon	Steens Bridge to River Severn	Ledbury
River Severn	Worcester Bridge to Maisemore	Worcester Malvern Cheltenham, Hayden

Options for action are shown on Page 63

ISSUE 5 THE IMPACT OF THE RIVER CHELT ON THE WATER QUALITY OF THE RIVER SEVERN

The Chelt enters the River Severn at Wainlodes below Tewkesbury. It contains a high percentage of treated sewage effluent from Cheltenham (Hayden) Sewage Works. It is also subject to periodic bursts of storm sewage during heavy rainfall and the combined effect on water quality produces a drop in quality below the sewage outfall. This continues to the confluence with the River Severn.

Below the sewage works outfall the Chelt is used for crop irrigation and cattle watering. The poor quality at Boddington has led to complaints over many years from a user of the water. The sewage discharge affects both chemical and biological quality to such an extent that fish are only present further down towards the River Severn confluence.

The main source of storm sewage is the storm overflow at Arle, which discharges in a public park and leads to public complaints from stranding of sewage solids on the river banks and vegetation. Improvements to the sewerage system are programmed to be constructed during the next five years.

It has long been an objective to improve quality, at this site. Agreement has now been reached with Severn Trent Water for capital expenditure to improve the quality of the River Chelt in the period 1995-2000. The option to divert sewage effluent directly into the River Severn could be at the expense of lowering water quality in the River Severn - possibly threatening its Water Quality Objectives and impacting on fish spawning grounds. This option may also have a direct impact on abstractions from the Chelt. The River Severn water quality is affected by the cumulative affects of eutrophication at this point and the Chelt has a noticeable impact on quality and uses, both actual and potential. Like the Avon, the Chelt is a significant contributor of nutrients - while it adds only 0.6% to the mean flow of the River Severn at their confluence, it increases the phosphorous and nitrogen present by approximately 2.5% and 1.5% respectively. The River Severn is classified as a cyprinid fishery at Wainlodes and there are important fish spawning gravels at this location. The NRA will seek to maintain the present quality of the River Severn in its assigned River Ecosystem Class (RE2). Raising the quality of the Chelt will have an important role in this.

As noted in Table 4 (Issue 12) the River Severn is a candidate for designation as a Sensitive Water (Eutrophic) under the UWWTD and as part of the investigations during 1995-96 it will be necessary to consider nutrient removal at Cheltenham STP.

Options for action are shown on Page 64

ISSUE 6 IMPACT OF INVESTMENTS AND IMPROVEMENTS AT GLOUCESTER SEWAGE WORKS ON THE TIDAL RIVER SEVERN

Until recently, sewage from Gloucester was given partial treatment (settlement only) at Netheridge before discharging into the Upper reaches of the tidal River Severn. Organic matter from the partially treated sewage and from storm sewage was then trapped in the estuary mud and, when re-suspended by the incoming tide, had a serious de-oxygenating

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effect on the water. The Estuary is an essential route for migratory fish and, during spring tides in the dry summers of 1989 and 1990, many salmon died from the unacceptably low oxygen levels. Other effects were slime and sewage fungus growths.

Severn Trent Water plc subsequently agreed to carry out improvements to the Netheridge plant in advance of UWWTD requirements. In March 1992 temporary plant was brought into use to remove about half the sewage load.

Since the temporary plant has been in operation oxygen levels after high tides have improved significantly and only a handful of salmon deaths have been reported. Storm diluted sewage is now being controlled and a substantial scheme for full treatment is nearing completion.

While the Gloucester discharge is considered to have been the main cause of quality problems in this part of the tidal river, monitoring is still required to identify any effects of low flows on quality (see Issue 20).

Options for action are shown on Page 64

ISSUE 7 SEWAGE AND INDUSTRIAL DISCHARGES

This issue addresses particular discharges causing water quality problems. These fall into two main categories of point source discharges and problems associated with storm overflow.

Point Source Discharges

Downgraded quality in River Leadon

Current quality of the River Leadon below Leadon STP falls within River Ecosystem Class RE3 (see Table 13). However, the water quality is dependent upon maintenance of the present level of treatment at the STP, which exceeds the requirements of the Discharge Consent. That Consent does not include an ammonia standard though ammonia removal by nitrification is a constant feature of the present biological treatment plant.

Under the procedure and agreements drawn up following the DOE's 1993 document "Water Charges - the Quality Framework" the NRA must take account of "over-performance" of a water company sewage treatment plant in setting downstream quality objectives and cannot review an existing Consent to add new requirements (such as an ammonia standard) unless this is necessary to comply with, for example, the EC Fisheries Directive. On this basis, short-term objectives for the first two river stretches below Ledbury have been defined as RE(1995), although current quality is RE3. Long term Objectives have not been changed.

There is no commitment for work to achieve nitrification in Severn Trent Water plc's AMP2 capital programme. The matter would normally have to be addressed at the next water company price review in 1999/2000. However, committed housing development in Ledbury will dictate an early Consent Review and the likely requirement for an ammonia standard in order to achieve compliance with the Fisheries Directive requirements for a salmonid fishery below Preston Brook. River Quality Modelling will be needed to define the standard and this

work is currently being assessed.

High levels of ammonia in Hatherley Brook

The discharge from Longford STP forms a large proportion of the flow in Hatherley Brook. The plant does not achieve nitrification of ammonia and the Discharge Consent does not include an ammonia standard. A short-term downstream quality objective cannot be set within the River Ecosystem Classification because ammonia levels do not need the minimum requirement of RE5. Setting an objective in the short-term will imply ammonia removal at the plant and there is no commitment for such improvements in Severn Trent Water plc's AMP2 capital programme. The matter will be addressed at the next water company price review in 1999/2000.

River Frome

Stroud, Stanley Downton, STP and Dairy Crest Creamery discharge to the north and south arms of the River Frome respectively. There is an immediate combined effect, on river quality and fisheries down to Whitminster. The NRA has successfully prosecuted the Creamery for pollution on a number of occasions.

In order to prevent deterioration in water quality, Severn Trent Wwater plc has carried out at Stanley Downton capital programmes to improve effluent quality. A tightening of consent conditions is being processed, to include limits for metals and pesticides. Further work is scheduled in the AMP2 programme in the period 1995-2000. Discussions are continuing with Dairy Crest to secure more effective and reliable treatment.

Cam/Little Avon

Coaley STP has a very marked, but localised effect on the stretch of the Cam immediately downstream of the discharge, an effect exacerbated by channel profiling. The river meets current quality targets below Coaley Mill.

Work to improve effluent quality is not included in the water company's AMP2 capital programme for 1995-2000. However, the works is a "qualifying discharge" in relation to the possible designation of the Gloucester-Sharpness Canal as a Sensitive Area (Eutrophic) and this may lead to a requirement for nutrient removal during this period.

Storm sewage overflows and associated problems

The problem of pollution arising from storm sewage overflows is a nationwide issue which is a concern at very local levels. Often small watercourses are the particular problem areas with intermittent incidents causing watercourses to be littered and polluted. These incidents are short but have a long term effect on the biological and aesthetic quality of the river.

One long term solution is to separate flows into surface water and foul sewers, so that storm water is excluded from the foul sewage system. This can be extremely costly for existing systems and other options can be more cost-effective, including on-sewer balancing tanks, fine screens and possibly reed-bed treatment. Computer modelling tools have now been developed

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to find optimum solutions which minimise costs as well as pollution.

Storm water from separate sewer systems can be polluted, especially from industrial areas. Treatment using ponds and "constructed wetlands" is increasingly being considered to minimise impact on receiving watercourses. While the primary purpose is as treatment systems these can have additional value for conservation and recreation as well as flood storage, provided that appropriate maintenance is established at the outset.

The issue is catchment-wide, but particular problems occur in:

Forest of Dean

The sewerage system in Cinderford and from the town to Blakeney has been refurbished in recent years. Several combined sewer overflows were removed as well as Soudley STP. However, intermittent sewage pollution in Cinderford Brook remains a problem, owing to blockage and local surcharging.

Frome Valley

There is a long history of inadequacy of the sewerage system in the Frome valley. Regular blockages lead to overflow in dry weather with devastating effect on local stream ecology and many public complaints. Detection of pollution from overflows relies on public awareness. Some sections of the sewerage system have been replaced and a number of overflows have been closed permanently since the NRA was formed.

Cam/Little Avon

Sewage effluent from the settlements of Kingswood and Wotton under Edge is conveyed to a treatment works on the downstream side of Kingswood for disposal. Wotton under Edge is at a considerable elevation from the works and the main trunk sewer operates at a great flow velocity. The sewer is old and overloaded and frequently discharges, both via consented storm overflows to the Dyers Brook and via surcharging manhole covers on agricultural land. The latter occurrence in particular has been the cause of complaint from land owners and operators.

Kingswood sewage overflows have been identified for improvements to commence in the next 5 years, under Wessex Water Services plc AMP2 programme, subject to available funding.

Avonmouth Area

Avonmouth STP is the largest sewage treatment works within the NRA South Western Region serving a population equivalent of around 650,000. Effluent arises from the City of Bristol, Kingswood, Yate and Chipping Sodbury and includes domestic and a substantial trade effluent component arising from industries as diverse as metal plating, brewery and paper and board manufacture. In addition, crude and digested sewage sludge is imported from a number of other Wessex Water plc sites and the sewage treatment works is a licensed waste disposal facility for both domestic and industrial tankered waste. As a consequence of the diverse inputs, the works effluent may contain virtually any known inorganic and organic species but

is only consented for a very limited range of parameters including suspended solids, copper and lindane.

Options for action are shown on Page 65

ISSUE 8 UPSTREAM IMPACTS ON WATER QUALITY IN THE RIVER SEVERN

Effect of extending navigation in the Upper Severn

Proposals have been put forward for extending the navigable length of the River Severn upstream of the Catchment area. This raises concern about the water quality in the lower reaches of the river because of the potential for aggravating the conditions which lead to algal blooms by slowing the flow (with impoundments) and reducing the river's natural process of self-purification. Blue-green algae produce toxic substances, but blooms of all species have a detrimental effect on quality and can lead to decline in fish populations and even fish deaths.

Extending the navigation may be achieved by dredging out and maintaining new channels where the water is currently too shallow for navigation. The effect would be to reduce average river flow velocity and increase retention or residence times in the new navigable reaches. Residence time is one of the factors determining algal growth and it is for this reason that blooms are most pronounced in the lower reaches of the river. The extra retention in the upper reaches would increase total time of travel down the river and could lead to an increase in the incidence of algal blooms in the lower reaches, to the detriment of water quality, fisheries and river ecology.

Effect of colour from upland sources

Summer storms on uplands in Wales and Shropshire can flush large amounts of peat derived compounds into upper reaches of the River Severn. These have a strong brown colour, which can persist throughout the river owing to their non-biodegradable character and give rise to pollution complaints that the river "looks like tea". The humic compounds can also cause taste and odour problems.

Effect of the Warwickshire Avon

The River Avon is the largest tributary of the River Severn in this catchment area. The river and its tributaries were the subject of the Warwickshire Avon Catchment Management Plan, published by the NRA in 1994. The Avon has been designated as a Sensitive Area (Eutrophic) under the UWWTD. The main impact of the Avon on River Severn water quality is the significant contribution to nutrient levels. While the Avon adds approximately 20% to the mean flow of the River Severn at their confluence, it increases the phosphorus and nitrogen present by approximately 55% and 45% respectively. This reflects the high proportion of treated sewage effluent present in the Avon, mostly derived from the conurbations at its headwaters (Rugby, Coventry, Warwick/Leamington, Stratford and Redditch).

Options for action are shown on Page 66

ISSUE 9 POLLUTION FROM INADEQUATE RURAL SEWERAGE

Outside sewered areas, properties are served mainly by individual septic tanks with soakaways for effluent disposal. Although these are adequate for the majority of cases, several communities have growing pollution problems caused by concentration of properties, poor ground conditions for soakaways, increased water consumption and further development beyond the capacity of existing facilities. High costs and changes to financial mechanisms for providing sewerage have stopped District Councils taking an active role to resolve these matters.

Sewage pollution caused by lack of adequate sewerage has been identified in several rural communities in the catchment. In most cases, the pollution affects local watercourses, but can also affect groundwaters. This pollution reduces chemical and biological quality and can affect the value of wildlife habitats. It may also impinge on the potential use of the water for irrigation and agricultural purposes. Recreational value and amenity are affected and this is often the main cause of complaint to the NRA and to Environmental Health Officers of District Councils.

There are also cumulative impacts on the catchment. The impact on groundwater can adversely affect long term use of water resources. Development pressures have a major effect where sewerage is inadequate since every additional house adds to the problem. Individual solutions, such as package sewage treatment plants for individual houses can be effective in purifying sewage to a standard suitable for discharge to a watercourse, but suitable watercourses are not normally available in a village environment. Sealed cesspits also offer a solution, but the high cost of emptying (over £1000 a year) is a major burden on householders. This can lead to misuse and illegal connections to ditches and watercourses.

The preferred technical solution is provision of a public sewerage system. This would normally be done through a Requisition served by the District Council on the Water Company. The system is constructed to Water Company standards, the Council pays the bulk of the cost and the system is adopted on completion by the Water Company.

While this is a proven method, costs for first time sewerage have grown dramatically over the past twenty years and the schemes must compete with other Council priorities in the constrained financial environment of the public sector. The Water Industry Act 1991 provides for the creation of "Inset Appointments" licensed by OFWAT within existing water company areas, where new bodies can take on the role of statutory sewerage undertaker within a defined area - such as an individual village. This offers the prospect of more cost-effective solutions based on local circumstances, using innovative and environmentally sensitive techniques such as reed-beds. Other arrangements are possible, but the major issue is always that of ensuring proper long-term maintenance.

Stroud District Council estimate that 30% of its population is not connected to a public sewerage system. Arlingham, Claypits, Longney and Oakridge are villages where the lack of sewerage has given rise to pollution problems. Others include Beachley and Blaisdon in the Forest of Dean, Green Street, High Green and Much Marcle in Malvern Hills, and Minsterworth and Hasfield in Tewkesbury Borough.

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ISSUE 10 THE IMPACT OF PESTICIDES ON WATER QUALITY

Pesticides (i.e. Insecticides and Herbicides) are widely used throughout the catchment in agriculture and by local authorities. While the most toxic and persistent organochlorine pesticides such as DDT and Dieldrin have long been banned, other chemicals can be equally persistent. Recent years have seen a large growth in herbicide usage on cereals and other crops, as well as widescale use by local authorities and British Rail.

The EC Surface Water Directive specifies that water used for drinking water supply must not contain more than to 0.1 µg/l of pesticides. This level is exceeded on occasions in a number of rivers. Of greatest concern are occasions when the limit is breached at water supply intakes. Triazine, Phenoxy and Uron herbicides are most commonly encountered, linked to periods of usage on crops. Three in particular, Trifluralin, Atrazine and Simazine are on the UK "Red List" of prescribed substances.

Arable catchments such as the Leadon are most affected, though no acute toxic effects have been identified from normal use. However, sub-toxic levels have been shown to affect invertebrate life and therefore stream ecology. The probable route for contamination is via seepage to land drainage systems.

Pesticides in eels in the Rivers Severn & Frome

In the Frome valley, which contains a number of woollen mills, imported wool was found to contain residues from pesticides banned in this country. These were scoured out during processing, to bio-accumulate eventually in eels at the bottom of the valley.

The concentrations of pesticides in eels have been regularly monitored over the last 9 years. It is the responsibility of MAFF to determine suitability or otherwise for human consumption. Levels have declined significantly in the last few years.

Pollution risks from pesticide control of flies at Ledbury WRW

Flies can sometimes be a problem at water reclamation works and excessive numbers can result in nuisance to local residents. Various methods of fly control have been employed by water undertakers, including the pesticide Actellic. Some fly control chemicals have been found to be toxic to aquatic organisms (both directly and as a result of bioaccumulation) and can pass into the effluent stream and thence to local watercourses. Current practice is to control fly emergence using fine mesh coverings to biological filters and, if this continues to be effective, it will obviate the need for chemical control.

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ISSUE 11 FARM POLLUTION INCLUDING THE EFFECTS OF AMMONIA AND NITRATE

Ammonia and nitrate are produced from many sources, notable sewage effluents, animal wastes and farm fertilisers. The relative quantities arising from various sources are different in each catchment depending on land use.

Ammonia in sewage is largely converted to nitrate in sewage treatment plants, but ammonia in animal manures is not normally treated, reliance being placed on soil bacteria for oxidation to nitrate. There can be particular problems from dairy farming and from disposal of manures from intensive animal rearing, e.g. piggeries and poultry units. Ammonia is toxic to fish and other aquatic invertebrates and watercourses can be seriously affected by uncontrolled discharges and runoff from land used for disposal.

The NRA has had considerable success over recent years in stemming the number of such incidents by targeted investigations (e.g. in the upper River Leadon catchment) and have worked in co-operation with farmers to secure improvements to slurry and manure handling systems, with assistance from the MAFF Farm and Conservation Grant Scheme. This Scheme terminated in November 1994.

The Code of Good Agricultural Practice for the Protection of Water gives farmers non-statutory guidance on good practice in slurry and manure disposal and aims to limit the amount of nitrate applied to land to that which can be utilised by a growing crop. Excessive amounts are not utilised and are available to leach into groundwater and watercourses.

The EC Nitrates Directive (91/676/EEC) defines Nitrate Vulnerable Zones (NVZs) as areas where water sources are high in nitrate. In an NVZ farmers are required to observe an action programme of measures to reduce nitrate loss and help reduce nitrate levels in water. In this country the measures are defined as adherence to the Code of Good Agricultural practice. Two prospective NVZs have been defined in the Plan area - at Bromsberrow and Cheltenham (see Map 21 in Section 5 of this report).

The Government has also defined Nitrate Sensitive Areas (NSAs) around two groundwater sources in the Plan area, at Bromsberrow and Lintridge. Within the NSA, compensation is available to farmers for limiting nitrate usage.

The water quality of the Little Avon and its tributaries is good to fair. However, farming activity (e.g. discharges of slurry, silage and run-off from land) prevents some river stretches from achieving good water quality because of elevated levels of BOD and total ammonia. In addition accidental farm discharges cause temporary water quality problems.

Where the NRA have been targeting the impact of farming activities there has been a noticeable improvement in water quality.

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ISSUE 12 POLLUTION RISKS FROM CONTAMINATED LAND

Land contamination is usually the result of industrial practices and waste disposal. Redevelopment of contaminated sites and laying of drainage can release previously trapped contaminants and increase the risk of pollution to both surface and groundwater. Special care must therefore be taken to deal appropriately with pollutants and avoid worsening the effects of the historic contamination.

Gas Works present a large pollution potential since quantities of tar wastes and spent oxides are often left on site after closure. Redevelopment can disturb and mobilise contaminants and which can include Tar Oils, Ammonia, Sulphates, Sulphides, Phenols, Cyanides, Thiocyanates, Polycyclic Aromatic Hydrocarbons (PAHs), Lime, Lead and Iron. There are no statutory limits for contamination, but guidance is provided by the ICRCL (Interdepartmental Committee on the Redevelopment of Contaminated Land) standards. Where possible, the NRA requires development of contaminated land to be subject to environmental assessment.

Close liaison between NRA, developers and planning authorities needs to be maintained to identify pollution risks at an early stage. Environmental assessment must include risks to Groundwater and surface water. Prospective purchasers of contaminated land need to be aware of their liability with regard to potential pollution.

Although no complete survey has been carried out of contaminated land within the area covered by this CMP, sites for concern within the catchment are as follows:

River Severn Corridor*Cheltenham Gas Works Site*

This site is partly redeveloped and although surface contamination has been removed, much of the underlying ground is contaminated and there remains a risk of polluted groundwaters draining to the adjacent River Chelt.

Gloucester Gas Works Site

This site is undeveloped although new industrial units are being built adjacent to the land. Groundwater in the site is contaminated and presents a risk of pollution. Extensive remedial measures are likely to be needed before the area would be suitable for redevelopment and the NRA will oppose redevelopment until this takes place.

Gloucester Trading Estate, Brockworth

Land at the rear of the estate is contaminated by toxic metals from electroplating wastes including cadmium. This has been sold for redevelopment and special remedial measures are being negotiated in view of its proximity to Wotton Brook.

Forest of Dean

Industry in the Forest developed in pockets during the 19th century, with the growth of mining, smelting and foundries. When the mines closed, these industries failed and the sites were left derelict. There are very few records of what took place on the sites or what was left behind. Redevelopment can lead to a release of pollutants trapped for generations. In other cases, sites have been in continuous industrial use but, owing to poor management, ground has become heavily contaminated with metals, solvents, oils etc.

A particular site of concern is Fred Watkins Engineering near Sling, where various liquid and solid wastes have been deposited in a disused mine shaft and on the ground since the 1940's. The underlying mine works which were used for potholing have been closed by HM Mines Inspectorate owing to poor air problems which may be directly related to historical tipping activities. The matter is being progressed primarily by Gloucester County Council as the Waste Regulation Authority and also the Forest of Dean District Council as the Environmental Health Authority. The NRA is working closely with these Authorities on the water quality aspects. Surface waters likely to be in hydraulic continuity with the groundwaters beneath the site are sampled by NRA Severn-Trent and Welsh Regions. The groundwater cannot be directly accessed for sampling at present (as noted the mine works are closed). There is currently no evidence of surface water contamination but monitoring continues.

Avonmouth Area

Zinc and other non-ferrous metal smelting has taken place in the Avonmouth area for the past 100 years or so with until recently very little control over the disposal of solid waste. In former times, the solid slag was in fact seen as an asset and widely used for infilling of land that was below sea level and prone to flooding leading to a situation whereby large tracts of Avonmouth have been infilled with slag which has a high concentration of metals, especially zinc, lead and cadmium. In addition, as more recent legislation has required Britannia Zinc and its predecessors to retain waste slag, a stockpile has accumulated on the smelting works site which is rapidly approaching capacity and which may be leaking metals, particularly zinc, into the Kingsweston Rhine. Many of the rhines around Avonmouth have elevated levels of metals which cannot be attributed to a point source discharge and which are likely to be the legacy of former slag disposal practices.

The NRA works closely with Planning Authorities and Waste Regulation Authorities to ensure environmental assessment is carried out before development is decided and clean-up requirements are fully implemented to safeguard the aquatic environment. Pressure to release sites for redevelopment may not take full account of the remedial work required.

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ISSUE 13 POLLUTION FROM MINING AND QUARRYING IN THE FOREST OF DEAN

The Forest of Dean has a long history of mining and quarrying for minerals, including coal, iron and stone and there are many disused mines and quarries in the area. Quarrying is still significant with imminent expansion at Drybrook and new drift mines at Oakenhill and Lightmoor are proposed.

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Waters from abandoned mines may be acidic, usually contaminated with heavy metals and particularly iron and can have a devastating effect on receiving streams. Present legislation does not empower the Authority to control these discharges. Minewaters are particularly significant in the Cannop Brook/River Lyd Catchment. The discharge from Norchard's Drift near Whitecroft affects the quality of the River Lyd as far as Lydney, where it is a source of industrial water supply before discharging into the Estuary, a distance of five kilometres.

Abandoned mines are also illicitly used for unregulated tipping of wastes, both solid and liquid. Away from the public gaze, such activities can continue for many years before being detected despite being illegal and an offence under waste regulation legislation. These can have serious groundwater pollution effects and at a later date surface waters, as in the Sling and Mitcheldean areas.

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ISSUE 14 WATER CONTACT SPORTS AND RELEVANT QUALITY STANDARDS

Water quality is of particular significance for the recreational use of the River Severn. Demand for sailing, rowing, canoeing, raft racing or simply pleasure boating is constant. The level of risk from water-borne infection varies with the amount of contact with the water. Other recreational users, such as anglers, have more limited contact with the water.

Proposed water quality objectives may include a use-related quality standard for contact sports, although this is considered a long term goal. The only relevant water quality standards at present for contact sports relate to the EC Bathing Water Directive which are primarily bacteriological in nature. Viral contamination may also be of more consequence than bacteria. There is thus a need to examine the status of water quality in freshwater in relation to contact sports.

The health risk associated with sports and recreational activity may constrain development of their full potential. Public perception of the risks may not be informed enough to enable them to take appropriate precautions against infections such as leptospirosis (Weil's Disease).

Whilst the NRA has no duty to warn of the presence of waterborne pathogens it seeks to promote awareness of the dangers of contact sports including those related to bacterial and viral infections.

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ISSUE 15 IMPACTS OF MARINAS AND OIL POLLUTION FROM BOATS ON WATER QUALITY

Oil pollution from boats arises from spillages of lubricating and diesel oil during maintenance and refuelling and also from pumping out oil contaminated bilge water while travelling. Sources may be shore based (as at marinas and boatyards) or individual boats using the navigation. Individual incidents are hard to trace to source when moving boats are involved.

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Many of the reports of oil on the navigable River Severn result from boats. The oil threatens water supply intakes, fouls river banks, vegetation and water birds and affects amenity and recreational value. Equipment installed at water supply intakes is capable of preventing oil being taken into treatment but even small quantities can impart a taint to drinking water. Individually, many incidents are small, but the impact is increased by their frequency.

The remedy lies mainly in standards of boat construction designed to prevent oil contamination of bilge water. Boat standards published by British Waterways and the joint NRA/BW document "Boat Safety" require all boats to have a separate engine compartment with a tray to contain any oil spilled or leaking from the engine. This is intended to prevent oil contaminating the main bilge compartment. It was intended that the boat standards should apply from January 1993 to all boats registered with BW and they are now being implemented on a voluntary basis. They are not now likely to be made mandatory until after the passage of a Waterways Bill through Parliament.

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ISSUE 16 RIVER LITTER

Although the majority of litter items do not contribute to the chemical quality of the river, it is a strong public perception that a littered river is a polluted one. This has been taken into account in new NRA GQA Classification Schemes for rivers where "Aesthetic Quality" will be a future criterion. The NRA can have access to rivers to remove debris if it is either posing a pollution or flood risk, but does not have a duty to remove it or any other litter problem. Local authority refuse collection does not cover this category because most river banks are privately owned. Other than voluntary organisations and some NRA activity for flood defence, this is a major problem with no statutory solution.

In the Stroudwater Canal and urban Frome, domestic refuse, builder's rubble and chemical drums seriously affect the river environment. As well as the potential pollution it is costly to remove and can have secondary nuisance effects.

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ISSUE 17 SEASONAL EFFECTS OF BLUE-GREEN ALGAE ON THE STROUDWATER CANAL AND FRAMPTON LAKES

Blue-green algae are phytoplankton which produce toxic waste products, potentially affecting livestock and human health from contact. They are normally present in many waters at non-hazardous levels. Mild winters often lead to greater concentrations in the following summer, when a population explosion, or "algal bloom" occurs. Sections of the Stroudwater Canal and Frampton Lakes have been affected in recent seasons. The NRA investigates all reported occurrences and notifies riparian owners and public health authorities when reportable levels are found. Enclosed waters are more susceptible, such as lakes and canals.

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ISSUE 18 POLLUTION RISKS ASSOCIATED WITH HEMPSTEAD TIP GLOUCESTER

Hempstead Tip is a large waste disposal site, operated by a subsidiary Waste Company, of Gloucestershire County Council. It is licensed to accept domestic, commercial and industrial wastes. Like many such tips, its older sections were constructed to standards which would not be acceptable today. The tip is situated in the estuary flood plain and is bordered by a stream. Because of its construction and location there are risks of flooding and uncontrolled emissions of tip leachate entering the watercourses. The NRA has opposed the extension of the landfill licence for these reasons.

Hempstead Tip poses no risk to water supplies, being below the river's fresh water limit. Treated leachate is discharged direct to the Severn Estuary under the terms of an NRA Consent. However, owing to high water levels in the tip, untreated leachate discharges have affected the small stream taking local drainage to the River Severn. The Authority is concerned to ensure that measures are taken to improve the long term hydrological security of the site.

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ISSUE 19 IMPACTS OF LARGE INDUSTRIAL PLANT

The Avonmouth industrial complex is home to the largest concentration of chemical and manufacturing plant in the South West. Major companies include Britannia Zinc (non-ferrous smelting), Rhone Poulenc (mineral acid, inorganic and fluoroaromatic chemical manufacture), ICI Chemicals (ammonium nitrate fertilizer), Zeneca (pharmaceutical manufacturers), Sevalco (carbon black manufacturer) and Birds Fragmentation (non-ferrous scrap metal distribution) along with a vast number of smaller manufacturing, distribution, storage and retail premises. Companies make legitimate discharges of industrial waste water to controlled waters which are invariably covered either by a Consent to Discharge or an Integrated Pollution Control (IPC) Authorization. Most of the discharges enter the Severn Estuary and so the impact of this industry will be dealt with in the forthcoming Severn Estuary CMP. Many of the discharges from Avonmouth will, in future, be consented under an IPC Authorization. Aspects of this change will also be dealt with in the Severn Estuary CMP as they principally affect estuary waters.

Although most discharges are controlled and monitored, the Severn Estuary foreshore is likely to be contaminated with an extensive variety of exotic inorganic and organic chemical species. There are inevitably a considerable number of other unregulated discharges consisting of run-off of surface water, heating and cooling water and process water, some of which may require control via consents or authorisations and all of which may pose a risk of pollution. The majority of the local rhines are lifeless, drab and permanently contaminated with oil, silt and biodegradable waste matter.

Options for action are shown on Page 72

ISSUE 20 MAINTENANCE OF RIVER FLOWS AT GLOUCESTER FOR ABSTRACTION TO THE GLOUCESTER-SHARPNESS CANAL AND OTHER ENVIRONMENTAL USES

The 1991 Water Resources Act outlines the NRA's duties to conserve, redistribute or augment water resources and to ensure proper use of these resources. In order to do this, the NRA can propose minimum acceptable flows for inland waters. The flow should have regard to water quality, conservation duties and navigation authorities, safeguarding public health, meeting the requirements of existing lawful users, the needs for land drainage and migratory fish. Recent reports outline the need for the existing River Severn control rules to be revised to include consideration for flow requirements to the Severn Estuary. The flow control point at present is at Bewdley which is some 75 km above Gloucester. Such a control point cannot fully take account of abstractions which occur between Bewdley and Gloucester. While the main regulation of river flows during dry periods is by the release of water from Mid Wales (Llyn Clywedog and Lake Vyrnwy) and the Shropshire Groundwater Scheme, future options for the maintenance of minimum acceptable flow may depend on the availability of local storage close to the tidal/fluvial interface and co-operation between NRA, Bristol Water and British Waterways to make best use of water resources.

Options for action are shown on Page 73

ISSUE 21 POTENTIAL EFFECTS OF A SEVERN THAMES TRANSFER SCHEME

In 1994 the NRA published 'Water Nature's Precious Resource' which is an Environmentally Sustainable Water Resources Development Strategy for England and Wales.

The strategy does not consider that major inter-basin transfers such as the Severn-Thames are preferred options for the future as demand management and the promotion of water efficiency should limit the requirement for such schemes.

This involves

- * lobbying for OFWAT and water companies to be given statutory duties to promote the efficient use of water
- * companies being required to achieve economic levels of leakage and metering before new abstraction licences are granted for strategic developments
- * promoting water efficiency in the home, industry, commerce and agriculture
- * advising the government on use of incentive charging schemes.

While demand management may cover needs for water in the short term it is important to identify other options so that the strategy can be adjusted to meet increased demand should this be necessary. In this context the NRA believes that the possibility of a transfer of River Severn water into the River Thames is of such environmental significance that a firm NRA position must be established in the near future. This option involves the transfer of water from the River Severn near Deerhurst into the Thames Catchment.

One major consideration is the effect on the ecology of the Thames of transferred River Severn water. While this is not directly associated with the Lower Severn Catchment it may take local resources from the NRA to establish the full chemical and biological nature of the River Severn water.

There are many direct effects on the River Severn of altering the flow regime to allow for such abstractions. These include:

- * Biological impacts
- * Deleterious effects on the eutrophic state of the River Severn
- * Disruption to upstream salmon migration
- * Effects on the water quality of the Gloucester-Sharpness Canal
- * Routes of pipeline may be disruptive to archaeological sites, SSSI's etc.
- * Increased tidal influence on water quality and saline intrusion from the estuary
- * Possible needs for enlarging Craig Goch reservoir in the Upper Wye Catchment and its implications.
- * Redeployment of Vyrnwy reservoir in the Upper Severn Catchment and its impacts.

Options for action are shown on Page 74

ISSUE 22 IMPACT OF LOW FLOWS IN THE LEADON, FOREST OF DEAN, FROME AND CAM/LITTLE AVON

Low flows in river networks have widespread effects. Water quality deteriorates as dilution of contaminants is lessened and natural aeration reduced. The river habitat is degraded as the aquatic life can no longer be sustained. Fisheries suffer not only from the water quality effects but also by reduction of water volume available and the hinderance of fish movement - especially where there are weirs which act as barriers; more so where there is no flow over them at all.

Sites where low flows have become a particular problem in this Catchment are:

River Leadon

The **Glynch Brook**, a tributary of the River Leadon, is renowned for having low flows during periods of dry weather. The reason is thought to be over abstraction of groundwater. In 1991 Severn Trent Water applied to the NRA for two new boreholes at Public Water Supply pumping stations in this area as the quality of the existing boreholes was giving rise to concern. One of these new boreholes at Bromsberrow was test pumped in November 1993. A condition was set so that during pumping a discharge was made to the Glynch Brook as

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a compensation flow. This proved very successful. As part of any licence variation the NRA will seek both a reduction in the overall quantities abstracted and a long term compensation flow to the brook, as yet an application has not been received.

Low flows owing to over abstraction of surface waters, are also a problem in the Kempley, Peacocks and Preston Brooks as well as the Leadon itself.

Forest of Dean

The River Lyd supports a major abstraction for local industry. Flows in the Lyd are partly dependent on any long term trends in the discharge from Norchards Drift - the lowest drainage point of the abandoned Forest of Dean Coalfield. They could also be affected by any new mining activity in the Forest. Mining activity has also been suggested as a possible cause of low flows in Blackpool Brook.

River Frome

Low flows have been reported within the upper reaches of the River Frome catchment. Parts of the river have relatively little, if any, water flowing through them during prolonged dry periods. The main cause of the problem probably lies with the deterioration of the old clay lining of the river bed which was installed to ensure adequate flows.

Other possible causes of the low flows are abstractions close to the Cotswold watershed and changes in land drainage altering flow patterns.

Cam/Little Avon

Residents of Kingswood are concerned that summer flows in the Little Avon have diminished substantially during the last decade. Although the local perception is that this is as a result of abstractions for fish farming, this is unlikely to be the cause as the water is not permanently removed from the system.

Options for action are shown on Page 75

ISSUE 23 SEVERN EXEMPT AREA ORDER

The Leadon subcatchment has an area which is exempt from licensing for abstraction from groundwater (See Map 17 in Section 5 of this report). This exemption stems from the Severn River Authority (Exceptions from Control) Order 1967 established under the Water Resources Act 1963.

There is concern now that control is urgently needed, as many wells and boreholes have yielded substantial supplies. The current diversification of farming and need for more public water supplies could result in exploitation of water resources through lack of management. Also, the protection that licences provide is not there; common law action would have to be used to provide any sort of control over the amount of water being abstracted. Therefore a review is needed of the present licensing exemptions policy.

Options for action are shown on Page 76

ISSUE 24 LOCAL ISSUES RELATING TO FISH FARMS IN THE LITTLE AVON CATCHMENT

Commercial trout fish farming is carried out on the Ozleworth Brook, a tributary of the Little Avon, just upstream of Kingswood. Elevated levels of total ammonia and low dissolved oxygen occur in the stretch from Nind Farm to Gatehouse as a result of fish farming. Each fish farm is subject to abstraction licensing and discharge consenting and although compliance is generally satisfactory there is a perception amongst residents of Kingswood that the farms are responsible for a variety of local problems including diminishing natural fish numbers, low flows from abstractions during summer and flooding during winter. Although much has been done to reassure local people through liaison with Kingswood Parish Council that their fears are largely unfounded, they remain concerned and continue to voice their complaints via both South Western and Severn -Trent Regions.

Another complaint which has often been voiced, and which to some small degree may be substantiated, is that the flow regime through the fish farms is not strictly specified on the various licences. This leads to localised deprivation of water from some of the various small back channels and mill races that are a local feature of the river.

Options for action are shown on Page 76

ISSUE 25 FLOODING FROM THE RIVER SEVERN AND THE RIVER CHELT

River Severn

There are two categories:

- * fluvial flooding in two reaches between Worcester and Gloucester
- * tidal flooding in the estuary below Gloucester

These differ in their origins, problems and impact.

Fluvial flooding occurs frequently in the main valley of the River Severn where extensive tracts of low-lying land are regularly inundated. Most of the area is protected to a limited extent by agricultural standard defences and much of the property at risk shares this protection. However this falls below the standard which would normally be considered appropriate. Further substantial numbers of properties, notably in Kempsey, Upton-upon-Severn and Gloucester, have no defences at all.

The NRA are currently investigating these problems to determine the extent to which it may prove practicable to alleviate them. There is likely to be little scope for increasing the levels of protection afforded by the existing flood defence embankments as this would increase the severity of flooding elsewhere (Worcester, Kempsey, Upton, Tewkesbury, Gloucester etc). Kempsey and Upton are particularly difficult sites where the requisite works are likely to prove difficult to promote on grounds of practicability, economic viability and acceptability (on amenity, conservation and similar grounds).

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Gloucester has a well documented history of flooding. It has been investigated by the NRA in a joint model study with the Department of Transport. This concluded that flood alleviation at Gloucester was not economically viable. Subsequent discussions with Gloucester City and Gloucestershire County Councils indicate that some form of joint approach combining new roadworks, redevelopment of flood plain fringe areas and flood defences may prove viable. Examination of this option is planned.

The current NRA programme of flood defence works is concentrated on the estuary below Gloucester in a comprehensive improvement scheme which has been running for over 15 years. The final lengths are now under review and some will not qualify for improvement on cost-benefit grounds. In appropriate areas the possibility of adopting a "managed retreat" approach may be an option.

River Chelt

The River Chelt runs through the heart of the town of Cheltenham. Present head of "main river" is the main west coast railway line. The river through the town is an "ordinary watercourse" but an application for its maining is currently being considered by MAFF.

Over the centuries the river was exploited for water power by a series of water mills. With the decay of these mills and the expansion of the town, development has encroached on the river and the original channels have been lost in many places. Thus the conveyance of flood waters now has to rely on the remaining elevated mill leats (channels) which are inadequate for the purpose, being of barely 1 in 5 year capacity. The consequence is flooding of significant parts of the town centre, the last major occasion being in 1979.

Since that event Cheltenham Borough Council have been investigating a possible flood alleviation scheme for Cheltenham but have been constrained by financial considerations due to the high cost involved. However in the mean time they have managed new development proposals to ensure compatibility with the planned scheme and to take advantage of any opportunities for the advance provision of works.

The NRA were already investigating an improvement scheme on the main river length downstream to ensure its compatibility with Cheltenham's proposals. Thus both schemes on the Chelt are essentially separate parts of a single comprehensive scheme. When the town length of the river is mained the NRA will be able to promote both schemes in conjunction with Cheltenham Borough Council.

Options for action are shown on Page 77

ISSUE 26 FLOOD WARNING

The present flood warning service on the River Severn is limited to the fluvial reaches from Powick (just downstream of Worcester) to the Gloucester area. With the exception of a trial storm warning scheme at Severn Beach near Avonmouth, there is at present no tidal flood warning service for the estuary below Gloucester.

Such a tidal flood warning scheme is needed, as demonstrated by the last major flooding

event on 16 February 1995. However, it has not yet proved feasible to devise one which can operate with a reasonable degree of reliability and credibility. A pre-requisite will be:

- * Improvement of tide and surge forecasts for the Bristol Channel generally.
- * Development of a suitable flood forecasting model for the estuary from Avonmouth to Gloucester.

The former is largely in the hands of Government Departments and external agencies. The latter is the subject of a current NRA research project.

Options for action are shown on Page 78

ISSUE 27 FLOOD PLAIN MANAGEMENT

The flood plain is a natural phenomenon resulting from overspill of the river channel at times of high flow. Under normal circumstances it would periodically be inundated, creating a particular range of natural habitat types including wetland areas of marshes, reedbed, herbaceous or grassland character. With saline influence, this extends to saltmarsh, reedy margins and silts of the estuary. Rivers are also major agents in the formation of landscape in the course of which they were instrumental in creating their valleys.

This flood plain is an essential part of the river. Its flooding is entirely natural and essential to the transmission of flood waters. If it is reduced by ill-conceived development then flood levels both upstream and downstream may be increased with corresponding increases in flood damage.

Land use change and re-development can offer opportunities for flood plain restoration whereby the errors of the past can be corrected in whole or in part. Development on the floodplain or allocation of its use for agriculture creates a need for flood protection and destroys natural habitat. It is therefore the aim of the NRA to not only oppose new development on floodplain but also manage it towards recreation or preservation of its natural state. Agricultural land is now of low priority with regards to the need for flood protection. Reduction in the intensity of agricultural use and changes in land use will make available opportunities for restoration of the natural floodplain as a flood storage facility and will alleviate problems of soil erosion, increased pesticide application (and consequent increased pollution)etc. One important step in this process of rehabilitation will be an accurate definition of floodplain. The NRA are currently surveying the Frome and Chelt for this purpose.

The land behind the sea defences at Avonmouth as coastal flood plain can also be considered. The saltmarshes and wetlands of the Avonmouth area are important both as habitat type and providing feeding sites for birds. The simplest and most cost effective ways of providing flood defences have the potential to degrade the existing habitat and change the conditions which have allowed these habitats to form in the first place. A secondary impact of such development is the creation of additional land with the potential for development e.g. Mitchell's Salt Rhine. This puts further pressure on the preservation of saltmarshes, reedbeds and wetlands as estuarine habitats of high conservation value.

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There are various ways in which this issue can be addressed. Land use in the floodplain can be influenced by a number of bodies such as the NRA and MAFF but direct planning control is with local authorities. The policies of introduction of buffer zones, Countryside Commission Stewardship Grants and the concept of managed retreat are all endorsed by the NRA and actively employed where appropriate in mitigation or enhancement of its own works. In addition, management of the land for conservation and other uses while maintaining drainage by Water Level Management Plans is an active tool for managing the floodplain.

Although this is a catchment wide policy issue, it is important to target specific areas where either restoration is needed or can be done. The NRA seeks guidance from other bodies on this aspect with a collaborative approach. A change in policy towards better remuneration for taking these steps for landowners should also be sought.

Options for action are shown on Page 79

ISSUE 28 REHABILITATION OF RIVER CORRIDORS

Past engineering practices have led to a significant number of river channels now needing restoration and improvement to allow more natural and diverse habitats. In some cases, re-profiling of the channel or in others de-culverting, are a key aspect.

The NRA recognises that there is a need to identify, appraise and prioritise sites within the CMP area and subsequently embark upon a programme with achievable results (See Map 22 Section 5). To do this will require co-operation from landowners, user groups and conservation bodies and technical experts in this field.

There are 4 aspects to this issue:

1. **Landscape and Visual Quality** - In order to re-create a natural landscape there must be both a baseline study of what is required, using the Landscape Appraisal Methodology already developed, and a strategy for achieving it.
2. **Channel Profile/Geomorphology** - In many cases, where restoration is indicated, natural channel profiles need restoration. This must be appraised in conjunction with land drainage and flood defence requirements. Potential sites include Norman's, Hatherley and Horsebere Brooks, the Rivers Frome, Leadon and Cam, particularly in the downstream flood plain reaches.
3. **Habitat Value** - This requires an integrated approach in order to achieve the rivers' habitat potential. The reasons for loss of vulnerable habitat must be assessed to establish where appropriate remedial action lies.
4. **Use and Access** - Restoration will lead to a use demand for recreational access - this must be recognised and accommodated. This can be complicated in that the NRA may own flood banks or structures but may not be empowered to grant access via private land. Many uses compete for land in the river corridor and these pressures may eventually destroy the full use or enjoyment of the river corridor. The

preservation of a balance of uses requires careful assessment of all proposals in relation to the overall provision of such facilities.

Options for action are shown on Page 80

ISSUE 29 COMPETING REQUIREMENTS OF RIVER ENGINEERING AND OTHER USES

A necessary part of NRA Flood Defence operations is the construction, maintenance and improvement of engineering works such as floodbanks, flood walls and in-channel structures, such as weirs and sluices. Works on rivers implemented directly by NRA engineers, contractors or riverside developers, can create a conflict with environmental interests. This includes main river and raised flood defences.

The NRA is aware that in the past channel works have been designed in the most efficient hydraulic way for the purpose of conveying surface water, sometimes via culverts, engineered or trapezoidal channels. However, such works have not always been designed to provide the best all round solution in a situation where there are environmental issues to be considered. Today, an integrated approach produces solutions which do not threaten the conservation of habitat, cultural heritage or landscape. Areas of special vulnerability can be identified as follows:

1. **Landscape/visual impact** - the natural beauty of a watercourse can be lost in a day without careful planning of proposed works. The cultural heritage of riverside towns and settlements must also be considered e.g. around Gloucester Docks, Tewkesbury or Upton, when constructing structures in areas where the river landscape is a tourist focus. Design must be in sympathy with the townscape and materials in keeping with the landscape heritage. Where sites may involve archaeological interest, consideration of known and investigation of potential sites must be taken into account as the area is historically rich in flood plain settlements. The function of the river and the role of the river corridor in the perspective of its current usage must also be considered carefully.
2. **Nature conservation** - the wetland, reedbed, saltmarsh, saline pill habitats of the lower River Severn are rare and threatened and must be protected. A large part of the area is protected by SSSI designation, so all engineering work must be thoroughly assessed.
3. **Threatened species** - whether by removal of habitat or disturbance, species can be lost from an area if works are not designed and executed sensitively, e.g. some of the rarer waders and migrant birds by drainage of roosts or feeding grounds. NRA sea defence operational works occur in the Avonmouth area near to sensitive bird habitats. The NRA must be able to demonstrate that its standards are monitored both during and after completion of works. To assess the effects of operational works it is NRA practice to do an Environmental Assessment. This ensures that mitigation works are carried out. In this area, the sensitivity of bird habitats in proximity to the works sites will need collaboration with the NRA and ornithological organisations such as RSPB to monitor and manage the situation.

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4. **Recreation** - provision should be made for recreational access particularly where structures are on or near the river. Proposed work should allow opportunities for the improvement of facilities or access, but must not compromise the needs for maintenance of existing defences whose primary use is to provide flood protection. Floodbanks can appear to make ideal routes for cycling or walking but there may be implications for maintenance and the ability, if needs be, to change their height or course.
5. **Maintenance of water levels** - It is recognised that ground and surface water systems upon which important nature conservation or archaeological sites rely, should not be changed adversely. This is dealt with in more detail under Issue 37 - Water Level Management Plans.
6. **Physical Geomorphology/Channel Profile** - conflicts can arise where the optimum design profile for the conveyance of water is not compatible with conservation objectives. In most cases, a compromise is possible, achieving a balance between land drainage and environmental considerations.
7. **Public Interest** - Due attention must be given not only to the effects of works on the environment but also on local people (materials, disturbance, etc.) and visual aspects of the works to a community.

The NRA addresses all of these aspects at the initial stages of an NRA project by carrying out an Environmental Assessment. Such assessments are sometimes published as Environmental Statements to invite public comment. A similar assessment procedure is also applied to all incoming consultations or applications.

Options for action are shown on Pages 81/82

ISSUE 30 RECONCILIATION OF COMPETING REQUIREMENTS BETWEEN RECREATIONAL USERS AND CONSERVATION INTERESTS

Recreational access, whether existing or created by improvements, can conflict with other uses of the watercourse. By creating a river habitat which is pleasant and of high conservation value, there is a consequent demand for access. Recreational activities also need support facilities such as car parking, toilets etc. where large numbers of visitors are attracted. These too may have impacts on land erosion, conservation requirements and local needs.

Options for action are shown on Page 83

ISSUE 31 DEVELOPMENT OF RECREATIONAL ACCESS

The NRA has a policy to develop the amenity and recreational potential of inland and coastal waters and associated lands. This can conflict with other uses but it is important to consider where recreational access to rivers is needed and can be developed.

The aquatic environment attracts a variety of recreational users including watersports, angling

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and walkers. The general public may just want a pleasant riverside picnic spot or pathway. In the catchment as a whole, there is a demand for this access, leading to initiatives where appropriate. There are three main development areas for this:

The Severn Way.

The NRA is collaborating with Local Authorities in the River Severn Upper and Middle Reaches to develop this footpath amenity. An extension from Worcester to Tewkesbury is also proposed. Parking and picnic areas would form nodal points.

Viewing of the Severn Bore

The NRA publishes a leaflet on this subject and indicates that viewing can be obtained at three sites - Over Bridge, Stonebench and Minsterworth. Of these, only Minsterworth has reasonable parking facilities and access.

There are also more general access issues. Car parking is one particular source of conflict, where local residents may not wish to see areas given over to it, but for which there is a demand. Similarly, the needs of local residents and business must be carefully considered as well as those of visitors.

Moorings

Existing moorings need improving and new ones creating up-stream from Tewkesbury to the Teme confluence to develop the River as a tourist focus and even an artery through urban areas leading into the open countryside where the Severn Way starts.

Options for action are shown on Page 83

ISSUE 32 PROTECTION OF RARE AND THREATENED SPECIES

Crayfish

The native British Crayfish (*Austropotamobius pallipes*) is a protected species under the Wildlife and Countryside Act 1981. Crayfish populations are under serious threat of extinction on a local, regional and national scale. The threat arises principally from the farming of exotic crayfish, principally the signal crayfish, which carries a fungal disease, "crayfish plague". This is invariably fatal to our native species and mortalities have been recorded close to the boundary of the Lower Severn Area in the NRA Thames and South Western Regions. Once the disease gets into a watercourse the entire population of native crayfish within that river system is often eradicated. Some crayfish deaths have been recorded in the Little Avon Sub-Catchment but it is not clear whether these were due to the plague. Controls on the introduction of signal crayfish are the responsibility of MAFF and not the NRA.

Otters

Otters are a protected species under the Wildlife and Countryside Act 1981. The Upper Severn catchment is a national stronghold for otters and a resource from which future expansion down the Severn Corridor will take place. The habitat requirements of otters include undisturbed areas of river bank plus bankside tree and shrub cover. The preservation of existing high quality habitats is vital for the protection of otters and for any future recolonisation of their former range. There is also concern about the effects of mink, including the disturbance to otters by mink hunting.

Shad

There are two species of shad indigenous to mainland Britain, the twaite (*Alosa fallax*) and the allis (*Alosa alosa*). Both species breed in freshwater, entering estuaries in April and May and migrating upstream to spawn over gravel soon after. Many shad return to the sea and can spawn again in successive years. The juveniles migrate seaward in their first year and spend the next four or five years of their life in estuaries and at sea before returning to spawn in the same river.

Although reduced in numbers, twaite do not appear to be in any danger of extinction at the present time but allis must be regarded as rare and those caught in the UK may well be strays from more southerly European populations. Known spawning populations of twaite in Great Britain are now confined to the rivers Severn, Wye and Usk. Weir construction, habitat degradation and pollution are thought to be the reason for the loss of other populations eg. on the Thames but the reasons for the rarity of the allis, particularly on rivers such as the Wye, are unclear.

There is now little or no exploitation of shad stocks so proposed barrages in estuaries are probably the most significant threat to the species. Discussions have been undertaken between NRA Severn-Trent and Welsh regions with the intention of producing a conservation strategy for shad. Allis are protected from knowingly being taken or killed (under the Wildlife and Countryside Act 1981) and this fact needs to be widely advertised.

Brown trout

Native brown trout populations are a nationally threatened resource. A number of the rivers in the Lower Severn catchment still contain good stocks of these fish, particularly in the Forest of Dean.

The characteristics of native trout stocks have been modified in rivers such as the Frome, Leadon and Little Avon by introductions of hatchery reared trout of diverse origin and escapees from fish farms. Numbers of wild fish have declined in some instances. Rainbow trout have also been introduced into an onstream lake on a Frome tributary and have escaped from several trout farms, notably on the Horseley Brook to the Nailsworth Stream and the Ozleworth Brook to the Little Avon. To protect the native brown trout populations, it may be necessary to prohibit stocking in rivers where this does not currently take place and restrict stocking in other rivers to brown trout only, preferably of local origin and of a size comparable to the wild fish.

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While this situation is irreversible in these rivers, areas where introduction has not yet occurred e.g. Forest of Dean brooks, the legislation relating to introduction of fish (Section 30 of the Salmon and Freshwater Fisheries Act 1975) can be used as a preventative measure.

The high quality habitats that are required to support brown trout will also need protection through the application of the NRA's regulatory powers, and decline of wild brown trout stock in some rivers will require investigation and remedial action where appropriate.

Options for action are shown on Page 84

ISSUE 33 THE ELVER FISHERY - ASSOCIATED PROBLEMS

Elvers have been considered a great local delicacy for many centuries and have traditionally been caught from the bank using a hand net. At times, over the years, fishing for and/or the sale of elvers has been prohibited by law, or a close season has been in force.

From the late 70's there has been a considerable decline in the catch of elvers. A three year NRA Research and Development project was started in 1990 to investigate this decline. The resulting report, published in January 1994, confirmed the fall in recruitment of elvers from the Atlantic to both Europe and North America over the last 15 years. Natural mortality rates were high in the estuarine migration phase. Following recommendations the NRA concluded that a close season was inappropriate but the conservation of stocks would best be achieved by construction of elver passes on weirs and by getting better data on catches from the elver stations.

Today elvers can legally be taken by licensed fisherman using a hand held tagged net of limited size. Most fishing is done after dark on spring tides in March and April. It is the NRA's responsibility to issue and enforce licences. The NRA has no legal control over trespass. There is some misunderstanding amongst fishermen as to the legal methods of fishing especially where boats are concerned. Boats are sometimes used on the river without the necessary navigation lights, or inappropriate methods such as trawling are reported. Clearly a number of parties are involved and despite discussions over the years problems still arise from time to time and can be difficult to resolve to the satisfaction of all parties.

Options for action are shown on Page 85

ISSUE 34 CANAL RESTORATION

There are three canals in the CMP area which are undergoing or have planned restoration namely the Stroudwater, Severn-Thames and Herefordshire & Gloucestershire Canals. These projects have implications not only for nature conservation, recreation and amenity but also for water resources, quality and land drainage and flood defence. Whereas the re-opening of the canals is normally welcomed by the public, canals require an appreciable amount of water to support navigation. This has resource implications for the Rivers Frome and Leadon, as well as effects owing to changes in flow regimes on their quality and habitats. There is some concern that there will not be enough water to support these canals. Land owners near the

canal are also concerned at possible loss of conservation sites.

The Stroudwater Canal is now under the management of the Cotswold Canals Trust. This Canal linked the Thames and Severn Canal in the east with the Gloucester and Sharpness Canal in the west, which originally provided the mill owners with a valuable route by which to transport their products. The Frome was the only major source of water for the Stroudwater canal when it was operating, providing resources at various stages during its course. Calculation by consultants shows that over 20 Megalitres per day was required to keep the canal operative (this is equivalent to water supplies for all domestic and industrial requirements for Stroud and District). A 'reasonable' flow needs to be maintained in the Frome, not only for environmental reasons but also to support existing abstractors. This needs to be considered in the restoration plans. The status of the old connections between the Frome and the canal also need to be reviewed. The possibility of inclusion of the River Frome and the Dudbridge Flood Relief channel as part of the navigation is of concern from land drainage and flood defence viewpoints.

The Severn-Thames Canal, if restored, would reinstate the link between the River Severn and the Thames. As such this issue is also addressed in the NRA Catchment Management Plan for the Upper Thames (January 1995). The Cotswold Trust promoting the Severn-Thames scheme have suggested incorporating the canal into Wiltshire County Council's Mineral Plan, using water from de-watering of gravel extractions sites for supply and strategic water transfer. This is currently under consultation.

There is presently an active canal restoration and extension programme under way on the Gloucestershire-Herefordshire canal. Such a project requires water - this creates complications as to the rights to water and impacts on water resources. Although this project would have an effect more on the River Wye Catchment, it may also create water resource problems for the Ell Brook and River Leadon.

Options for action are shown on Page 85

ISSUE 35 HYDROPOWER DEVELOPMENT ON THE FROME, CAM AND LITTLE AVON

Small scale hydropower is an alternative energy source with a good deal of potential in the Frome and Cam valleys. The NRA generally supports hydropower provided it does not have a detrimental effect on quality, fisheries, water resources, land drainage, flood defence or significantly impede other users. There are several sites proposed:

Frome

Because of the nature of the River Frome valleys, there are numerous old mill sites that could be used for power generation. The first private proposal is to install a turbine within the Ebley Mill complex. The hydro installation would be built into an existing weir directly in-line with the river flow. This would mean that theoretically there is no loss of water and therefore no resource effect upon the river. The proposal would, however, affect the current flow gauging record on the Frome (based at Ebley Mill) which is used to control abstractions on the river and by British Waterways to control flows to the Gloucester-Sharpness Canal.

Cam/Little Avon

Once a licence has been granted for abstraction of water the NRA must have regard to its existence in granting further licences. A licence of entitlement has been granted on the River Cam to abstract water for hydropower purposes. The licence limits the granting of licences for any new abstractions upstream as it depends on a substantial through flow. This has implications for further licensing and development upstream as with the Frome situation.

Options for action are shown on Page 86

ISSUE 36 DEVELOPMENT ISSUES

New development has a major impact on the catchment. Early involvement in land use strategies and proposals will facilitate the protection and enhancement of the water based environment. The process of Town and Country Planning is the regulatory mechanism for land use planning. The NRA actively participates within this process and is a statutory consultee for Development Plans (Structure Plans, Local Plans, Mineral Plans, Waste Plans) and certain planning applications.

The NRA has produced the document "Guidance Notes for Local Planning Authorities on the Methods of Protecting the Water Environment through Development Plans". The NRA, through consultations with Planning Authorities, seeks the inclusion of appropriate policies and site allocations.

The main area for new development in the catchment is within Gloucestershire. Development within the County include the existing towns and settlements in addition to a possible new settlement.

Other areas of development or redevelopment have a significant impact on the catchment e.g. Avonmouth/Sevenside. This area covers some 2338 hectares (ha) of Avonmouth, and the Little Avon Catchment. A large part is already developed but substantial tracts of land are potentially available for development. Some has the benefit of already existing planning consent and development plan allocations. New infrastructure provisions e.g. the new motorway junction on M49 to link the Second Severn Crossing and improvements to rail access, will enhance development potential. Guiding principles for this have been identified in the Interim Draft Avonmouth/Sevenside Strategy, 1994; (the majority of the development is to be of mixed employment use).

The Avonmouth/Sevenside Strategy area is almost wholly below high tide levels in the River Severn and is drained by a series of rhines. This low lying area is protected by sea defences, that in the future are to be improved by the NRA to a protection to the 1 in 100 years flood event. The NRA is also responsible for the tidal outfalls through the defences. The system of rhines is under the jurisdiction of the South Gloucestershire Internal Drainage Board (IDB) who have commissioned a drainage area study to assess the implications and requirements of future development. It is essential that any development in this area does not reduce the capacity available for the storage of surface water run-off during tide-lock conditions. Future developments will be expected to fund part of the overall drainage strategy which will be

drawn up by the IDB in consultation with the NRA. Provisions in the emerging Local Plan for Bristol City and Northavon reflect this.

In addition to drainage aspects, the rhine system has a distinctive wetland landscape and ecology, providing important wildlife corridors. Links with the rhine system and the Community Forest initiative should be explored. The issue of Water Level Management Plans is also important to this area.

An important local impact of transport/infrastructure is the construction of the Second Severn Crossing. The construction of a second motorway crossing across the River Severn along with associated access roads is now approximately half way through its four year contract period. The completed bridge, spanning from Redwick (England) to Sudbrook (Wales) is intended to run in parallel with the existing bridge and although intended to relieve vehicular pressure on the existing system will no doubt lead to increased traffic with the attendant greater risk of accidents and spillages. Furthermore, maintenance of a structure this large is vast and carries a risk of contamination of the Severn Estuary and its fringes from materials such as shot blast and flaked paint.

The river corridor through Gloucester is another area of major concern where highway proposal and development pressures threaten encroachment into the River Severn flood plain in an area where there is an established flooding problem. The NRA is working with Gloucester City and Gloucestershire County Councils to develop a river corridor management policy to integrate possible flood alleviation proposals with planned highway works and new development or redevelopment of flood plain fringe sites.

Run -off from new Development

Many development sites can be located in the upper parts of catchments where receiving watercourses may not have sufficient capacity to accommodate the additional run-off generated. This problem is particularly prevalent on "ordinary watercourses" where the NRA does not have the necessary powers of regulation or to carry out maintenance or improvement works. NRA policy is that new development must not increase flood risk to others. In such cases a choice must be made between off-site channel works or some form of flood attenuation. The former may be unacceptable on environmental or other grounds and recourse is made to run-off control or flood balancing.

Flood balancing may itself present problems in a particular catchment and its use must therefore be considered in the context of its location within the catchment and relevant constraints elsewhere on the river system. NRA policy is to investigate such proposals within the wider catchment framework.

Coastal Planning

In recent years the coast has come under scrutiny from a variety of organisations with regard to Coastal and Estuarine Management Planning. The result of the findings of a Government Select Committee on this subject was that no one authority has been given a lead role, but rather the process is envisaged as being collaborative between all interested parties. Several of these parties have documented their visions for how the process should take place. English

ISSUES AND OPTIONS

Nature have published guidelines on Estuary Management Planning and have a list of estuaries nationwide which they have targeted for such plans. MAFF have also published a consultation report on Coastal Cell Management which looks at coastal management in terms of physical processes of erosion and deposition of sediments. In the Severn Estuary specifically a study leading to a management strategy is being formulated by a group led by local authorities but also having NRA, EN and other membership. The project is seeking EC funding.

The NRA's responsibilities extend to not only inland waters but also to river estuaries and coastal waters (3 Mile limit for pollution control; 6 Miles for coastal net fisheries under NRA jurisdiction). In terms of Catchment Management Planning, this body of water represents the largest "catchment" of all. The NRA CMP national programme has included coastal and estuary plans in its timetable - the Humber Estuary Plan has already been published. Severn Trent, South Western and Welsh Regions of the NRA will jointly produce a CMP for the Severn Estuary during 1995 -96; the timetable for this plan is concurrent with that of the Severn Estuary project noted above to ensure that the two planning processes can be effectively integrated.

As noted in Section 2.0 (Overview), this CMP is concerned with the River Severn - Lower Reaches and as such issues in the tidal upper estuary will inevitably overlap with those in this plan. It is important to raise both the issue of effective collaboration and the interface between river and estuary processes at this consultative stage to get an integrated picture of how the NRA and interested parties can progress this plan and following plans for the estuary. Particular areas of concern are:

- * Pollution Control (Chemical quality/biological quality/coastal and riverine litter control)
- * Conservation (Landscape, heritage, aquatic habitat protection)
- * Sea Defences (Coastal processes and flood risk; investments in flooding protection linked to land use changes as well as these dynamic processes)
- * Water Resources Residual flow requirement to the estuary from the River Severn and major tributaries.
- * Development & Planning (Influencing all of the above)

Options for action are shown on Page 87

ISSUE 37 WATER LEVEL MANAGEMENT PLANS

The Ministry of Agriculture, Fisheries and Food (MAFF) have recently published guidelines for the production of "Water Level Management Plans". These plans are envisaged to provide a means by which the water level requirements for a range of activities in a particular area (eg. agriculture, flood defence, conservation) can be balanced and integrated. As such, the formulation of WLMP's is an important process to include in a Catchment Management Plan.

The NRA has a significant role to play in the process but other interested parties such as English Nature and the Internal Drainage Boards will be key players in identifying and taking forward the plans. The NRA sees the catchment management planning process as the main vehicle for liaising with these bodies.

There are no plans in this catchment where the NRA is the lead organisation. There may still, however, be a call for NRA input. At present we are monitoring water levels at Walmore Common SSSI as part of a data gathering process for that plan as an abstraction may affect the site. In addition, a collaborative project between RSPB, NRA and EN will carry out a comprehensive survey of the Severn Vale grasslands as breeding wader habitats for the purposes of WLMP.

The issue for the NRA is how much resource we will commit to help in production of these plans in the next 5 years. While there may be significant benefits for the environment this is not one of our statutory duties.

Options for action are shown on Page 88

3.3 A SUMMARY OF THE ISSUES AND OPTIONS FOR ACTION

The issues and options facing the catchment, described in the previous section, are shown in summary tables in the following pages. These are intended to provide quick reference to the issues and options that need to be addressed. Abbreviations used can be found in the Glossary (Appendix 2) at the back of the report.

Wherever possible the body responsible for carrying out each option has been identified. In some cases this is identified as an individual(s) or an organisation other than the NRA. However, the options as presented are intended to facilitate improvements to the water environment for the benefit of all users. Their implementation will entail many bodies and individuals co-operating. Costs, both capital and revenue, are significant to most of the issues. The Final Plan will provide more detailed budget and timetable implications.

This should not be taken as a definitive list of issues, nor should the proposed options be taken to be the only ones available. We hope that interested parties will debate these issues and pass their comments to the NRA for consideration when preparing the final version of the plan.

ISSUES AND OPTIONS

ISSUE NO: 1	Achievement of River Water Quality Objectives		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Pursue achievement of medium term quality class within timescale set, by pollution prevention, liaison with public and other bodies and enforcement of pollution legislation	NRA/Severn Trent Water plc/ Farmers/ Industry	Quality targets achieved	Costs of improvements
2. Establish reasons for non-compliance with all long-term targets during period of Plan	NRA	Preparation for future target setting	Resources

ISSUE NO 2	Extension of designated fishery reaches		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Resolve apparent mis-match between actual fishery status and water quality	NRA	Extend designations	May not be possible

ISSUE NO: 3	Protection of water supplies from River Severn and Gloucester-Sharpness Canal and designation as Water Protection Zone		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Consider designation of Severn and Gloucester-Sharpness Canal as Source Protection Zones	NRA/DOE	Increased powers to control potentially polluting activities	
2. Install additional automatic water quality monitors at Kempsey and Slimbridge	NRA	Early warning of water quality changes	
3. Establish targeted programme of inspections of potentially polluting premises and act on deficiencies identified	NRA/Farmers/ Industry	Identify sources of potential pollution and reduce risk	Resources
4. Initiate publicity campaigns to mobilise pollution prevention effort in Agriculture and Industry	NRA/Farmers/ Industry	Greater awareness of pollution risks and commitment to remedies	Resources
5. Liaise with Planning Authorities and Developers to minimise pollution risk from development	NRA/Planning Authorities/ Developers	Secure pollution prevention measures	None

ISSUES AND OPTIONS

ISSUE NO: 4	Impacts of the Urban Wastewater Treatment Directive and designation of Eutrophic Sensitive Areas		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Monitor Severn Trent Water plc implementation of agreed capital programme of specified timetable	NRA/Severn Trent Water plc	Compliance with UWWTD and upgrading of the River Chelt	Resources
2. Review consents in line with agreed programme	NRA/Severn Trent Water plc	Compliance with UWWTD and upgrading of the River Chelt	Resources
3. Gather data to enable decisions to be made on proposed Eutrophic Sensitive Areas	NRA	Improved long term water quality	Resources
4. Carry out Eutrophication Project to assess impact and benefits of nutrient removal from sewage works in eutrophic sensitive areas	NRA	Quantify benefits of nutrient removal	Resources

ISSUE NO: 5	The impact of the River Chelt on the water quality of the River Severn		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Liaise with Severn Trent Water plc to define optimum schemes to upgrade quality in line with AMP 2 commitments	NRA/Severn Trent Water plc	Upgrade of water quality from RE5 to RE4 by year 2000	None
2. Assess need for nutrient removal at Cheltenham STP during 1995/6 in connection with proposed ESAs for the River Severn and Gloucester-Sharpness Canal	NRA	Determine impact of discharge on nutrients in the River and Canal	Resources

ISSUE NO: 6	Impact of investments & improvements at Gloucester Sewage Works on the tidal River Severn		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Monitor completion of new works and improvements in effluent quality	NRA/Severn Trent Water plc	Quantify reduced pollution load	None
2. Continue to monitor effect of improvements to estuarine water quality	NRA	Upgrade Estuary Quality Class	Resources
3. Assess effects on migratory fish	NRA	Minimised mortality and improved migratory passage	None

ISSUES AND OPTIONS

ISSUE NO:7	Sewage and industrial discharges		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Recommend appropriate controls on new development in Ledbury and impose controls on Ledbury STP to minimise potential pollution.	NRA/Malvern Hills District Council/ Severn Trent Water plc/Developers	Maintain and improve water quality below Ledbury	Costs to developers and the water company
2. Address upgrading of Hatherley Brook at next water company price fixing round (1999/2000)	NRA/Severn Trent Water plc	Improved water quality by 2005	Cost
3. Assess need for nutrient removal at Coaley STP during 1995/6 in connection with proposed ESAs for the River Severn and Gloucester-Sharpness Canal	NRA	Determine impact of discharge on nutrients in the River and Canal	Resources
4. Oppose development where inadequate sewerage is likely to lead to pollution	NRA/District Councils	No deterioration on existing situation	Pressure for development. Local Authority decision

ISSUE NO:8	Upstream impacts on water quality in the River Severn		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1.Environmental assessment into question of extension of navigation in Upper Severn	Developer NRA to make scoping suggestions	Maintenance of water quality	Cost of study
2. Continue to monitor impact of colour	NRA	Ability to warn abstractors and inform public	Resources
3. Continue to monitor the River Avon	NRA	Identifies impact of Avon on Severn	Resources

ISSUE NO: 9	Pollution from inadequate rural sewerage		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1.Promote action by District Councils and others to provide sewerage	NRA/District Councils	Lower pollution and benefit to householders	Cost of schemes
2. Oppose development where inadequate sewerage is likely to lead to pollution	NRA/District Councils	Prevention of pollution.	Local Authority planning decision
3. Explore feasibility of alternative sewage treatment methods e.g. reed-beds	District Councils/Developers/Water plcs	Widens options available.	None

ISSUES AND OPTIONS

ISSUE NO: 10	The impact of pesticides on water quality		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Target farm visits and inspections. Prosecute polluters when found	NRA	Educate users to reduce impact on water quality	Resources
2. Continued monitoring of eels in the catchment for Dieldrin etc.	NRA/MAFF	Ensure eels are not carrying excessive levels of dieldrin	

ISSUE NO:11	Farm pollution including the effects of ammonia & nitrate.		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Maintain targeted farm inspections and identify remedial action needed	NRA/Farmers	Identify sources of potential pollution and reduce risk	NRA resources
2. Serve Notices under 1991 Farm Waste Regulations to secure remedial action	NRA/Farmers	Response required within defined timescale	Appeal Procedure
3. Prosecute identified polluters	NRA	Publicity for enforcement policy. Penalty for offences committed	None
4. Monitor effectiveness of Nitrate Vulnerable Zones in reducing nitrate in local watercourses and groundwater	NRA	Quantify benefits of NVZ	Resources

ISSUE NO: 12	Pollution risks from contaminated land		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Impose planning conditions and secure associated Section 106 obligations on redevelopment of affected sites	NRA/ Local Authorities	Establish appropriate monitoring and ensure remediation protects water resources	Resources NRA input to Planning Agreements not always accepted
2. Encourage engineering and waste management solutions	NRA/HMIP/ Landowners/ Local authorities Waste Regulation Authorities	Controls existing problems. Good schemes may save energy and money. Sites can be made fit for development	Requires co-operation of landowners. Initial capital cost
3. Maintain liaison with Waste Regulation Authorities	NRA/ Waste Regulation Authorities	Co-ordination of effort with better inspection and monitoring of sites	Recent legislative changes exempt some contaminated sites from licensing
4. Maintain database of information on existing contaminated land sites	NRA/ Local Authorities	Identify possible problems with development proposals. Identifies possible source of pollution problems	Reduction of value of land if data misused
5. Recommended environmental assessment and scope of study on significant planning application concerning contaminated land	NRA/ Local Authorities	Full identification of environmental problems	Contaminated land register rejected by government. Costly and time consuming, not relevant for all sites
6. Implement intensive survey of rhines & groundwaters around Avonmouth	NRA	To identify those areas most contaminated with metals from slag disposal	

ISSUE NO:13	Pollution from mining and quarrying in the Forest of Dean		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Enforce legislation for discharges to controlled waters, including underground waters, where justified by available evidence	NRA/Mining Companies	Safeguard groundwater and surface water quality	Legal restrictions. Additional resources required in tracing discharges underground
2. Liaise with companies to secure improved pollution prevention measures	NRA/Mining Companies	Minimise accidental pollution	
3. Assess possibility of remedial measures to the riverbed habitat, including removal of iron-contaminated substrate	NRA	Improved ecosystem and fishery	Resources

ISSUE NO:14	Water contact sports and relevant quality standards		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Education on problems of contact sports in relation to water quality	NRA/ Environmental Health Department Local Authority	Prevention of disease	Still a very uncertain area - not statutory NRA responsibility
2. Identify Water Quality Standards for contact sports	NRA/ Environmental Health Department Local Authority	Identification of suitable reaches of rivers for sports	Not statutory responsibility - some liability may be implied

ISSUE NO:15	Impacts of marinas and oil pollution from boats on water quality		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Press for polluting discharges from vessels to become an offence	DOE	Quality improvement in rivers and canals	Requires legislation
2. Adherence to boat standards prescribing separation of engine compartment & provision of oil spill trays. (Voluntary since Jan 1993; may be made mandatory within Waterways Bill)	BW/Navigation & Canal Trusts	Ensures that oil spills are contained within the engine compartment	Costs to builders, and owners of boats

ISSUE NO: 16	River Litter		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Better security at industrial sites to prevent vandalism	Site Owner	Crime prevention and reduction of pollution risk	Cost
2. Educate and organise preventative action	NRA/Police/Local Groups (e.g. Neighbourhood Watch)/Tidy Britain Group	Prevention rather than cure	Needs support of statutory changes and enforcement of existing litter laws
3. Change in legislation to clarify responsibilities	Lobbying by interested parties and public.	Would provide statutory duty for an agency to be responsible for litter in rivers	Extra cost

ISSUE NO:17	Seasonal effects of blue-green algae on the Stroudwater Canal and Frampton Lakes		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Continue to monitor all reported occurrences and notify interested parties when reportable levels found	NRA	Increased awareness of problem	none

ISSUE NO:18	Pollution risks associated with Hempstead Tip Gloucester		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Use powers under Water Resources Act 1991 to enforce pollution control and preventative measures	NRA/site owner	Improved environmental quality	None
2. Liaise with the Waste Regulation Authority on appropriate Licence conditions to minimise potential pollution	NRA/Waste Regulation Authority	Minimise pollution risk	None

ISSUE NO:19	Impacts of large industrial plant		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Frequent consent reviews to ensure continued tightening of legitimate discharges to rhines & estuary	NRA/HMIP	Improvements in environmental quality.	Cost
2. Identify, regulate & control discharges from industrial & trading estates	NRA/HMIP	As above	Cost. Acceptance of legal responsibility by dischargers
3. Increase range & frequency of chemical & biological monitoring	NRA/HMIP/ Discharger	Better assessment of effects . Will assist options 1 & 2	Cost. Resource implications
4. Close co-operation with Fire Services to ensure that environmental hazards are known and action plans agreed	NRA/ Local Fire & Rescue Services Industrial Site Owners	Minimise impacts on the water environment	None

ISSUE NO: 20	Maintenance of flows at Gloucester for abstraction to the Gloucester-Sharpness Canal and other environmental uses.		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Review of operation of Clywedog and Shropshire Groundwater to provide required flows at Gloucester	NRA	More efficient use of available water resources. Maintains required flows at Gloucester	Cost if increased flow support required
2. The use of Gloucester & Sharpness Canal to store water for use during periods when pumping at Gloucester is restricted	BW/ Bristol Water/ NRA	Small increase in resource	Risk of deterioration of water quality and canal ecology with possible construction effects. Does not meet requirements
3. Bankside storage equivalent to 5 days of the Purton (Bristol Water) abstraction	BW/ Bristol Water/ NRA	Any new reservoir could be designed for conservation /recreation uses	The reservoir may have visual impact and problems with access road
4. Review the operation of the Sharpness Docks to prevent freshwater being released from the canal during operation	BW/ Bristol Water/	Small increased resource may be achieved through pumping	Risk of saline intrusion and possible construction effects
5. River storage in the River Severn by adjustment of weirs at either Maisemore, Llanthony, Upper Lode or a tidal exclusion barrier below Lower Parting	NRA/ BW	Would meet most requirements and provide a control of flow to the estuary. A tidal barrier may improve water quality for abstraction at Gloucester	Risk of contamination of the water retained in pound. Threat to ecology and fisheries during construction. Mechanised control structure. Bank protection required. Interference with drainage of riverside land
6. Installation of new flow monitoring site	NRA	Better assessment of flows	Cost

ISSUE NO: 21	Potential effects of a Severn-Thames Transfer scheme		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Appraisal of environmental implications of the scheme for Severn	NRA	Allow full implications of the scheme to be realised	Possible time constraints and cost of study
2. Investigations into Biology and Chemistry of Severn to assess impact on Thames	NRA	Allows NRA to establish policy on transfer	Costs
3. Promote best use of present resources	NRA/ Water Companies	No environmental impacts	Does not allow for contingency planning

ISSUE NO: 22	Impact of low flows in the Leadon, Forest of Dean, Frome and Cam/Little Avon		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
Leadon (Glynch Brook) 1. Provide compensation borehole 2. Reduce licensed quantity in unit 3. Provide new flow measurement capacity to Glynch Brook	Severn Trent Water plc NRA	Compensation flow to the Glynch Brook during dry periods. Improved habitat, ecology and fish stocks Long term improvement Monitor and enforce compensation discharges	No practical long term solution to over abstraction of groundwater. Other water sources needed to supply local requirement Cost
Forest of Dean 1. Provide new flow measurement on River Lyd 2. Monitoring of flows to be part of planning agreement in any opencast mining operation	NRA	Improvement to flow predictions and safeguard supplies to abstractors. Early warning of flow changes	Costs of new gauging station
Frome 1. River bed maintenance 2. Appraise effect of local abstractions. 3. Operating agreement with landowners to control flows to Canal and River.	Riparian Owner/Canal Society/NRA NRA Riparian Owner/Canal Society/NRA	Reinstate and preserve flows Identify real causes of problems Improved flow in Frome. Possible flooding relief	Costs and continued maintenance may be prohibitive Costs
Little Avon 1. Conduct seasonal flow monitoring investigations and compare with historical records 2. Ensure all licence abstractions operate within specified conditions 3. Increase frequency of checks for non-licensed abstractors	NRA NRA/ Abstraction licence holders NRA	More control and accurate monitoring Establish whether real problem exists	None None Resources

ISSUE NO:23	Severn Exempt Area Order		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. NRA to review policy of exempt area to support proposals for legislative changes	NRA Abstractors	Clarification of the exempt area and possible protection of existing abstractors	Reappraisal of existing abstractors requires a substantial administrative input

ISSUE NO:24	Local issues relating to fish farms in Little Avon Catchment		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Review of flow management practices	NRA	More accurate reflection of actual practices. Enforcement against transgressors	None
2. Chemical & Biological survey upstream & downstream of fish farms to determine any change in water quality <i>Sites for Action: Ozleworth brook & Little Avon</i>	NRA	Basis for consent enforcement or revision	Resources

ISSUE NO: 25	Major flooding from the River Severn and Chelt		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Complete investigation of possible flood alleviation works at Upton-upon-Severn and Kempsey	NRA	Provision of defences in priority areas	Practicability of works, economic appraisal and acceptability to beneficiaries
2. Develop river and flood plain management strategy for Gloucester	NRA/Local Authorities	Provision of defences in priority area. Control of development. Flood plain restoration	Economic appraisal. Availability of funds
3. Complete Severn Tidal Defences Improvement Scheme in accordance with NRA capital works programme agreed by Regional Flood Defence Committee	NRA	Improvement of tidal defences in priority areas	Economic appraisal. Availability of funds
4. Complete registration of Chelt through Cheltenham as "main river"	NRA/MAFF	NRA authorised to carry out maintenance and improvement works	Objections raised to maining
5. Develop flood alleviation scheme on River Chelt through Cheltenham	NRA/ Cheltenham Borough Council	Provision of flood protection in priority area	Practicability of works, economic appraisal and acceptability to beneficiaries

ISSUE NO:26	Flood Warning		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Complete improvement of existing flood warning scheme	NRA	Improve flood warning	Accuracy of forecasting model. Cost
2. Investing etc. in extension of flood warning scheme	NRA	Provide flood warning for areas not previously covered	Practicability (especially lead times). Economics. Cost
3. Develop new tidal flood warning scheme for estuary	NRA/Government Departments/ External Agencies	Provide flood warning areas not previously covered	Practicability. Forecasting/ modelling limitations. Economics. Cost

ISSUE NO:27	Flood plain management		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Accurate definition of the floodplain for Rivers Frome and Chelt	NRA	Gives baseline information or "terms of reference" for management purposes for NRA & other parties	Shortfall in basic data will be costly and time consuming to address.
2. Promotion of Buffer Zones particularly in areas of arable farming. <i>Leadon, Ell Brook, Swilgate, Normans Brook, lower reaches of Cam, Chelt and Frome.</i>	NRA/EN/ Conservation bodies/CoCo/ MAFF/CPRE/ CLA/ Landowners/ NFU	Protection and improvement of the riverside habitat. Reduced pollution effects	Inadequate grant emphasis to encourage landowners
3. Managed Retreat. <i>Severn Estuary Strategic Study has identified potential sites e.g. Berkeley Estate land at Slimbridge</i>	MAFF/EN/ NRA/NFU	Creation of new wildlife habitat while maintaining flood or sea defence	Reduced land availability for development. Very little appropriate area
4. Better incentives for landowners to take up grants for environmental improvements	Government/ MPs (as advised by NFU/MAFF/ others)	Puts 2 & 3 higher on the priority list for land management	None
5. Investigate removal of redundant structures at Gloucester	NRA/ Gloucester City Council/ British Rail	Potential increase in flood storage area	None

ISSUE NO: 28	Rehabilitation of river corridors		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
<p>Landscape/Visual Quality a)Landscape Appraisal programmes using established methodologies. <i>Chelt, Frome, Cam</i> b) Planned programme and strategy to improve character, e.g. planting willows to pollard, hedgerows and re-creation of flood plain river corridor vegetation "wildlife corridor" <i>Lower reaches of Cam, Frome, Hatherley, Norman, Horsbeere Brooks</i></p>	<p>NRA/Local Authorities</p> <p>NRA/MAFF/Landowners/FWAG/LA's etc.</p>	<p>Allows prioritisation and a baseline for planning improvements.</p> <p>Follows on from a). Can incorporate costs at source. b) Re-creation of historically more typical landscape.</p>	<p>Cost.</p> <p>Economic - available funding generates priorities. Land ownership</p>
<p>Channel Rehabilitation Recreating Natural Profile/Geomorphology Development of a collaborative strategy for deculverting and/or removal of redundant structures</p>	<p>NRA/LA's/ Landowners/ Developers</p>	<p>Restores river habitat</p>	<p>Cost</p>
<p>Habitat Value a) Restoration of habitats by strategic management, particularly otter habitat and wetland/salt marsh/reed bed</p>	<p>NRA Landowners EN/Wildlife Trusts</p>	<p>Improved natural state of the river corridor</p>	<p>Cost Land uptake. Flood Defence requirements</p>
<p>Uses & Access a) Survey of existing recreational needs and potential requirements as a result of improvements b) Collaboration with user groups to identify needs and resolve conflicts of interest c) Promotional/ collaborative projects to extend provision and access</p>	<p>NRA</p> <p>NRA/Sports Council/CLA/ Conservation Bodies/ National Trust CC's/LAs/EH/ Co Co</p>	<p>Allows formulation of a strategy</p> <p>As above, plus development and conservation of built and natural environment</p>	<p>May need to reach a compromise between access and conservation</p> <p>As above</p>

ISSUE NO: 29	Competing requirements of river engineering and other uses		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
<p>1. Nature conservation Protection of Habitats. Methods: a) Environmental assessment of proposed sites for works b) Grant schemes c) Countryside Stewardship d) Managed Retreat e) Zoning f) Maintenance of advisory role</p>	<p>NRA/EN/ Developers/ Local Authorities/Co Co/landowners</p>	<p>Allows the ecology of the river to be protected and new habitats to be created. Separation of potentially conflicting uses. Provision of advice on best practice</p>	<p>Flood Defence requirements Land uptake requirements Local Authority planning concerns Communication. Resource implication</p>
<p>2. Threatened Species a) As above plus b) Surveys of particular species or groups at risk c) Habitat recreation (e.g. River Severn Otter Project)</p>	<p>NRA/EN/ RSPB/Wildlife Trusts As above</p>	<p>Provides information upon which to plan for works and/or mitigative procedures. Can be an active means of compromise either on site or elsewhere</p>	<p>Can be lengthy and costly</p>
<p>3. Landscape/Visual Impact a) Environmental Assessment b) Programme of Landscape Appraisal c) Consultation</p>	<p>NRA/ Landowners/ Developers/ Local Authorities NRA/Local Authorities As above</p>	<p>Provide an assessment of the overall impact of works & provides basis for consultation between interested parties Protects the cultural heritage of the river landscape As above</p>	<p>Cost None</p>

ISSUE 29 CONTINUED	Competing requirements of river engineering and other uses.		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
d) Use of appropriate designs and materials for the locality	NRA/Local Authorities/ designers /engineers	Blends with surroundings	May add cost to the project
Recreation a) Provision when designing projects to incorporate access for recreational uses b) Integration of recreational requirements with existing land use	As above NRA/Local Authorities/Wildlife Trusts/EN/CoCo	Allows the works themselves to become a recreation asset. Increased recreational access/activity	As above Needs careful design - has to be matched up with existing uses
Maintenance of Water Levels See Issue 37			
Physical Geomorphology/Channel Profile a) De-culverting wherever possible (See Issue 28) b) Appropriate design of features to allow compromise between efficient flood water conveyance and natural structure of channel	NRA/Landowners/ Developers/Local Authorities	Re-creation of wildlife habitats Improved river landscape Protection of channel geomorphology	Flood Defence requirements
Public Interest a) Consultation via Environmental Statements (where appropriate) /press releases/notice boards/etc b) Full use of tendering procedures to allow best local facilities to be used	NRA As above	Allows local interest to be accommodated at an early stage Ensures that the full benefit of the project locally is realised	Can be a lengthy process with not all interests accommodated fully Must follow government finance rules

ISSUE NO: 30	Reconciliation of competing requirements between recreational users and conservation interests		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Survey present recreational uses and assess on-site conflicts arising	NRA/User Groups	Gives information upon which to formulate a strategy	Cost
2. Formulate a strategy for action at specific sites - in conjunction with rehabilitation and landscape strategies (cf Issue 29)	As above	Provides a framework for discussion and resolution of conflicts	May not be able to resolve all user conflicts
3. Investigate options for zoning of activities to geographically separate uses	As above	Removes conflicts between different user requirements	May not be possible to link with footpaths etc. or get access permission

ISSUE NO:31	Development of Recreational Access		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Collaborative projects within Tewkesbury, Upton and other potential sites	NRA & Others	Fulfilment of NRA aim to improve access and promote recreation	Cost. Agreement with landowners
2. Continuation of Severn Way Project	NRA/ Landowners	As above	As above
3. Investigation of potential cycle tracks	NRA/Sustrans	As above	As above
4. Analysis of recreational use and development of nodal points with facilities such as parking, interpretation, etc.	NRA	As above	As above
5. Promote access to or along all rivers within catchment where appropriate and where opportunities arise	NRA/ Landowners / Local Authorities	As above	As above

ISSUE NO: 32	Protection of rare species		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
Shad 1. Preparation and adoption of Shad Conservation Strategy to include e.g identification and protection of spawning habitat, provision and assessment of use of fish passes 2. Quantification of numbers and exploitation rates	EN/CCW/NRA	Maintenance of species diversity	Cost
Crayfish 1. Liaise with MAFF to limit further consents under Section 30 of Salmon & Freshwater Fisheries Act 1975 plus Wildlife & Countryside Act 1981	MAFF/NRA	Allows control over introduction of alien species	Relies on NRA being informed of proposals
Brown Trout 1. As above	NRA	As above	
Otter 1. Reintroduction and development of otter habitats via the Severn Otter Project	Worcestershire Wildlife Trust/ NRA	Otters on the Severn	Costs of proactive projects

ISSUE NO: 33	The Elver Fishery - associated problems		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Continued enforcement of the requirement for a licence and compliance with the fishery legislation	NRA	Regulation of the elver fishery	Cost
2. Increased patrol work and prosecution of boat owners contravening the navigation legislation	BW	Fewer complaints from fishermen	
3. Provision of eel & elver passes on weirs and sluices in the catchment	NRA	Improved eel stocks	Cost
4. Elver station should be encouraged to make catch data available to the NRA on an annual basis	NRA/MAFF	Improved data on elver numbers for better management of the fishery	

ISSUE NO:34	Canal Restoration		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
Frome 1. Restoration of Stroudwater Canal	Cotswold Canals Trust/ NRA	To encourage recreational amenities in the area	The impact on water resources to supply the canals with water. Flood defence
2. Review of status of old connections and use of existing channels	NRA/Canal Trust/ Landowners	Protection of existing requirements	Protection of environmental quality. Impact on other abstractors (present and future)
Severn-Thames Canal Water requirements met by gravel extractions dewatering	NRA/ Canals Trust/ Wiltshire County Council	Less pressure for water on River Frome	May have environmental quality implications. Requires further study
Herefordshire & Gloucestershire Canal 1. Restoration 2. Use of river channels	Herefordshire & Gloucs. Navigation Trust/NRA/ Council	Improve the navigation in the area	New route is required in certain areas and impact on water resources and flood defence Protection of ecology

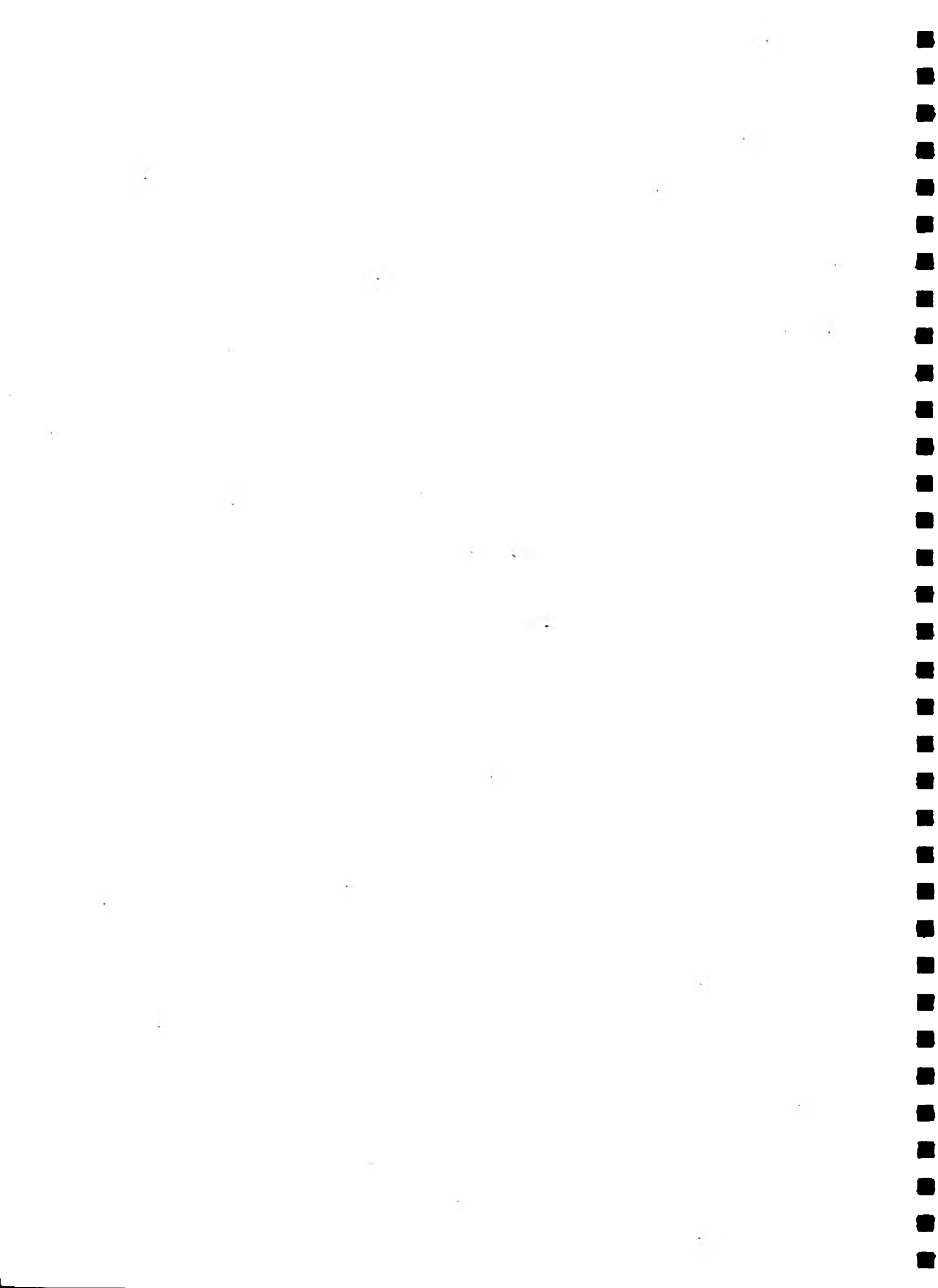
ISSUE NO:35	Hydropower Development		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
<p><i>River Cam</i> Make an agreement with the existing user to create a water resources bank upstream for future applicants</p>	<p>NRA/ Abstractor</p>	<p>To support an alternative form of power generation but at the same time maintain the availability of water resources</p>	<p>Possible costs to compensate for loss of power production</p>
<p><i>River Frome</i> Ensure agreements are made with developers to ensure long term maintenance and protect river gauging record</p>	<p>Developer/ NRA/ Landowners</p>	<p>Long term protection of river</p>	<p>None</p>

ISSUE NO:36	Development Issues		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Ensure all reasonable pollution prevention devices are included within design specifications	NRA/ Developers/ Local Authorities	Protection of water based environment	Costs involved
2. Ensure all outfalls are properly authorised	NRA/HMIP/ Dischargers	As above	As above
3. Ensure maintenance is conducted in a manner to avoid problems with aquatic environment	As above	As above	As above
4. To be proactive with regard to land use strategies, development plans and proposals	NRA/ Local Authorities/ Developers	Protection of the water based environment	Resources
5. Develop good communications with groups/organisations involved in land use issues	NRA Local Authority/ Developers/Other organisations/ HBF/Public	Promote a proactive approach to development issues affecting the water environment	Resources
Avonmouth 1. Maintenance and protection of sea defences and outfalls	NRA/ Local Authorities	Existing flooding situation not made worse	Limitations of developable land. High cost of infrastructure
2. Protection of rhine system	South Gloucs. IDB/ Local Authorities	Retention of wildlife corridors and wetland habitats	As above
3. Protection of available storage capacity for flood waters in tide-lock conditions	NRA/South Gloucs. IDB/ Local Authorities	Ensure that new and existing properties are not put at greater risk	As above
4. Contaminated land surveys and remediation works required for contaminated sites	Developer	Avoid putting both the watercourse system and those living or working in the area at risk from contaminants that could be mobilised by development	

ISSUE NO: 37	Water Level Management Plans (WLMP)		
OPTION/ACTIONS	Responsibility	Benefits	Constraints
1. Produce WLMPs	EN/IDBs/ NRA as agreed	Allows appropriate land drainage management whilst also providing for other uses	Conflicts of user requirements; Difficult to sustain unless there are water level controls (sluices, valves, gates etc.)
2. Do not produce WLMP's	As above	None	Cannot achieve the aim of management for drainage and conservation uses.
3. Provide Hydrological information to produce plans. <i>Sites for Action:</i> <i>Walmore Common</i>	NRA/ IDB	Appraise effect of abstractions and potential development	

PART II

SUPPORTING INFORMATION



SECTION 4.0

CATCHMENT USES AND RESOURCES

This section details all the current and future uses of the catchment. A general description of the nature of the NRA's responsibility is given, together with a set of management objectives and targets. A Local Perspective describes the use in the catchment.

4.1 DEVELOPMENT (Housing, Industry, Commerce and Infrastructure)

General

Development, be it residential, industrial or commercial, can have a major impact on other uses of a river catchment. Whilst the NRA has responsibility to protect the water environment, to achieve this aim its statutory powers need to be complemented by those of local Planning Authorities (LPAs). To ensure this co-operation, the NRA in its role as a statutory consultee of the LPAs provides advice on proposals that may have an impact on the water environment.

A major objective of this Catchment Management Plan is to provide the LPAs with a clear picture of the NRA's responsibilities and policies towards development of this catchment. The plan identifies all legitimate uses of the catchment so that those interests can be fully taken into account by LPAs in Development Plans. Land use, past, present and future is the principal driving force in planning river management as it effects all aspects.

The NRA has produced guidance notes for LPA's (**Guidance Notes For Local Planning Authorities On The Methods Of Protecting The Water Environment Through Development Plans; NRA 1994**) that outline methods of protecting the water environment. Copies of this document are available from any NRA office. The NRA proposes that these should be incorporated into the LPAs' own Development Plans whenever possible.

The NRA also seeks to pursue its aims and policies regarding development through the planning consultation process for individual proposals. Although the final decision on planning matters rests with the LPA, government guidelines advise on the need to consider the NRA's concerns when determining proposals.

Local Perspective

The catchment is located within the boundaries of three County Councils. The majority of the catchment (about 69%) is located within Gloucestershire, 21% in Hereford and Worcester and approximately 10% in Avon. The County Councils are currently reviewing their Structure Plans and applying the principles of sustainable development. The present status of Development Plans covering the Catchment is given in Table 5.

Gloucestershire provides the main area of growth within the catchment, a further 19,200 dwellings are required by 2011. One of the options being considered by the County is a possible new settlement. In the remainder of the catchment housing is to be allocated within existing settlements. By 2001, approximately 3500 dwellings need to be provided in the part of the catchment that falls within Hereford and Worcester, these will be located within Great Malvern, Upton on Severn and Ledbury. In the southern part of the catchment, future major residential development will be allocated to the main urban areas (350 houses are required for Avonmouth and Severnside) and not within rural areas such as Thornbury.

CATCHMENT USES AND RESOURCES

The larger employment sites are to be located around or within existing urban centres. By 2001 about 525 hectares of new employment land is required for the catchment. The Avonmouth and Severnside area will provide 200 hectares. The Severnside Development Strategy sets out the guiding principles for the development of mixed employment uses in this area.

Retail developments have occurred at the urban fringe of some parts of the catchment e.g. Gallagher Retail Park in Cheltenham. Some 50 hectares is to be developed for retail, light industrial, business and residential use at Malvern Link.

Recent completed or road schemes under construction include the widening of the M5 north of Tewkesbury, Cheltenham South-West Distribution Road, Ebley By-pass, Brockworth By-pass and motorway junction, Lydney By-pass and the Second Severn Crossing.

Some proposed new roads include the Gloucester Southern Radial Road, Brockworth By-pass to the Elmbridge Roundabout, Cheltenham Inner Ring Road, the Second Severn Crossing is to be linked with a road (M49) to the M5 near Avonmouth. The M49 will have junctions to serve the Avonmouth/Severnside Development Area. A further link is proposed from the M4 to the new bridge. As part of the strategic network the A403 will be realigned to form a North/South spine road through the development area.

The catchment has an extensive rail network. A rail freight terminal is planned at Avonmouth with a land requirement of some 22 hectares. Passenger traffic is proposed for the present freight line at Hallen and within Gloucestershire the re-opening of railway stations is to be encouraged by the County Council. A light rail transit system is being considered for Avon, part of the proposal includes the conversion of the Severn Beach rail line to rapid transit.

Sustainable transport is provided within the catchment by networks of cycle tracks in some areas.

Aspects of mineral working and waste disposal are considered in more detail in Sections 4.9 and 4.10.

Objective

The objective for this use is:

- * To ensure that development does not adversely impact on the water environment and, wherever possible, to ensure that it proceeds in a way that benefits the water environment.

CATCHMENT USES AND RESOURCES

Environmental Requirements

The requirements for this use are:

Water Quality

- * The water environment should not suffer any detriment owing to development.
- * Adequate pollution prevention methods, that are consistent with the Groundwater Protection Policy and the NRA's Guidance Notes, should be incorporated into developments.

Water Quantity

- * Protection of surface and groundwater resources from the adverse effects of development, including mineral extraction, landfill, afforestation, road construction and other changes in land use.

Physical Features

- * The risk of flooding on new development should be kept within the standards of service recommended by MAFF and the NRA.
- * To ensure any work that is needed to reduce the risk of flooding created by the development is paid for by the developer and not from public funds.
- * Adequate access (and responsibility) should exist for proper maintenance at watercourses and structures within them, including flood defence schemes.
- * Wildlife associated with the water environment should not suffer any detriment owing to development and, wherever possible, development should enhance wildlife.

CATCHMENT USES AND RESOURCES

TABLE 5 LOCAL PLANNING AUTHORITIES AND DEVELOPMENT PLANS

Local Authority	Percentage of Catchment Area	Population Estimated in Catchment	Development Plan and Current Status
Avon County Council			Structure Plan - Third Alteration March 1991 Minerals Working Local Plan - Adopted July 1993 Waste Disposal Plan - Adopted October 1989
Northavon District Council	10%	32,900	Northavon Local Plan - Consultation Draft July 1994
Gloucestershire County Council			Structure Plan - Second Alteration April 1994
Stroud District Council	23%	105,400	Stroud District Local Plan - Draft for Consultation November 1992
Gloucester City Council	1.5%	104,800	City of Gloucester (Pre and Post 1991 Boundary Extension) Local Plan. Inspectors Report June 1994
Cheltenham Borough Council	1.5%	106,700	Cheltenham Borough Local Plan - Inspectors Report January 1994
Cotswold District Council	7%	2,360	Cotswold District Local Plan Public Inquiry January 1995
Forest of Dean District Council	26%	58,300	Forest of Dean Local Plan Public Inquiry completed September 1994
Tewkesbury Borough Council	10%	72,200	Tewkesbury and Ashchurch Local Plan Proposed Modifications November 1992 District Wide Local Plan Consultation Draft awaited.
Hereford & Worcester County Council			Structure Plan - Second Alteration Minerals Local Plan
Malvern Hills District Council	20%	61,660	Malvern Hills District Local Plan Deposit Draft June 1994
Wychavon District Council	negligible	200	Wychavon District Local Plan - Deposit Version - Public Inquiry March 1993 Inspectors Report awaited
South Herefordshire District Council	1%	500	South Herefordshire District Local Plan Deposit Version - July 1994

**River Severn Lower Reaches
Catchment Management Plan**

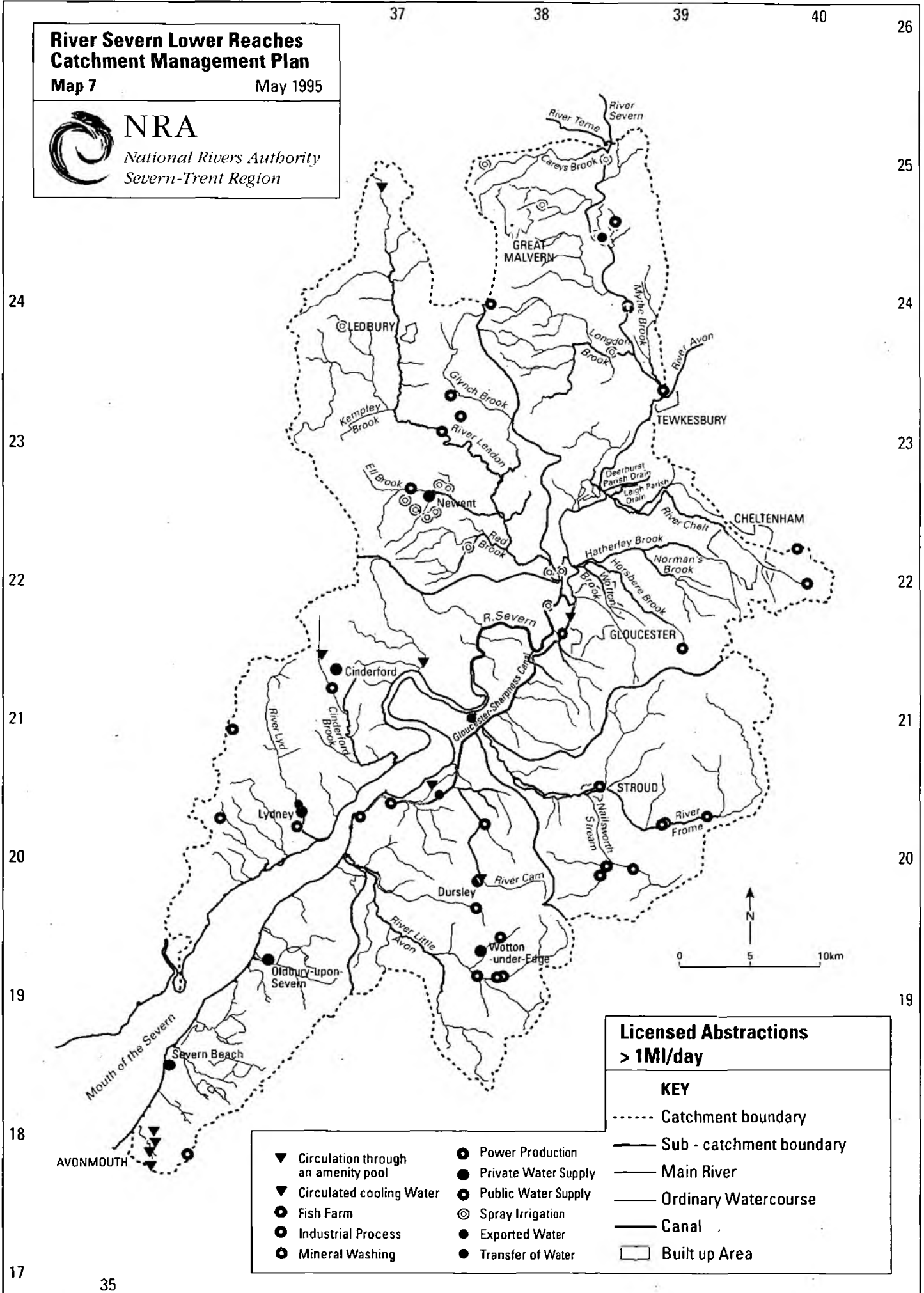
Map 7

May 1995



NRA

National Rivers Authority
Severn-Trent Region



Licensed Abstractions > 1MI/day

KEY

- - - - - Catchment boundary
- Sub-catchment boundary
- Main River
- Ordinary Watercourse
- Canal
- Built up Area

- ▼ Circulation through an amenity pool
- ▼ Circulated cooling Water
- Fish Farm
- Industrial Process
- Mineral Washing
- Power Production
- Private Water Supply
- Public Water Supply
- ⊙ Spray Irrigation
- Exported Water
- Transfer of Water

4.2 ABSTRACTION

General

Most abstractions of water either from surface waters (streams and rivers) or from groundwater (wells and boreholes) require an abstraction licence issued by the NRA under the Water Resources Act 1991. Recently the NRA have produced a National Water Resources Strategy (1993) which is an approach to integrated management of the water environment.

The north west part of the Leadon subcatchment comes within the area of the Severn River Authority (Exceptions from Control) Order 1967 which exempts abstractions from groundwater, for whatever purpose, from licensing requirements. The Order may well be reviewed by the NRA in the near future but in the meantime all abstractions from surface water sources within the area are controlled under the Act.

All abstraction licences specify quantities that the licence holder may take, but not exceed, and may contain conditions that restrict the impact of the abstraction on the environment and other abstractors. The exceptions are licences granted as "Licences of Right" in 1965, or "Licences of Entitlement" in 1990 where the legislation did not permit the NRA and its predecessors to restrict pre-existing abstractions. All licensed sites are visited on a regular basis to enforce the conditions on the licence. Licensed abstractions in this catchment are shown in Map 7.

In considering applications for new licences, the NRA must ensure that no derogation of existing abstractors occurs, and that the aquatic environment is properly safeguarded. The NRA does not guarantee that the authorised volume will be available at all times, nor that the water will be fit for the purposes for which it will be used. However, the NRA does have a duty to protect water quality. There are specified protection zones around some groundwater sources and flow thresholds set on rivers for maintaining the physical habitat.

Local Perspective

The main surface water abstractions in the subcatchments covered by the plan are:

River Severn:	Public Water Supply, spray irrigation, industrial purposes, (both direct and indirect as a feeder to the Gloucester-Sharpness Canal).
River Frome:	Canal feeder (Gloucester-Sharpness) so indirectly for Public Water Supply, Industrial Purposes, Private Water Supply and Hydropower.
River Leadon:	Spray Irrigation.

CATCHMENT USES AND RESOURCES

River Lyd:	Industrial Purposes and Spray Irrigation.
River Cam:	Canal feeder (Gloucester Sharpness) so indirectly for Public Water Supply, Industrial Purposes and directly for Hydropower.
Gloucester Sharpness: Canal	Public water supply, Navigation and Industrial Purposes.
Cinderford Brook:	Spray Irrigation and Fish Farms.
Westbury Brook:	Spray Irrigation.
Little Avon:	General agriculture and private water supply.
Severnside:	Industrial and agriculture.

Other abstractions for agriculture other than spray irrigation from the rivers and streams, cattle watering etc. are outside the control of the NRA but known to it.

The different abstraction uses outlined above are considered in the following sub-sections:

- * Drinking Water (Potable supply)
- * Industry
- * Agriculture
- * Other abstractions

CATCHMENT USES AND RESOURCES

TABLE 6: SUMMARY OF ABSTRACTION LICENCES IN THE CATCHMENT

Type of Abstraction	Surface Water Abstraction		Groundwater Abstraction	
	No. of Licences	Abstraction MI/annum	No. of Licences	Abstraction MI/annum
Public Water Supply	11	182,578	9	13,904
Agriculture (other than spray irrigation)	29	90	212	462
Spray Irrigation	134	2,237	30	625
Private Water Supply	59	154	19	1,174
Circulation Pond	11	1,421		
Frost Protection	1	4	1	73
Mineral Washing	1	750		
Exported water	6	1,702	1	179
Transfer	3	4,724		
Fish Farm	14	17,009		
Hydropower	5	64,560		
Cooling water	11	2,374	7	3903
Compensation discharge	1	1,605		
Domestic & agriculture	1	7	1	0.7
Industrial process	32	6031	11	394
Industrial water cooling	2	1,032		
Military	1	46		

The main abstractions (>1 MI/day) are shown in Map 7. The different types of abstraction - potable supply, industrial, agricultural and others - are considered in detail below.

DRINKING WATER (POTABLE) SUPPLY

General

The NRA has duties to conserve, redistribute or augment water resources and to ensure proper use of these resources.

This use is related to the supply of water from ground and surface sources for public supply. Groundwater abstractions constitute supply from wells and boreholes drilled into underground permeable rocks, termed aquifers; surface water abstractions are direct from rivers, canals, lakes and reservoirs.

The NRA is not responsible for the quality of the raw water nor of the delivered, treated water. However, it does have a duty to protect water and will specify protection zones around groundwater sources, that seek to control certain potentially polluting activities. The Groundwater Protection Policy forms the basis for the NRA's activities in this area, on a wider, aquifer, basis by identifying Groundwater vulnerability; at a more localised level specific sources can be identified as "Source Protection Zones" within which activities which threaten the source can be prohibited (see Section 5.2 for further details).

Local Perspective

Severn Trent Water plc and British Waterways(BW) as suppliers to Bristol Water hold licences for public water supply throughout the catchment. There are two large abstraction licences for Severn Trent from the River Severn supplying a population of approximately 1.14 million. The company abstracts water from the River Severn at Ripple, which is then 'exported' to Coventry via the Strensham Water Treatment Works. A majority of this water is returned to the River Severn via the Avon which joins the River Severn at Tewkesbury by way of a discharge at Finham Water Reclamation Works to the Avon. The second abstraction at the Mythe, Tewkesbury is for public water supply to the Gloucestershire area. British Waterways holds the largest water supply licence for Bristol Water Co supplying a population of 350,000. Water is abstracted from the Gloucester-Sharpness Canal, treated at Purton Water Treatment Works and distributed throughout the Bristol area. Although a large percentage of this water is lost to the catchment, it is returned to the Estuary via Bristol Sewage Works. Water abstracted by BW from the River Severn to support the canal is done without a licence because one is not needed under the terms of the Water Resources legislation. There is also a major import of water to the catchment from the River Wye. Severn Trent Water plc abstracts water and supplies the Forest of Dean area via the Mitcheldean Water Treatment Works. There are a further 17 licences throughout the catchment abstracting from surface and groundwater. The 9 groundwater abstractions lie mainly in the Bromsberrow and Oxenhall units and the Cotswold minor aquifer (13,904 Ml/a). There are also a number of private water supply licences in the Cotswold area where properties have their own supply of water where mains water is not available.

INDUSTRY

General

All abstractions for any industrial or commercial use must be authorised by a licence granted by the NRA under the Water Resources Act 1991. The only exceptions are those situated in the exempt groundwater area near Ledbury.

Industrial licences may be for a variety of uses; either general industrial, mineral washing or cooling water.

Local Perspective

There are 37 licences for industrial purposes, 6 of which are from ground water and 31 from surface water sources. Most of these licences are situated in Avonmouth, Stroud, Forest of Dean and the Cheltenham/Gloucester districts. There are also 18 licences for cooling water, 1 for transfer of water to a mill leat for subsequent abstraction for industrial purposes and 2 for mineral washing. A paper mill in Lydney holds licences of right and can take 4,600 MI/a from the River Lyd (Cannop Brook) via an old mill leat. The industrial use on the Lyd for paper making requires very good quality water. The Lyd flow is partly dependent on the outflow from Norchards Drift which is the lowest drainage point from the abandoned deep mining operations within the Forest. The water apart from being ochrous is of excellent quality and deposition of the ochrous material near the discharge point leaves it suitable for papermaking downstream. Rhone Poulenc (ISC) have four large groundwater licences throughout the Avonmouth area, some with associated water quality problems.

AGRICULTURE

General

Agricultural abstractions can be for a variety of purposes and this may determine whether a licence is required. Abstractions from surface water sources that are less than 20m³/day do not require a licence. This includes general stock watering, use around the farm and crop spraying. All other abstractions greater than this quantity, from groundwater or for any other use such as spray irrigation or fish farming, do require a licence. There is an exception in that trickle irrigation is still presently exempt from licensing because of its low impact on the environment. There are also parts of the Leadon sub-catchment where all groundwater licences are exempt from licensing.

Each use is considered according to its impact on water resources. For example spray irrigation is a high impact use as much of the water is lost through evaporation, a problem compounded in summer months when flows are generally low and irrigation is needed most, yet fish farming is low loss as most of the water is returned directly.

Local Perspective

Within the River Severn Lower Reaches Catchment there are 241 licences for general agricultural purposes; 164 for spray irrigation and 14 for fish farming.

There are concerns in some areas where the number of irrigation licences has caused low flows in some watercourses. A good example is the Peacock Brook which rises at the foot of May Hill near Newent and later joins the Ell Brook. During dry periods in the summer, a number of calls are received regarding low flows because of spray irrigation abstractions, many of which are Licences of Right. Another example is on the Glynch Brook, near Ledbury, where over abstraction of groundwater for public water supply has derogated existing agricultural abstractions.

OTHER ABSTRACTIONS

General

There are a variety of other uses for abstracted water. These include topping up of pools, transfer of water, cooling water and industrial processing, frost protection, mineral washing, private water supply and fish farming.

Some are licensed and others are exempt from licensing. The watering of livestock from a river, stream or pond does not require an abstraction licence. Also, abstractions from surface or groundwater less than 20m³/day for domestic use are exempt from licensing. When an abstraction licence is received, its use must be considered together with all existing abstractors. This can prove quite difficult when there is no information on existing unlicensed users and the catchment is reaching its resource limit.

Local Perspective

Under the Water Resources Act 1991 Section 26, any registered navigation authority is not restricted for abstraction to transfer water from an inland water to a canal for navigation purposes. This exception is used by British Waterways to supply the Gloucester-Sharpness Canal.

Also exempt is abstraction for dewatering of quarries, mines and engineering works. This may apply to the mines and quarries found in the Forest of Dean and Cotswold areas. If such dewatering would cause problems then these must be highlighted during the Town and Country Planning Process forcing new proposals. In certain cases the Authority may serve Conservation Notices but these are of limited use.

Objectives

The objectives for this use are:

- * To manage the abstraction of water so as to safeguard existing abstractors and the environment.
- * To enforce all licence conditions and to assess all new licences so that there is no further derogation to the water environment.
- * To develop and implement a Regional licensing policy to enable the NRA to manage water resources at a catchment level to achieve a balance between the needs of the environment and the abstractor.
- * To encourage efficient water use including leakage reduction.

CATCHMENT USES AND RESOURCES

- * To encourage winter abstractions and storage of water. New licences in the Leaddon and Frome catchments will have a summer flow restriction clause.
- * To ensure that the discharge arising from fish farms is returned as close as possible to the point of abstraction.

Requirements

The requirements for this use are:

- | | | |
|--------------------------|---|--|
| Water Quality | * | The quality of water for licensed potable surface abstractions should meet the standards set out in the EC Surface Waters Directive (75/440/EEC) and the standards for Aesthetic Criteria. |
| Water Quantity | * | Water to be available to allow abstraction up to the amounts authorised and within the terms specified in the abstraction licences. |
| | * | To forecast future demands and plan to meet the requirements of the water supplier and redistribute the source if necessary. |
| | * | To develop and implement a national policy to manage water resources at a catchment level to achieve the needs of the environment |
| Physical Features | * | Abstraction and associated activities must not lead to an unacceptable reduction in or alteration to the physical habitats required by other uses. |

4.3 HYDROPOWER

General

Hydropower is a renewable source of energy which should reduce emissions to the environment. The NRA supports the Government's policy to develop renewable energy sources wherever they have prospects of being economically attractive and environmentally acceptable. It has published guidelines to developers in a leaflet "Hydropower Developments and the National Rivers Authority".

There may be positive and negative effects on the water environment. If an abstraction licence is issued, subject to the rights of existing users there may be limitations incurred on all future applications upstream because all the resource is committed to the hydropower user. There may be benefits for water quality in that some types of turbines increase oxygenation. However, if an impounding licence is required and significant amounts of water stored, the residence time of water is increased causing algal growth and siltation.

The turbines and impoundment may act as barriers to fish movement and may lead to fish mortalities as a result of getting entrained in the turbines themselves.

Local Perspective

There are 5 hydropower licences in the catchment, all located in the Cotswolds (Map 8). They abstract from four different sources, River Frome, River Cam, Horsley Stream and some springs. The licence on the River Cam has a major impact as far as water resources is concerned. The turbines rely on the whole of the flow so the river is now 'sterilised' upstream and no new licences can be issued. At Bakers Mill there is a licence for hydropower on the River Frome. Presently the control of the lakes at this site is under review with the land owner, British Waterways and the NRA. There are two sluice gates on these lakes controlling the flow into the canal or the Frome. Further development of hydropower in this sub-catchment is proposed.

Objectives

The objectives for this use are:

- * To facilitate hydropower developments where possible.
- * Hydropower developments, which restrict the ability to use upstream water resources, to be opposed unless the licence authorising the abstraction for hydropower is subject to an agreed volume of derogation and a time limit.
- * To allow hydropower developments in such a way that they do not prevent use

**River Severn Lower Reaches
Catchment Management Plan
Cam/Little Avon and Frome Sub-Catchments**

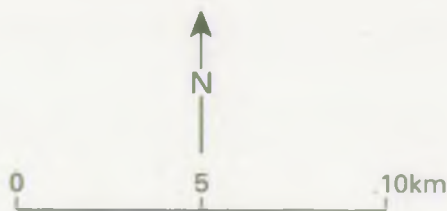
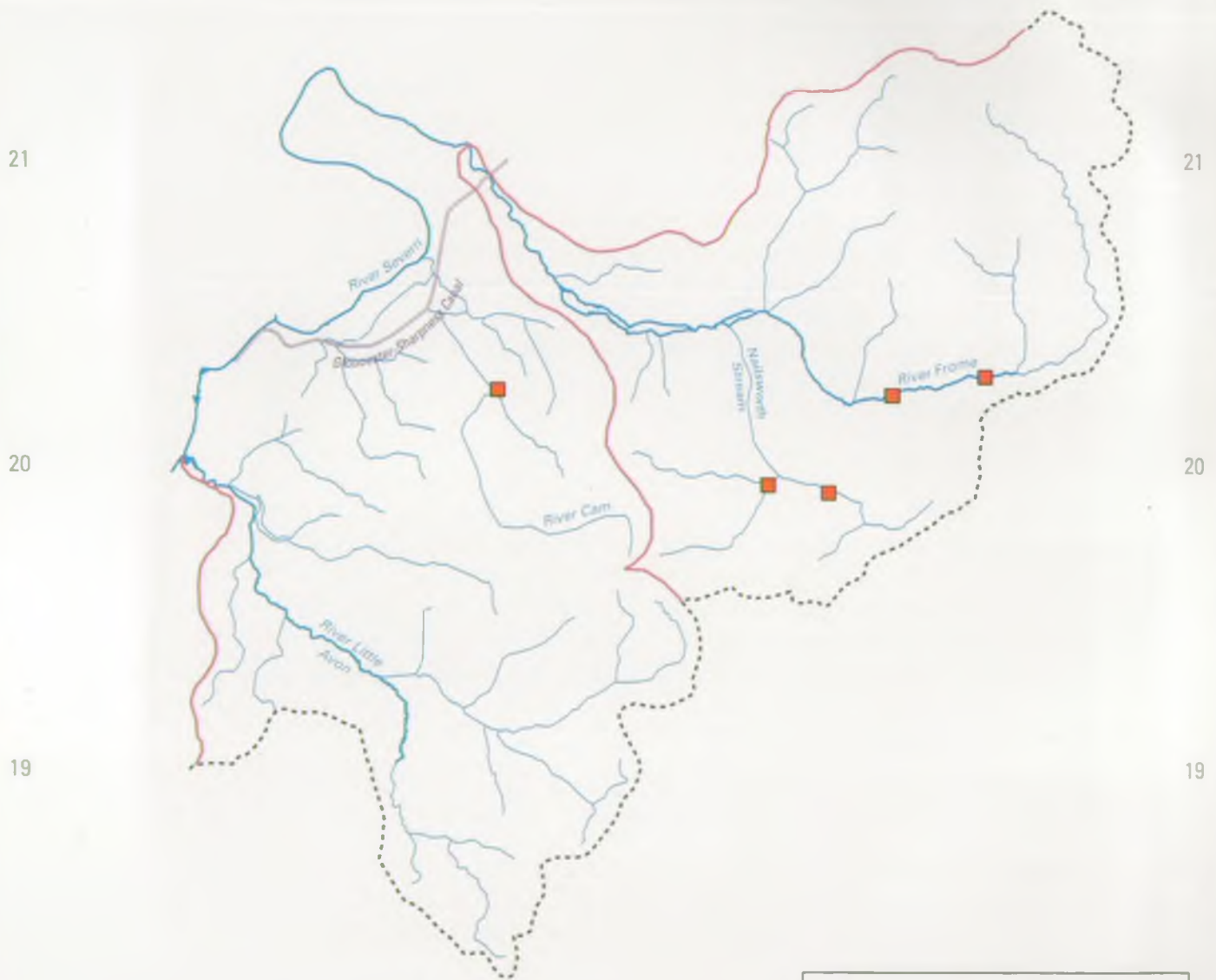
Map 8

May 1995



NRA

National Rivers Authority
Severn-Trent Region



Hydropower Sites (Licensed)

KEY

- Catchment boundary
- Sub - catchment boundary
- Main River
- Ordinary Watercourse
- Canal
- Licensed Hydropower Site

CATCHMENT USES AND RESOURCES

of upstream water resources for other purposes and do not have significant downstream impacts.

- * To ensure that discharge is made as close as possible to the point of abstraction.
- * To ensure that the downstream impacts of hydropower developments are minimised.
- * To advise on and guide restoration of historic structures.
- * To ensure that the siting of wind turbines and associated infrastructure does not adversely impact on the water environment.

Environmental Requirements

The requirements for this use are:

- | | |
|--------------------------|---|
| Water Quality | <ul style="list-style-type: none">* That use of water for power generation does not result in inadequate dilution in the river system.* That any water storage for hydropower purposes does not result in increased plant and algal growth with consequent possible siltation problems upstream.* Consent conditions for discharges to adequately safeguard downstream water quality and prevent exceedance of EC Directive parameters. |
| Water Quantity | <ul style="list-style-type: none">* That use of water for power generation does not adversely affect other users. |
| Physical Features | <ul style="list-style-type: none">* The use of existing structures or creation of new ones for hydropower must not increase the risk of flooding or cause detriment to the riverine environment.* Structures do not entrap migratory fish. |

4.4 FISHERIES AND ANGLING

General

This use relates to the maintenance of populations of Salmonid, ie. salmon and trout, or "game fish" and Cyprinid, ie. "coarse fish". The EC Fisheries Directive (78/659/EEC) provides the statutory basis for protecting water quality to achieve this. The ability of a watercourse to sustain fish populations of salmonids or cyprinids is used to assess water quality, in that salmon require the highest quality water and coarse fish good quality. Their presence also indicates the general quality of the habitat and the ecosystem.

The fisheries interest in the area covered by this CMP includes a broad variety of fish species. These range from resident coarse fish of interest to the rod and line angler, through game fish, such as the resident brown trout and migratory salmon, to other migratory species such as the eel, river and sea lamprey, flounder, twaite shad and the specially protected allis shad. Though saline water rarely enters the river within the area covered by this plan, flow reversal and "backing up" of the river water has a marked impact on fish movement and distribution. Some of the migratory fish such as salmon, lamprey and shad come into the river to spawn whilst others, notably the eel, return to sea to breed.

Local Perspective

There are 40.6 km of river designated under the EC Fisheries Directive as salmonid fishery and 76.3 km of river and canal designated as cyprinid (coarse) fishery within the catchment on the Rivers Severn, Leadon, Frome and Little Avon (Map 9). Shad are protected under EC legislation with both twaite and allis shad being listed in the Bern Convention and Annex II and V of the Habitat Directive which provide protection by placing an obligation on English Nature (not on the NRA) to assess numbers and exploitation of the population.

Fish populations are very much dependent on quality and quantity of water present and the variety and quality of the habitat. The control of demand for water and the maintenance of water quality standards are, therefore, of paramount importance to fisheries. Low flows have been identified as a problem at various locations within the catchment and long term solutions are needed to alleviate these problems.

The quality of waters is assessed upon their ability to support salmonid (trout) and cyprinid (coarse) fish. Where designated, water quality should be maintained to comply with standards set in the EC Fisheries Directive. Fish populations will be monitored and managed where necessary to maintain the fishery potential.

Fishery habitat has been degraded in the past by the construction of weirs, use of the river for navigational purposes and bankside and channel works for flood alleviation purposes. Some of the resident coarse fish spawn on submerged aquatic plants, others over or in gravel. Salmon, trout, lamprey and shad spawn in or over gravel to which they need satisfactory

CATCHMENT USES AND RESOURCES

access. Most of the salmon spawning gravels, in particular, are outside the area covered by this plan but spawning and nursery areas within the catchment need to be protected from disturbance at critical times of the year.

Commercial eel and elver fishing is carried out using licensed elver nets, putcheons, fyke and eel nets in this area (and also in the area covered by the Severn Estuary Plan to follow). Commercial salmon fishing is practised mainly in the estuary, though rod and line fishing for salmon is seen upstream, mainly at Upper Lode Weir, Tewkesbury. Issues concerned with the River Severn commercial salmon fishery will be covered by the Severn Estuary Plan to follow.

Several tributaries of the River Severn, such as the Leadon, Frome, Cam, Little Avon and Forest streams contain stable mature wild brown trout populations, especially in their middle and upper reaches. Some rod and line fishing for these trout is carried out, but the majority of trout anglers are to be found on still waters in the catchment. Reservoirs and lakes of suitable quality such as Witcombe Reservoirs near Gloucester can be stocked with trout, often rainbow trout, and make popular trout fishing venues.

River Severn Corridor

During the 1993-94 season, 19 angling clubs were known to lease, rent or own water on the main River Severn covered by this plan. Most fishing rights are in private ownership, though the NRA does control the rights on two sections of the River Severn. Fishing on these waters at Upton and Ripple is made available, free of charge, to individual licence holders and leased to clubs for matches. Angling is fairly good and many nationally important contests are held in this part of the river. Upstream of Tewkesbury the river is gaining a reputation for large barbel and this is now popular with specimen anglers.

Forest of Dean

In the Forest of Dean there is coarse angling through Lydney Angling Club and game angling on the pond chain known as Soudley Ponds with Dean Heritage Centre at the lower end. There is also angling at Lydney Park Lake.

River Frome

Angling on the River Frome is predominantly coarse. Some trout are found but the numbers are not significant. Mostly local clubs fish the section from Ebley to Wheathurst in the main and to a lesser extent up to Chalford. There is no angling of any note on the tributaries. There are no still waters of significance for angling other than Frampton.

Cam/ Little Avon

On the Cam there is a limited amount of coarse angling confined to the length downstream of the A38 and there is no formal angling upstream.

CATCHMENT USES AND RESOURCES

In the Little Avon sub-catchment there is some angling interest in the area, mainly coarse with some game downstream from Charfield to Stone, which is controlled by local clubs. A few small still waters are fished by local clubs.

Objectives

The objectives for this use are:

- * To maintain, improve and develop fisheries.

Environmental Requirements

The requirements for this use are:

- | | | |
|--------------------------|---|---|
| Water Quality | * | Maintenance of water quality to comply with standards set in the EC Fisheries Directive 78/659/EEC. |
| | * | Maintenance of Water Quality Standards via River Quality Objectives to support this use. |
| Water Quantity | * | Maintenance of minimum flows required for fisheries and fish migration. |
| Physical Features | * | No further loss in fisheries habitat. |
| | * | Maintenance and protection of spawning habitats. |

4.5 CONSERVATION, AMENITY, LANDSCAPE AND HERITAGE

General

The NRA's aim is to:-

- * Conserve and enhance wildlife, landscape and archaeological features associated with inland and coastal waters of England and Wales.

The NRA, whilst carrying out its duties and functions or in consenting or licensing the work of others, has a duty under Section 16(1) of the Water Resources Act 1991 to further the conservation and enhancement of natural beauty, flora, fauna and geological or physiographic features of special interest. It also has to consider the protection and conservation of buildings, sites and objects of archaeological, architectural or historic interest. 'Conservation' is thus dealt with in its broadest sense. In carrying out its functions it must also take into account its effect on the beauty and amenity of any rural or urban area. A similar assessment procedure is applied to all planning and other application received by the NRA in consultation.

This use deals with:-

- * The protection of the wider environment including the enhancement of those areas where the aquatic environment has become degraded and the mitigation of any adverse impacts of necessary NRA operational works. This is achieved through the environmental assessment process.

Local Perspective

The character of the catchment is diverse (Maps 10 and 11). In many parts, it is rich in visual, cultural and ecological quality, but there are also pockets where the river corridors are canalised and degraded by loss of vegetation and habitat. River corridors, such as the Gloucestershire rivers or straightened sections of the Leadon are often associated with former river maintenance or agricultural practices. As such they are regarded as of lesser quality in the context of landscape and conservation owing to the degradation of the river habitat by culverting or habitat destruction. Apart from Cheltenham, the urban areas are all closely related to the river corridor.

River Severn Corridor

The north of the area includes the Malvern Hills Area of Outstanding Natural Beauty (AONB) which forms the eastern fringe of a relatively flat agricultural plain centred on Upton-upon-Severn. The Severn Vale itself provides the major landscape feature within this plain and not surprisingly provides most of the ecological interest. For example there are wet grassland Sites of Importance for Nature Conservation (SINCs), Walmore Common Site of Special

CATCHMENT USES AND RESOURCES

Scientific Interest(SSSI) and the Lammas Meadows SSSI. Walmore Common flood meadows has multiple designations and is a site considered to be of international importance principally for water fowl (RAMSAR). This site consists of naturally occurring water meadows ie. not controlled or managed, which are used as hay meadows. The Severn Vale is known to have the highest concentration of traditional unspoilt hay meadows in Britain. Other examples are Upton, Twynning, Tewkesbury Hams and Ashleworth Ham SSSI's. Some of these water meadows are of considerable significance for overwintering and breeding birds and many others, with proper management, would have potential for such use.

The area east of the River Severn, with Cheltenham at its centre, is relatively flat agricultural plain becoming more wooded to the east and south as it grades into the Cotswolds. Numerous small rivers and streams, which are tributaries of the River Severn cross the plain. The majority are fairly treeless, heavily managed and have been greatly modified. The area is generally of lower landscape, ecological and conservation value than might be expected.

The River Severn is non-tidal to the north of Alney Island although occasionally limited tidal effects are experienced as far north as Worcester. The freshwater channel is a totally engineered navigation channel with weirs at Upper Lode, Maisemore and Llanthony and has stone bank revetments as far upstream as Worcester built in the 1950's and 60's. Both banks of the river are tree-lined throughout much of its length and the banks have been maintained to a high level to accommodate a range of water levels, all of which makes for a visually important river corridor. The river corridor is recognised as providing a route for the spread of otters from the upper reaches of the River Severn to both the lower reaches and the Avon. Worcestershire Wildlife Trust are, with the NRA, currently formulating a strategy for otter conservation on the River Severn.

Leadon

The sub-catchment is an agricultural area, rural throughout and gently undulating. There is a scatter of small woodlands and villages interspersed with large tracts of open mixed farmland. Above Ledbury the river is generally less well tree-lined but downstream the river banks become progressively treeless. There are some heavily modified (canalised) sections of channel in the lower reaches. The main tributaries, the Glynch, Ell, Red and Collier's Brooks are similar in character to the main river with some stretches of high conservation value. In many other areas, agricultural cultivation has been extended to the bank top, restricting the river corridor to an often narrow channel within the banks. In places, this over-zealous cultivation has caused bank erosion. In others, the actual banks themselves are grazed. The lower reaches would benefit from the improvement of degraded channels and enhancement generally. The establishment of "buffer" zones ie. wildlife/landscape strips along the banks, would greatly improve the conservation value of the catchment.

Forest of Dean

The Forest of Dean is a well known high profile tourist area of great scenic, ecological and archaeological character and therefore recreational potential. Part of the area lies within the Wye AONB. The dense forest, broadleaved to the north and mixed elsewhere, clothes a well-

CATCHMENT USES AND RESOURCES

defined plateau of higher ground attaining 200m above mean sea level in places. This plateau, situated between the Wye Valley and the Severn Estuary forms a visually significant wooded backdrop rising above and extending along the upper right bank of the Estuary. All the watercourses, including the upper reaches of the River Lyd and Cinderford Brook, are narrow and fast flowing. Mostly tree-lined, these provide superb wildlife corridors, some sections of which are inaccessible owing to the overhanging vegetation. Numerous open water areas exist which support rich flora and fauna e.g. Cannop Ponds, Soudley Ponds and Moor Green SSSI. Adjacent to the water courses there are many areas of marsh adding to the habitat diversity of the area. The forest also contains several Nature Reserves e.g. the Nagshead RSPB Reserve at Park End. Other reserves are managed by the Gloucestershire Wildlife Trust.

The area is rich in historical and archaeological remains mostly related to the redundant iron mines. Dismantled mineral railways traverse the area formerly serving Lydney Dock, the old harbour, now a Scheduled Ancient Monument (SAM). Small hamlets/settlements clustered in forest clearings can be seen, spread haphazardly through the area. There is also evidence of Roman occupation. Despite the fact that there has been some alteration to the lower reaches of the River Lyd, the potential for aquatic life has been enhanced and there are now improved habitats for otters as a result of the Flood Alleviation Scheme.

Frome

The Frome along with the Cam and Little Avon to the south drains westwards into the River Severn from the Cotswold Hills to the east, which is an AONB. The upper reaches of the Frome are relatively unspoilt. Arising on the west side of the Cotswold scarp the headwaters are rural and natural. The river flows southward, turning west towards Stroud, where it is contained within a steeply sided valley with abundant bankside vegetation and adjacent wooded slopes. Some of these are Woodland Trust Sites and Gloucestershire Wildlife Trust Reserves. Within this upper part of the river, the water is prone to disappear down sink-holes in the limestone leaving dry sections, particularly in dry summers. The middle section of the river is more urbanised in character and flow through a valley of restricted width. Downstream of Chalford there is a chain of water mills which create a series of engineered water channels. The water mills are now redundant and have mostly been converted to other uses. This section of the Frome, extending downstream as far as the Gloucester- Sharpness Canal, is an Industrial Heritage Conservation Area. This is interspersed by sections of very attractive and diverse natural channel which creates a valuable contrast to the industrial development. The lower Frome shows evidence of otter use whilst the upper sections are prime habitat for otters. Dippers and Grey Wagtails are often present even into the town of Stroud.

Cam/Little Avon

The Cam serves a low lying area draining agricultural land forming part of the Severn Vale. Arising near Dursley, the upper reaches are tree-lined with a diverse mix of bank and channel vegetation. The lower reaches are less rich ecologically although there is reasonably good channel vegetation with an interesting aquatic fauna. The river flows into the Gloucester -

CATCHMENT USES AND RESOURCES

Sharpness Canal through featureless culverts (below the A38), with little or no vegetation, passing through an area of pasture with some species rich meadows. The lower reaches are within the flood plain landscape of the River Severn and flood banks dominate the river scene. The high drainage system is pumped into the River Severn via an NRA pumping station, giving the area strong fenland characteristics. The area is not managed by an Internal Drainage Board (IDB).

The upper reaches of the Little Avon have meandering steep wooded banks enclosing and shading the river, which consequently has a somewhat restricted channel vegetation. This part of the river corridor is considered to be of high conservation value. The lower sections by contrast traverse the open flood plain of the River Severn in similar fashion to the Cam flowing through agricultural land of medium quality. Some watercourses in the area have been straightened in the past to facilitate and improve the drainage of the valley bottom. The corridor of the Little Avon is lined with floodbanks and well vegetated in parts with oak, ash, alder and pollarded willows. Beyond the outfall/tidal trap, the river forms an 'estuarine pill' and meanders through mud flats forming a salt marsh habitat. Such habitat is both vulnerable and rare.

Avonmouth Area

This is an area characterised by a drainage system of managed ditches or "rhines" which drain this very low lying area into the tidal estuary via tidal exclusion flaps. The area therefore is distinguished by its drainage function. The drainage ditches managed by the South Gloucester Internal Drainage Board are not significant or interesting landscape wise. Their conservation value is at present unknown. However, in contrast, the conservation value of adjacent saltmarshes and wetland habitats are of great interest, in particular in the context of water level management and possible loss of such habitats as a result of increased development in the area.

The landscape character has often become degraded by both drainage and agricultural practices and is now relatively open and lacking in vegetation. Typical floodplain features such as lines of pollarded willows have become old and depleted in number. There is a need for a policy to reinstate these features.

Objectives

The objectives for this use are:

- * to protect the landscape, archaeological, architectural, historical and ecological features associated with rivers in the catchment and to safeguard designated sites and, where appropriate, access to these sites
- * to carry out enhancements wherever possible
- * to reinstate those areas where aquatic environment has become degraded

CATCHMENT USES AND RESOURCES

- * to seek to maintain river corridors in as natural a state as possible, conserving their individual character and evaluating the various pressures which threaten their quality
- * to assess the environmental impact of all NRA operational activities and ensure that any adverse impacts are mitigated.

Requirements

- | | | |
|--------------------------|---|---|
| Water Quality | * | Relevant surface waters to comply with the standards for amenity protection and other site specific water quality criteria. |
| Water Quantity | * | Flow regimes not to be significantly altered from the monthly natural historic flow conditions in the river. |
| | * | All significant new net abstractions to be subject to a prescribed flow condition where necessary. |
| | * | Groundwater levels not to be artificially lowered where it is likely to adversely affect flora and fauna dependent on those water levels. |
| Physical Features | * | The diversity of river and wetland habitats to be maintained and enhanced where possible. The special characteristics of designated conservation sites to be preserved. |
| | * | River works should not adversely affect sites of landscape importance or sites of archaeological, architectural and historical interest. |
| | * | Any works to the river channel to retain the channel form appropriate to the natural flow regime where possible. |

4.6 RECREATION AND NAVIGATION

General

This section deals with recreational activities that take place on lakes, reservoirs, coastlines or in the proximity of river corridors. Recreational activities include navigation and those often termed as 'informal countryside recreation', such as walking, rambling, birdwatching, cycling and horse riding, as well as watersports. Angling is regarded as a recreational activity, however, it is considered in this plan in the context of fisheries under section 4.4

The NRA does not encourage swimming in rivers, lakes and canals because of the risk of drowning and the possibility of swimmers catching water borne diseases.

The NRA has duties to improve and maintain inland waters and their facilities for use by the public where it is the navigation authority.

Local Perspective

The CMP area varies greatly in actual or potential recreational opportunities depending upon the locality and the mix of natural and man-made resources (Map 12). The Forest of Dean has the greatest variety and individual character as a recreational and tourist area with other features being the Wildfowl and Wetlands Trust at Slimbridge and the Gloucester Docks.

River Severn Corridor

There is considerable tourism in this extensive rural area based around the historic towns of Tewkesbury, Cheltenham and the City of Gloucester. To the north the area includes the Malvern Hills (AONB), an important tourist and recreation area in its own right. The river generally plays an important part in the attraction of tourists to such towns. Gloucester with its restored Docks and National Waterways Museum has a special attraction.

Some birdwatching interest occurs in the winter months centred on the Duckeries (Ashleworth Ham) on the Hasfield Drain and also the Coombe Canal, Deerhurst Parish Drain and associated flood meadows.

The River Severn is a statutory navigation from Stourport in the north to Gloucester in the south i.e. above the Gloucester Weirs. British Waterways is the Navigation Authority. Navigation of the river below Gloucester is possible but would be very hazardous. The navigable waterway below Gloucester Docks is usually the Gloucester and Sharpness Canal which gives access via Sharpness Docks to the Bristol Channel and the open sea. Navigation continues upstream beyond the limit of the Catchment Management Plan to just above Stourport-on-Severn and links via the River Avon and various canals into the inland waterway system. There are many on-river moorings, some of which are very unsightly and are often associated with caravan parks. The Severn Motor Yacht Club have their headquarters at

**River Severn Lower Reaches
Catchment Management Plan**

Map 12

May 1995



NRA

National Rivers Authority
Severn-Trent Region

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Recreation and Navigation

	Focal Access Point	KEY		Catchment boundary	
	Riverside Footpath		Sub - catchment boundary		Main River
	Regular Angling		Ordinary Watercourse		Canal
	Navigable Canal		Rowing		Sailing
	Rowing		Marinas/Moorings		Built up Area
	Sailing				
	Marinas/Moorings				

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CATCHMENT USES AND RESOURCES

Clerkenleap and there is a sailing club at Chaceley.

Canoeing interest extends along the river and there are several rowing clubs at Gloucester and Tewkesbury. Canoe access for clubs occurs via slipways at several points eg. Upton Marina, Bredon School, Lower Lode, Chaceley, Hawbridge, Ashleworth Key and Wainlodes. Raft racing is common on the main River Severn - these are mainly charity events.

In the estuary there is little in the way of boating interest as the conditions are very hazardous. In any case the area is by-passed by the Gloucester-Sharpness Canal. The canal has much tourism potential and has an identity and character of its own.

The estuarine river is big enough for water skiing and is not subject to navigational speed limits. There is a thriving water ski club at Minsterworth.

River Leadon

Within this sub catchment area, bordering the northern edge of the Forest of Dean, very little recreation takes place and the potential for recreation is very limited. A canal restoration project is under way on the Gloucestershire and Herefordshire Canal. This is in its early stages and to date not much restoration has taken place.

Forest of Dean

Is a much used tourist area with both local and national visitors attracted to the open water areas within the forest. There are abundant opportunities for many forms of passive and active informal recreation such as walking, picnicking, barbecues and mountain biking. Water related areas are the recreational focus providing coarse and game angling, sailing and bird watching interest.

Sailing occurs on Mallards Pyke in the Forest of Dean.

River Frome

Tourism exists in this area owing to its proximity to the Cotswolds and more particularly because of the Stroud Industrial Heritage Conservation Area. The Stroudwater and Severn Thames Canals are under restoration by the Cotswold Canals Trust. Some lengths have been restored providing limited boating opportunities along with towpath restoration. There are some footpaths along the river but these are not continuous.

There are no still waters of any significance for angling or any other water based recreation other than at Frampton (angling and sailing).

The Cam/Little Avon

The major tourist and recreational attraction of the lower part of this sub-catchment is the Wildfowl and Wetland Trust at Slimbridge. This contains the worlds largest collection of

CATCHMENT USES AND RESOURCES

wildfowl and was founded by Sir Peter Scott in 1946. The estuary attracts many thousands of waterfowl in winter and is of considerable interest to birdwatchers. The large expanse of water and the spectacular views attracts tourists to various viewpoints. On the west bank viewpoints occur at Newham, Lydney and Beachley. There are a greater number of similar viewpoints on the east bank.

The Severn Way long distance footpath links footpaths, bridleways and roads beside the River Severn and follows the Gloucester-Sharpness Canal towpath to divert around the Wildfowl Trust and Slimbridge. At present the Severn Way relates only to that section which passes through Gloucestershire on the east bank between Tewkesbury in the north and Sheppardine, about one mile south of the County boundary - a total distance of about 50 miles. Work is under way to open up the west bank path between Mythe Bridge, north of Tewkesbury and Lydney harbour. There are at present extensive footpaths on the west bank but they are not continuous. The Severn Way continues up to the Gloucestershire border and a continuation will in the future be made up river to the Shropshire/Wales border.

Objectives

The objectives for this use are:

- * To safeguard the quality and quantity of the water sufficient for its recreational use.
- * To protect and promote public access to watercourses, including facilities for the disabled, within the framework of existing local authority and National Trust policies for visitor management.
- * To ensure that works on river channels do not prejudice recreational activities as far as is practical and, where appropriate, take opportunities to enhance recreational facilities.
- * To promote the use of water and associated land for recreational purposes.
- * To raise public awareness of the dangers of Weil's disease.

Environmental Requirements

- | | |
|-----------------------|--|
| Water Quality | <ul style="list-style-type: none">* Water Quality should be adequate to prevent any public nuisance arising from surface film, discolouration, extraneous floating material and unpleasant odour.* Compliance with basic amenity quality standards. |
| Water Quantity | <ul style="list-style-type: none">* Sufficient water should be available for recreational purposes within the limitations of existing licences and a reasonable licensing policy. |

CATCHMENT USES AND RESOURCES

- Physical Features**
- * To manage visitor pressures to limit problems of environmental damage to the water environment.
 - * To promote riverside amenity, without unreasonably constraining other users, in collaboration with other bodies as opportunities arise.
 - * Controlled access for boating and watersports should be maintained.
 - * Formalised sites for launching and retrieving canoes should be promoted.

**River Severn Lower Reaches
Catchment Management Plan**

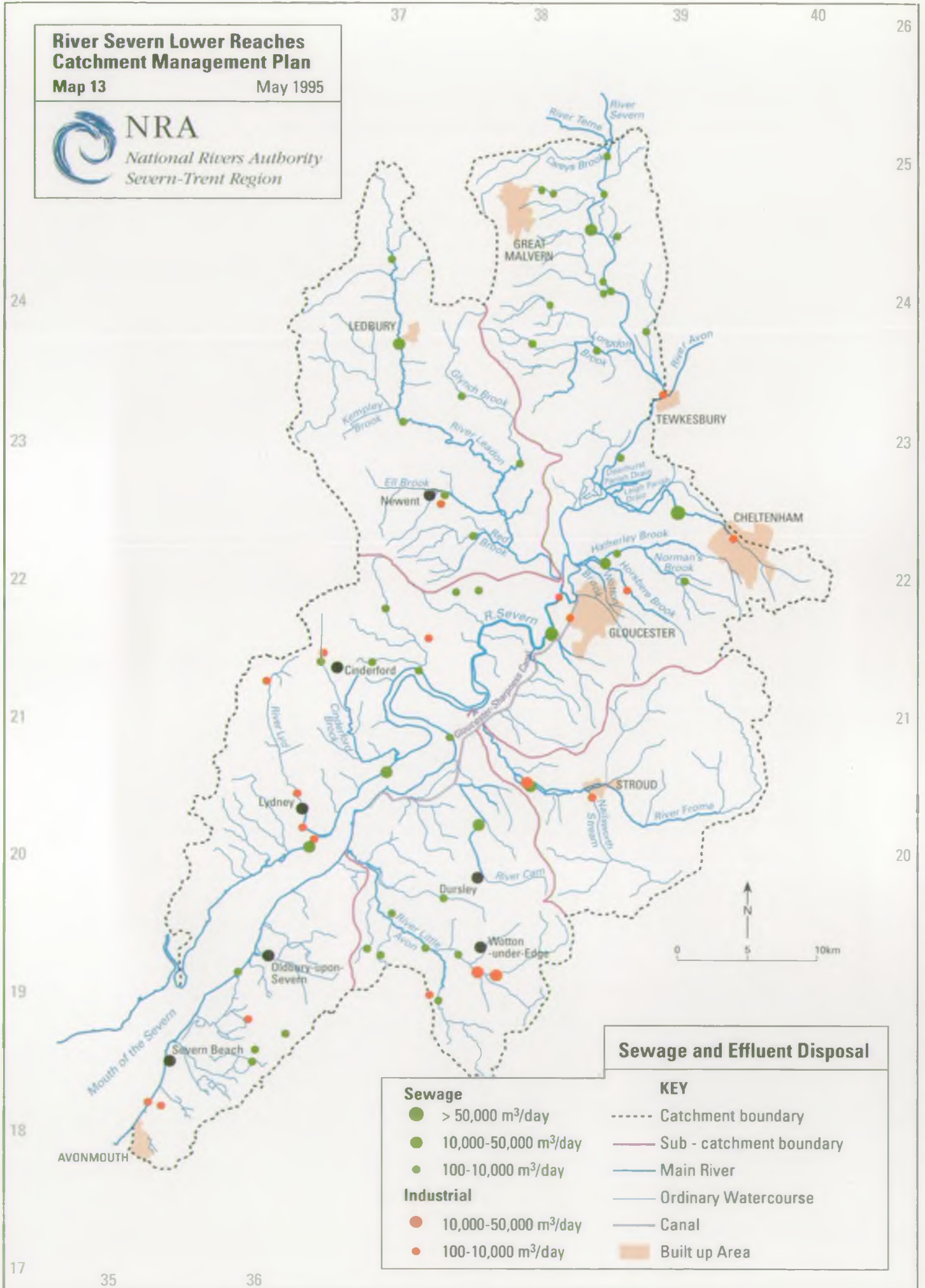
Map 13

May 1995



NRA

National Rivers Authority
Severn-Trent Region



Sewage and Effluent Disposal

KEY	
● > 50,000 m ³ /day	----- Catchment boundary
● 10,000-50,000 m ³ /day	— Sub - catchment boundary
● 100-10,000 m ³ /day	— Main River
● Industrial	— Ordinary Watercourse
● 10,000-50,000 m ³ /day	— Canal
● 100-10,000 m ³ /day	■ Built up Area

4.7 SEWAGE AND INDUSTRIAL EFFLUENT DISPOSAL

General

The NRA's aims are:-

- * To achieve a continuing overall improvement in the quality of rivers, estuaries and coastal waters through the control of pollution.
- * To 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.

All discharges of sewage and treated sewage effluent require a consent from the NRA except on sites monitored by Her Majesty's Inspectorate of Pollution (HMIP). The consent specifies the volume that can be discharged and what it may contain. These conditions are calculated by taking into account the water quality and the amount of water available to dilute the effluent at the point of discharge and by ensuring that downstream water quality remains acceptable for all its many uses and meets the relevant water quality standards. All consents are reviewed on a regular basis.

Consent conditions are normally set to take account of the worst case situation, in order to protect water quality and use in the vast majority of circumstances. The worst case is normally when dilution is at a minimum during prolonged periods of dry weather, so standards are normally defined to meet quality targets at the "95% Exceedence" value (i.e. the consent is set for a flow which is exceeded 95% of the time).

The Urban Waste Water Treatment Directive (UWWTD) now defines minimum standards for sewage treatment plants serving more than 2000 population. Targets for toxic substances defined by other EC Directives are set according to limits defined in the Directives.

Some Consents for water company sewage treatment plants are based on historical performance rather than target river quality and the targets can only be met by improvements in effluent quality. The NRA has negotiated a programme of improvements with the DoE and water companies under the terms of Asset Management Plans (AMP). The second stage of these plans (AMP2) was agreed in July 1994 with the industry regulators OFWAT. The plans will govern priorities for investment for the period covered by this CMP.

Local Perspective

There are over 1000 consented discharges in the catchment area at present. Those over 100 m³/d are shown in Map 13. The major sewage and industrial discharges are shown in Tables 7 and 8 respectively.

TABLE 7: MAJOR SEWAGE DISCHARGES

DISCHARGE	RECEIVING WATERCOURSE	CONSENTED VOLUME (MI/DAY)
Gloucester, Netheridge	Tidal River Severn	42.8
Cheltenham, Hayden	River Chelt	33.1
Stroud, Stanley Downton	River Frome	24.3
Gloucester, Longford	Hatherley Brook	6.5
Coaley	River Cam	5.5
Malvern	River Severn	13.4
Charfield	River Little Avon	1.7
Wotton-under-Edge	River Little Avon	1.2

TABLE 8: MAJOR INDUSTRIAL DISCHARGES

DISCHARGE	RECEIVING WATERCOURSE	CONSENTED VOLUME (MI/DAY)
Dairy Crest Creamery, Stroud	River Frome	1.4
Hempstead Tip, Gloucester	Tidal River Severn	0.23
Norchard's Drift, near Lydney	Cannop Brook/River Lyd	Exempt
Alderley Fish Farm	River Little Avon	30
Nind Fish Farm	River Little Avon	45

In addition, there are a number of major trade effluents discharging to water company treatment plants, some of which include "Red List" substances (pesticides etc.). Consent standards for the relevant parameters are applied to the treatment plant discharge.

Major discharges from the Avonmouth Complex impact predominantly on the estuary and as such will be dealt with in the Severn Estuary Catchment Management Plan in 1996.

Crown Property Discharges

Tortworth Brook receives the discharge from Leyhill prison. This is crown property which

CATCHMENT USES AND RESOURCES

in the past was crown exempt and did not require a consent to discharge. However, the NRA can now issue consents on such properties and a future review should set consents for crown properties including Leyhill Prison.

Objectives

The objectives for this use are:

- * to ensure sewage and industrial effluents do not prejudice downstream water quality targets and uses
- * to maintain downstream river ecosystems, including fisheries
- * to avoid persistent visual impact on the receiving watercourse.

Environmental Requirements

- | | | |
|--------------------------|---|--|
| Water Quality | * | To maintain or improve water quality below the discharge |
| Water Quantity | * | Flow characteristics need to be maintained in order to control impact on quality |
| Physical Features | * | Discharge should have no persistent visible effect on the watercourse |

4.8 RIVER ECOSYSTEM

General

River ecosystems consist of interacting communities of organisms together with the chemical and physical environment in which they live. The term "River Ecosystem Use" is intended to encompass the natural ecological function of rivers as a habitat for aquatic flora and fauna (including fish) and as a carrier of chemical and biological products of the water cycle. It is defined in terms of parameters which measure the general "health" of rivers and classify their ability to support natural ecosystems.

Primary duties of the NRA are to maintain or improve water quality, conserve flora and fauna which are dependant on an aquatic environment and maintain, improve and develop fisheries. Each duty requires good husbandry of water ecology and river ecosystems.

The classification system was formally defined in the Surface Water (River Ecosystem Classification) Regulations 1994. Although defined by chemical and physical parameters only, it is based on empirical ecological data which have been refined over many years and thus gives a reliable indication of the diversity of aquatic life which a river is capable of supporting.

One very important relationship is between chemical quality and fishery status. This is described in Section 5.1.

Local Perspective

The present and target quality of rivers in the River Severn Lower Reaches area are presented in Section 5.1 of this Plan. The area includes a wide variety of rivers, from shallow upland streams draining the Cotswolds to deep lowland rivers such as the River Severn itself and drainage "rhines" which are effectively linear ponds. This natural diversity is mirrored by wide differences in ecosystems, which are then modified by the adjacent land uses, i.e. agricultural and urban influences.

Objectives

The RE Classification will form the basis of future statutory Water Quality Objectives (WQOs). Proposals for each classified river stretch are given in Section 5.1. Objectives are defined as medium-term and long-term. Medium-term objectives are those which are met now, or which will be met within the next 5-10 years as a result of committed expenditure or other achievable improvements. For some stretches the medium and long-term objectives are the same.

Aims underpinning these objectives are

CATCHMENT USES AND RESOURCES

- * to maintain or improve water quality
- * to conserve flora and fauna which are dependant on an aquatic environment
- * to maintain, improve and develop fisheries.
- * to enable the widest possible use of rivers consistent with the objectives
- * to give a firm base for decisions on future effort and investment

Pollution prevention measures aim to protect ecosystems by

- * preventing silting by inorganic and organic solids
- * maintaining dissolved oxygen levels
- * preventing fouling by offensive materials and oil
- * controlling polluting discharges and toxic materials
- * controlling hydraulic effects from discharges, e.g. scouring

Environmental Requirements

Water Quality	*	As above
Water Quantity	*	Maintenance of flow velocity and depth within acceptable limits for the species present
Physical Features	*	Minimise disturbance of the physical habitat by dredging, culverting and other land drainage works

**River Severn Lower Reaches
Catchment Management Plan**

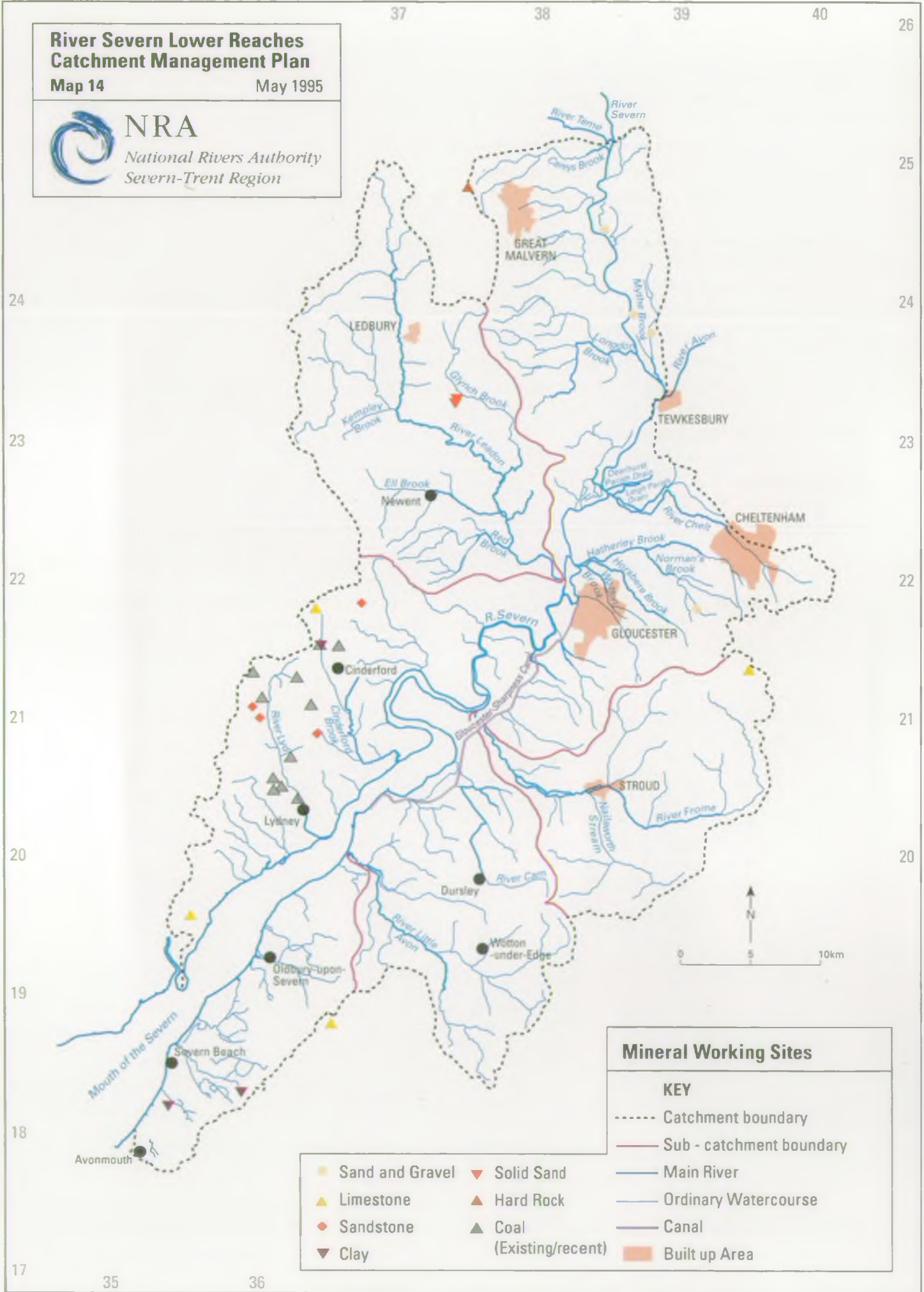
Map 14

May 1995



NRA

National Rivers Authority
Severn-Trent Region



Mineral Working Sites

KEY

- - - - - Catchment boundary
- Sub-catchment boundary
- Main River
- Ordinary Watercourse
- Canal
- Built up Area
- Sand and Gravel
- ▲ Limestone
- ◆ Sandstone
- ▼ Clay
- ▼ Solid Sand
- ▲ Hard Rock
- ▲ Coal (Existing/recent)

4.9 MINERAL WORKING

General

Areas of current or former mineral workings pose a threat to ground and surface waters by exposing, at times, toxic spoil or veins of potentially toxic minerals to the weathering process. As a result, run off and discharges from quarries and mines can contain toxic and suspended materials that are harmful to aquatic life. Discharges from active sites are subject to normal discharge consent procedures. However, discharges from abandoned mines are not adequately controlled by the law and may cause severe problems locally.

The exploitation of minerals can have a major impact on water resources by altering groundwater flows and hence streamflows. The removal of material from above the water table reduces the opportunity for natural filtering and decreasing the concentration of pollutants, which will consequently enter the groundwater more readily. Summer spring flows can be reduced as a result of the loss of water storage capacity of the mineral that has been removed. Reclamation with impermeable material will increase run off and reduce the recharge of groundwaters, whilst the use of mineral extractions sites for landfill waste disposal also poses a significant threat to groundwater quality.

Gravel extraction may take place from the river channel or floodplain and is controlled by planning law. It may also require a land drainage consent from the NRA. If extraction works are not properly managed, the river channel can be seriously damaged. There can also be serious implications for salmon and trout spawning sites.

Contaminated land reclamation schemes may cause renewed, or even exacerbate existing, problems as unweathered toxic materials are exposed or fine solids run off into watercourses. Consequently such schemes require consultation with the NRA and any discharges consented and monitored.

All mineral workings are subject to general planning controls. The NRA is a consultee on such applications, and the final planning consent should contain conditions which control the operations in order to satisfy the NRA's requirements.

Local Perspective

Current mineral sites in the catchment are shown in Map 14. Sandstone is mainly quarried in the Forest of Dean, however, some is also quarried at Cromhall and Wickwar in the Little Avon sub-catchment. Coal has been historically mined in the Forest of Dean, however, it is confined to small scale production at opencast sites and shallow private mines. The preferred areas for sand and gravel extraction include river terrace deposits along the Severn Valley at Ripple and Ryall.

CATCHMENT USES AND RESOURCES

Objectives

The objective for this use is:

- * To ensure mineral extraction and any associated activity including land reclamation does not compromise water quality or water reserves.

Environmental Requirements

- | | | |
|--------------------------|---|--|
| Water Quality | * | Discharge consents to adequately safeguard water quality. |
| | * | Operations to be carried out in accordance with advice given in the NRA's Policy and Practice for the Protection of Groundwater. |
| | * | Restored sites not to pose a long term risk to Water Quality by inappropriate use of landfill materials. |
| Water Quantity | * | The operation to be carried out so no significant derogation of ground and surface water resources results. |
| Physical Features | * | Mineral working, land reclamation and associated activities must not reduce the quality of the physical habitats available. |
| | * | Gravel extraction in rivers must not adversely affect salmon and trout spawning grounds. |

4.10 SOLID WASTE DISPOSAL

General

Land can be contaminated with significant levels of pollutants as a result of industrial and agricultural activities and through waste disposal. These pollutants can adversely affect surface and groundwater quality through run-off and percolation to underlying aquifers.

Prior to the mid 1970's there was no control over the types of waste tipped and the methods of operation relating to its disposal. Since 1976, waste disposal sites have required a licence to operate from the local Waste Regulation Authority - the County Councils in England. The NRA has to be consulted about each application for a licence. The Waste Management Licence details how the site is to be constructed and operated.

A valid planning permission is also required before a Licence can be issued. The Planning Permission contains conditions which control the way in which the site is restored and monitored to prevent the closed site causing future damage to the environment. The Waste Management Licence cannot be revoked until a Certificate of Completion is issued by the Waste Regulation Authority, stating the site is unlikely to cause pollution of water.

Landfill sites can cause water pollution. This is because rain falling on the site can become contaminated and drain from the site (called leachate) into groundwater or streams. If the site is properly managed, long term harm to the environment can be avoided. This can be achieved by either collecting the leachate for disposal elsewhere, treating it, or allowing it to be diluted in the groundwater where it may naturally break down. Detailed studies are being carried out to help decide on the best way to deal with leachate. Badly managed sites can lead to serious pollution problems.

The NRA has published a Groundwater Protection Policy (1992) to advise planning authorities and others of the dangers of allowing certain types of development in areas where groundwater could be affected. It is designed to protect groundwater abstractions and resources in general from activities which could lead to contamination such as: waste disposal, sludge spreading and chemical storage and manufacture.

Local Perspective

Map 15 shows current waste disposal sites. There is a statutory duty placed upon each Waste Regulation Authority by the Environmental Protection Act 1990, Section 50, to produce a Waste Disposal (Management) Plan. This plan forms the basis for a county's waste disposal strategy. The County of Avon has a current Waste Disposal Plan and a plan for Gloucestershire is in its initial stages.

**River Severn Lower Reaches
Catchment Management Plan**

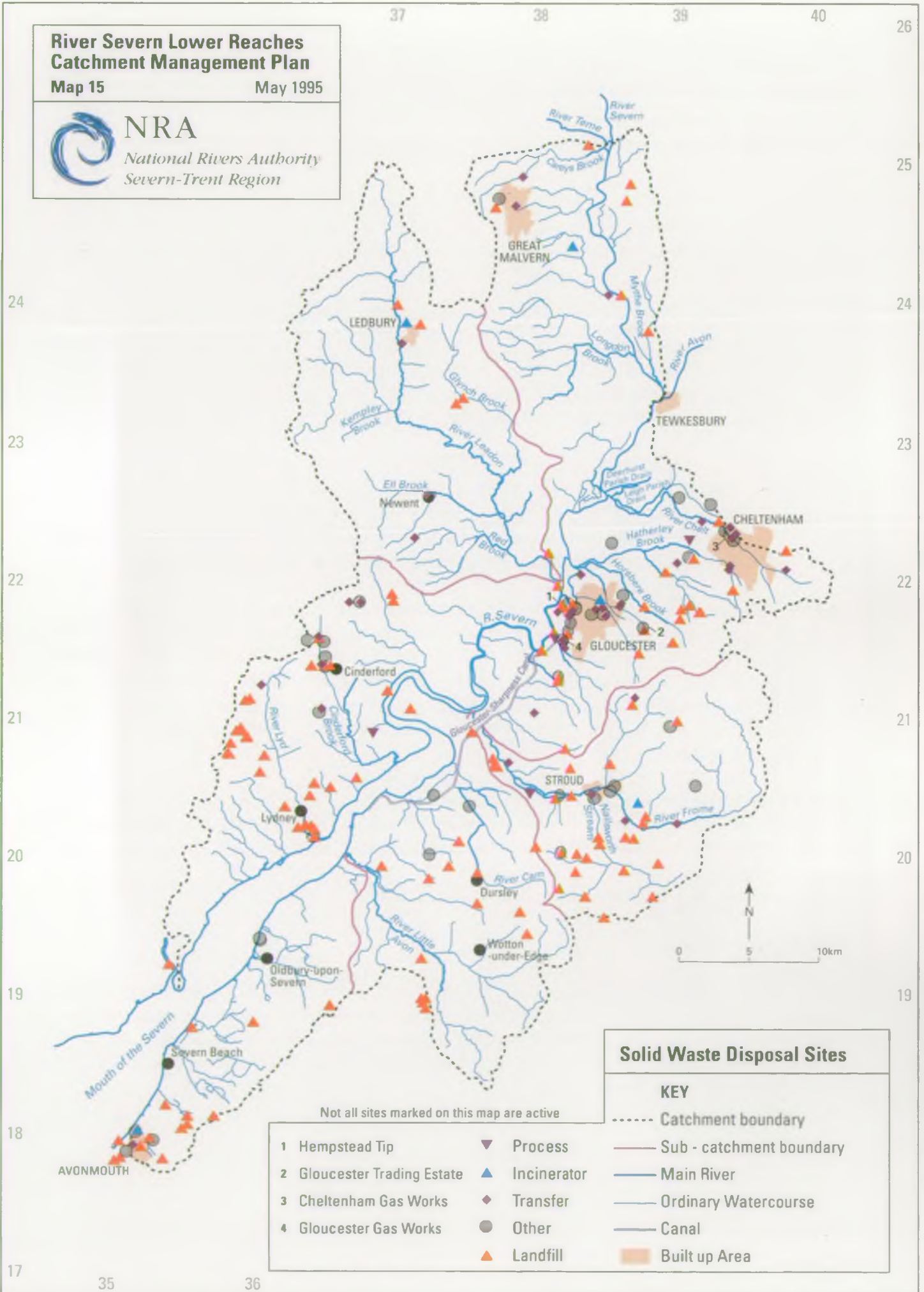
Map 15

May 1995



NRA

National Rivers Authority
Severn-Trent Region



Solid Waste Disposal Sites

KEY

- Catchment boundary
- Sub-catchment boundary
- Main River
- Ordinary Watercourse
- Canal
- Built up Area

Not all sites marked on this map are active

- 1 Hempstead Tip
- 2 Gloucester Trading Estate
- 3 Cheltenham Gas Works
- 4 Gloucester Gas Works
- ▼ Process
- ▲ Incinerator
- ◆ Transfer
- Other
- ▲ Landfill

CATCHMENT USES AND RESOURCES

Objective

The objective for this use is:

- * To ensure that waste disposal storage and transfer activities do not adversely affect water quality or water resources.

Environmental Requirements

The requirements for this use are:

- | | | |
|--------------------------|---|--|
| Water Quality | * | EC Directives on dangerous substances discharged to surface and groundwaters to be complied with. |
| | * | Discharge consent conditions or prohibition notices to be complied with. |
| | * | Landfill to be carried out in accordance with advice given in the NRA's Policy and Practice for the Protection of Groundwater. |
| | * | Restored sites not to pose a long term risk to the water environment. |
| | * | Pollution prevention measures on bunding and drainage to be fully implemented at waste transfer sites and scrapyards. |
| Water Quantity | * | Waste disposal activities must not harm groundwater resources or adversely affect the rights of water abstractors. |
| Physical Features | * | To control disposal such that watercourses and ditches are not infilled, restricted or altered. |

**River Severn Lower Reaches
Catchment Management Plan**

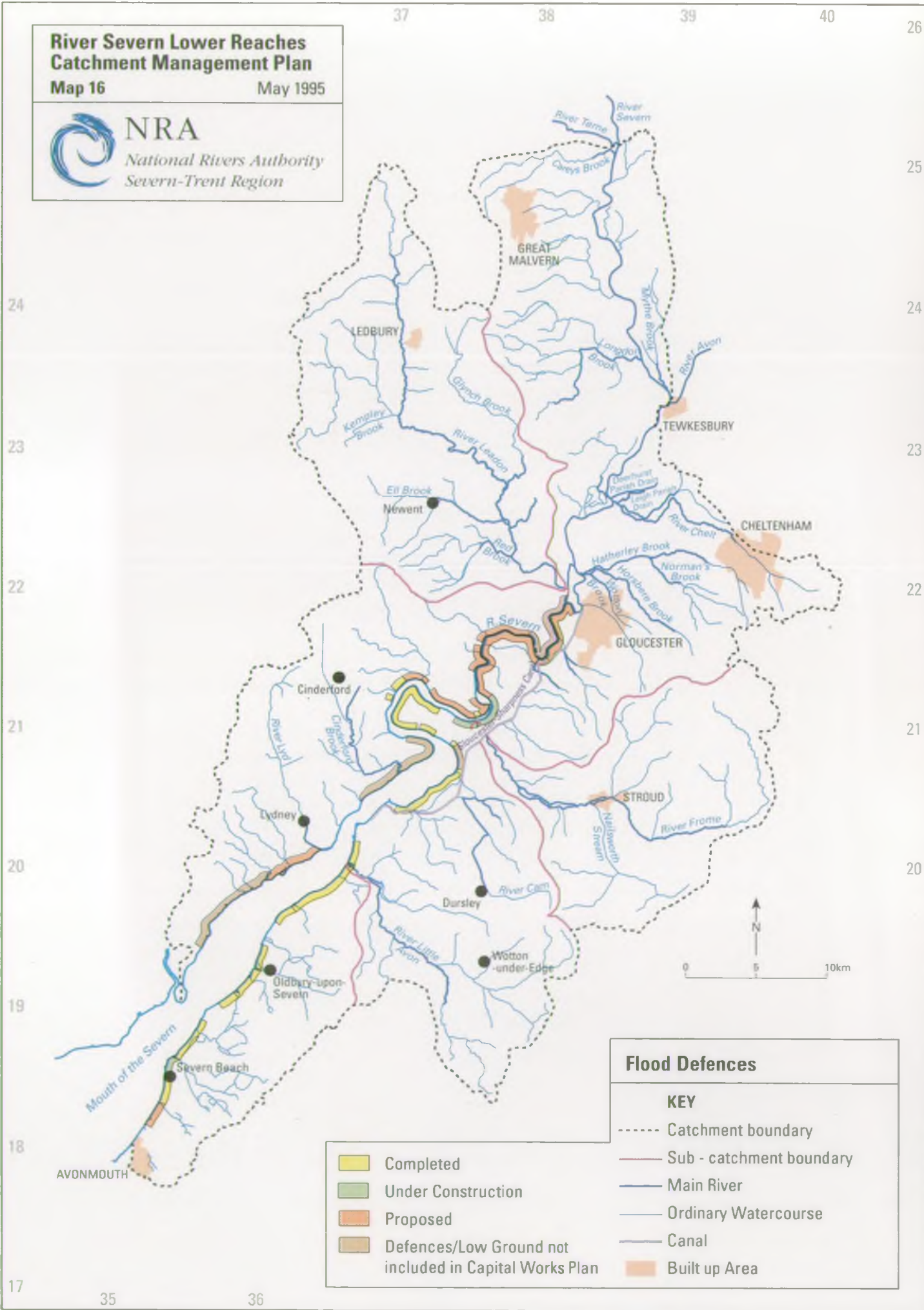
Map 16

May 1995



NRA

National Rivers Authority
Severn-Trent Region



Flood Defences	
KEY	
-----	Catchment boundary
-----	Sub - catchment boundary
—————	Main River
—————	Ordinary Watercourse
—————	Canal
■	Built up Area

■	Completed
■	Under Construction
■	Proposed
■	Defences/Low Ground not included in Capital Works Plan

4.11 FLOOD DEFENCES

General

Flood Defences are built to protect people and property from flooding. In inland waters the flow capacity of rivers is limited and when this is exceeded the adjoining land, or floodplain, acts as a temporary storage for water. In low lying coastal areas, the flooding of land by the sea during high tides and onshore currents occurs in a similar way.

It is the aim of the NRA under its duties described in the Water Resources Act 1991 to exercise a general supervision over all matters relating to flood defence and to carry out surveys of the areas in which it carries out its flood defence functions. In respect of Flood Defence the NRA has a supervisory role over all matters relating to water courses. It has direct powers of control over the construction or alteration of structures in, over, under or within 8 metres of those watercourses classed as "Main River", and over the construction or alteration of culverts, mill dams, weirs or other like obstructions in any watercourse. Flood Defence roles are further detailed in Appendix 1. District and County Councils also have permissive powers to carry out works on "ordinary" watercourses but these require NRA consent.

In order to use rivers as channels for flood waters while at the same time protecting people and property from flooding, the NRA carries out a programme of construction and maintenance of river channels and flood defences. Widening and deepening the river channel optimises its use as a carrier of floodwater. Defences, whether floodbank or sea wall, allow the present uses of land to be maintained which would otherwise not be available without these defences. Major flood defence works are costly and have to be balanced with the needs of other uses such as recreation. As well as flood risk, development on floodplain will reduce ground carrying capacity, increase run-off rates and this exacerbates flooding problems associated with the carrying capacity of the river channel. It is therefore the policy of the NRA, when advising Local Planning Authorities, to oppose new development in vulnerable floodplain.

Normally the NRA will provide a standard of flood protection in terms of the frequency at which, on average, it will be effective e.g. standards to "1 in 50 years" relates to flood defences which will protect against a flood peak which would, on average, occur once every 50 years. Different types of land use are protected against different sizes of flood. These target "Standards of Service" are described in detail in Section 5.3.

Local Perspective

The sub-catchments in this plan have quite different flood-carrying characteristics and flood defence requirements. Two of the identified sub-catchments have significant flood defences:

River Severn Corridor

The River Severn valley from Worcester to Tewkesbury has a total of 28 km of flood defence embankments. These protect some 4600 ha of flood plain to a nominal 1 in 5 year standard. The remaining flood plain areas at Kempsey, Upton and Longdon Marsh still flood annually. All these flood plain areas provide essential protection or relief from flooding for property both in this reach and downstream. Drainage of low lying areas is limited by impounded navigation levels.

From Tewkesbury to Gloucester there are 34 km of embankments protecting some 5000 ha of flood plain to an annual standard. Unprotected areas around Tewkesbury and the Avon confluence flood more frequently.

Avonmouth Area and Little Avon

This sub-catchment contains most of the hard defences in this CMP area (Map 16). The Estuary lowlands, from Gloucester to Beachley on the west and Avonmouth on the east, are protected by 100km of sea/tidal defences, with 15,600 ha of land lying below high tide level. Drainage of these areas is a problem due to low levels, tide-lock, slack gradients and "foreign water" drainage from the extensive uplands which back them.

Raised embankments also exist on the lower reaches of the following tributaries:

Chelt	Little Avon
Frome	Leadon
Cam	Cinderford Brook
Wicksters Brook	Lyd

There are a host of other tributaries and lesser watercourses on which the drainage of the farthest parts of the catchment depends. Many of these are "ordinary watercourses" and as such primarily the concern of District Councils. Over the winters of 1992-93 and 1993-94 there was extensive local flooding on these minor drainage systems which caused much alarm and distress to the property owners involved.

The lowlands of the River Severn comprise the flood plain above Gloucester and the coastal lowlands below. Both lie below river or tide flood levels and have local drainage problems. This problem is illustrated by the fact that all four Internal Drainage Boards which lie within Lower Severn area are located along this part of the River Severn.

Additions to the current Main River are proposed, including the River Chelt, Ham Brook and the tributaries around Bishop's Cleeve.

Objectives

The objectives for this use are:

- * To provide effective flood defence on Main Rivers for the protection of people and property to a standard appropriate to the land use. (See Section 5.3 Standards of Service).
- * To provide an adequate flood forecasting and flood warning service and to respond to flood events.
- * To ensure that increased run-off from new development to a watercourse does not result in increased flood risk downstream.
- * To ensure where possible that the effectiveness of the floodplain to store and convey flood waters is not impaired.

Environmental Requirements

The requirements for this use are:

- | | | |
|--------------------------|---|--|
| Water Quality | * | That increased run-off from new developments, or any other works, does not increase the volume of water entering the draining watercourse to the extent that the ecology of the watercourse is detrimentally affected. |
| Water Quantity | * | That run-off from new development does not affect aquifer recharge or support for base flows in local watercourses. |
| Physical Features | * | The flood plain to be kept free from development which creates additional flood risk. |
| | * | Standards of protection to be maintained by the upkeep of flood defence schemes. |
| | * | 'Main Rivers' to be maintained to ensure their flood carrying capacity is appropriate to the land use in the vicinity. |
| | * | Environmental requirements to be taken into consideration when undertaking flood defence works. |

4.12 AGRICULTURE

General

Modern farming practices involve the use of a wide range of agrochemicals, including pesticides, artificial fertilizers and sheep dips. Also vast quantities of animal waste plus effluent from silage storage and slurry pits have to be disposed of to land. All of these practices have significant scope for impacts on the water environment. The principal concerns of the NRA are:

- * Pollution of surface waters and groundwaters from animal wastes effluents, fertilizers, pesticides and other Agro-chemicals.
- * Soil erosion resulting in increased siltation of watercourses, including destruction of river banks by uncontrolled livestock.
- * Land drainage leading to rapid surface water run-off. This results in greater concentrations of contaminants reaching the watercourse more quickly.

The Government responded to these concerns in September 1991 with the implementation of the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991. This set down minimum standards for the design, construction and operation of storage and disposal systems for these substances. The NRA is required to enforce these regulations.

It is also an offence under Section 85 of the Water Resources Act 1991 'to cause or knowingly permit any poisonous noxious or polluting matter or any solid waste matter to enter any controlled waters'.

The Ministry of Agriculture, Fisheries and Food (MAFF) has produced a Code of Good Agricultural Practice for the Protection of Water and also two other codes for Air and Soil. These provide practical advice on a range of farming practices to minimise the risk of water pollution.

The NRA is also adopting other initiatives to reduce pollution from farms. These include:

- * A systematic programme of farm visits to work with the farmer to identify and eliminate illegal point source discharges.
- * Identification of Government 'Sensitive Areas' where restriction of certain agricultural practices is required e.g. Nitrate Sensitive Areas, Nitrate Vulnerable Zones(NSAs and NVZs).
- * Full collaboration with MAFF, the National Farmers Union and other agricultural organisations to promote and establish an effective way forward

CATCHMENT USES AND RESOURCES

for the prevention of farm pollution.

Recent pressure on farm profitability, Government policy and the need for alternative sources of income are leading to an increasing range of Farm Diversification Schemes. Many are associated with leisure and tourism, often exploiting water resources, which is resulting in an additional range of concerns to the NRA.

Local Perspective

As illustrated in Map 2 in the Overview Section, this catchment is predominantly rural with a high proportion of agricultural land. Arable and grassland represent nearly 73% of the total area. Land use policy and development are key factors influencing the water environment. Use of fertilisers on arable land has contributed to the designation of two groundwater Nitrate Vulnerable Zones in the catchment. The Common Agricultural Policy has led to profound changes in agricultural practice not only in terms of crops and livestock reared but also in areas of diversification into recreational uses of land - for example set aside has increased in the County of Avon from 0% of total land use in 1982 to 1.7% in 1992. Development Plans will play an important role in future land use, diversification and employment in agriculture in the catchment.

Objective

The objectives for this use are:

- * To ensure farming practices are carried out in a way so as not to compromise the use of surface and groundwaters.
- * To ensure that agricultural practices do not threaten the sustainability of the river corridor ecosystem.
- * To encourage the use of set aside.

Environmental Requirements

The requirements for this use are:

- | | |
|----------------------|---|
| Water Quality | <ul style="list-style-type: none">* Minimum standards set down in the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991 to be met.* Farmers to be encouraged to follow the advice given in the Code of Good Agricultural Practice.* To control the use of Agro-chemicals so that pollution of surface water or groundwater does not occur. |
|----------------------|---|

CATCHMENT USES AND RESOURCES

- Water Quantity**
 - * To press for Nitrate Vulnerable Zone Status where this is appropriate in critical areas.
 - * The NRA will develop and implement a Regional abstraction licensing policy that will enable the effective management of water resources within the catchment. This will achieve the right balance between the needs of the environment, abstractors and the river users.
- Physical Features**
 - * Control farming activities such that drainage ditches and watercourses are not blocked with slurry and debris, or used as disposal outlets.
 - * Encourage conservation of river corridors and their margins by farmers and other landowners.

SECTION 5.0

TARGETS AND CURRENT STATE OF CATCHMENT

This Section examines the ability of the catchment to support the Uses identified in Section 4 and outlines the targets in the Catchment for Water Quality, Water Quantity and Physical Features. The targets are compared with the current state of the catchment to identify areas where there is a shortfall against the target. In this manner key Issues in the catchment can be identified. The Issues are discussed in detail in Section 3.

5.1 WATER QUALITY

Introduction

The NRA uses two principal schemes for the reporting and management of river water quality: the General Quality Assessment (GQA) scheme; and the Water Quality Objectives (WQOs) scheme. These schemes have recently replaced the former National Water Council (NWC) classification scheme used previously.

General Quality Assessment (GQA) scheme

The GQA scheme is used to make periodic assessments of the quality of river water in order to monitor geographic trends over time. The scheme comprises four components - general chemistry, nutrients, aesthetics and biology - each providing a discrete 'window' upon the quality of river stretches. The general chemistry component of the GQA comprises six tiered grades (A-F) defined by standards for Dissolved Oxygen, Biochemical Oxygen Demand (BOD) and Total Ammonia. These 3 determinants are chosen as they reflect the extent to which waters are affected by waste water discharges and rural run-off containing organic material. The remaining three windows are still under development and will be applied when available.

However, the NRA can, at present, relate its long term biological monitoring programme to the GQA by comparing the method of BMWP scoring (as discussed earlier - in Section 2.3 on Catchment Monitoring) with corresponding grades i.e. BMWP scores can be banded into grades described as "Very Good", "Good", "Moderate" and "Poor" and compared to water chemical quality grades as defined by the GQA criteria. This is not a direct relationship, but rather a comparative one. They do, however, have a broad correspondence to the chemical quality in terms of the overall environmental quality in that for a Class A (Chemical) and "Very Good" (Biological) one would expect to find high BMWP scores and good chemical quality.

The importance of monitoring biological as well as chemical quality is highlighted when, for a given stretch, these two assessments don't indicate the same quality. A chemical grade higher than a biological grade usually indicates intermittent sources of pollution which are not picked up on a regular, point sample programme for chemical samples but have a long term effect on the ecology of the river. Biological surveying is thus an important complement to chemical sampling in the monitoring of overall environmental quality.

The chemical gradings used for the GQA are given in Table 9

TARGETS AND CURRENT STATE OF THE CATCHMENT

TABLE 9 GQA RIVER CLASSIFICATION - WATER QUALITY CRITERIA

Water Quality	Grade	Dissolve Oxygen	Biochemical Oxygen Demand (ATU ¹)	Ammonia
		(% saturation) 10-percentile	(mg/l) 90-percentile	(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	9.0
Bad	F ²	-	-	-

¹ as suppressed by adding allyl thiourea.

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

Water Quality Objectives (WQOs) scheme

The WQO scheme establishes clear quality targets to provide a commonly agreed planning framework for regulatory bodies and dischargers alike. The proposed WQO scheme is based upon the recognised uses to which a river stretch may be put. These uses include: River Ecosystem; Special Ecosystem; Abstraction for Potable Supply; Agricultural/Industrial Abstraction; and Watersports. The standards defining the five tiered River Ecosystem (RE) use classes, which address the chemical quality requirements of different types of aquatic ecosystems, were introduced by *The Surface Waters (River Ecosystem) (Classification) Regulations 1994* (Standards for further uses are still under development). For each stretch of river, a target RE class will be assigned, including a date by which this level of water quality should be achieved. Until WQOs are formally established and on a statutory basis by Legal Notice served by the Secretary of State, they will be applied on a non-statutory basis through a translation of previous River Quality Objectives (RQOs) from NWC classes to appropriate RE classes and target dates.

WQOs are established for lengths of river (river stretches) which share the same quality target. River stretches are defined according to their upstream and downstream limits; a target River Ecosystem (RE) class is applied, together with a date for its achievement. Physical features such as tributaries, weirs, or significant discharges often mark the ends of river stretches.

TARGETS AND CURRENT STATE OF THE CATCHMENT

Details of the WQOs assigned to river stretches, compliance with WQOs including the monitoring data upon which compliance assessment is based will be included on the Public Register.

State of the Catchment

Water Quality

Table 10 describes the water quality criteria of the River Ecosystem classification. Maps 17, 18 and 19 give the current status in terms of GQA, Biological Quality and Water Quality Objectives. Map 19 is a representation of the state of the catchment in terms of how the current quality compares with the River Ecosystem Targets. 3 categories are described - based on statistical analysis of how compliant current quality is with long term objectives - these are "Compliant", "Marginal" failure and "Significant" failure. The categorisation of compliance allows problems to be both identified and quantified.

Water quality within each River Ecosystem class can be described as:

Class RE 1: Water of very good quality (suitable for all fish species).

Class RE 2: Water of good quality (suitable for all fish species).

Class RE 3: Water of fair quality (suitable for high class coarse fish populations).

Class RE 4: Water of fair quality (suitable for coarse fish populations).

Class RE 5: Water of poor quality (which is likely to limit coarse fish populations).

No class: Water of bad quality (in which fish are unlikely to be present), or insufficient data available by which to classify water quality.

TABLE 10: RE RIVER ECOSYSTEM CLASSIFICATIONS: WATER QUALITY CRITERIA

Class	Dissolved Oxygen % saturation	BOD (ATU) mg/l	Total Ammonia mg N/l	Un-ionised Ammonia mg N/l	pH Lower limit as 5 percentile; upper limit as 95 percentile	Hardness mg/l CaCO ₃	Dissolved Copper µg/l	Total Zinc µg/l
	90 percentile	90 percentile	90 percentile	95 percentile			95 percentile	95 percentile
	2.5	0.25	0.021	6.0-9.0	≤10 >10&≤50 >50&≤100 >100	5 22 40 112	30 200 300 500	
	4.0	0.6	0.021	6.0-9.0	≤10 >10&≤50 >50&≤100 >100	5 22 40 112	30 200 300 500	
	60	6.0	1.3	0.021	6.0-9.0	≤10 >10&≤50 >50&≤100 >100	5 22 40 112	300 700 1,000 2,000
RE4	50	8.0	2.5	-	6.0-9.0	≤10 >10&≤50 >50&≤100 >100	5 22 40 112	300 700 1,000 2,000
RE5	20	15.0	9.0	-	-	-	-	-

River Severn Lower Reaches
Catchment Management Plan
Map 19 May 1995

ERRATUM Map 19
 River Little Avon:
 Wickwar to Southwood Farm = Compliant
 Southwood Farm to B4060 = Significant Failure
 B4060 to R. Avon confluence with Ozleworth Brook = Marginal Failure

Pollution Incidents

The NRA receives reports of pollution incidents from a wide range of sources. These are logged and a response made within defined target timescales. Action is taken to deal with each incident according to its severity, ranging from warnings accompanied with advice on future pollution prevention for minor incidents, to prosecution in the Crown Court for the most serious incidents.

Incidents are categorised according to the type, cause and severity (from Class 1 - a major incident to Class 3 - a Minor incident). A breakdown of confirmed incidents for the period 10/91 - 9/94 is given in Table 11 below.

TARGETS AND CURRENT STATE OF THE CATCHMENT

TABLE 11 POLLUTION INCIDENTS

	91/92	92/93	93/94
Total number of Pollution Incidents	765	909	873
Type of Incident			
Chemical	32	38	48
Oil	114	212	167
Sewage	120	156	113
Farms	66	73	68
Miscellaneous	196	221	259
Cause			
Highway spill	27	24	32
Industrial	67	99	78
Sewage treatment plants (Water Company)	11	12	19
Sewerage	71	96	61
Sewage treatment plants (private)	46	42	42
Agricultural	64	63	65
Domestic	16	17	10
Boats	7	10	6
Natural	56	50	59
Other/unknown	86	131	148
Class			
Class 1	21	15	7
Class 2	229	431	331
Class 3	424	408	513

TARGETS AND CURRENT STATE OF THE CATCHMENT

EC Directive Reporting

Relevant EC Directives also apply to the quality of surface water. These include Urban Waste Water Treatment, quality required to support fish life and the control of discharges of dangerous substances. These are summarised in Table 12.

TABLE 12: SUMMARY OF RELEVANT EC DIRECTIVES

EC DIRECTIVE	STATUTORY INSTRUMENT	RELEVANT CLASSIFICATION	APPLIES TO
1. Urban Waste Water Treatment Directive 91/271/EEC	Water (England and Wales) the Urban Waste Water Treatment (England and Wales) Regulations 1994. SI 1994 No 2841	Minimum standards for requirements to provide sewage systems and treatment facilities	All sewerage systems and sewage works
2. Quality of Freshwater to Support Fish Life 78/659/EEC	(Regulations being prepared)	Separate classes for Salmonid and Cyprinid Waters	Designated stretches of water
3. Dangerous Substances legislation arising from 76/464/EEC	Surface Waters (Dangerous Substances) (Classification) Regulations 1989 and 1992, SIs 1989/2286 and 1992/337	DS1, DS2 and DS3 Classifications for List II substances in Circular 7/89	All waters receiving discharges of these substances.
4. Nitrate Directive 91/676/EEC	(Regulations being prepared)	Identification and allocation of Nitrate Vulnerable Zones for surface and groundwaters.	Waters used for public supply with nitrate inputs from agricultural sources

Asset Management Plan 2 (AMP2)

Asset Management Plan 2 (AMP2) is a document which describes proposed capital investment by the water industry. It has been agreed by OFWAT, the Government and the Water Companies. On 6 July 1994 the Secretary of State for the Environment announced the extra expenditure that is to be allowed for river quality improvements in the AMP2 period 1995-2000.

This announcement was followed at the end of July by the publication by OFWAT of the price limits for the water companies for the next ten years. The expenditure on the environmental programme was included in OFWAT's price limit determinations.

The arrangements flow from the Government's policy statement entitled "The Quality Framework" published in a response to OFWAT's "Cost of Quality" report. Estimates for the cost nationally of achieving river water quality improvements to meet existing non-statutory river quality objectives exceeds £1.6 billion. The estimated cost of the schemes identified by

TARGETS AND CURRENT STATE OF THE CATCHMENT

the NRA as high priority is £916 million. The national expenditure allowed by the Secretary of State in his 6 July statement is £522 million with an allocation to Severn Trent Water plc of £194 million.

In his announcement the Secretary of State stated that the £522 million is specifically for improving river quality. It is for the NRA, in consultation with the water companies, to determine the most cost effective use of this expenditure.

Catchment Targets

Table 13 identifies the river stretches covered by the plan and assigns various River Ecosystem Classes to them.

The column headed Current Quality describes the actual quality of the river over the last three years (1991-1993) in terms of an RE class.

The next column, Short Term Objective, shows the RE class assuming that all the consented discharges within each stretch of river discharge up to their consent limits in terms of both quality and quantity. This objective should be met within the plan period, i.e. the next five years, and will take account of any improvements planned by Severn Trent Water plc under AMP2.

The final column entitled Long Term Objective is the objective beyond the plan period and is a translation of the River Quality Objective from the former NWC scheme.

TARGETS AND CURRENT STATE OF THE CATCHMENT

TABLE 13: RE OBJECTIVES

River	Stretch Description	Reach (km)	River Quality Objectives			EC Fisheries Desig ^a Present	EC Fisheries Desig ^a Proposed
			Current Quality	Short Term Objective	Long Term Objective		
Severn	Confluence R. Teme to Hatfield Brook	3.4	RE2	RE2(1995)	RE2	C	C
Severn	Hatfield Brook to Ripple Supply Intake	12.6	RE2	RE2(1995)	RE2	C	C
Severn	Ripple Supply Intake to confluence R. Avon	8.5	RE2	RE2(1995)	RE2	C	C
Severn	Confluence R. Avon to R. Chelt	10.0	RE2	RE2(1995)	RE2	C	C
Severn	Confluence R. Chelt to Ashleworth	3.5	RE2	RE2(1995)	RE2	C	C
Severn	Ashleworth to Llanthony Weir	8.2	RE2	RE2(1995)	RE2	C	C
Careys Brook	A449 Bastonford Bridge to DS Powick STP	3.5	RE2	RE2(1995)	RE2		S
Careys Brook	FB DS of Powick STP to R. Severn	2.5	RE2	RE2(1995)	RE2		S
Hatfield Brook	FB at Norton to R. Severn	4.5	RE2	RE2(1995)	RE2		
Madresfield Brook	Road Bridge at Madresfield to R. Severn	4.3	RE2	RE2(1995)	RE2		
Whiteacres Brook	Southwood, Guarford to Madresfield Brook	2.0	RE4	RE4(1995)	RE4		
Pool Brook	Hanley Castle to B4209 BR Hanley Swan	1.8	RE3	RE2(1995)	RE2		C
Pool Brook	B4209 Bridge, Hanley Swan to R. Severn	3.2	RE3	RE3(1995)	RE2		C
Mere Brook	US of Gilberts End to Pool Brook	2.5	RE3	RE2(1995)	RE2		
Bushley Brook	0.5Km DS of Horse Bridge to Mill Brook	4.1	RE5	RE4(1995)(1)	RE2		
Bushley Brook	Confluence with Mill Brook to R. Severn	3.8	RE4	RE3(1995)	RE2	C	C
Mill/Marlbank Brook	Sansome Farm to Trib DS Welland Court	2.4	RE5	RE4(1995)	RE2		C
Marlbank Brook	Trib DS Welland Court to Bushley Brook	4.0	RE3	RE3(1995)	RE2		C
Ripple Brook	Stratford Road Bridge to Bow Bridge	2.6	RE2	RE2(1995)	RE2		
Ripple Brook	Bow Bridge to R. Severn	2.3	RE4	RE3(1995)	RE2		C
River Chelt	Charlton Kings to confluence trib, Moor End	2.0	RE2	RE2(1995)	RE2		S
River Chelt	Trib, Moor End to Arle Avenue, Cheltenham	2.8	RE3	RE2(1995)	RE2		
River Chelt	Arle Avenue Cheltenham to B4634, Springbank	2.6	RE2	RE4(1995)	RE4		
River Chelt	B4634 RD BR, Springbank to M5 Culvert	2.4	RE2	RE4(1995)	RE4		
River Chelt	M5 Culvert to FB Near Becketts Farm	2.2	RE5	RE4(2000)	RE4		
River Chelt	FB Near Becketts Farm to R. Severn	5.0	RE5	RE4(2000)	RE4		

TARGETS AND CURRENT STATE OF THE CATCHMENT

Leigh Brook	Coombe Hill to R. Chelt	5.0	RE3	RE2(1995)	RE2		
Ashleworth Brook	Wick Ridge ST to R. Severn	3.0	RE4	RE3(1995)	RE2		
Hatherley Brook	Shurdington Road to Fiddlers Green Lane	2.9	RE3	RE2(1995)	RE2		
Hatherley Brook	Fiddlers Green Lane to Innesworth STP	6.0	RE3	RE2(1995)	RE2		
Hatherley Brook	Innesworth STP to Innesworth Brook	1.5	RE2	RE2(1995)	RE2		
Hatherley Brook	Confluence Innesworth Brook to R. Severn	2.5	No class	No Obj Set	RE5		
Horsebere Brook	Below Witcombe Reservoir to B4063, Elmbridge	4.6	RE3	RE2(1995)	RE2		
Horsebere Brook	B4063 Elmbridge to confluence with R. Severn	5.7	RE2	RE2(1995)	RE2		
Wooton Brook	Below Trading Estate to Cole Brook, Gloucester	4.3	RE3	RE2(1995)	RE2		
Wooton Brook	FB, Oxtalls Campus to Horsebere Brook	2.6	RE3	RE2(1995)	RE2		
Twyver	A46, Upton St. Leonards to Tredworth	3.5	RE2	RE2(1995)	RE2		
Twyver	Tredworth to confluence with R. Severn	5.5	RE3	RE2(1995)	RE2		
Sud Brook	B4073 Gloucester to Glos/Sharpness Canal	5.0	RE2	RE2(1995)	RE2		
Daniel's Brook	US Brookthorpe to Glos/Sharpness Canal	5.1	RE2	RE2(1995)	RE2		
Leadon	US Evesbatch Pools to FB to Hill Farm	2.2	RE4	RE4(1995)	RE2	S	S(2)
Leadon	FB To Hill Farm to confluence with Stoney Brook	5.6	RE2	RE2(1995)	RE2	S	S
Leadon	Stoney Brook to confluence with Stores Brook	2.0	RE2	RE2(1995)	RE2	S	S
Leadon	Stores Brook to A438, New Mills	1.8	RE2	RE2(1995)	RE2	S	S
Leadon	A438, New Mills to Ledbury STP	2.0	RE2	RE2(1995)	RE2	S	S
Leadon	Ledbury STP to Siddington Farm	1.5	RE3	RE4(1995)	RE3		
Leadon	Siddington Farm to confluence with Preston Brook	4.0	RE3	RE4(1995)	RE2		
Leadon	Confluence with Preston Brook to Road Bridge, Ketford	4.3	RE3	RE2(1995)	RE2	S	S
Leadon	Ketford to Upleadon Road Bridge	9.4	RE3	RE2(1995)	RE2	S	S
Leadon	Upleadon Road Bridge to R. Severn	12.0	RE3	RE2(1995)	RE2	C	C
Preston Brook	FB at Laddin Farm to R. Leadon	6.0	RE5	RE5(1995)(1)	RE1		S(2)
Kempley Brook	Whittocks End to confluence with Preston Brook	5.0	RE4	RE4(1995)(1)	RE1		S(2)
Glynch Brook	Bury Court Road Bridge to R. Leadon	11.5	RE3	RE3(1995)	RE3		S(2)

TARGETS AND CURRENT STATE OF THE CATCHMENT

Ell Brook	Gorsley/Kilcot Tribs to FB near Malswick	5.0	RE3	RE2(1995)	RE2		S
Ell Brook	FB Near Malwick to confluence with R. Leaddon	4.1	RE2	RE2(1995)	RE2		S
Red Brook	Taynton Court/Drews FB to Huntley Brook	2.4	RE2	RE2(1995)	RE2		S
Red Brook	Confluence with Huntley Brook to R. Leaddon	2.9	RE5	RE5(1995)(1)	RE2		S(2)
Huntley (Tibberton) Brook	FB at Merrimans to confluence with Red Brook	4.4	RE2	RE2(1995)	RE2		S
Dimore Brook	Waterwells to confluence with R. Severn	3.7	RE3	RE4(1995)	RE4		
Ley Brook	FB at Round Hill to R. Severn	5.0	RE4	RE2(1998)(3)	RE2		
River Frome	FB at Duntisbourne Common to Slad Brook	16.8	RE2	RE1(1995)	RE1	S	S
River Frome	Confluence with Slad Brook to Ryford	3.5	RE2	RE2(1995)(4)	RE1	C	C
Frome (Southern Arm)	Ryford to Stanley Downton STP	2.7	RE2	RE2(1995)(4)	RE1		
Frome (Southern Arm)	Stanley Downton STP to confluence North Arm	2.0	RE4	RE3(2000)	RE3		
Frome (North Arm)	Ebley to confluence South Arm	5.0	RE2	RE1(2000)	RE1		S
Frome (Southern Arm)	Confluence with North Arm to R. Severn	8.2	RE2	RE2(1995)	RE2	C	C
Slad Brook	Above Uplands to Stroudwater Canal	2.0	RE2	RE2(1995)	RE1		S
Painswick Stream	FB at Damsells to Stroudwater Canal	7.5	RE2	RE1(1995)	RE1		S
Nailsworth Stream	DS of Cherington Pond to Avening STP	2.7	RE1	RE1(1995)	RE1		S
Nailsworth Stream	Avening STP to Nailsworth	3.0	RE2	RE2(1995)(5)	RE1		S
Nailsworth Stream	Nailsworth to confluence with R. Frome	5.0	RE2	RE2(1995)	RE2		S
Horsley Stream	Kingscote Wood to Nailsworth Stream	4.0	RE2	RE2(1995)(4)	RE1		S
Westbury Brook	Sharpbridge to Longhope Brook	4.5	RE2	RE2(1995)	RE2		S
Westbury Brook	Longhope Brook to confluence with R. Severn	2.7	RE2	RE2(1995)	RE2		S
Longhope Brook	A4136 Longhope to Longhope STP Outfall	1.5	RE2	RE2(1995)	RE2		S
Longhope Brook	Longhope STP to confluence with Westbury Brook	3.5	RE2	RE2(1995)	RE2		S
Cinderford	Drybrook Brook to Bilson Green Industrial Estate	2.5	RE2	RE2(1995)	RE2		C
Cinderford	Bilson Green Estate to FB Stockwell Green	1.9	RE4	RE4(1995)	RE3		C
Cinderford	FB Stockwell Green to Ruspidge	2.5	RE5	RE3(1995)(6)	RE3		C
Cinderford	Ruspidge to Road BR, Upper Soudley	0.6	RE4	RE3(1995)(6)	RE3		C
Cinderford	Upper Soudley to B4227, Lower Soudley	1.0	RE2	RE2(1995)	RE2		C
Cinderford	B4227 Lower Soudley to R. Severn	8.7	RE2	RE2(1995)	RE2		S

TARGETS AND CURRENT STATE OF THE CATCHMENT

Blackpool Brook	Road Br, Blakeley Walk to Cinderford Brook	4.0	RE1	RE1(1995)	RE1		S
Cannop Brook	Cannop Ponds outlet to Norchards Drift	7.0	RE2	RE1(1995)	RE1	C	S
Cannop Brook	Norchards Drift to Bifurcation, M. Forge	0.7	RE3	RE3(1995)	RE3		C
Cannop Brook	Bifurcation, M. Forge to A48, Lydney	0.8	RE2	RE3(1995)	RE3		C
Cannop Brook	A48 RD BR, Lydney to confluence with the cut	2.0	RE3	RE3(1995)	RE3		C
Cannop Brook	Confluence with the cut to R. Severn	1.5	RE2	RE3(1995)	RE3		C
Cannop Brook	Bifurcation, M. Forge to US Crompton	1.5	RE3	RE3(1995)	RE3		C
Cannop Brook	US Crompton to Junction of cut and Cannop Brook	0.6	RE5	RE3(1995)	RE3		C
Birches Dingle	Source at the Birches to Cannop Brook	1.5	RE2	RE2(1995)(4)	RE1		
Colliers Brook	Cottage Farm, Aylburton to R. Severn	5.0	RE2	RE2(1995)	RE2		S
Park Brook	Curves Hill to confluence with Colliers Brook	3.5	RE1	RE2(1995)	RE2		S
Cone Brook	Below Smallbrook to R. Severn	3.0	RE1	RE1(1995)	RE1		S
Cam	Below Dingle Farm to Upstream Listers	4.5	RE2	RE1(1995)	RE1		S
Cam	Upstream Listers to Coaley STP outfall	5.0	RE2	RE1(1995)	RE1		S
Cam	Coaley STP outfall to Waterend Farm	1.0	RE3	RE3(1995)	RE3		C
Cam	Waterend Farm to Gloucester/Sharpness Canal	3.6	RE3	RE3(1995)	RE3		C
Coaley Brook	Tickshill - Hydegate Bridge to River Cam	3.8	RE3	RE2(1995)	RE1		S
Gloucester/Sharpness Canal	Gloucester Lock to confluence Daniels Brook	3.0	RE2	RE2(1995)	RE2	C	C
Gloucester/Sharpness Canal	Confluence Daniels Brook to confluence R. Frome	12.5	RE3	RE2(1995)	RE2	C	C
Gloucester/Sharpness Canal	R.Frome to Sharpness Docks	12.5	RE3	RE2(1995)	RE2	C	C
Little Avon	Wickwar - Southwood Farm	1.7	RE2	RE2(1995)	RE2		
Little Avon	Southwood Farm - B4060	2.8	RE3	RE2(1997)	RE2		
Little Avon	B4060 - Confluence with Ozleworth Brook	1.7	RE3	RE2(1997)	RE2		
Little Avon	Confluence with Ozleworth Brook - Works	0.4	RE2	RE2(1995)	RE2		
Little Avon	Works - Damery	1.3	RE3	RE2(1995)	RE2		
Little Avon	Damery - Confluence with Tortworth Brook	2.4	RE2	RE2(1995)	RE2		
Little Avon	Confluence with Tortworth Brook - Confluence with Fal Brook	2.5	RE2	RE2(1995)	RE2		
Little Avon	Confluence with Fal Brook with Dovert Brook	2.8	RE2	RE2(1995)	RE2		
Little Avon	Confluence with Dovert Brook - Hook Street (estuary)	1.4	RE3	RE2(1997)	RE2		
Tortworth Brook	Cromhall - Eastwood Park	4.8	RE4	RE4	RE3	C	
Tortworth Brook	Eastwood Park - Confluence with Little Avon	3.2	RE3	RE3	RE3		

TARGETS AND CURRENT STATE OF THE CATCHMENT

Ozleworth Brook	Wortley - Confluence with Kilcott Stream	0.6	RE2	RE2	RE2		
Ozleworth Brook	Confluence with Kilcott Str - Nind Farm	0.7	RE2	RE2	RE2		
Ozleworth Brook	Nind Farm - Gatehouse	1.1	RE3	RE2(1996)	RE2		
Ozleworth Brook	Gatehouse - Works	1.1	RE2	RE2	RE2		
Ozleworth Brook	Works - Confluence with Little Avon	2.1	RE3	RE3	RE2		

Footnotes

(1) Natural Low Dissolved Oxygen

(3) Farm pollution problems to be resolved

(5) Avening STP Consent Appeal

(2) Salmonid Fishery not matched by water quality.

(4) Low Dissolved Oxygen - to be investigated.

(6) pH problem resolved.

Abbreviations used:

DS Downstream

US Upstream

FB Footbridge

RDBR Raodbridge

STP Sewage Treatment Plant

5.2 WATER QUANTITY

SURFACE WATER

General

There are four main use types which affect the natural flow regime of a river. These are:

- * Abstractions
- * Discharges
- * Reservoirs and Impoundments
- * Developments

Abstractions can reduce the quantity of water in rivers and streams. Discharges increase the flow. Reservoirs and impoundments affect flow and levels in a more complex manner. Where an impoundment is used for water power, for example, a head may be built up to generate electricity over a short period. This has the effect of cutting down the flow in the river while the reservoir fills, then increasing flow during generation.

Abstraction licences have been issued in their present form since 1965. Initially, "licences of right" were issued to anyone who had been abstracting during the previous five years. Conditions protecting the environment or other abstractors could not be imposed on the licences. Since then, applications to abstract have been determined on an individual basis and conditions imposed to protect the environmental and other abstractors' rights except for Licences of Entitlement (Cf. Section 4.2). In addition the Catchment is split into "Policy Areas" to protect surface water resources. These areas define how and under what conditions licences are operated and granted. (Map 20)

However, since abstraction licences were first issued it has been very difficult to assess how much water may be abstracted without adversely affecting the environment. The NRA is therefore undertaking a number of research projects to help answer this question. It will be several years before answers are available, but when concluded, it will be possible to set flow targets throughout the catchment.

Surface water flows to watercourse are also affected by increased development in the catchment. Development reduces the amount of infiltration thus increasing the quantity of run-off and decreasing the amount of rainwater which is absorbed into the ground. The time taken for the rain to reach the watercourse system is reduced, particularly where the developed area is sewered direct to the watercourse system. These two aspects affect the flow regime in a catchment often leading to increased flood peak flows and reduced base flows.

Through liaison with Planning Authorities, the NRA seeks to ensure that the effects of development on the flow regime of the catchment's watercourses are minimised.

TARGETS AND CURRENT STATE OF THE CATCHMENT

State of the Catchment

The present policy for licensing surface water is for any new licences within the Leadon and Frome catchment to be restricted. The first licences to be restricted in a catchment are tied to a flow which is close to the measured dry weather flow - defined as the mean of the average flows of the driest week of the year. This restriction threshold is called the primary. After a significant number of licences have been issued at the primary threshold a secondary threshold is introduced to ensure that existing uses do not suffer.

One of the main areas of national work in water resources at present is to review the requirement and method of setting these environmental threshold levels for flow. The Leadon catchment has a primary and secondary restriction. The secondary threshold is at 30.0 MI/day and the primary is 22.7MI/day. There is still only a primary restriction on the Frome which is 50.0MI/day, although new licence applications need to have consideration for Bristol Water's abstraction at Purton.

Control of flows in the River Severn itself is complex as the river can be supported by releases from Llyn Clywedog and Llyn Vyrnwy in Mid Wales (up to 500MI/d and 70MI/d) respectively, and boreholes in Shropshire (up to 85MI/d). Regulation of the River Severn at present is tied to flows at Bewdley. In the past this has been estimated to provide a minimum flow at Gloucester of 1150MI/d.

The requirement for flow at Gloucester is presently being reviewed in light of abstractions downstream of Bewdley and the effect on fisheries, conservation and quality. Changing the River Severn Control Rules requires legislation and proposals should be made within the 5 year life of this plan. This will need to encompass the long term requirements of Severn Trent Water and Bristol Water.

During the period of maximum flow support to the river from Llyn Clywedog the abstractions from major water supply sources are restricted on a daily basis to the annual daily average flow as shown below:

	Daily Abstraction (MI/d) (No regulation)	Daily Abstraction (MI/d) (Regulation)
Upton	167	100
Mythe	125	109.0
Bristol W.	215	190.0

In the rest of the catchment if there is a particular concern for issuing the licence a local flow restriction can be enforced. The licence holder would need to monitor the flow downstream of the abstraction so when the flow falls below a specified level the abstractor would have to cease or reduce abstraction.

TARGETS AND CURRENT STATE OF THE CATCHMENT

Catchment Targets

New Abstractions

The NRA will determine new abstraction licence applications within the framework of the Water Resources Act 1991. The impacts of new abstractions will be carefully considered on their own merits and viewed in the light of problems specific to the catchment. The NRA will only grant new licences if it is confident that the available resources are able to sustain the proposed abstraction in the long term without harm to the environment or existing abstractors, and the demands of the applicant are justified.

To overcome this, it has been the practice in the NRA Severn-Trent Region to restrict licences to different flow rates. The more recent the licence then the earlier in the abstraction season is the likelihood of a licence restriction being imposed.

While these restrictions help to provide protection to the environment they are not in themselves targets. Actual flow is often less than the dry weather flow. This is caused by 'licence of right' abstractions over which the NRA has little control except in extreme conditions. Gradual control of some of these licences of right is the only means of achieving future quantity targets. One measure of environmental requirement for river flows that has been suggested is a minimum of 60% of the dry weather flow.

Surface Water Control

Unless carefully sited and designed, development can increase the rate and volume of surface water run-off, resulting in increased risk of flooding downstream. This can also reduce flow in watercourses during dry weather as the recharge from the ground is reduced. Surface water control is vital in expanding urban areas.

Future Demands for Water Use

The NRA has analysed information on water use and has prepared a Regional Water Resources Strategy. It will be reviewing forecasts of future demands to try and anticipate needs for water resources developments and consider ways of meeting those future demands.

For public water supplies the NRA expects the fullest opportunities will be taken for effective demand management, particularly in the area of leakage control and in the introduction of domestic metering in zones of resource shortage. In all dealings with potential new abstractions, the NRA will seek to achieve environmental benefits from any new arrangements, whether for minor local improvements or from strategic considerations associated with conjunctive use of major sources.

TARGETS AND CURRENT STATE OF THE CATCHMENT

GROUNDWATER

General

The NRA's 'Policy and Practice for the Protection of Groundwater' (PPPG) provides advice on the management and protection of groundwater on a sustainable basis. This new policy deals with the concepts of vulnerability and risk to groundwater from a range of human activities. It considers both the source and resource protection, i.e. protection around the point of abstraction (source) and protection for the area which drains to the abstraction point (resource).

It deals in particular with;

- * discharges to underground strata
- * waste disposal to land
- * disposal of slurries and sludge to land
- * contaminated land
- * diffuse pollution
- * unacceptable activities in high risk areas.

The implementation of the policy relies in part on the construction of a series of maps showing the location of the sources to be protected.

The policy recognises three groundwater source protection zones, which are currently being defined. These are:-

Zone I (Inner Source Protection): Immediately adjacent to the source area defined by a 50 day travel time from any point below the water table to the source (based on biological contaminant decay).

Zone II (Outer Source Protection): Area defined by 400 day travel time (based on the delay and attenuation of slowly degrading pollutants).

Zone III (Source Catchment): The complete catchment area of groundwater source. The controls to be exerted on a given activity will be more stringent the more vulnerable the resource and the nearer the source.

The vulnerability of groundwater to pollution, based on geology and the candidate Nitrate Vulnerable Zones (NVZ's) are shown in Map 21. The NRA have examined all groundwater sources used for public water supply. Any at which the nitrate level exceeds 50mg/l (as NO₃) or are likely to exceed this level by 2010 have been put forward as candidate zones for

TARGETS AND CURRENT STATE OF THE CATCHMENT

designation under the EC Nitrate Directive (91/676/EEC). This aims to limit nitrate losses from agricultural land by means of measures to be put out for consultation during 1995 as an "action plan". The draft action plan includes restrictions on the application of both inorganic and organic fertilisers as well as on agricultural practice. These measures are likely to be in line with good agricultural practice.

The NVZ around Bromsberrow and Lintridge has also been designated as a Nitrate Sensitive Area. This is a voluntary scheme whereby farmers can agree to more restrictive practices under a number of options and in turn receive compensation in line with the perceived reduction in yield.

Resource Capacity

The NRA's Severn-Trent Region categorise areas of groundwater (aquifer units) on the basis of their capacity to provide further groundwater resources. The classification is:-

- A: No resources available
- B: Special study needed and presumption against large licences
- C: Special study - no presumption
- D: Resources available

NRA Severn-Trent Region manages groundwater by assessing the amount of recharge which enters discrete areas of aquifer called aquifer units. Each aquifer unit is examined to determine whether it supports the baseflow to rivers in which case a significant proportion of the recharge must remain unabstracted to maintain that support. This is the case with the Oxenhall unit. If base flow is not required, a larger proportion of the recharge is available for abstraction. Whilst this is true for the Bromsberrow unit, this unit is also over abstracted. It is not acceptable to over abstract any unit as this inevitably leads to falling groundwater levels and environmental damage to wetland features supported by groundwater. In overabstracted units the NRA will not grant licences and will seek reductions in the licensed and actual abstraction when licences are renewed or changed.

The data summarised below are a review of groundwater resources. This is conducted annually; Table 14 relates to 1994:

TABLE 14: GROUNDWATER ABSTRACTION REVIEW

	Oxenhall	Bromsberrow
Assessed Recharge	16.57	7.17
Licensed Abstractions	6.61	9.10
Actual Abstractions	4.10	9.05

TARGETS AND CURRENT STATE OF THE CATCHMENT

Any other groundwater licences are assessed according to the local availability of resources. In parts of the Leadon Catchment, there is an area which extends into the Upper Severn reaches, where groundwater abstractions are exempt from licensing. Owing to the geology it was thought that water resources in this area are limited, and therefore licensing was not required, but this is to be reviewed.

5.3 PHYSICAL FEATURES TARGETS

General

This section considers targets for physical features on rivers and river corridors in the catchment. Fishery, Conservation and Recreational matters and Flood Defence works are dealt with under this heading. The term conservation includes nature conservation as well as features of archaeological, architectural, historic and physio-graphical interests.

CONSERVATION (INCLUDING WILDLIFE, LANDSCAPE AND ARCHAEOLOGICAL INTEREST)

State of the Catchment

Many uses are affected by the physical characteristics or features of the river and this is especially true of Uses related to wildlife and its conservation. The habitat requirements of the wildlife associated with rivers are too complex to allow simple targets to be set, even if such habitats could be effectively measured. Consequently, Catchment Plans will adopt the general qualitative target that the abundance and diversity of physical features, typical of the type of river, should be maintained and where possible, improved. Although this is of a subjective nature, the NRA's development of quantitative assessment methods namely River Corridor Survey, River Habitat Surveys and River Landscape Assessment will facilitate a more quantitative approach. The NRA is also developing a habitat classification system and use related targets for physical features such as spawning and nursery sites for fish.

The Catchment area has been reviewed to identify stretches where issues arise relating to this function - these are described in Map 22. This is not a quantitative analysis but rather a response to known concerns.

Targets

Until more detailed targets are set the following general targets are to:

- * Ensure that future development does not reduce the conservation value of the river corridor and where possible improves it.
- * Undertake environmental assessment of all NRA works and identify opportunities for increasing the conservation value of rivers and wetlands and for improving the quality of the water-related landscape in association with these works.
- * Carry out NRA consenting practices and respond to development proposals in a manner that ensures that natural features such as emergent vegetation, meanders, pools and the landscape are preserved and enhanced where appropriate, and features of archaeological, architectural and historic interest are preserved.

**River Severn Lower Reaches
Catchment Management Plan**

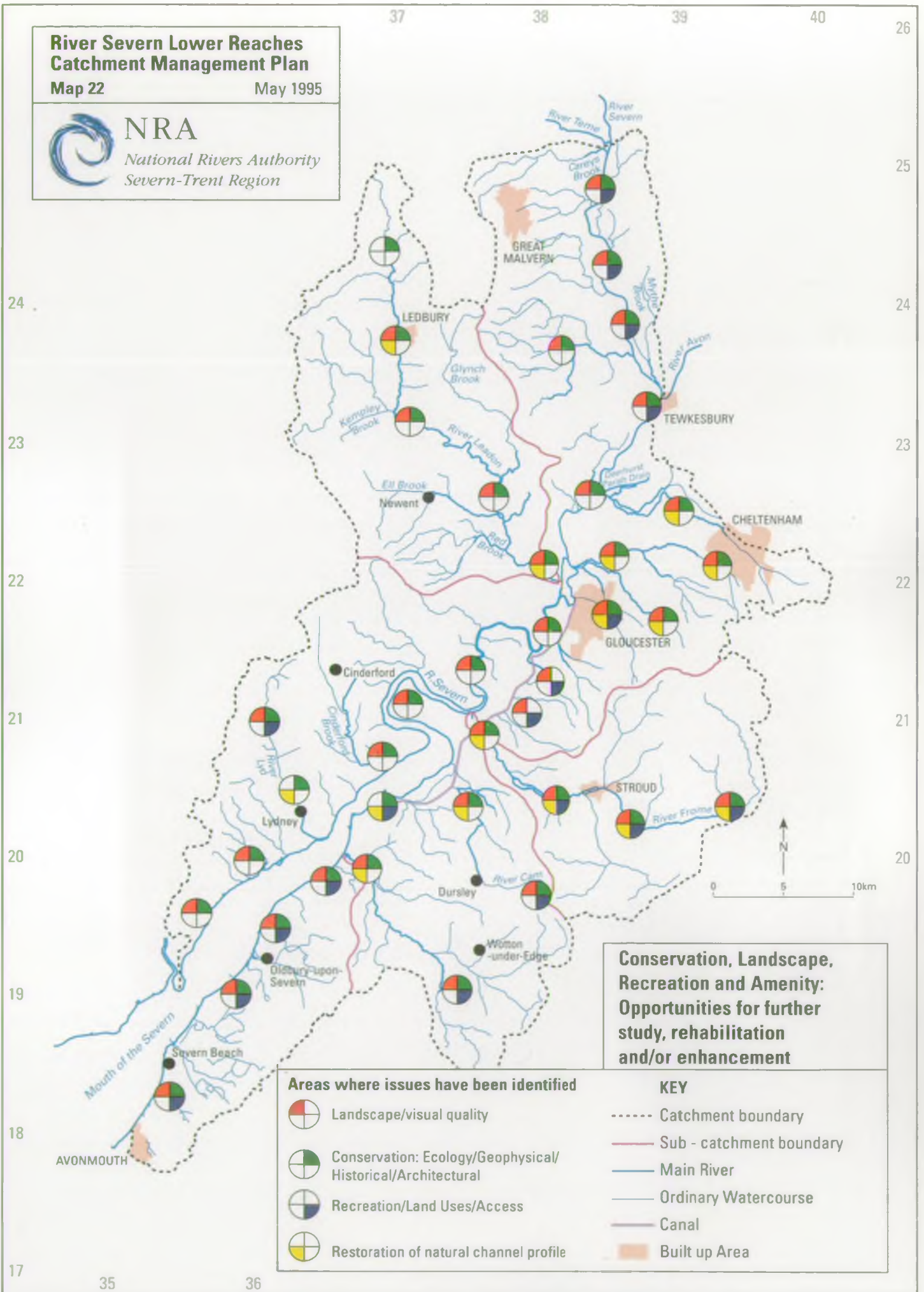
Map 22

May 1995



NRA

National Rivers Authority
Severn-Trent Region



TARGETS AND CURRENT STATE OF THE CATCHMENT

- * Seek opportunities for the NRA to carry out capital projects to protect or improve the physical character of the water environment.
- * Liaise with other bodies to promote and support initiatives for the maintenance of wetland, wet meadows, in-stream and bankside habitats.
- * Rehabilitate degraded sections of river corridor.

FISHERIES

State of the Catchment

River Severn Corridor

The resident fish population in the part of the River Severn covered by this Catchment Plan is dominated by coarse fish and eels. Most coarse fish species are present and bleak, roach, bream and eels are common in most sections. Complaints were received from anglers concerning the quality of the fishing on the River Severn downstream of the Mythe Bridge, Tewkesbury in the mid 1980's and extensive survey work was carried out in 1986, 1987 and 1988. It was found that fish densities were low in some sections of the river but that the population structure of most species was well-balanced, with a good spread of age groups present. Despite the low densities of fish, growth rates of bottom feeding species in particular were below average suggesting that natural food was limited or feeding impaired. A number of changes in the ecology of the river were identified including changes in flow pattern, nutrient cycles and siltation. These are thought to be due to long term changes in population, land use within the catchment and changes in boat traffic on the river. Invertebrate survey work, confirmed a sparsity of invertebrates but the situation has gradually improved since 1988 and has been reflected in improved angler catch.

Elver catches from the River Severn are also much poorer when compared with the situation in the 1970's and estimates suggest a decrease up to 10 fold in some years. At that time there was no requirement for elver fishing to be licensed and fishermen were not obliged to make an annual return. Despite the decline in elver catch, research work both on the River Severn and elsewhere in the catchment has shown that eel stocks have not been affected. Indeed, due to a restocking policy which has operated since the mid 1970's, eel stocks have improved greatly in some catchments such as the Upper Avon. This problem with elvers has been noted throughout Europe and is therefore thought to be caused by factors beyond the control of the NRA, such as changes in oceanic currents in the Atlantic. Eel and elver passes are, nevertheless being installed on weirs within the area to facilitate easy upstream movement, increase dispersal and enhance stocks of adult eels to maintain the brood stock. The problem is being addressed internationally by the European Inland Fishery Advisory Commission (EIFAC).

TARGETS AND CURRENT STATE OF THE CATCHMENT

Leadon

The River Leadon upstream of Dymock and a number of tributaries including the Ell, Pixley, Kempley, Red and Stoney Brooks contain good stocks of native wild brown trout. Restocking has been necessary over the years and the genetic integrity of the stock has probably been diluted but populations are normally self-sustaining. The lower reaches of the River are populated by coarse fish such as roach, dace, chub, gudgeon and eels, with good densities of fish downstream of Wedderburn Bridge. The section of the river immediately downstream of Ledbury was fishless in the 1970's due to water quality problems from Ledbury. It has gradually improved and stoneloach are now abundant within that section. However water quality remains mediocre. The stock of trout in the uppermost section of the river is also poor and intermittent pollution problems from agricultural units have been identified as a possible cause and rectified by NRA pollution control staff in recent years.

Forest of Dean

Many of the Forest streams, including the River Lyd, Longhope, Westbury, Blackpool and Cone Brook hold good stocks of mature wild brown trout, at least in their upper reaches. On occasion salmon and sea lamprey are also known to spawn in these streams. Important coarse fisheries exist in the lower River Lyd, Lydney Lake, Cannop Ponds, Steam Mills Lake and a number of other lakes and pools. The River Lyd is adversely affected by an old mine discharge at the Norchard Drift just upstream of Lydney. This causes cementation of the gravels due to the precipitation of iron oxide. The river was also adversely affected by the illegal tipping of toxic waste in October 1992 but is now recovering following restocking.

Frome

The upper reaches of the Frome and its tributaries again hold good stocks of mature wild brown trout though reduced flows in the Frome upstream of Brimscombe can cause downstream migration and reduced densities in that area. Trout are to be found in good numbers on the North Arm downstream to Eastington and at various locations on the South arm. Conditions in impounded sections are, however, better suited to coarse fish and roach, bream and eel predominate in these areas. Downstream of the M5 Motorway coarse fish densities are very low in some sections despite significant restocking over the last 20 years. The river, in this area was channelised for land drainage purposes in the past and poor habitat may well be a significant factor.

Cam and Little Avon

The upper reaches of the Cam and Little Avon and its tributaries generally contain good stocks of native wild brown trout, which are self-sustaining. Localised problems of reduced stock density have, however, been identified on one or two tributaries including the Nibley Brook and Ozleworth Brook. Intermittent water quality problems may be the reason. Populations in the lower reaches of both the Cam and Avon are dominated by coarse fish and eels. Stocks on the Lower Cam were low in the 1980's following land drainage work and restocking was carried out. Weed growth can be prolific downstream of the A38 and the

TARGETS AND CURRENT STATE OF THE CATCHMENT

channel is somewhat featureless. Recent fishery survey work in this lower reach has, however, shown excellent stocks of roach in particular, though these are thought to move to and from the Gloucester-Sharpness Canal during the year.

Avonmouth Area

With the exception of pool and lake fisheries, the predominant fish species to be found in the streams and rhines in this area is the eel. Good numbers are found in many of the watercourses despite their small size and uniform habitat.

Targets

The general aim for all fisheries is a sustainable level of exploitation by the rod fishery whilst conserving the natural history of the stock. Trends in fish stock abundance can be identified and comparisons made with 'expected' abundances based upon habitat characteristics. A methodology to determine specific salmon spawning targets is presently being adopted in the Upper Severn area where salmon from this catchment spawn.

General targets are to:

- * Control illegal fishing by use of a bailiff force in anti-poaching patrols and by targeting the market in illegally caught fish.
- * Maintain an abundance of juvenile salmon, brown trout and coarse fish (where they presently exist) which is related where possible to the carrying capacity of the catchment based upon habitat characteristics.
- * Maintain existing high quality fishery habitats in the catchment and where possible restore damaged fishery habitats.
- * Provide access, where appropriate, for salmon and trout to all suitable spawning and nursery areas.
- * Maintain a monitoring programme which quantifies accurately stock abundance.

RECREATION

State of the Catchment

The catchment has potential for development of water related recreational activities. Access and facilities such as car parking need to be carefully reviewed in order to not conflict with the local requirements or other uses such as nature conservation.

TARGETS AND CURRENT STATE OF THE CATCHMENT

Targets are to:-

- * Undertake or commission Recreation Survey of catchment
- * Formulate strategy for specific sites to avoid conflicts
- * Promote nodal points on Severn Way to ensure reasonably spaced access/car parking etc.
- * Liaise with appropriate organisations (Sustrans etc.) re. opportunities for off-road cycle tracks
- * Promote improved facilities re. viewing of Severn Bore to avoid conflict with local population and to resolve safety problems at Stonebench
- * Establish links with recreation organisations and Local Authorities re. recreation requirements and provisions
- * Consider the need for a User Group for the catchment either as a separate entity or as an expansion of the remit of the existing River Avon User Group

FLOOD DEFENCE

State of the Catchment

In deciding where to invest resources the NRA has determined Standards of Service based on land use bands. These define an "acceptable" level of protection in terms of frequency of flooding of land or property. This frequency is expressed in terms of frequency of flooding of land or property. This frequency is expressed as a return period, for example 1 in 50 years. This is a measure of the likelihood of a flood where a 1 in 50 year flood has a 2% chance of occurring in any year.

A detailed description of flooding problems was first undertaken in 1980 to satisfy Section 24(5) of the Water Act 1973. This was most recently updated in 1990 (now under Section 105 of the Water Resources Act 1991). Table 15 indicates, by local authority, the number of riverine flooding problems during the 1980-1990 period, split between main river, where the NRA is empowered to undertake remedial works and ordinary watercourses where the local authority has similar powers.

Targets

Flood Defence targets nearly all relate to physical features and the requirement for the river channel to contain certain specified flows at different points in its length. The current state of the Catchment has been assessed by looking at flood histories and areas known to flood (Table 15). Standards are set according to land use.

**River Severn Lower Reaches
Catchment Management Plan**

Map 23 May 1995



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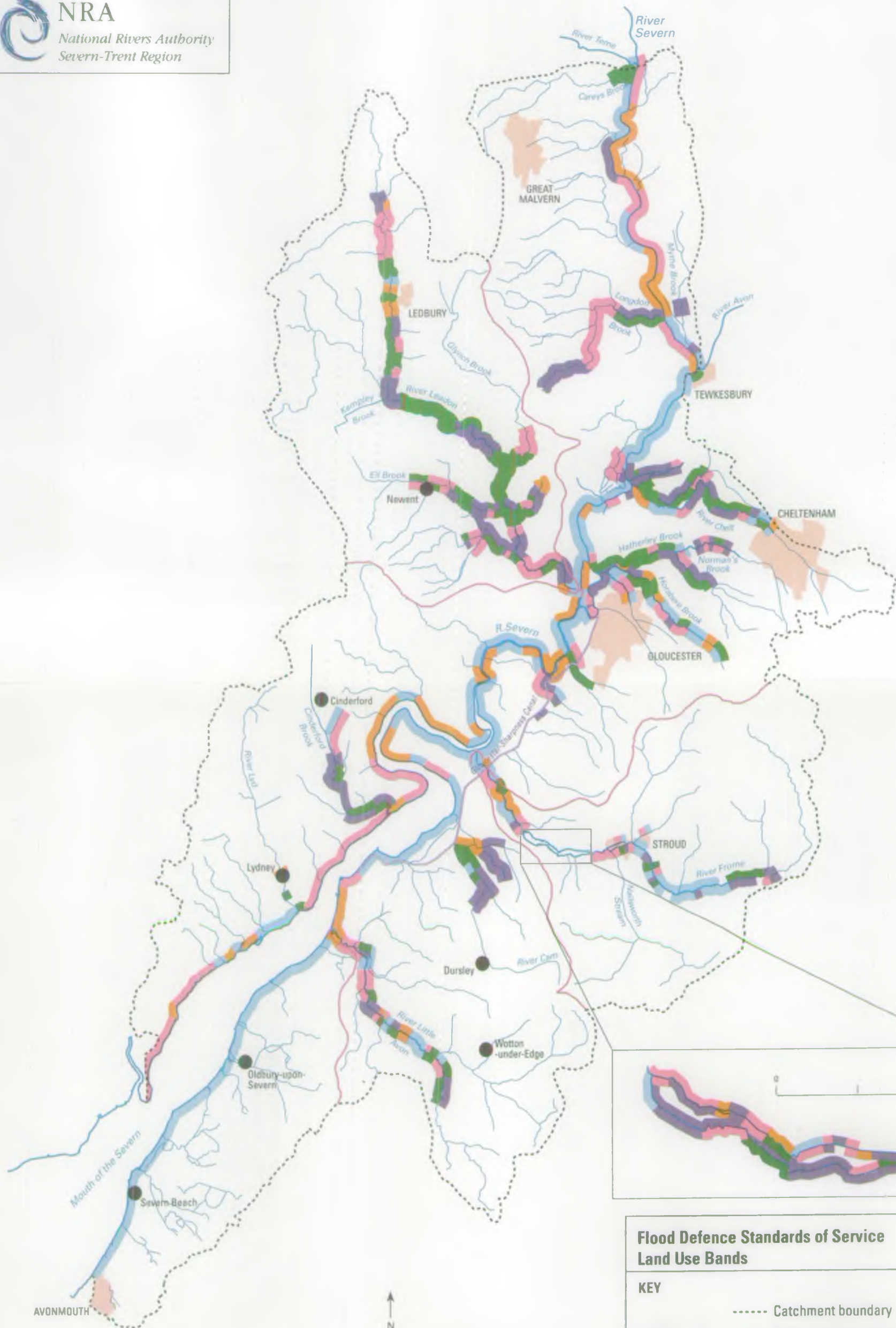
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










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**Flood Defence Standards of Service
Land Use Bands**

KEY

- | | | | |
|---|---|---|--------------------------|
|  | A |  | Catchment boundary |
|  | B |  | Sub - catchment boundary |
|  | C |  | Main River |
|  | D |  | Ordinary Watercourse |
|  | E |  | Canal |
| | |  | Built up Area |

TARGETS AND CURRENT STATE OF THE CATCHMENT

TABLE 15 FLOODING PROBLEMS

District/Borough Council	Total	Main River	Ordinary Watercourse
Northavon DC	33	1	32
Stroud DC	48	5	43
Gloucester City	5	2	3
Cheltenham BC	2	1	1
Cotswold DC	4	0	4
Forest of Dean DC	44	2	42
Tewkesbury BC	26	11	15
Malvern Hills DC	34	6	28
Wychavon DC	NONE		
South Herefordshire DC	NONE		

Map 23 shows Land Use Bands in the catchment and full definitions are given in Table 16.

The NRA uses a system of land use identification for flood defence purposes which is based on the concept of House Equivalents (HE). This takes each type of land use in the flood plain for example housing, commercial, retail, manufacturing, rural (arable, pasture, horticulture) and using the potential losses due to flooding equates them to HE figures. The HE figure also takes into account the flooding of transport routes and the resultant costs to the community of alternative transport arrangements.

**River Severn Lower Reaches
Catchment Management Plan**

Map 23

May 1995

TARGETS AND CURRENT STATE OF THE CATCHMENT

TABLE 16 - Indicative Standards of Protection for Flood Defence and Land Drainage

Land Use Band	Description of Typical Land Use	Indicative Standards of Protection*	
		Non Tidal (Return Period)	Tidal
A	High density urban containing significant amounts of both residential and non-residential property.	100	200
B	Medium density urban. Lower density than Band A, may also include some agricultural land.	75	150
C	Low density urban or rural communities with limited numbers of properties at risk. Highly productive agricultural land.	25	50
D	Generally arable farming with isolated properties. Medium productivity agricultural land.	10	20
E	Predominantly extensive grass with very few properties at risk. Low productivity agricultural land.	1	5

* The quoted Indicative Standards of Protection provide a starting point to guide the investigator of a potential flood alleviation scheme towards a practical level of investigation. The resulting Standard of Protection would be the outcome of a case specific and appropriately detailed appraisal. This would consider Benefit/Cost Incremental Benefit/Cost ratios, plus any other significant factors, for example, legal, environmental, etc.

Improvement and maintenance works are targeted towards those watercourses which are under serviced, particularly where the higher land use bands (A to C) are involved.

With respect to preservation of the floodplain and flood risk management, the NRA seeks to ensure that the flood risks are not increased by development, thereby resulting in unnecessary measures. It does this by close liaison with local planning authorities. The following targets are used:-

- * No loss of flood plain or storage capacity.
- * No increase in flood risk as a result of development.

TARGETS AND CURRENT STATE OF THE CATCHMENT

- * No new development in an area where the existing level of service is considered below the standard required for the type of development proposed.
- * Provision of suitable access for maintenance of the river channel.

Flood Warning

The NRA target is to provide a minimum of 2 hours warning of the commencement of flooding. It is currently reviewing in particular, flood warning on the estuary.

APPENDICES

APPENDIX 1 FLOOD DEFENCE ROLES

A 1.1 DURING FLOOD EVENTS

A1.1.1 National Rivers Authority

The NRA forecast likely flood levels, issue warnings to the Police and give advice to the public. We also patrol main river and remove any blockages, inspect formal flood defences and carry out any necessary remedial works.

The flood warning system is operated on the following main rivers in the catchment:

River Severn and River Frome.

Warnings are issued for three phases (Yellow, Amber and Red) each of which is associated with increasing flood risk. Details can be obtained from the Lower Severn Area office at Tewkesbury.

A1.1.2 Emergency Services

A1.1.2.1 Police

The Police receive flood warnings from the NRA and either contact those directly at risk, or pass the warning to Local Authorities of flood wardens.

They can also advise on which roads are closed due to flooding.

A1.1.2.2 Fire Service

The fire service provide help in flood emergencies if they are able to do so. The local station will be able to advise the public on what help is, or is likely to be available and whether or not a charge will be made.

A1.1.2.3 RSPCA

This organisation can provide assistance with rescuing animals in danger from floods.

A1.1.3 Local Authorities

A1.1.3.1 District Councils

These have permissive powers to offer assistance (eg. sandbags) during floods. Each Council has a different policy on the amount and type of help they give. Details are available direct from each Council.

Some District Councils are involved in dissemination of flood warnings, generally via flood wardens. These systems have been set up by the councils in consultation with the NRA. Flood Wardens are local residents who each contact several other residents to pass on flood warnings.

A1.1.3.2 County Councils

County Councils are the Authorities responsible for Public Highways and any flooding problems associated with road drainage should be referred to them.

All County Councils have Emergency Planning Officers who may become involved in more serious flood events.

In Warwickshire the County Emergency Planning Office disseminates flood warnings to flood wardens.

The Councils' Social Services Departments can become involved in providing assistance in the event of evacuation of people from flooded areas.

A1.1.4.3 Water Companies

Public surface water sewerage systems are the responsibility of Water Companies, who sometimes use District Councils as their Agents. Any problems relating to flooding, other than from watercourses, should be directed to the local Water Company.

A1.2 GENERAL MATTERS

A1.2.1 National Rivers Authority

The NRA's Flood Defence powers are contained in the Water Resources Act 1991, the Land Drainage Act 1991 and the Authority's Land Drainage Byelaws.

The Authority has a supervisory role over all matters relating to land drainage and has a duty whilst carrying out this function to:

"further the conservation and enhancement of natural beauty and the conservation of flora, fauna and geological or physiographical features of special interest". It must also "have regard to the desirability of protecting and conserving buildings, sites and objects of archaeological, architectural or historic interest"

Any work in, over, under or within 8 metres of main river requires the consent of the NRA, as does the construction or alteration of a culvert, mill dam, weir or like obstruction on any watercourse.

The Authority is a statutory consultee of the Local Planning Authorities for statutory plans and planning applications. The Planning Authorities are not obliged to incorporate NRA

requirements or comments in their planning decisions but must consider them. It should be noted that control over development in the flood plain, even main river, is through the Planning Act not under Flood Defence legislation.

The NRA has powers to maintain and improve main river watercourses and construct flood defences. Any such work must be both financially viable and environmentally acceptable. The NRA does not carry out erosion protection unless a formal flood defence is likely to be affected.

A1.2.2 Local Authorities

Both County and District Councils have powers which relate to and affect the river system.

As stated above they have the power to control development by use of the Planning Act.

In addition they have direct powers under the Land Drainage Act 1991 to take action against riparian landowners, or others, who cause obstructions to watercourses. They are also empowered to carry out watercourse improvements that will benefit the community but need to obtain the NRA's consent for such work.

A1.2.3 Riparian Landowners

Riparian landowners are those people who own land adjacent to watercourses. Generally ownership is taken to be up to the centre line of a watercourse, unless deeds show otherwise.

Riparian landowners are responsible for maintaining their watercourses, and under common law may not diminish the flow in terms of quantity nor "throw water back" on upstream landowners.

Erosion is a natural process which can cause significant loss of land. If the landowner wishes to carry out protection work to the river bank, or indeed any alteration to a watercourse, then the NRA must be consulted as a Land Drainage Consent may be required.

APPENDIX 2 GLOSSARY

Abstraction	The removal of water from any source, either permanently or temporarily.
Abstraction Licence	An authorisation granted by the NRA to allow the removal of water from a source of supply.
Algae	Plants, floating or attached, which occur in still and flowing water.
Ammonia	A chemical compound found in water often as a result of pollution by sewage effluents. It is widely used to determine water quality.
AMP2	Asset Management Plan 2 - A document describing proposed investment (capital) by the water industry as agreed by OFWAT (see also in this glossary), the Government and the water companies.
AONB	Area of Outstanding Natural Beauty.
Aquifer	A porous water-bearing underground layer of rock, sand or gravel capable of holding significant quantities of water.
Base Flow	The flow in a river derived from groundwater sources.
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed in water (over 5 days), usually by organic pollution. Oxygen is vital for life so the measurement of the BOD test whether pollution could affect aquatic animals.
BW	British Waterways.
CCW	Countryside Council for Wales.
CLA	Country Landowners Association.
Co Co	Countryside Commission.
CPRE	Council for the Protection of Rural England.
Cyprinid Fish	Coarse fish belonging to the carp family, like roach, dace and bream.
Dangerous Substances	Substances defined by the European Commission as in need of special control because of their toxicity, bio-accumulation and persistence in plants and animals.
Discharge Consent	A statutory document is issued by the NRA which defines the legal limits and conditions on the discharge quality and volume of an effluent to a water.
DO	Dissolved Oxygen. The amount of oxygen dissolved in water. Oxygen is vital for life so this measurement is a test of the health of a river.
DoE	Department of the Environment.

DWF	Dry Weather Flow. For rivers this is calculated as the average of flows during the driest seven consecutive days in each year for the period of record. For sewage works it is calculated by adding estimates of the domestic sewage discharge (population x per capita consumption) plus any industrial discharges and infiltration into the sewer.
EC Directive	A type of legislation issued by the European Union which is binding on Member States in terms of the results to be achieved but which leaves to Member States the choice of methods.
Ecosystem	A functioning, interacting system composed of one or more living organisms and their effective environment, in biological, chemical and physical sense.
Effluent	Liquid waste from industrial, agricultural or sewage plant.
EH	English Heritage.
EN	English Nature.
Eutrophication	The biological effects of an increase in plant nutrients - nitrates and phosphates.
Floodplain	Land adjacent to a watercourse that is subject to flooding.
Fluvial	That pertaining to the river itself.
FWAG	Farming and Wildlife Advisory Group.
Gauging Station	A site where the flow of a river is measured.
GQA	General Quality Assessment (water quality).
Groundwater	Water which flows or is stored below the surface of the land (in aquifers).
Groundwater Units	Administrative sub-divisions of aquifers, defined on geological and hydrogeological criteria, which form the basis for groundwater resource management and licensing policy decisions.
Habitat	The locality or environment in which a plant or animal species lives.
HBF	House Builders Federation
HE	House Equivalents.
HMIP	Her Majesty's Inspectorate of Pollution.
IDB	Internal Drainage Board
Landfill	Site used for waste disposal into or onto land.

Leachate	Liquid emanating from solid matter.
Leaching	Removal of soluble substances by action of water percolating through soil, waste or rock.
Main River	The watercourses shown on the statutory 'Main River maps' held by NRA and MAFF. The NRA has permissive powers to carry out works of maintenance and improvements on these rivers.
MAFF	Ministry of Agriculture, Fisheries and Food.
mg/l	Milligrammes per litre.
ML/d	Megalitres per day.
µg/l	Microgrammes per litre.
m³/d	Cubic metres per day.
NH₃	Ammoniacal Nitrogen.
Nutrient	A chemical essential for life. if present in excess nutrients can produce the effects of eutrophication. In this report the term, nutrient, implies plant nutrients, primarily, nitrate and phosphate.
OFWAT	Office of Water Services.
Ordinary Watercourse	A watercourse that does not form part of a Main River.
Piscivorous	Feeding on fish.
Potable Water	Water of quality suitable for drinking.
Prescribed Flow	A flow set to protect lawful downstream users and the aquatic environment.
RAMSAR	Name of the place in Israel where an international convention agreed that members (including the NRA) would designate wetland sites of national or international importance.
Reach	A length of river.
Recharge	Water which percolates downward from the surface into groundwater.
Residual Flow	The flow remaining in a watercourse after abstractions have taken place.
Rhine	Small drainage channels.
River Corridor	A term which describes a stretch of river, its banks and a varying amount of adjacent land that is affected by the presence of the river.
Salmonid Fish	Game fish of the salmon family, for example, trout and salmon.

SAM	Scheduled Ancient Monuments. the key sites nationally for archaeology, designated by the Secretary of State for National Heritage, through English Heritage and CADW. Statutory; designated under the Ancient Monuments and Archaeological Areas Act 1979.
SINC	Sites of Importance for Nature Conservation.
SS	Suspended Solids
SSO	Storm Sewer Overflow.
SSSIs	Sites of Special Scientific Interest. The best examples of the national heritage of wildlife habitats, geological features and landforms, designated by English Nature and the Countryside Council for Wales. Statutory; notified under the Wildlife and Countryside Act 1981.
STP	Sewage Treatment Plant.
Surface Water	Water which flows or is stored on the surface of the land.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Sustrans	The Railway Path and Cycle Route Company - a national charity.
Telemetry	Automatic monitoring of river levels, rainfall, wind and temperature.
UWWTD	Urban Waste Water Treatment Directive.
WQO	Water Quality Objective.
WRW	Water Reclamation Works.

**APPENDIX 3 PARTICIPANTS AT RIVER SEVERN LOWER REACHES CMP FORUM
HELD 18 JANUARY 1995**

Bristol Water
Bristol City Council
British Waterways
Cotswold Canals Trust
CPRE
English Nature
Farming and Wildlife Advisory Group
Forest of Dean District Council
Forestry Authority
Friends of the Earth
Gloucester City Council
Gloucester County Council
Gloucester United Anglers
Gloucestershire Wildlife Trust
Hereford & Worcester County Council
HMIP
House Builders Federation
National Association of Boat Owners
NFU
Northavon District Council
Ramblers Association
RSPB
Severn Trent Water Ltd
South Gloucestershire IDB
Stroud District Council
Water Power Engineering, Coaley Mill
Wildfowl & Wetlands Trust
Worcestershire Wildlife Trust



ENVIRONMENT AGENCY

NATIONAL LIBRARY &
INFORMATION SERVICE

HEAD OFFICE

Rio House, Waterside Drive,
Aztec West, Almondsbury,
Bristol BS32 4UD

The National Rivers Authority Guardians of the Water Environment

The National Rivers Authority is responsible for a wide range of regulatory and statutory duties connected with the water environment.

Created in 1989 under the Water Act it comprises a national policy body coordinating the activities of 8 regional groups.

The main functions of the NRA are:

- | | |
|---|--|
| Water resources | — The planning of resources to meet the water needs of the country; licensing companies, organisations and individuals to abstract water and monitoring the licences. |
| Environmental quality and Pollution Control | — maintaining and improving water quality in rivers, estuaries and coastal seas; granting consents for discharges to the water environment; monitoring water quality; pollution control. |
| Flood defence | — the general supervision of flood defences; the carrying out of works on main rivers and sea defences. |
| Fisheries | — the maintenance, improvement and development of fisheries in inland waters including licensing, re-stocking and enforcement functions. |
| Conservation | — furthering the conservation of the water environment and protecting its amenity. |
| Navigation and Recreation | — navigation responsibilities in three regions — Anglian, Southern and Thames and the provision and maintenance of recreational facilities on rivers and waters under its control. |



NRA

NRA EMERGENCY HOTLINE

0800 80 70 60

24 hour emergency telephone line