POLICY AND PRACTICE FOR THE PROTECTION OF GROUNDWATER

REGIONAL APPENDIX

THAMES REGION

NRA

National Rivers Authority

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POLICY AND PRACTICE FOR THE PROTECTION OF GROUNDWATER

THAMES REGION APPENDIX

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POLICY AND PRACTICE FOR THE PROTECTION OF GROUNDWATER

THAMES REGION APPENDIX

1 INTRODUCTION

1.1 Purpose of the Regional Appendix

This is one of ten regional appendices to the NRA's "Policy and Practices for the Protection of Groundwater". Its purpose is to give consideration to matters specific to Thames Region which are not included in the national document. The regional appendices should be read in conjunction with the main document.

1.2 Thames Region

1.2.1 Thames Region comprises the main drainage basin of the River Thames and its tributaries. Major sub-catchments include the Colne, Lee, Kennet, Wey and Loddon. Main rivers within the Region are shown in figure 1.

1.2.2 The Region covers an area of 12900 km^2 with a population of over 11.5 million. Fourteen counties and 91 Districts and Boroughs lie fully or partly within the Region. These administrative areas are shown in figure 2.

1.2.3 Much of the Region, particularly in the west, is rural in character, where the dominant land-use is agricultural. Population density in the Region however is high and there are many important urban areas with long histories of industrial development. The resulting economic and social consideration can present particular pressures regarding protection of groundwater.

1.3 The Importance of Groundwater in the Thames Region

1.3.1 There are many hundreds of private, domestic and commercial boreholes and springs in daily use. The total volume of groundwater licensed for abstraction amounts to about 2305 Ml/d, of which approximately 86% is used for potable supply.

1.3.2 Waater companies in the Region operate over 300 public supply sources from groundwater with licensed abstraction rates for individual sources exceeding 20 Ml/d in many cases. The locations of these sources are shown on figures 3 and 4. The companies with sources in Thames Region are:

1.3.3 Thames Water Utilities Ltd; Southern Water Services Ltd; Wessex Water; Three Valleys Water Services Plc (comprising Colne Valley Water Plc., Lee Valley Water Plc and Rickmansworth Water Plc); Essex Water Co.; East Surrey Water Plc.; Mid Southern Water Co.; North Surrey Water Co.; Sutton District Water Plc; East Worcestershire Waterworks Co.

1.3.4 Groundwater also provides a considerable base flow component to many rivers, particularly in the upper reaches of the catchment. It is therefore clearly of great importance to ensure that groundwater is afforded adequate protection from pollution.

1.4 Water Resources Considerations

1.4.1 Approximately two-thirds of the catchment is permeable and thus subject to direct recharge from rainfall. Polluting discharges may also infiltrate into ground in these areas. The remainder of the catchment consists mainly of low permeability strata and is dominated by surface run-off into watercourses.

1.4.2 Rainfall varies from 850 mm/a in western parts of the catchment to less than 650 mm/a in eastern parts. Rates of recharge to groundwater vary considerably from 524 mm/a in the north-west to 124

mm/a in the east. Where groundwater lies at depth, particularly in granular aquifers, recharge may take months following rainfall infiltration. Where fissures are well developed or the water table is at a shallow depth, recharge may occur within days or weeks. Such recharge characteristics are important factors in assessing pollution risks.

1.4.3 In much of the catchment a situation has been reached where there is no remaining capacity for abstraction because of the need to protect stream flows and the valley environment. In some areas the resource has experienced historic over-abstraction leading to reduced flows and drying up of some groundwater fed rivers, particularly on the Chalk aquifer. This also has consequences for groundwater quality since potentially polluting discharges made to such rivers would tend to soak into aquifers. Abstraction in proximity to the Thames estuary has resulted in the ingress of saline waters several kilometres inland.

1.4.4 A notable exception to the above trend is the Chalk aquifer in the London Basin. The considerable reduction in abstractions over the last 25 years has resulted in rising groundwater levels. This is likely to increase the mineral content of groundwater as it rises into previously dewatered strata above the Chalk.

1.4.5 In addition to a natural rise in groundwater level artificial recharge of the Chalk aquifer for subsequent abstraction takes place intermittently in the Lower Lee Valley and in North London between Stoke Newington and Enfield.

2. GEOLOGY AND HYDROGEOLOGY

2.1.1 The main geological feature of note is the London Basin where the Chalk dips below a Tertiary cover of mainly clays and silts. To the north of the Region Jurassic and Cretaceous strata dip south-easterly towards the London Basin. In the south, Cretaceous strata dip northwards. Regional groundwater flow direction corresponds generally with the direction of strata dip.

2.1.2 Other significant geological features are the escarpments at the boundary between the Chalk and underlying clays, in the north formed by the Berkshire and Wiltshire Downs and Chiltern Hills and in the south the North Downs.

2.1.3 Major Aquifers

2.2.1 The Chalk is the most important aquifer. The three major divisions, the Lower, Middle and Upper, are all of important occurrence within Thames Region. The water table varies in depth from surface springflow to more than 100m below ground level. The Chalk is relatively porous but the interstices are so small that water movement is predominantly through fissures which can allow very rapid flow rates. Fissures are far better developed under valleys than high ground, with correspondingly higher flow rates and greater yields. Swallow holes, allowing rapid infiltration into the aquifer, are common particularly at the junction with the overlying Reading Beds. The Chalk is essentially a pure white fine-grained limestone and in consequence its capacity for attenuation of pollution is limited to dilution and oxygenation. The Lower Chalk is more clayey and less-well fissured

2.2.2 The Jurassic Limestones are a complex series of mainly limestones and clays occurring in the west of the region. The two main aquifers are the Great Oolite and Inferior Oolite, other strata being of minor importance. Water movement is predominantly via a small number of large fissures and rapid flow rates are possible. Springflow is common as is the tendency for streams to lose water to ground in certain sections. Pollution attenuation mechanisms are limited to dilution and oxygenation. This, combined with the complicated hydrogeology presents particular difficulties in assessing pollution risks. To the north east these strata are of lesser importance and may be considered as minor aquifers.

2.2.3 The Lower Greensand is of major importance in the south of the catchment. Water is drawn from the Hythe Beds and Folkestone Beds, which in some areas form distinct aquifer units, being largely separated by the sandy clays and silts of the Sandgate Beds. The aquifers comprise mainly fine to medium grained sand. Flow is predominantly intergranular although fissure flow is also of some importance in the Hythe Beds. These strata can afford good natural filtration and degradation of some pollutants will occur.

In the north-west of the region small remnant outcrops of Lower Greensand are in local hydraulic continuity with similar occurrences of Portland Beds. They form the composite Portlandian - Lower Greensand minor aquifer.

2.2.4 River gravels, where they overlie impermeable strata, constitute distinct aquifers, in total providing resources of major importance which are being increasingly utilised. River gravels in the Middle Thames Valley are classed as a major aquifer. Those in the upper Thames Valley and the Lee and Lower Thames Valleys constitute minor aquifers.

Groundwater flow is intergranular and is generally oblique towards the main rivers. A degree of hydraulic continuity between rivers and groundwater is common. Mineralogy is variable but where the silt/clay content is significant there is some potential for attenuation of pollution. However the water table is normally high and groundwater has a corresponding susceptibility to pollution.

2.3 Minor aquifers

2.3.1 The Lias is predominantly clay or shale but contains a number of thin limestone bands which can yield small supplies. The most notable of these is the Marlstone rock which is heavily exploited in the North Oxfordshire and Banbury area. Flow is via fissures and pollution attenuation potential is restricted. springflow is common.

2.3.2 The Corallian is one of the more important minor aquifers. Its main area of use is around Abingdon where it supports a number of industrial abstractions; public supply abstractions have ceased in recent years. Fissure flow dominates with consequent limited potential for pollution attenuation.

2.3.3 The Portlandian - Lower Greensand aquifer occurs only on the north side of the London Basin. It is a composite unit comprising discontinuous patches of four different formations, Portland Beds, Purbeck Beds, Wealden Sands and Lower Greensand. Flow in the Portland and Purbeck Beds is via fissures, in the Wealden Sands and Lower Greensand intergranular. Potential for pollution attenuation is consequently higher in the latter two formations.

2.3.4 The Wealden Series includes two separate groups of water-bearing strata in North Sussex and West Kent but little water is taken from either of them. However there are many significant springs rising from the limestones and sandstone bands within the Weald Clay which feed small streams.

2.3.5 The Upper Greensand is, in places, in hydraulic continuity with the overlying Chalk e.g. west of Wantage, east of Farnham and the two aquifers are often penetrated by the same borehole. Elsewhere, the Upper Greensand outcrop is wider, receives significant recharge and is used as a separate aquifer, particularly for local private supply purposes. Both intergranular and fissure flow take place.

2.3.6 The Lower London Tertiaries group of strata include several permeable units of which the most consistent is the Thanet Beds. For the most part this unit behaves effectively as an upward extension of the Chalk aquifer. Abstractions have also occasionally been made exclusively from other horizons

within the group. Groundwater flow, where this occurs is intergranular. Silty and clayey horizons exist which act as aquitards or aquicludes. Generally the potential for pollution migration is limited except where there is direct hydraulic continuity with underlying Chalk.

2.3.7 The Bagshot Beds have an extensive outcrop although this gives a misleading impression of its importance as an aquifer. Due to the fineness of the sands, yields are usually low and its use is normally restricted to small domestic supplies. It is noteworthy for the very acidic nature of the groundwater held within it. This characteristic may enhance solubility and migration of certain pollutants.

2.3.8 River gravels in the Middle Thames are considered a major aquifer in Thames Region. Those in the Upper Thames Valley and the Lee, Lower Thames Valleys constitute minor aquifers. The characteristics of river gravel aquifers are considered above under major aquifers.

2.3.9 The glacial gravels are extensive in Hertfordshire and Buckinghamshire. They are usually only recognised as a separate aquifer where they overlie clay formations. However, generally they overlie the Chalk and are often dry.

2.4 Non-Aquifers

Dominantly clay strata cover more than one third of the catchment. They are normally fine-grained strata which act as effective impermeable barriers to water movement. In theory there should be little risk to groundwater supplies from such areas, but due to the low permeabilities, problems of polluted surface run-off may occur with consequent damage to nearby river systems or groundwater recharge areas downstream.

3. PARTICULAR GROUNDWATER PROBLEMS IN THE REGION RELATED TO THE POLICY STATEMENTS

In view of the number of groundwater abstractions in Thames Region specific protection zones will cover large areas of aquifer outcrop. This will impose severe constraints on potentially polluting activities over many parts of the catchment. In addition restrictions of a more limited nature will be required for the remaining areas of aquifer outcrop. There will be significant consequences for a range of activities and the following matters are highlighted with regard to particular policy issues.

3.1 Control of Groundwater Abstractions (Policy A)

3.1.1 Flows in several rivers have been depleted as a result of large groundwater abstractions close to the headwaters or along the river valley. Worst affected are the Rivers Misbourne, Ver, Wey, Pang and the Letcombe Brook. In consequence a remedial scheme, "The Alleviation of Low Flows" (ALF), has been instigated and engineering solutions are being contemplated. These include reduction of groundwater abstraction to allow baseflow recovery and the possibility of lining river beds with low permeability materials. Any proposals to increase abstraction particularly in these river valleys will warrant careful study.

3.1.2 Where groundwater has been affected by saline intrusion along the River Thames there will be limited scope for resource development in order to avoid exacerbating the existing situation.

3.2 Waste Disposal to Land (Policy C)

Most sites which have been considered suitable in the past for landfill are quarries located on aquifers, such as sand and gravel quarries overlying the Chalk aquifer. However in many of these areas, such as South Hertfordshire, groundwater is used extensively for public supply. In such circumstances there will be particularly strict limitations on landfilling activities.

3.3 Contaminated Land (Policy D)

There is continued pressure for redevelopment of former industrial sites many of which occupy prime locations in urban areas. The land is frequently contaminated and there is often associated groundwater pollution, with possibly considerable pollution potential remaining. These sites are often close to groundwater sources of supply. Extensive works may be necessary to decontaminate ground and remediate groundwater. Requirements are likely to be more stringent on the more important aquifers such as the Chalk than for example the Lower Thames Gravel.

3.4 Discharges to Underground Strata (Policy F)

Thames Region currently requires all discharges of sewage and trade effluent to be consented under the Water Resources Act 1991. Formal Prohibition Notices, which prohibit discharge unless consent is obtained, will normally be served on dischargers in order to enforce this. Consent will not usually be granted for any discharge, including surface water run-off, which is to be made directly into groundwater.

3.5 Diffuse Pollution of Groundwater (Policy G)

3.5.1 As an exercise separate from the protection policy, Nitrate Sensitive Areas have already been established for public supply sources at Ogbourne St. George and Old Chalford. In these areas farmers have been encouraged to join a scheme to change farming practice and limit the amount of nitrate leached. Rising nitrate concentrations are evident in other parts of the catchment. Consideration will be given to the establishment of further sensitive areas where concentrations are already unacceptably high or where rates of increase will lead to excessive levels.

3.5.2 Other chemicals, such as pesticides, are in widespread usage across the catchment and the frequency of detection in groundwater has risen. Thames Region will continue to discuss pesticide application with relevant parties, such as Highway Authorities and the farming community. The Region will seek to limit pesticide application within sensitive areas on aquifers and pesticide types to those least harmful to groundwater.

3.5.3 Groundwater in some urban areas has been contaminated by leakage from sewers and through widespread usage of chemicals such as solvents. Thames Region will seek to reduce incidences of contamination by liaising with relevant parties and has instigated a programme of site visits aimed at pollution prevention.

4. MAIN OFFICE LOCATIONS AND CONTACTS RELATING TO GROUNDWATER MATTERS

4.1 Thames Region is divided into three Operational Areas as shown in figure 1 with a Groundwater Protection team based at the main offices in Reading, Waltham Cross and Abbey Wood. Normally all groundwater quality matters will be dealt with in the Area offices. Figure 2 and table 3 show the appropriate NRA office to contact for matters falling within the various local authority areas in the Region.

4.2 All matters concerning groundwater quantity, such as resource assessment and abstraction licensing, are dealt with by the Water Resources Section based at the Head Office in Reading. The groundwater quality monitoring network and liaison with water companies are also dealt with centrally at head office. Principal points of contact are shown in table 3.

5. HOW TO USE THE POLICY AND PRACTICE FOR THE PROTECTION OF GROUNDWATER PRIOR TO THE INTRODUCTION OF NEW GROUNDWATER VULNERABILITY MAPS AND SOURCE PROTECTION ZONES

Protection of groundwater will be in accordance with the concept of aquifer vulnerability and different levels of protection for specified aquifers and areas around boreholes. These concepts are given full explanation in the main policy document. Maps showing this information are currently being produced. In the interim period before coverage is complete Thames Region will adopt the following procedure in conjunction with the policy document to assess risks to aquifers and individual sources.

5.1 Groundwater Vulnerability Maps

These are to be produced at a scale of 1:100 000 and coverage will be on a county basis. In providing an assessment of vulnerability the maps will take account of type of soil and drift cover, nature of strata and depth of unsaturated zone. Full coverage of all NRA Regions is scheduled for 1996. In the interim consideration will be given to those factors affecting groundwater vulnerability when assessing development proposals.

5.2 Geological Classification

The following classes of protection for aquifers are referred to in the policy document.

Major Aquifer)
Minor Aquifer) Geological Classification
Non-Aquifer)

Strata have been identified under the above classes in the section, "Geology and Hydrogeology" and locations are shown in figures 3 and 4. Summary information is also provided in tables 1 and 2. These areas will therefore constitute the Geological Classification for the purposes of the protection policy.

5.3 Source Protection Zones

5.3.1 The policy identifies the following Source Protection Zones.

Zone I - Inner Source Protection
(based on 50 day travel time within saturated aquifer)

Zone II - Outer Source Protection
(based on 400 day travel time or 25% of the recharge catchment area)

Zone III- Source Catchment
(based on the area for long term annual recharge to support the abstraction)

5.3.2 Definition of Source Protection Zone is currently in progress under contract to the NRA. Zones for about half of the major public supply sources will be produced for Thames Region by July 1993. The remaining zones will be defined after this time using the same methods, although it is not anticipated that this process will be complete before the end of 1994. Figures 3 and 4 show locations of public

supply groundwater sources in Thames Region.

5.3.3 In contrast with many other Regions Thames Region does not have previously published protection zones around boreholes. However for internal purposes to aid in assessment of developments sensitive areas around boreholes are considered with reference to 400 day travel times in the saturated aquifer. Standard hydrogeological techniques are employed with consideration given to the following parameters:

abstraction rate
hydraulic gradient
transmissivity
hydraulic conductivity
specific yield
saturated thickness

Zone 1 areas will be assessed by appropriate scaling down of the 400 day travel time.

5.3.4 Given that many parameters cannot be defined exactly, simplified assessment methods are normally adopted. The zone width and distance downgradient of the borehole to the stagnation point are based on steady state theory. Methods for assessing upgradient distances include those which take account of abstraction rates and those based on regional groundwater flow rates.

5.3.5 Final assessment of sensitive zones will take account of local geology, including drift cover, topography, and proximity of river and valley systems. Due regard will be given to local knowledge and experience.

5.3.6 It must be borne in mind that groundwater flow and pollution risk cannot easily be defined. Definition of the theoretical extent of zones will continue to be in accordance with established hydrogeological methods using the best available data. Certain principles of assessment have been outlined above, this will not preclude the refining of zone boundaries where improved knowledge of aquifer behaviour becomes available. If, in connection with their proposals, developers and applicants wish to submit data they may have in relation to protection zones this information will be given due consideration.

TABLE 1

AGE	FORMATIONS	PRINCIPAL DIVISIONS	DESCRIPTION	THICKNESS m	FLOW MECHANISM	GEOLOGICAL CLASSIFICATION
QUATERNARY	Plateau gravels	) Not in order of age	Gravel, clayey gravel	0-5	I	Mi
	Glacial sand and gravel		Sand, gravel	0-10	I	Mi
	Flood plain gravels) Terrace gravels)		Flint gravel, limestone, gravel, brickearth	0-10	I	Ma or Mi
	Alluvium		Clay, silt, peat	0-3		dependent on underlying strata
	Boulder clay		Clay with rock fragments (mainly chalk and flint)	0-50		
	Clay-with-flints		Clay, silt, sand, gravel	0-10		
TERTIARY	Lenham Beds		Sand	0-5	I	Mi
	Bagshot Beds	Barton Beds	Fine sand	15		
		Bracklesham Beds	Clay, silt, sand	15-20	I	Mi
		Bagshot Beds	Fine sand with clay	15-35		
	London Clay	Claygate Beds	(Clay, sand - Claygate Beds) Clay, sandy at top and bottom	5-150		N
	Woolwich & Reading Beds	Blackheath Beds	(Sand, pebbly sand - Blackheath Beds) Mottled clay, silt, sand	15-25		N
	Thanet Beds		Silty sands	0-25	I	Mi
CRETACEOUS	Chalk	Upper Chalk	White chalk with flint; Chalk Rock at base	50-130		
		Middle Chalk	Off-white chalk, little flint; Melbourn Rock at base	50-70	F	Ma
		Lower Chalk	Grey or buff chalk, very clayey towards base; including Totternhoe Stone and "Glauconitic Marl" at base	45-90		
	Upper Greensand		Fine sand, sandy silt, malmstone	0-45	I F	Mi
	Gault		Clay, silty clay	30-85		N

Continued at (A) or (B) on following pages

TABLE 1 GEOLOGICAL SUCCESSION

(A) NORTH SIDE OF LONDON BASIN

AGE	FORMATIONS	PRINCIPAL DIVISIONS	DESCRIPTION	THICKNESS	FLOW MECHANISM	GEOLOGICAL CLASSIFICATION
CRET.	Lower Greensand		Sand, gravel, clay	0-60	I	
	Wealden	Shotover Sands	Sand	0-15	I	Mi
	Purbeck Beds		Limestone, marl	0-3	F	
	Portland Beds	Whitchurch Sand	Sand, limestone	0-12	F	
	Kimmeridge Clay		Shale, clay	45-90		N
	Corallian		Very variable; sand, silt, clay, limestone	25-30	F	Mi
	Oxford Clay	Kellaways Beds	Clay, shaly clay (Sand, sandstone, clay - Kellaways Beds)	120-175		N
	Cornbrash		Limestone, clay	2-5	F	Mi
JURASSIC	"Forest Marble"	Forest Marble Clay / Forest Marble Limestone	Clay / Limestone			N
	Great Oolite	GREAT OOLITE: White Oolitic Limestone; Hampden Beds Marl; Taynton Stone Limestone; Stonesfield Slate	NORTH OXON.: U. Deltaic Series Sandstone, shale; Sharps Hill Beds Limestone, marl	Ind. members very variable. Overall 25-60 m	F	Ma
	Fullers Earth Series	COTSWOLDS: Fullers Earth Clay, limestone	NORTH OXON.: Chipping Norton Limestone	0-30		N
	Inferior Oolite	COTSWOLDS: U. Inferior Oolite Oolitic/shelly; L. Inferior Oolite Limestone; Scissum beds Sandy limestone	NORTH OXON.: U. Inferior Oolite Limestone; L. Deltaic Series Sandstone shale; Northampton Sands	0-85	F	Ma
	Upper Lias	Cotteswold Sands	Fine sand, sometimes clayey	0-85	F	
		Upper Lias Clays	Clay and shale with thin limestones			
	Middle Lias	Marlstone Rock	(Ferruginous limestone - Marlstone Rock) Silt, clay, shale	0-85	F	Mi
	Lower Lias		Clay, shale, thin limestones near base	90-290	F	

GEOLOGICAL SUCCESSION (Cont)

(B) SOUTH SIDE OF LONDON BASIN

AGE	FORMATIONS		PRINCIPAL DIVISIONS	DESCRIPTION	THICKNESS m	FLOW MECHANISM	GEOLOGICAL CLASSIFICATION
CRETACEOUS	Lower Greensand		Folkestone Beds	Fine to coarse sand; occ. clay	0-80		
			Sandgate Beds	Clay/silty clay or sand/stone	0-45		Ma
			Bargate Beds)			F	
			)	Sand and Sandstone often calcareous or cherty	0-90	I	
			Hythe Beds)				
			Atherfield Clay	Clay, silty clay	0-20		
	Weald Clay	WEALDEN S.		Clay, shale and mudstone with thin bands of sandstone and limestone	245-455		N
	Hastings Beds		U. Tun. Wells Sand	Sand, sandstone, silt	c.70	I	Mi
			Grinstead Clay	Clay	c.20	F	

ABBREVIATIONS:

U.	Upper	Ma	Major Aquifer	F	Fissure flow
L.	Lower	Mi	Minor Aquifer	I	Intergranular flow
S.	Series	N	Non Aquifer		

GEOLOGICAL SUCCESSION (Cont)

Table 2

NATIONAL RIVERS AUTHORITY - GROUNDWATER PROTECTION POLICY
GEOLOGICAL CLASSIFICATION IN THAMES REGION

MAJOR AQUIFERS	MINOR AQUIFERS		NON-AQUIFERS
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	Variably porous/ permeable but without significant fracturing. Generally only support locally important abstractions.	Formations with negligible permeability. Only support very minor abstractions, if any.
Middle Thames Valley River Gravels Chalk and Upper Greensand Lower Greensand Great Oolite Inferior Oolite	Wealden Series Portlandian Corallian Lias	Other river gravels Glacial sands and gravels Bagshot Beds Thanet Beds Other Tertiary Sands Upper Greensand (where not in hydraulic continuity with the Chalk)	All clays, shales, marls and siltones London Clay Gault Clay Atherfield Clay Weald Clay Kimmeridge Clay Oxford Clay

Table 3a **MAIN CONTACTS AND RESPONSIBILITIES: HEAD OFFICE**

Address
NRA Thames Region Kings Meadow House, Kings Meadow Road Reading RG1 8DQ Tel. 0734 535000 Fax 0734 502974
Principal Officer Groundwater Protection - all matters concerning groundwater quality; liaison on waste disposal proposals; discharges to ground; Nitrate Sensitive Areas; pollution to ground and groundwater; contaminated land.
Groundwater Quality Coordinator - groundwater monitoring network; liaison with water companies on groundwater quality data.
Principal Hydrogeologist - matters concerning groundwater quantity; groundwater management schemes; proposals for large abstractions; groundwater levels and flow; rising groundwater levels in London Basin; borehole and hydrogeological database.
Abstraction Control Manager - issuing of licences for abstraction of groundwater and surface water; public register of abstraction licences.
Principal Hydrologist - meteorological data; hydrometric data.
Principal Scientist Quality Regulation - public register for all discharge consents; public register for surface water and groundwater quality
Principal Officer, Pollution Control - expertise on surface water protection; advice on pollution incidents.

Table 3B MAIN CONTACTS AND RESPONSIBILITIES : REGION OFFICES

Address	Main Contact	Local Planning Authorities (See Fig. 2)
NRA Thames Region Rivers House Crossness STW Abbey Wood LONDON SE2 9AQ Tel. 081 310 5500 Fax. 081 311 9788	**Senior Groundwater Quality Officer** - all matters concerning groundwater quality and protection for south-eastern area.	**Berkshire,** Bracknell, Slough, Windsor & Maidenhead, Wokingham **Buckinghamshire,** South Bucks **Hampshire,** Basingstoke & Deane, East Hants, Hart, Rushmoor **Kent,** Dartford **Surrey,** Elmbridge, Epsom & Ewell, Guildford, Mole Valley, Reigate & Banstead, Runnymede, Spelthorne, Surrey Heath, Tandridge, Waverley, Woking **West Sussex,** Chichester, Crawley, Horsham, Mid Sussex **Boroughs:** Bexley, Bromley, Camden, City of London, Croydon, Greenwich, Hammersmith, Islington, Kensington & Chelsea, Kingston, Lambeth, Lewisham, Merton, Richmond, Southwark, Sutton, Wandsworth, Westminster
NRA Thames Region The Grange 97 Crossbrook Street WALTHAM CROSS Herts EN8 8HE Tel. 0992 645057 Fax. 0992 641931	**Senior Groundwater Quality Officer** - all matters concerning groundwater quality and protection for north-eastern area.	**Bedfordshire,** Luton, South Beds **Buckinghamshire,** Chiltern, South Bucks **Essex,** Brentwood, Epping Forest, Harlow, Thurrock, Uttlesford **Hertfordshire,** Broxbourne, Dacorum, East Herts, Hertsmere, North Herts, St Albans, Stevenage, Three Rivers, Watford, Welwyn Hatfield **Boroughs:** Barking, Barnet, Brent, Ealing, Enfield, Hackney, Haringey, Harrow, Havering, Hillingdon, Hounslow, Newham, Redbridge, Waltham Forest
NRA Thames Region Isis House Howberry Park WALLINGFORD Oxon OX10 8BD Tel. 0734 533375 Fax. 0734 533361	**Senior Groundwater Quality Officer** - all matters concerning groundwater quality and protection for western area.	**Berkshire,** Newbury, Reading, Wokingham **Buckinghamshire,** Aylesbury Vale, Wycombe **Gloucestershire,** Cotswold, Tewkesbury **Northamptonshire,** Daventry, South Northants **Oxfordshire,** Cherwell, Oxford, South Oxon, Vale of White Horse, West Oxon **Warwickshire,** Stratford-on-Avon **Wiltshire,** Kennet, North Wilts, Thamesdown

TO REPORT POLLUTION INCIDENTS AND OTHER EMERGENCIES, TELEPHONE 0800 807060

Table 3B

MAIN CONTACTS AND RESPONSIBILITIES : REGION OFFICES

Address	Main Contact	Local Planning Authorities (See Fig. 2)
NRA Thames Region, Rivers House, Crossness STW, Abbey Wood, London SE2 9AQ Tel. 081 310 5500 Fax. 081 311 9788	**Senior Groundwater Protection Officer** - all matters concerning groundwater quality and protection for south-eastern area.	**Berkshire**, Bracknell, Slough, Windsor & Maidenhead **Hampshire**, Basingstoke and Deane, E. Hants, Hart, Rushmoor **Kent**, Dartford **Surrey**, Elbridge, Epsom & Ewell, Guildford, Mole Valley, Reigate & Banstead, Runnymead, Spelthorne, Surrey Heath, Tandridge, Waverley, Woking **West Sussex**, Chichester, Crawley, Horsham, Mid Sussex **Boroughs:** Bexley, Bromley, Croydon, Greenwich, Hounslow, Kingston, Lambeth, Lewisham, Merton, Richmond, Southwark, Sutton, Wandsworth.
NRA Thames Region, The Grange, 97 Crossbrook Street, Waltham Cross, Herts. EN8 8HE Tel. 0992 645057 Fax. 0882 641931	**Senior Groundwater Protection Officer** - all matters concerning grounwater quality and protection for north-eastern area.	**Bedfordshire**, Luton, South Beds. **Buckinghamshire**, Chiltern, South Bucks **Essex**, Brentwood, Epping Forest, Harlow, Thurrock, Uttlesford **Hertfordshire**, Broxbourne, Dacorum, East Herts., Hertsmere, North Herts, Stevenage, Three Rivers, Watford, Welwyn Hatfield **Boroughs:** Barking, Barnet, Brent, Ealing, Enfield, Hackney, Haringey, Harrow, Havering, Hillingdon, Newham, Redbridge, Tower Hamlets, Waltham Forest Contact also for London Boroughs of: Camden, City of London, Hammersmith, Islington, Kensington & Chelsea, Westminster
NRA Thames Region, Napier Court, Kings Meadow House Kings Meadow Road Reading RG1 8DQ Tel. 0734 535433 Fax. 0734 502974	**Senior Groundwater Protection Officer** - all matters concerning groundwater quality and protection for western area	**Berkshire**, Newbury, Reading, Wokingham **Buckinghamshire**, Aylesbury Vale, Wycombe **Gloucestershire**, Cotswold, Tewkesbury **Northamptonshire**, Daventry, South Northants **Oxfordshire**, Cherwell, Oxford, South Oxon, Vale of White Hose, West Oxon **Warwickshire**, Stratford-on-Avon **Wiltshire**, Kennet, North Wilts, Thamesdown

TO REPORT POLLUTION INCIDENTS AND OTHER EMERGENCIES TELEPHONE 0800 252768

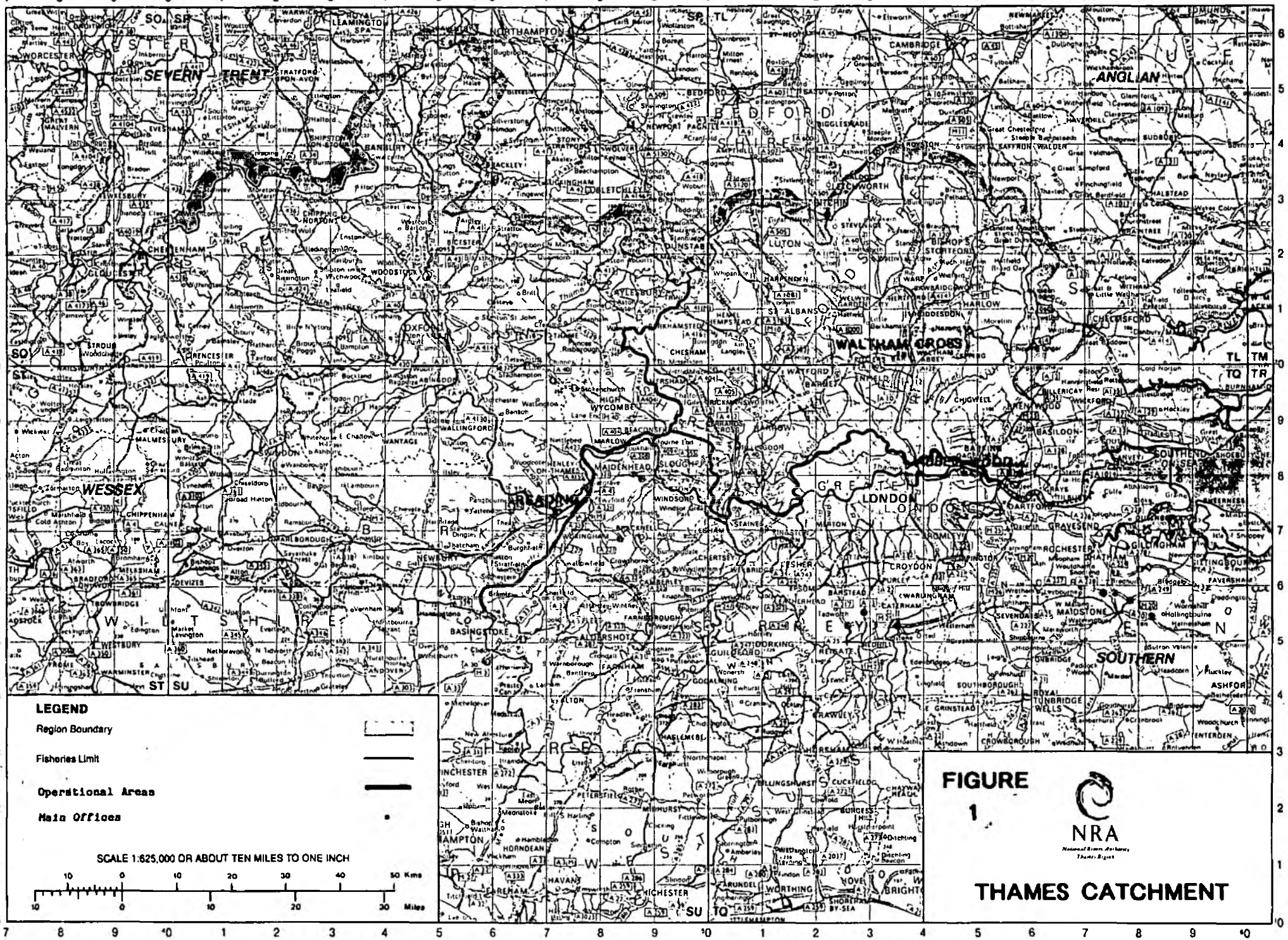

FIGURE 1

NRA
National Rivers Authority
Thames Region

THAMES CATCHMENT

Prepared by Thames Water, Cartographics, Reading 1990

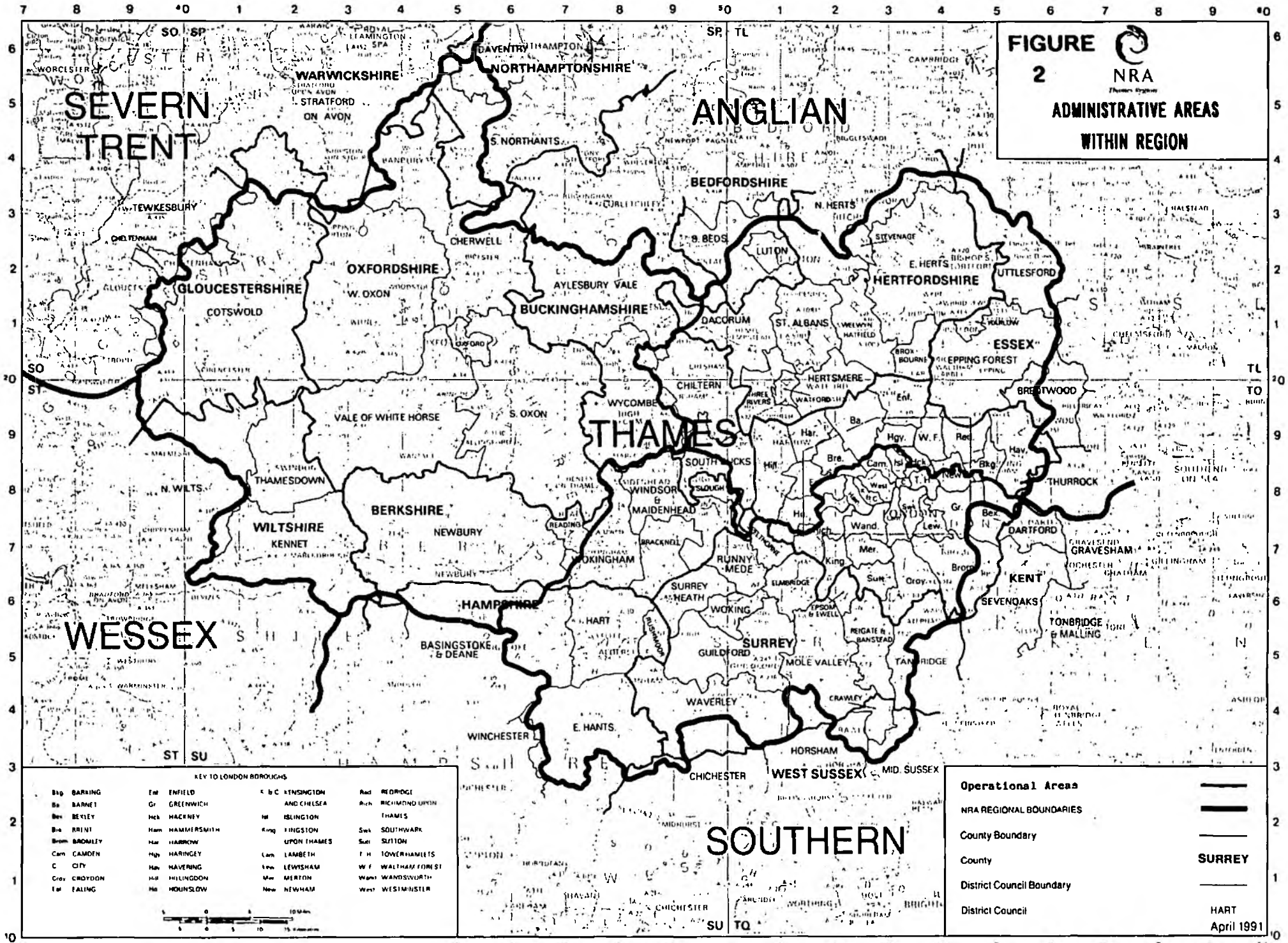
FIGURE 2
NRA
ADMINISTRATIVE AREAS WITHIN REGION
SEVERN TRENT
ANGLIAN
THAMES
WESSEX
SOUTHERN
WARWICKSHIRE
NORTHAMPTONSHIRE
S. NORTHANTS
BEDFORDSHIRE
N. HERTS
S. BEDS
E. HERTS
HERTFORDSHIRE
ESSEX
TEWKESBURY
CHERWELL
OXFORDSHIRE
W. OXON
GLOUCESTERSHIRE
COTSWOLD
AYLESBURY VALE
BUCKINGHAMSHIRE
DACORUM
ST. ALBANS
LUTON
STEVENAGE
UTTLESFORD
EPPING FOREST
BRENTWOOD
THURROCK
CHILTERN
WYCOMBE
HERTSMERE
VALE OF WHITE HORSE
S. OXON
THAMESDOWN
N. WILTS
WILTSHIRE
KENNET
BERKSHIRE
NEWBURY
WINDSOR & MAIDENHEAD
SLOUGH
SOUTH BUCKS
READING
WOKINGHAM
BRACKNELL
RUNNYMEDE
SURREY HEATH
WOKING
HAMPSHIRE
HART
BASINGSTOKE & DEANE
GUILDFORD
SURREY
MOLE VALLEY
TANDRIDGE
REIGATE & BANSTEAD
EPSOM & EWELL
WAVERLEY
CRAWLEY
HORSHAM
E. HANTS.
WINCHESTER
CHICHESTER
WEST SUSSEX
MID. SUSSEX
DARTFORD
GRAVESHAM
KENT
SEVENOAKS
TONBRIDGE & MALLING
KEY TO LONDON BOROUGHS
Operational Areas
NRA REGIONAL BOUNDARIES
County Boundary
County
SURREY
District Council Boundary
District Council
HART
April 1991

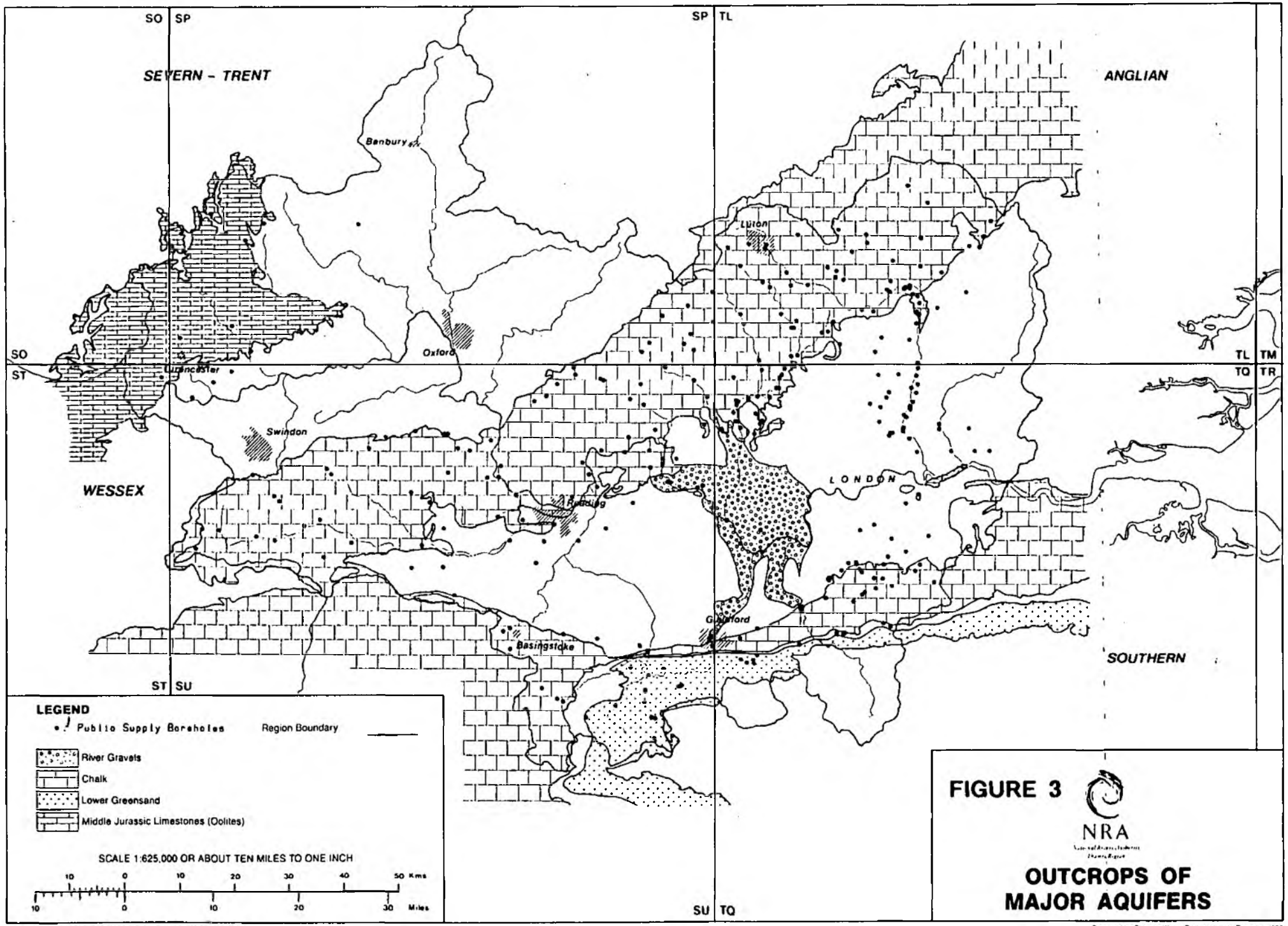

FIGURE 3

NRA

OUTCROPS OF MAJOR AQUIFERS

Prepared by Thames Water Cartographics, Reading, 1990

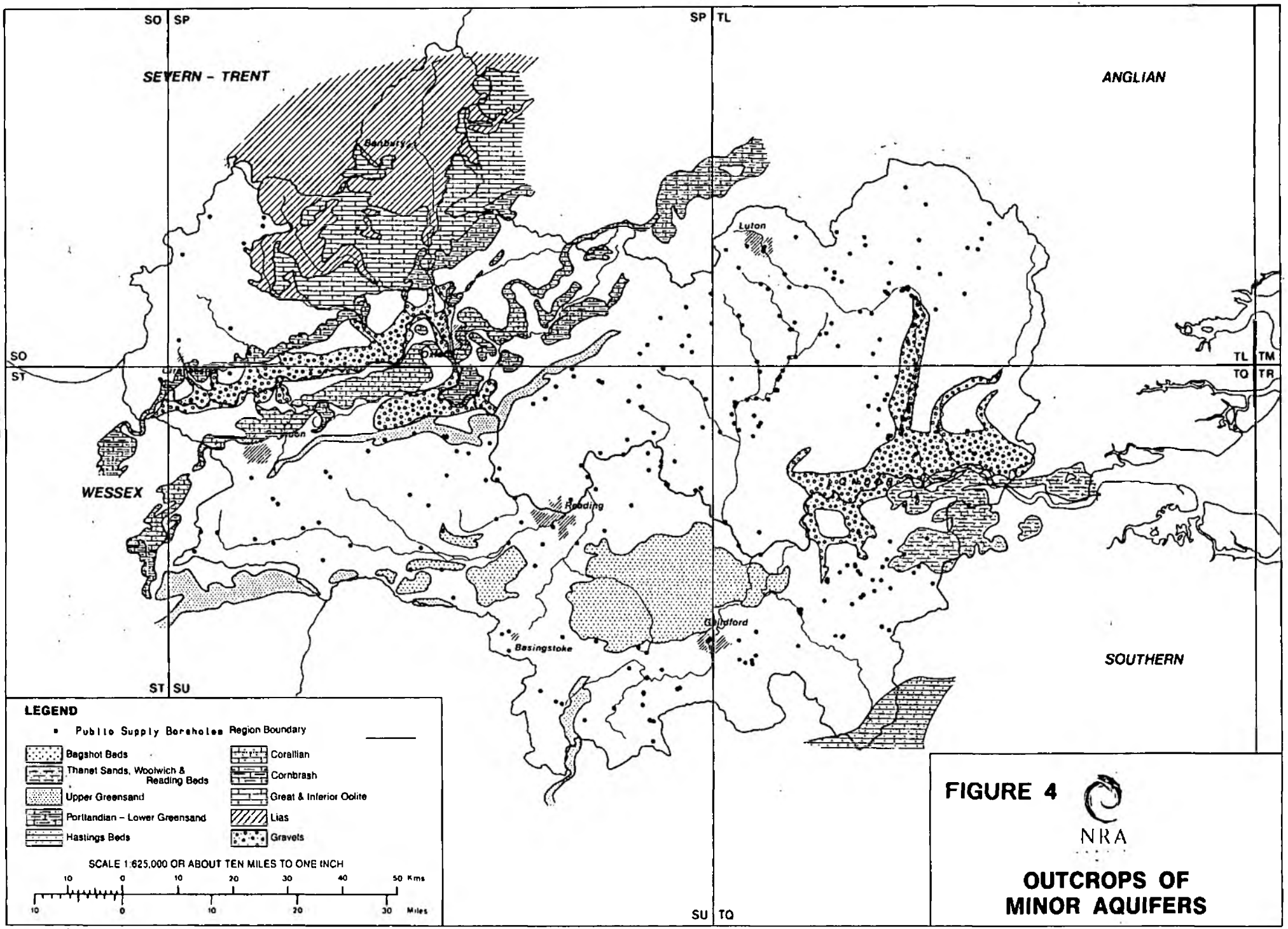

FIGURE 4

NRA

OUTCROPS OF MINOR AQUIFERS

Prepared by Thames Water Cartographics, Reading 1991

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

HEAD OFFICE
Rivers House
Waterside Drive
Aztec West
Almondsbury
Bristol
BS12 4UD
Tel: (0454) 624400
Fax: (0454) 624409

LONDON OFFICE
30-34 Albert Embankment
London SE1 7TL
Tel: (071) 8200101
Fax: (071) 8201603

ANGLIAN REGION
Kingfisher House
Goldhay Way
Orton Goldhay
Peterborough PE2 5ZR
Tel: (0733) 371811
Fax: (0733) 231840

NORTHUMBRIA REGION
Eldon House
Regent Centre
Gosforth
Newcastle Upon Tyne
NE3 3UD
Tel: (091) 2130266
Fax: (091) 2845069

NORTH WEST REGION
Richard Fairclough House
Knutsford Road
Warrington WA4 1HG
Tel: (0925) 53999
Fax: (0925) 415961

SEVERN-TRENT REGION
Sapphire East
550 Streetsbrook Road
Solihull B91 1QT
Tel: (021) 7112324
Fax: (021) 7225824

SOUTHERN REGION
Guildbourne House
Chatsworth Road
Worthing
West Sussex BN11 1LD
Tel: (0903) 820692
Fax: (0903) 821832

SOUTH WEST REGION
Manley House
Kestrel Way
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

WESSEX REGION
Rivers House
East Quay
Bridgwater
Somerset TA6 4YS
Tel: (0278) 457333
Fax: (0278) 452985

YORKSHIRE REGION
21 Park Square House
Leeds LS1 2QG
Tel: (0532) 440191
Fax: (0532) 461889