



**POLICY AND PRACTICE
FOR THE PROTECTION
OF GROUNDWATER**

**REGIONAL APPENDIX
NORTH WEST REGION**



NRA

National Rivers Authority



ENVIRONMENT AGENCY

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NATIONAL RIVERS AUTHORITY
NORTH WEST
REGIONAL APPENDIX
2nd Edition, 1995

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1.0 INTRODUCTION

1.1 Purpose of the Regional Appendix

This Regional Appendix to the National Rivers Authority "policy and practice for the protection of groundwater" provides information specific to North West Region. Details are given on the following subjects.

- * description of North West Region
- * geology and hydrogeology
- * main office locations and contacts relevant to groundwater matters
- * how to use the "policy" prior to the introduction of new Groundwater Vulnerability maps

This is one of ten appendices that have been produced. Each one is specific to a different NRA Region. Although the main document is a national one there are certain considerations within the headings listed above that are relevant only to this Region. Each appendix is produced to the same format with the extra information included. The appendices must be read in conjunction with the main document. Emphasis is given to Regionally important factors such as the vulnerability of particular strata.

1.2 North West Region

The total population of the Region is 6.8 million, which is the third largest of the ten Regions. It is the fourth largest in terms of geographic area. It covers the area west of the Pennines, from the Solway Firth in the north to Stoke on Trent in the south (see enclosed Water Resources brochure).

It includes a diversity of landscapes from the mountainous upland of the Lake District to the lowland plains of Cheshire. Land use varies from arable farming, stock grazing especially sheep in upland areas and market gardening. Heavy industry and coal mining is now declining. However tourism is an important and growing industry in the Region and there is much seasonal

SOLID GEOLOGY

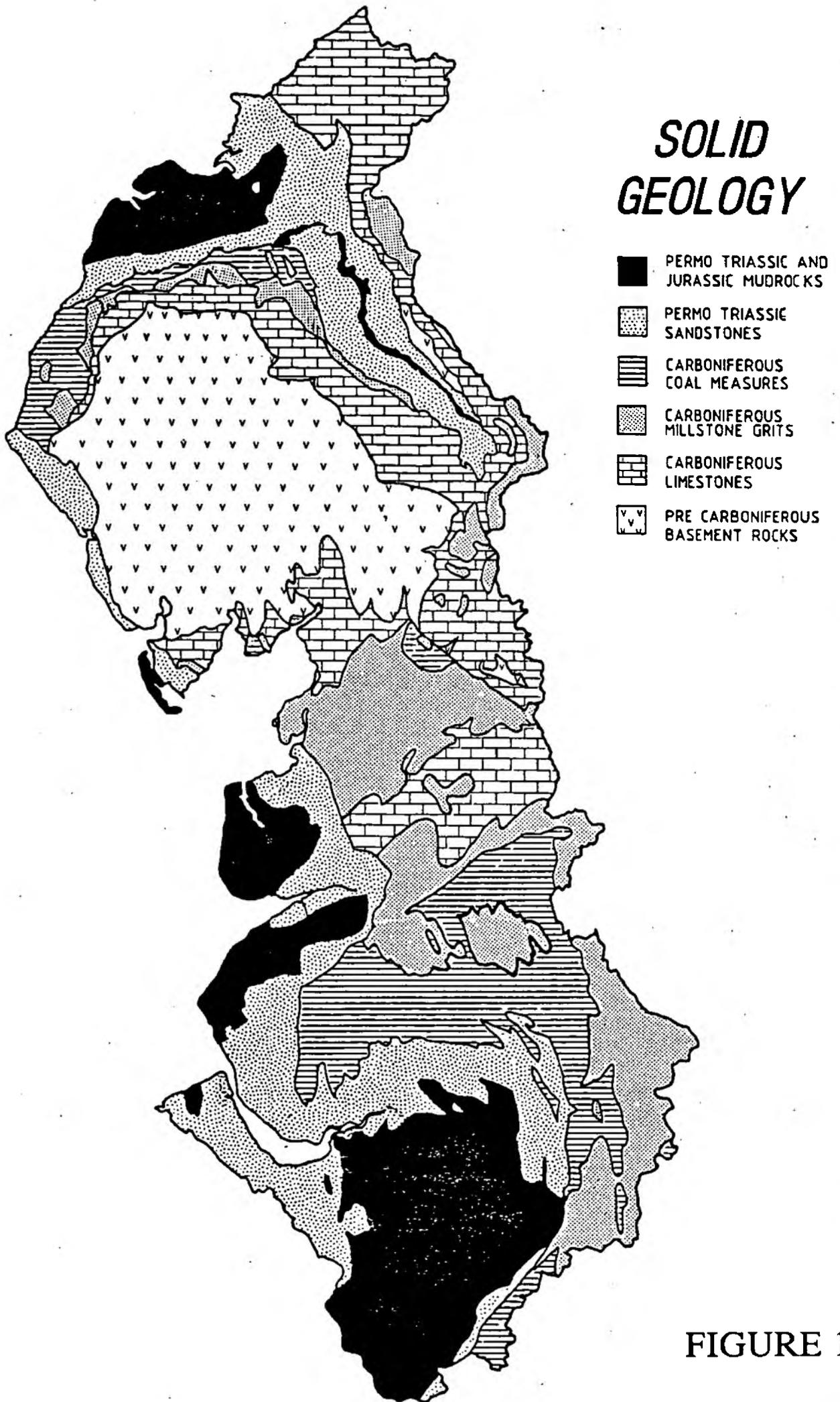


FIGURE 1

demand for water. For example the Lake District is an important tourist area and Blackpool itself attracts 150,000 visitors per year.

1.3 Groundwater in the North West

Abstraction of groundwater is carried out for a variety of potable, industrial, and agricultural uses throughout the Region ranging from small domestic supplies abstracting less than 2,000 litres per day (440 gallons per day) to major public supply sources abstracting over 9 Megalitres per day (2 million gallons per day). The North West Region has 308 public supply boreholes. The major abstractions are generally from the Permo -Triassic Sherwood sandstones, although significant resources exist in the Middle and Upper Carboniferous strata. There are few areas where groundwater is not exploited at some scale.

The enclosed brochure shows quantities of water abstracted in the Region based on purpose of use.

The main water supply company in the Region is North West Water Ltd which uses approximately 90% of the total volume of groundwater abstracted in the Region. Many major industries rely on a good quality source of groundwater throughout the Region. It is estimated that there could be as many as 20,000 private water supplies in the Region relying on groundwater often in the form of springs. Abstractions in the area for the production of bottled waters are often located on minor aquifer areas. All these supplies are particularly vulnerable to pollution from agricultural practices such as slurry spreading. The southern and central parts of the Region are highly productive for agriculture. Spray irrigation, often supported by groundwater makes this possible.

2.0 GEOLOGY AND HYDROGEOLOGY

2.1 Geology

The Region has a great diversity of both age and types of rock (Figure 1). The oldest strata, of Lower Palaeozoic age (Pre-Cambrian to Silurian), occur in the Lake District. They comprise rocks of igneous or metamorphic origin in the central lakes, flanked by Ordovician and Silurian low grade metamorphosed sedimentary rocks to the north and south. They are generally hard, resistant to erosion, and structurally tend to be intensely folded and faulted. In hydrogeological terms these strata may be considered to be effectively impermeable, except for some limited groundwater storage and movement within shallow fractured/weathered zones. Although classed as non-aquifer, they may be capable of supporting small scale private water supplies (springs).

Carboniferous strata cover the largest part of the Region. They are exposed to the north and south of the Lake District, as well as on the Pennines, in central Lancashire and east Cheshire. They comprise alternating shales/mudstones, siltstones, sandstones and, in the case of the Limestone Series (Lower Carboniferous) and Coal Measures (Upper Carboniferous) respectively, limestones and coals. The sandstone and limestone formations tend to act as individual 'minor'

aquifer units, separated by the lower permeability shales/mudstones. Groundwater movement is principally by fissure flow. In the case of limestones, rapid unpredictable movement can occur via solution cavity networks. Similarly, the presence of old coal workings can give rise to complex groundwater flow paths. The various minor Carboniferous aquifer units, particularly the sandstones within the Millstone Grit Series (Namurian), are extensively exploited to provide private domestic and agricultural water supplies in rural areas remote from the mains system.

Permo-Triassic sandstones (Sherwood Sandstone) and overlying marls/evaporites (Mercia Mudstones) rest unconformably on the older Carboniferous rocks. They are of aeolian/fluvial origin, having been deposited in inland basins under arid conditions. Significant thicknesses occur in the Carlisle basin and Eden valley, west Lancashire (Fylde), Merseyside and in the Cheshire basin. The Sherwood Sandstone deposits are relatively consistent and extensive. Groundwater movement is by both intergranular and fissure flow. They constitute major aquifers which are heavily exploited for public and industrial water supply purposes.

The Mercia Mudstones, in hydrogeological terms, may be considered to be effectively impermeable, except for some limited groundwater storage and movement within shallow fractured/weathered zones. Although classed as non-aquifer, they may be capable of supporting small scale private water supplies (springs).

With the exception of the higher ground of the Lake District and Pennines, much of the Region is covered by superficial (drift) deposits. These are mostly of glacial/fluvio-glacial origin, comprising till (boulder clay) and interbedded sands. The till is generally of low permeability, whereas the sands can act as important (albeit often undeveloped) minor aquifers. Alluvial deposits (clays, silts, sands and gravels), occur within the flood plains of most watercourses. The thickness, distribution and lithology of the drift geology is often complex and highly variable.

Features associated with the main rock types are summarized in Table 1.

Table 1.

AGE/ ROCK TYPE	MAIN LOCATIONS	DESCRIPTION	FLOW MECHANISM	GEOLOGICAL CLASSIFICATION
Alluvium	Throughout Region	Silts Clays	Intergranular	Minor Aquifer
Fluvioglacial sands and gravel	Throughout Region	Sands and Gravels	Intergranular	Minor Aquifer
Boulder Clay	Throughout Region	Clays with occasional sand lenses	Varied	Non - Aquifer
Jurassic	North Cumbria and South Cheshire	Clays	Fissure	Non - Aquifer
Permo-Triassic	Throughout Region	Sandstones Shales	Fissure/ Intergranular	Major Aquifer
Carboniferous	Throughout Region	Limestones Mudstones Siltstones Sandstones Coals	Fissure	Minor Aquifer
Devonian	Lake District	Greywackes Siltstones	Fissure	Non - Aquifer
Silurian	Lake District	Greywackes Mudstones Siltstones	Fissure	Non - Aquifer
Ordovician	Lake District	Mainly Tuffs and Lavas some Limestone	Fissure	Non - Aquifer
Igneous and metamorphic of various ages	Lake District	Granites Lavas Basalts	Fissure	Non - Aquifer

2.2 Hydrogeology

Rainfall is generally plentiful across the Region although the diversity of the geography and topography gives rise to major variations. It ranges from 3650mm in the Lake District to 680mm in Cheshire. Actual annual recharge is highly variable and controlled by the geology. Glacial till 'boulder clay' mantles much of the North West Region and can restrict recharge to 50mm compared say to an estimated 350mm for exposed sandstone in Cheshire. Table 2 is derived from the main policy document. The division of the rock formations into major, minor and non-aquifer reflects the Regional importance and vulnerability of the formation.

Table 2

MAJOR AQUIFER	MINOR AQUIFER	AQUIFER	NON - AQUIFER
Highly permeable formations usually with the known or probable presence of significant fracturing. Highly productive strata of Regional importance. Often used for large potable abstractions.	Fractured or potentially fractured but without high intergranular permeability. Generally only support locally important abstractions.	Variable porosity and permeability but without significant fracturing. Generally only support locally important abstractions.	Formations with negligible permeability. Only support very minor abstractions if any.
Permo - Triassic Sandstones	Coal Measures Millstone Grit Carboniferous Limestones Silurian Limestone	River sands and gravels Glacial sands and gravels Windblown sands.	All clays, shales, marls and siltstones. Igneous and metamorphic rocks Mercia Mudstones Lias Clay

3.0 GROUNDWATER PROBLEMS

- Policy A** Low river flows, reportedly as a result of over abstraction of groundwater, have been recorded in the Fylde area of Lancashire.
- Policy B** Quarrying has reportedly affected spring flows in a number of minor aquifers.
- Policy C** Waste disposal to land occurs throughout the Region but problems are minimised because of the good liaison between all parties.
- Policy D** Contaminated land especially in the Mersey Valley is seen as an increasing problem.
- Policy E** Sludge spreading has caused problems to private supplies from minor aquifers.
- Policy F** Discharge to underground strata from septic tanks occurs throughout the Region. It is not a specific problem except in limestone areas where silage effluent, too, is a concern.
- Policy G** Although nitrate sensitive areas have not been introduced in the North West a number of public supply boreholes show an increase in nitrate concentration and designation of one Nitrate Vulnerable Zone under the E.C. Nitrate Directive is currently proposed for an area near Kelsall in Cheshire.

Saline intrusion of aquifers occurs along the Mersey Estuary as a result of historic groundwater abstraction. Elsewhere connate saline water occurs.

4.0 MAIN OFFICE LOCATIONS

See brochure enclosed at the back of this Appendix.

The responsibility for Groundwater matters for the whole Region rests with the Specialist Services Groundwater Section at the Richard Fairclough House in Warrington
(Contact Groundwater Systems Manager Telephone no. Warrington [01925] -653999)

5.0 GROUNDWATER PROTECTION POLICY -INTERIM ARRANGEMENTS

There is a considerable amount of work involved in producing the new Groundwater Vulnerability maps for geological classification and the definition of Source Protection Zones. Eventually a series of Groundwater Vulnerability maps will be produced on a scale of 1:100,000. These maps are produced after considering the vulnerability of the groundwater, the geology, and also soil type. The first of these in the NW region (sheet 16) which covers much of Cheshire is now available. Sheet 10, covering SW Lancashire will be available from mid 1996.

The Source Protection Zones will not be produced on these maps but on large scale maps and in reports held in the Regional NRA offices. It will be possible for any developer to discuss the definition of any zone in relation to a particular proposal. The outlines of the zones will not however be altered without detailed hydrogeological information to support the amendment.

This programme of work has already started but will continue for many months. The first group of 87 Source Protection Zones were produced for the NRA in 1993. Priority has been given to those sources considered most vulnerable. Beyond this time the Source Protection Zones will be defined as soon as possible and when the necessity arises. An additional 34 sites will be zoned in the period ending 1997.

In the interim the existing methods of dealing with development proposals will continue.

All the following will be considered:

- * the local geology and hydrogeology
- * the local sources and resources
- * the effect of artificial influences such as adit and drainage soughs.

In problem areas every effort will be made to discuss with developers, at the earliest opportunity, their proposals to see whether alternative arrangements or precautions could solve the problem. Essentially each case will be dealt with on its own merits.

WATER RESOURCES

BROCHURE

WATER RESOURCES IN THE NORTH WEST OF ENGLAND

Water is a vital and valuable resource which has to be looked after carefully to meet the demands placed upon it. In England and Wales, this is the work of the National Rivers Authority, "Guardians of the Water Environment".

About 97% of all the water in the planet is contained within the Oceans and Seas.

Evaporation from the water surface and transpiration from plants enters the atmosphere and produces pure water as clouds and rain.

The prevailing winds over the British Isles are south-westerly bringing vast air masses containing water vapour from the Atlantic Ocean. Where the air has to rise over hills and high ground, it cools and the water vapour condenses - bringing higher rainfall in these areas.

The average rainfall across the North West Region is 1129 mm per year - ranging from 3650 mm in the Cumbrian mountains to 680 mm on the Cheshire plain. It is the NRA's job to balance the need for water between domestic, agricultural and industrial users on the one hand and natural environmental needs on the other. To do this, the NRA needs to look continually at the available amounts of water, the licensing of water abstractions, groundwater protection and the protection of water quality on the surface.

To care properly for the Water Resources of the North West, the NRA has to build up an accurate picture of the amount of water both above and below ground.

Measurements are made using raingauges, river flow gauges and groundwater boreholes.

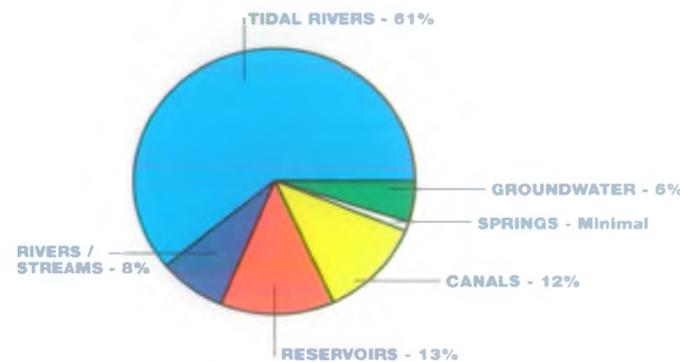


Taking a sample of groundwater from an observation borehole.

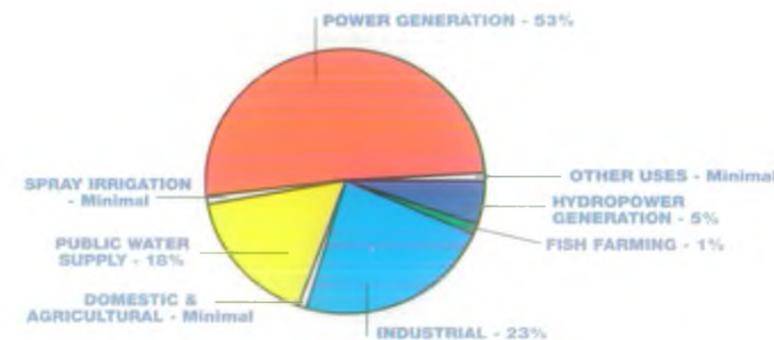
WATER MANAGEMENT

The Water Resources Act, passed by Parliament in 1991, has consolidated the NRA's legal powers to manage, plan and conserve water resources. In the North West, the NRA licenses 15,000 megalitres (3,300 million gallons) of water per day for abstraction. Of this, the largest part comes from intakes on tidal rivers and canals such as the Mersey and Manchester Ship Canal for cooling processes in industry.

QUANTITIES OF WATER ABSTRACTED IN THE NORTH WEST REGION - BASED ON SOURCE OF SUPPLY



QUANTITIES OF WATER ABSTRACTED IN THE NORTH WEST REGION - BASED ON PURPOSE OF USE



About 13% comes from reservoirs - most of which is used for water supply to industry and the general public by North West Water Ltd.

Water is also provided from groundwater aquifers (rocks deep in the ground saturated with water).

In the past, some of these valuable groundwater resources have been heavily exploited - particularly in the North West's main population centres. However, in recent years the declining demand for water from heavy industry has resulted in groundwater levels rising - most notably in the Liverpool area.



Liverpool - Rising groundwater levels need investigation.

The largest aquifers in the region are sandstone rocks. These are found throughout the region from Carlisle in the North to Cheshire in the South. They provide as much water each day as Thirlmere and Haweswater reservoirs combined!

Nearly all abstractions need to be licensed. The licence says how much water can be taken and how often. It may not be granted at all if the taking of water would harm the environment or adversely affect other water users.

The NRA ensures that the holders of the c.3,500 water abstraction licences in the North West comply with the conditions of their licences.

While the demand for water by industry has decreased in some areas, the overall demand for water nationally has increased dramatically in recent decades mainly due to the growth in the use of domestic appliances such as washing machines and dishwashers. In the North West, water demand is not growing at the same rate as in other parts of the country. Across the region as a whole there are enough supplies available to meet the demands of the next 20 years.



Checking abstraction licence conditions.



Measuring the flow of a river.

However, in localised areas over-abstraction can lead to low flows or even "disappearing rivers" which in turn causes loss of wildlife habitats and sometimes shortages for public water supply.



Haweswater reservoir during the 1989 drought.

Thankfully, the North West of England does not suffer as badly as other parts of the country. Nevertheless water shortages do occur from time to time.

NRA staff safeguard both surface and groundwater quality. Groundwater is particularly important because once polluted, it is almost impossible to clean up. An important part of this work involves preventing pollution from waste disposal sites whether closed or still in operation. Agricultural, industrial and domestic activities can also threaten groundwater quality.

Money for the work of Water Resources staff comes from charges levied on Abstraction Licences. Anyone abstracting water themselves (i.e. not obtaining water from a third party such as a Water Supply Company,) will usually require an abstraction licence from the NRA.

In the North West, around £6 million is spent each year on water resource activities.



Over-abstraction can cause rivers to dry up completely in extreme cases.

WHERE TO CONTACT US

AREA OFFICES

NORTHERN

Chertsey Hill,
London Road,
Carlisle
CA1 2QX
Tel: 0228 25151
Fax: 0228 49734

CENTRAL

Lutra House,
Dodd Way,
Off Seedlee Road,
Walton Summit,
Bamber Bridge,
Preston
PR5 8BX
Tel: 0772 39882
Fax: 0772 627730

SOUTHERN

"Mirwell"
Carrington Lane,
Sale
M33 5NL
Tel: 061-973 2237
Fax: 061-973 4601

REGIONAL HEADQUARTERS

P.O. Box 12,
Richard Fairclough House,
Knutsford Road,
Warrington
WA4 1HG
Tel: 0925 53999
TELEX: 628425
FAX: 0925 415961



NRA

National Rivers Authority
North West Region

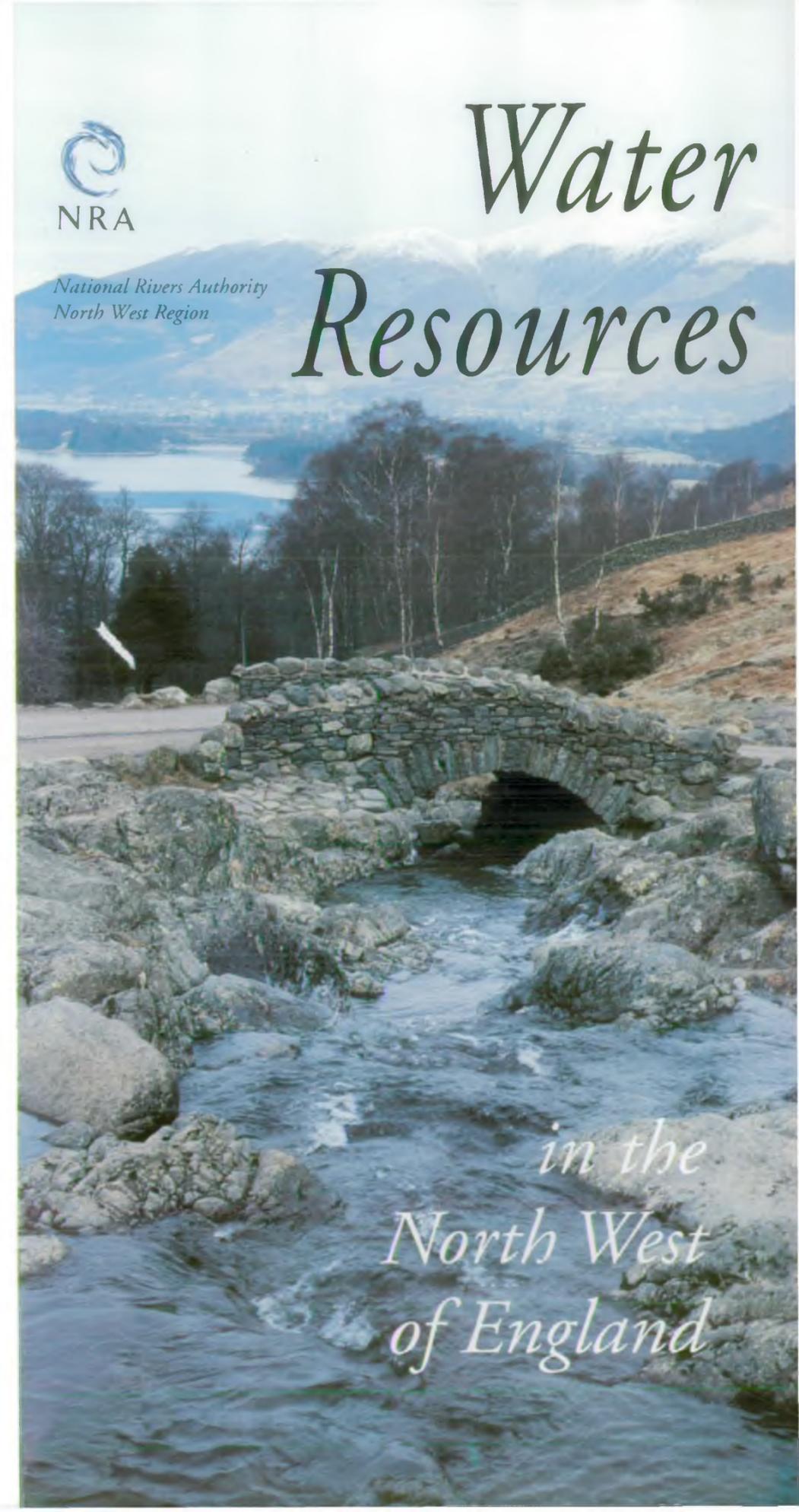
GUARDIANS OF THE WATER ENVIRONMENT



NRA

National Rivers Authority
North West Region

Water Resources



*in the
North West
of England*



NRA

National Rivers Authority

To obtain copies of any of the following documents, please send cheque (made payable to the National Rivers Authority) or postal order to:

National Rivers Authority
Newcastle-Upon-Tyne X
NE85 4ET

- Policy & Practice for the Protection of Groundwater (including the Groundwater Vulnerability Map) Price £15
 - Individual copies of the Groundwater Vulnerability Map Price £5
 - Summary Leaflets for the Groundwater Protection Policy Document No Charge
- Regional Appendices can be obtained from the appropriate regions free of charge

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Fax: (0903) 821832

SOUTH WEST REGION
Manley House
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Exeter EX2 7LQ
Tel: (0392) 444000
Fax: (0392) 444238

THAMES REGION
Kings Meadow House
Kings Meadow Road
Reading RG1 8DQ
Tel: (0734) 535000
Fax: (0734) 500388

WELSH REGION
Rivers House/Plas-yr-Afon
St Mellons Business Park
St Mellons
Cardiff CF3 0LT
Tel: (0222) 770088
Fax: (0222) 798555

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