Policy and Practice For The Protection of Groundwater

ENVIRONMENT AGENCY

A Water Quality (Box 7)

Policy and Practice For The Protection of Groundwater

London: The Stationery Office

Environment Agency
Rio House
Waterside Drive
Aztec West
Almondsbury
Bristol
BS32 4UD

TEL: 01454 624400
FAX: 01454 624409

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Preface

- The Environment Agency (the Agency) has a duty under the Water Resources Act 1991 to monitor and protect the quality of groundwater (Section 84) and to conserve its use for water resources (Section 19). It also has a duty (Section 16) to maintain and, where appropriate, enhance conservation of the surface water environment which in many cases is dependent upon proper management of groundwater. These duties relate only to England and Wales.

- The European Commission has published a proposal for an action programme for integrated groundwater protection and management (96/C 355/01). This has in turn been incorporated into a proposal for a Council Directive establishing a framework for Community action in the field of water policy (the Framework Directive; 97/C 184/02). The Agency therefore intends to give high priority to promoting this national framework policy for groundwater protection in the context of emerging European initiatives.

- The Agency will apply this policy, not only in the use of its own powers, but also in seeking to influence the policies and decisions of others whose actions can affect the protection of groundwater; for example in response to consultation under planning legislation. By publishing this policy the Agency is not seeking new statutory powers but it is establishing a technical framework which could form the basis of future regulations if these were necessary.

- For its implementation the policy partly relies on a series of vulnerability and protection zone maps which have been made accessible to the public to allow the widest appreciation of groundwater protection issues.

- Groundwater protection decisions are complex. They involve consideration of geology, soils, hydrogeology, geochemistry and ecology. They must take account of interaction with surface waters, land and air. They may require very detailed site investigations and monitoring over time before decisions can be made. Consideration will often need to be given to the balance of interests both within the water environment and in a wider context. The policy and the supporting maps provide a framework for decision-making, but they are not prescriptive and need to be qualified by site specific considerations.

- There will be situations where existing facilities or activities do not meet the requirements of the policy. The Agency recognises that the solution to historic problems needs to take account of what is practically achievable and by giving priority to the cases of greatest concern. The Agency will give consideration to the results of environmental monitoring and to the assessment of actual risk in determining priorities for change.

An abandoned ironstone excavation in Northampton Sand, which is overlain by Lincolnshire Limestone and has intercepted the water table

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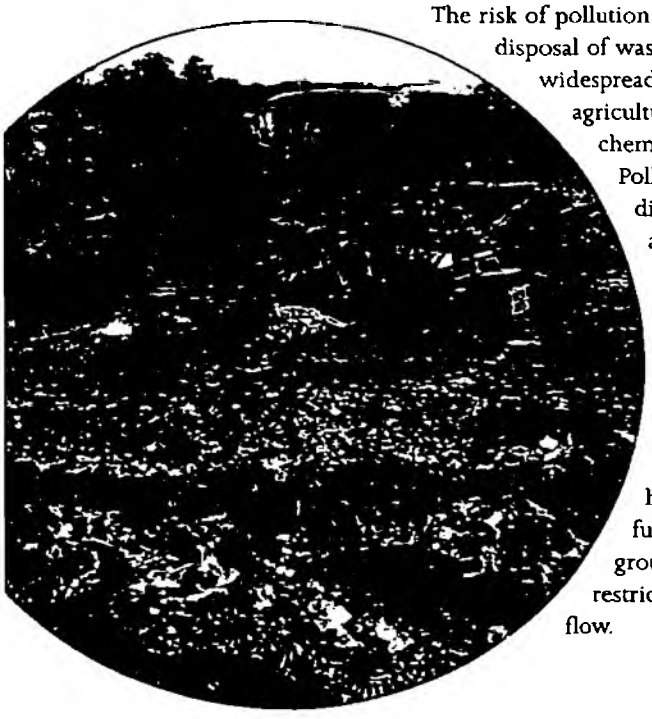
1. Introduction

Groundwater Protection

Groundwater forms the part of the natural water cycle which is present within underground strata (aquifers); out of sight and, unfortunately, all too often out of mind.

The volume of water stored in the pores and fractures of the strata vastly exceeds the volumes of fresh surface water. Groundwaters have a substantial strategic significance in public water supply; they provide 35 per cent of present demand and in some areas are the only available future resource. They also provide supplies for private abstractors who cannot obtain, or prefer not to use, water from the public mains.

The volume and quality of groundwater must be preserved by proper management. This is a difficult task. There is a problem of space because, unlike rivers which flow in defined channels, in many parts of the country groundwater is present everywhere beneath our feet, at risk from human activity. There is also a problem of time, because due to the very slow movement of groundwater through the strata, effects can take a long time to manifest themselves. Groundwater is particularly at risk from distributed and diffuse sources of pollution which accumulate over many years. These may be virtually impossible to clean up, (regardless of cost) even when the source of the problem is removed. The protection of groundwater quality and yield is therefore of paramount concern.



A landfill site in an old opencast coal excavation

The risk of pollution is increasing both from the disposal of waste materials and from the widespread use by industry and agriculture of potentially polluting chemicals in the environment. Pollution can occur either as discrete, point sources, such as from the landfilling of wastes, or from the wider, more diffuse use of chemicals, such as the application to land of fertilizers and pesticides. Through mineral extraction and changes in land use, humans can also affect the future availability of groundwater resources by restricting recharge and diverting flow.

Groundwater is not only protected to maintain water supplies from aquifers. It naturally feeds surface waters through springs and by base flows to rivers. Its presence is often important in supporting wetlands and their ecosystems. Removal or diversion of groundwater can affect total river flow. A reduction in either the quantity or the quality of the contributing groundwater can significantly influence surface water and the achievement of water quality standards. Surface water and groundwater are thus intimately linked in the water cycle, with many common issues. The protection of groundwater resources from the effects of human activity is, therefore, just one part of the total protection of the water environment.

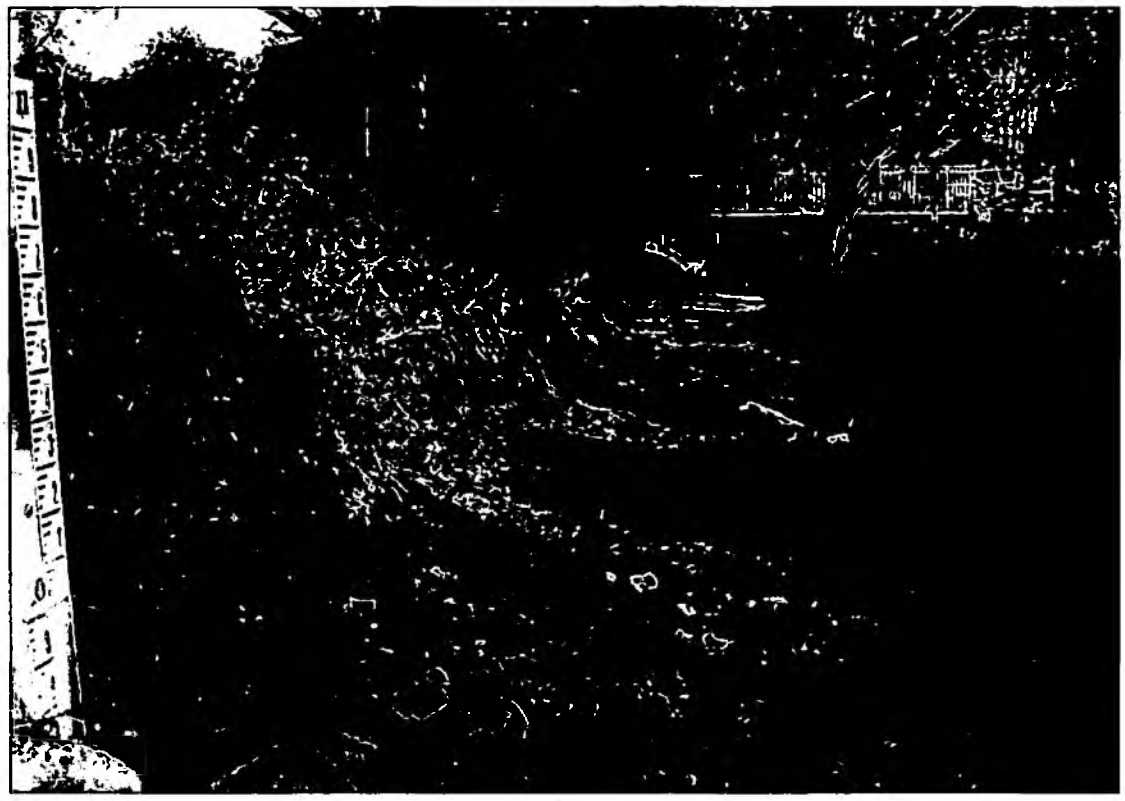
European Union Community Policy

In 1980 the European Commission introduced a Groundwater Directive (80/68/EEC) which was aimed largely at the control of discharges of specified substances (Appendix 1) to groundwater. The impact of the directive has been limited. Only a restricted range of substances is controlled. It does not address either diffuse pollution or the essential links to the management of abstraction and it does not establish a comprehensive system for the monitoring of groundwater.

Recognising the limitations of existing community wide regulations, the European Commission has published a proposal for an action programme for integrated groundwater protection and management (96/C 355/01). This follows a declaration of the Ministerial seminar held at the Hague in 1991 which recognised that:

- groundwater is a natural resource with both ecological and economic value, which is of vital importance for sustaining life, health, agriculture and the integrity of ecosystems;
- groundwater resources are limited and should therefore be managed and protected on a sustainable basis;
- it is essential to protect groundwater resources against overexploitation, adverse changes in hydrological systems resulting from human activities, and pollution, many forms of which can produce irreversible damage.

The declaration stresses that the objective of sustainability should be implemented through an integrated Approach, which means that:



Dry bed of the River Granta resulting from a lowered water table caused by groundwater abstraction

- surface water and groundwater should be managed as a whole, paying equal attention to both quality and quantity aspects;
- all interaction with soil and atmosphere should be taken into account;
- water management policies should be integrated within the wider environmental framework as well as with other policies dealing with human activities such as agriculture, industry, energy, transport and tourism.

The action programme has been incorporated into a proposal for a Council Directive establishing a framework for Community action in the field of water policy (the Framework Directive; 97/C 184/02). It is intended that this Directive will unltimately replace the Groundwater Directive (and other relevant water Directives) after implementation.

Environment Agency Powers

The powers and duties of the Agency for the protection of groundwater are set out in the Water Resources Act 1991 and the Environment Act 1995. In respect of groundwater quality these powers and duties are to:

- achieve Statutory Quality Objectives for groundwater which may be set by the Secretary of State;
- control discharges to groundwater through the discharge consent process;
- prevent pollution through regulations set by the Secretary of State;
- enforce against pollution events; and
- take remedial action when pollution has occurred.

In respect of groundwater yield and quantity these powers and duties are to:

- conserve water resources and ensure their proper use;
- manage groundwater so that it does not prevent the maintenance of acceptable flows in rivers;
- control abstraction of groundwater through the abstraction licensing process;
- enforce against illegal abstraction;
- take action to redistribute or augment resources where necessary.

The Agency also has powers, under the Environmental Protection Act 1990, and the Control of Pollution Act 1974 to:

- control discharges from prescribed industrial processes to natural waters;
- control waste disposal to land where it may cause pollution of water resources.

The Agency, as a statutory consultee under the Planning Acts, can influence planning decisions which may have an impact on the yield or quality of groundwater. The Agency is not a statutory consultee on all relevant planning matters but Planning Authorities are encouraged by Government to consult the Agency in any event.

In carrying out all these duties the Agency must have regard for the preservation, enhancement and conservation of the water environment.

Environment Agency Policy

Various Groundwater Protection Policies developed by the Water Authorities had evolved to meet their groundwater protection duties without any specific national coordination. They were different in approach and in their technical foundation and this led to differences in practice across the country. In order to consolidate and standardise the existing policies, to take account of new duties imposed on the National Rivers Authority (NRA) in 1989, and to support the EC objective of sustainability of groundwater quality and quantity through an integrated approach, the NRA adopted a new policy framework for protecting groundwater.

In going about this task the NRA reviewed the practices of the former Water Authorities. It also reviewed practices in Europe, the United States of America and Canada. The British Geological Survey (BGS) and the Soil Survey and Land Research Centre (SSLRC), both provided specialist technical advice and, through their geological and soils databases, have contributed to the vulnerability mapping which forms the basis of the definition of risk to groundwaters.

A key objective was to devise a framework which covers all types of threat to groundwater, whether large or small, from point or diffuse sources, and by both conservative or degradable pollutants. It is designed to provide a basis for implementation of legislation in England and Wales and anticipates, as far as possible, the likely requirements of future European legislation on the landfilling of wastes and from diffuse agricultural pollutants.

This approach and the Policies derived from it have been endorsed and adopted by the Agency as successors to the NRA.

This document provides:

Classification of Groundwater Vulnerability

based upon the key variables which determine vulnerability:

- nature of overlying soil cover;
- presence and nature of Drift;
- nature of strata;
- depth to water table (thickness of the unsaturated zone).

Definition of Source Protection Zones

determined by:

- travel time of potential pollutants;
- source catchment areas.

Statements on Groundwater Protection Policy

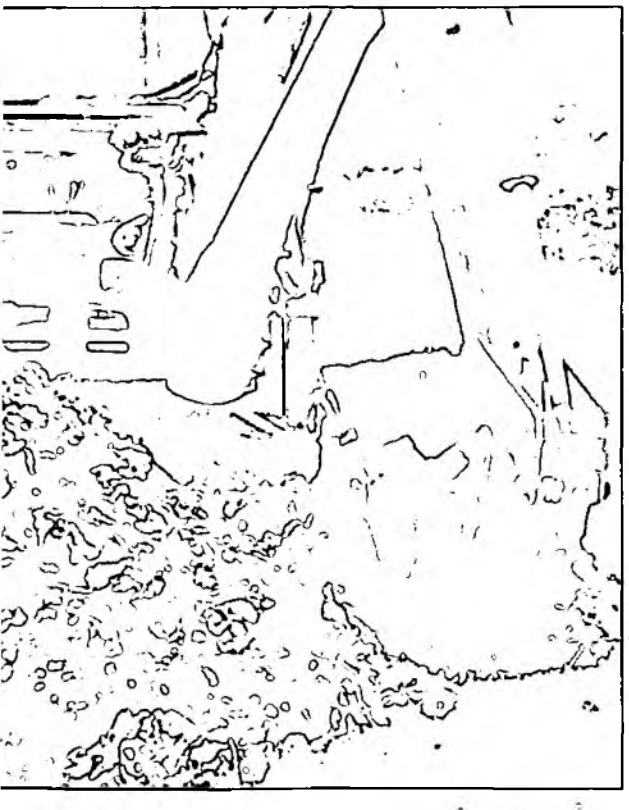
in relation to:

- control of groundwater abstractions;
- physical disturbance of aquifers and groundwater flow;
- waste disposal to land;
- contaminated land;
- disposal of sludges and slurries to land;
- discharges to underground strata;
- diffuse pollution;
- additional threats to groundwater quality.

Use of the Policy and Related Tools

The policy statements and the related maps and zones do not, of themselves, have a statutory status. They form part of a risk-based approach to decision making with respect to the protection of groundwater and should therefore not be used in a highly prescriptive way. The policy is intended to provide a framework within which the Agency can use its statutory powers in a consistent and uniform manner. It also guides the Agency in its responses to the various statutory and non-statutory consultations it has with other organisations, whose decisions can affect groundwater; for example in development planning.

The policy statements and related maps and zones do not, of themselves, have a statutory status. They will enable the Agency to use its existing statutory powers in a consistent and uniform manner and they will guide it in its response to the various statutory and non-statutory consultations it has with other organisations, whose decisions can affect groundwater; an example of this is in development planning. The Agency is publishing its policies so that land users and potential developers may anticipate the likely response of the Agency to a proposal or activity and to influence other organisations in the development of their own policy. The technical framework of the policy could, however, be used in regulations to increase legislative protection for groundwater under existing statutory powers, but this would be a matter for Government on advice from the Agency and others.



Trial pit investigation at a contaminated land site

Road sign in Germany delineating the edge of a groundwater protection zone

The variability of geology and soils, of hydrogeology, of waters in the natural environment and of the various preventative measures which might be taken can result in groundwater protection decisions being complex, dependent on local circumstances, and not capable of prescription within a general policy. The Agency will determine its position on any issue by the assessment of relevant local factors, but within the framework of this policy.

The Agency has mapped groundwater vulnerability in terms of geology and soils at a scale of 1:1,000,00 and maps have been published in both digital and paper formats. The programme was undertaken by the Soil Survey and Land Research Centre (SSLRC) together with the British Geological Survey (BGS). It is based on existing classifications of strata and soils and is described in 'Guide to Groundwater Vulnerability Mapping in England and Wales' (NRA 1995). The Agency has also mapped source protection zones for the significant public water supply abstractions. The methodology used has been published in 'Guide to Groundwater Protection Zones in England and Wales' (NRA 1995) and other companion documents (see Appendix 5).

2. Key Principles

Importance of Groundwater Protection

Groundwaters make up a very high proportion of the freshwater resources of England and Wales. Approximately 75 per cent of all abstracted groundwater is used for public supply and it makes up 35 per cent of the total public supply. The vast majority of people in England and Wales who rely on private water supplies use groundwater. Groundwater is also an important source for industry and agriculture as well as sustaining the base flow of rivers. The protection of groundwater quality is of critical importance for the following reasons:

• If groundwater becomes polluted, it is difficult, if not impossible, to rehabilitate. The slow rates of groundwater flow and low microbiological activity limit any selfpurification. Processes which take place in days or weeks in surface water systems are likely to take decades in groundwaters. It is therefore better to prevent or reduce the risk of groundwater contamination than to deal with its consequences.

• Its major and ubiquitous use is for potable supply which means that a high quality standard must be maintained for all resources.

• Aquifers provide storage for considerable volumes of high quality water which requires little treatment prior to use, even for potable supply. The loss of this widely available low cost water resource would require more expensive water resource options to be developed. Private potable supplies, independent of the public system, are also widely used. Examples of usage can be found in hospitals and in bottling and food processing.

• Groundwater provides the baseflow of many surface water systems. Some of these are used for potable, industrial and agricultural supplies as well as for fishing and other recreational uses. For these reasons and others of general amenity and conservation, the quality of the baseflow is critical. Hence the protection of groundwater resources in such areas is an important aspect of sustaining surface water quality.

Water Quality Objectives and Groundwaters

The Agency operates a framework for water quality which includes all controlled waters. It includes systems for classifying water quality and Water Quality Objectives (WQOs) which set specific targets for water quality. The Agency seeks to achieve these targets through exercising its powers under the Water Resources Act 1991 (as amended by the Environment Act 1995), including the use of powers granted by Regulations. Protection policies are one means by which these targets can be met. The Agency seeks to influence the activities of other relevant organisations, such as Planning Authorities, to support the achievement of its objectives.

The principal general use for groundwater is water supply. However, the quality of groundwater is generally much better than the requirements for potable waters under the EC Directive on the Quality of Water Intended for Human Consumption (80/778/EEC), as implemented and extended by the Water Supply (Water Quality) Regulations 1989. In protecting groundwaters due regard must be given to its potential use, taking account of whether its use is already compromised due to the natural quality of the water or where historical long-term pollution from numerous sources has lead to a deterioration in water quality (see Policy Statement D7).

The Environment Agency is developing and extending its existing groundwater monitoring networks. These complement those which exist for monitoring groundwater levels.

Relationship to Surface Water Resource Protection

Surface waters and groundwaters are closely integrated in the water cycle. Figure 1 shows how groundwater, rivers and different land uses can be related. Unsustainable abstraction of groundwater

The top of a public supply borehole
Courtesey Severn Trent Water

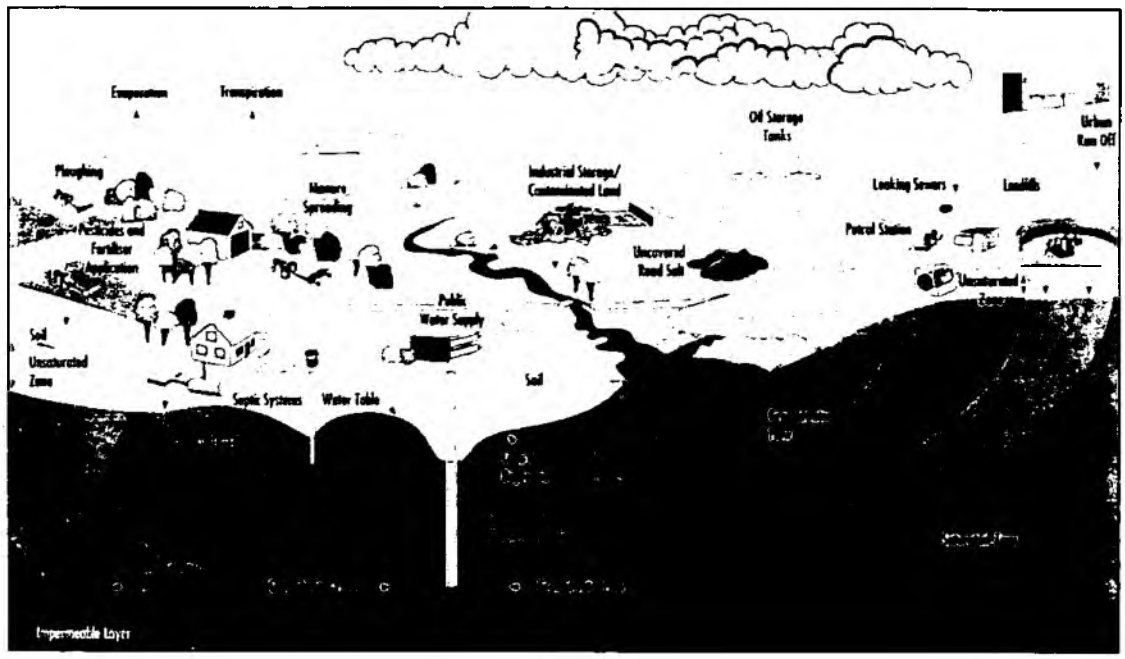


Figure 1

Diagrammatic representation of the Water Cycle showing groundwater and surface water relationships and groundwater pollution risks

may affect surface flows and ecological habitats while policies to protect groundwater quality may lead to polluting activities being directed to areas where run-off to surface waters is a threat. Balances have to be made within an integrated management framework and the approach of the merging European legislative initiatives reflects this need.

Where surface waters are naturally (or as a consequence of the effects of abstraction) influent to groundwater, the surface water catchment upstream of that point needs to be considered as part of the groundwater catchment for resource protection purposes. Conversely, ensuring the protection of groundwater can be critical in both the quantity and quality of baseflow to watercourses. Hence the maintenance of WQOs for surface waters may be dependent on the achievement of water quality objectives for groundwaters.

In order to harmonise policies on water resource protection, the Agency's practices for surface water protection, including catchment monitoring, catchment surveys and site audits are in the process of being reviewed and standardised to complement this document.

Relationship to Land Use Planning

Development and use of land is the one consistent element in the list of potential threats to the quality of groundwater; land use planning policies and procedures, therefore, play a significant role in effective groundwater protection.

The process begins at the development plan level. The Regional Planning Guidance procedures now in force provide an obvious route for appropriate policies to be incorporated which will have an impact on the whole of the development planning process. The Planning Policy Guidance Document PPG12 (February 1992) draws particular attention to the protection of groundwater as a relevant and important environmental objective. Local Plans, particularly the mineral and waste plans, are also very relevant to groundwater protection issues. The Agency has incorporated groundwater protection objectives into its own model planning policies for Local Planning Authorities to consider as part of the development planning process.

Awareness of Groundwater Protection

As groundwater resources are "out of sight" there is always the risk that they will be too much "out of mind" when land use management decisions are made. Both within and outside the field of water and environment specialists, there is a lack of awareness of the importance of groundwater protection. Publicity and education about the risks and the means of overcoming them are, therefore, an essential part of a national policy for groundwater protection.

Objectives of the Groundwater Protection Policy

The policy sets out how the Agency will meet its statutory responsibilities for the protection and conservation of groundwater resources.

In particular it aims to:

- ensure that all risks to groundwater resources, point source and diffuse, are dealt with in a common framework;
- provide a common basis for decisions affecting groundwater resources within and between its regions;
- encourage compatibility of approach between the Agency and other bodies with statutory responsibilities for the protection of groundwater.

Approach to Groundwater Protection Decisions

The Agency recognises that there are many factors affecting the risk of groundwater contamination at any location. These will vary according to the type of activity proposed and the vulnerability of the underlying groundwater to pollution from the surface. In considering the risks in any given situation there needs to be a professional assessment of the local circumstances before any decision is made. Consideration must also be given to the balancing of interests in the water environment as well as in a wider context. Therefore the policies and principles outlined here are seen as a framework for decision making and are not necessarily prescriptive in any individual circumstance.

Environmental Protection officer discussing farm waste management plans with a farmer

3. Powers and Responsibilties for Groundwater Protection

The Agency has a duty to maintain and protect the quality and yield of groundwater resources for abstracted and indirect uses. It does this by using its own powers (Table 1) and through statutory and non statutory consultation with other regulatory agencies. There are other bodies responsible for aspects of groundwater protection in England and Wales. These are listed in Table 2.

The UK legislation relating to groundwater protection implements the EC Directive on the Protection of Groundwater Against Pollution Caused by Certain Dangerous Substances (80/68/EEC) in which pollution is defined as "the discharge by man, directly or indirectly, of substances or energy into groundwater, the results of which are such as to endanger human health or water supplies, harm living resources and the aquatic ecosystem or interfere with other legitimate uses of water". The Department of the Environment/Welsh Office, in Circulars 4/82 and 20/90, state that any discharge containing certain specific substances (Appendix 1) in such quantity as to require a significant difference in the degree of treatment in the receiving water before use should be regarded as falling within the scope of the Directive. The main legislative provisions implementing the protection of groundwater in England and Wales are outlined below. They are shown together with other UK and European legislation in Tables 1 and 2.

EC Directive on the Protection of Groundwater Against Certain Dangerous Substances (80/68/EEC)

This Directive prohibits the direct or indirect discharge into groundwater of List I substances and limits discharges of List II substances, unless prior investigation can establish that pollution of groundwater will not occur, or unless the groundwater is permanently unsuitable for other uses.

In England and Wales it is currently implemented by the Environment Protection Act 1990 and more specifically Regulation 15 of the Waste Management Licensing Regulations 1994, the Water Resources Act 1991, and in generality by the Town & Country Planning Acts. Additional controls under the Groundwater Regulations are to be implemented during 1998. The designated substances are listed in Appendix 1 of this document.

Environmental Protection Act 1990

Part I of the Act relates to the application of Integrated Pollution Control (IPC) to those industries designated on the basis of the prescribed substances list. Part II of the Act relates to the disposal of waste on land. In England and Wales, both IPC and Waste Management Licensing are enforced by the Agency, which will ensure that its duties to protect the environment in general, and groundwater in particular, are compiled with.

Water Resources Act 1991

The Agency has powers to control direct and indirect discharge of the majority of trade and all sewage effluent into controlled waters under Part III of the Water Resources Act 1991. A discharge occurring as a result of a waste disposal site licence issued under Part I of the Control of Pollution Act 1974 (or Part II of the Environmental Protection Act 1990 when implemented) may obviate the need for a further consent.

Sections 92, 93 and 94 of the Act give additional preventative powers to the Agency by Regulation. Regulations made under Section 92 relate to specific activities and are being progressively drawn up. The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations were the first of these, although they were made under the Water Act 1989. They are enforced by the Agency. They set out minimum standards for silage, slurry and agricultural fuel oil installations in England and Wales. Powers under Sections 93 and 94 relate to water protection zones and are described more fully in Section G of this document.

The Water Resources Act 1991 consolidates all the provisions of the Water Resources Act 1963 in respect of the control of abstraction from groundwater. The dewatering of mines, quarries and engineering works are exempt from control. However, discharges from these activities require consents under the Act from the Agency unless a mine is abandoned. Domestic abstractions for the use of single households are also exempt.

The haphazard storage of chemical drums can lead to groundwater pollution

Water Industry Act 1991

The Private Water Supplies Regulations 1991 made under the Water Industry Act 1991 cover the monitoring and enforcement of quality standards in water used for private supply. As most of these are exempt from control under the Water Resources Act 1991 the private supply registers, when set up by local authorities, can provide a more comprehensive list of small groundwater sources (Circular 24/91 (DOE), 68/91 (Welsh Office)). Results from monitoring may also indicate situations where improved resource protection is required. Where contamination is found the Agency should be informed so that potential sources of pollution can be investigated.

Town and Country Planning Act 1990/ The Planning and Compensation Act 1991

Many developments may pose a direct or indirect threat to groundwater resources. Where planning permission is required (eg chemical stores, residential development, mineral extraction, industrial development) often the only control is by means of conditions on the permission document, an obligation (agreement or undertaking) under Section 106 of the Act, or by refusal of permission. It is, therefore, important to recognise developments that may be a potential risk to groundwater.

The latter Act introduces a "plan-led" system for Town and Country Planning for the first time. Regional guidance is issued by the Department of the Environment. Structure Plans, Mineral Local Plans and Waste Local Plans are prepared by County Councils and other Local Plans produced by District Councils. The concepts detailed in this document are highly relevant for inclusion in these more strategic documents which can influence the locations of individual developments.

The Agency is a statutory consultee on development plans and many aspects of development control. In the case of plans, the Agency's views must be considered unless the Planning Authority can justify why its requirements are not to be included. The Agency is also a statutory consultee on Environmental Assessments when these are required.

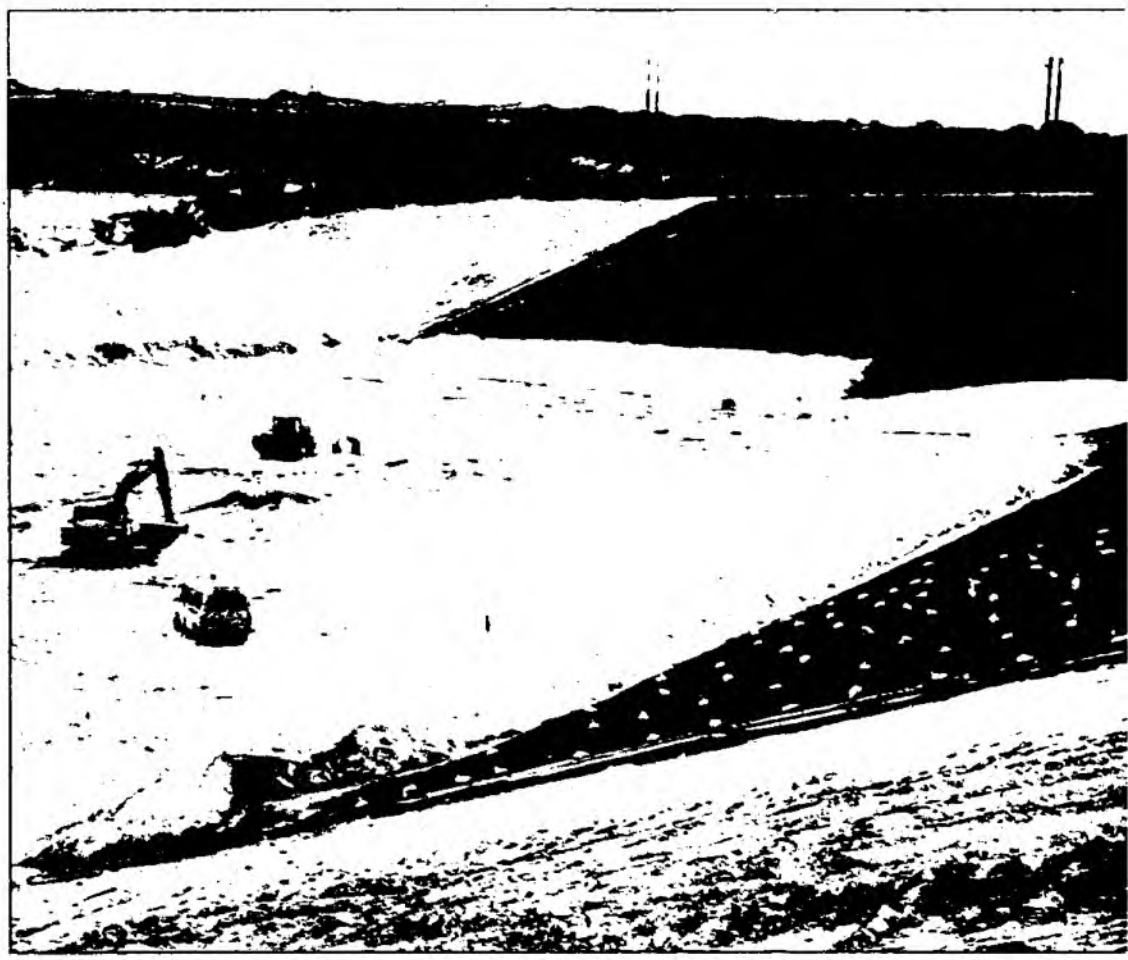
Guidance to Planning Authorities is given by Government in the form of Minerals Planning and Planning Policy Guidance Notes. Recent issues (eg MPG 9 and PPG 12) emphasise the environmental importance of planning decisions and refer specifically to the need to ensure that groundwaters are adequately protected.

Environment Act 1995

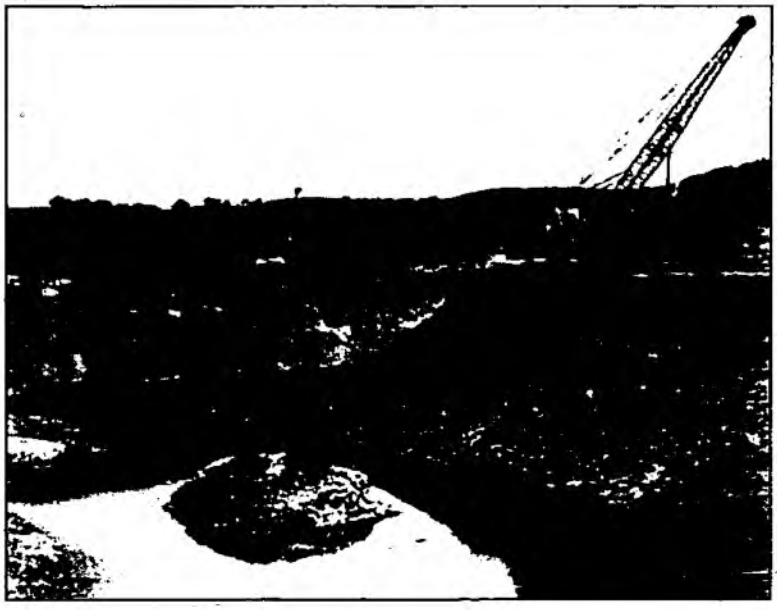
This Act brought together the NRA, Her Majesty's Inspectorate of Pollution and the Waste Regulatory Authorities to form the Environment Agency. The existing duties, powers and responsibilities of the component organisations were consolidated by the Act, some new or extended responsibilites are given and those of relevance to groundwater are:

- that the Agency should aim to contribute to the objective of achieving sustainable development, having regard to Ministerial guidance;
- that the Agency should compile information relating to pollution and follow developments in technology and techniques;
- that the Agency, in cooperation with local authorities, implement the procedures for the identification, investigation and remediation of contaminated land, when these are brought into force.

The spreading of farm waste onto grassland
Courtesy Severn Trent Water



The lining of a new landfill on the Chalk with an artificial membrane in order to protect groundwater



Sand and gravel extraction in River Terrace deposits

Table 1
Groundwater protection legislation directly implemented by the Environment Agency

Origin	Legislation	Agency Role
European	EC Groundwater Directive (80/68/EEC)	Competent authority in association with Mineral Planning Authorities
	EC Directive on Diffuse Pollution by Nitrates (91/676/EEC)	Direction to monitor, Identification of vulnerable zones Enforcement of action plans
UK	Environment Protection Act 1990 (Pt I)	Powers to regulate IPC preocesses, to control discharges to groundwater from prescribed processes, prevent land contamination from certain substances, and control discharge of radioactive substances to groundwater.
	Environmental Protection Act 1990 (Pt II)	Powers to regulate the handling, storage and disposal of controlled wastes.
	Environment Protection Act 1990 (Pt IIA) Environment Act 1995 (Sect 57)) (to be enacted)	Powers to advise local authorities in identifying, investigating and remediating contaminated land, and to act directly on sites designated as special sites.
	Water Industry Act 1991 (s.71(1))	Powers to control waste of water resources by artesian overflow
	Water Resources Act 1991 (s.24)	Powers to control by licence most types of abstraction
	Water Resources Act 1991 (s.30)	Powers to protect groundwater resources during dewatering
	Water Resources Act 1991 (s.83)	Provides for definition of Water Quality Objectives for controlled waters
	Water Resources Act 1991 (s.88)	Powers to control discharges to controlled waters
	Water Resources Act 1991 (s.92)	Powers under regulations to require pollution prevention measures to be taken
	Water Resources Act 1991 (s.93)	Provision for statutory water protection zones
	Water Resources Act 1991 (s.94)	Provision for Nitrate Sensitive Areas (NSA's)
	Water Resources Act 1991 (s.161A) (Environment Act 1995 (sch 22)	Powers to take remedial action to prevent pollution occurring or continuing
	Water Resources Act 1991 (s.199)	Powers to preserve and protect groundwater during mineral exploration
	Control of Pollution (Silage, Slurry & Agricultural Fuel Oil) Regulations	Powers to ensure high standards on all new and enlarged installations for silage, slurry and fuel oil to minimise the risk of pollution.
	Waste Management Licensing Regulations 1994	Powers to prevent pollution of groundwater by substances listing in EC Groundwater Directive.
	Groundwater Regulations (to be enacted)	Powers to prevent or control activities which may result in the discharge of specified pollutants to groundwater
	Action Programme for Nitrate Vulnerable Zones (England and Wales) Regulations 1998. (to be enacted)	Power to enforce the action plan to control agricultural activity to limit diffuse nitrate pollution

Organisation	Area of Responsibility	Relevant Legislation	Locus of Agency
Department of the Environment Transport and the Regions (DETR)	Sponsoring ministry of Agency	Water Resources Act 1991	Direct Liaison
	Making of regulations and directions under the Water Resources Act 1991	Water Resources Act 1991	Direct Liaison
	Determination of appeals on licences to abstract from, and consents to discharge to, groundwater	Water Resources Act 1991	Regulating Body
	Determination of appeals on waste management licences	Environmental Protection Act 1990	Regulating Body
	Determination of planning appeals	Town & Country Planning Acts	Statutory Consultee
	EC Groundwater Directive	80/68/EEC	Competent Authority with others
	EC Nitrate Directive	91/676/EEC	Competent Authority
	Mineral Extraction policy, Land Use Planning Policies and legislation	Town & Country Planning Acts and related Regulations	Consultee
	Contaminated Land Policy		Direct Liaison
	Waste Management policy		Direct Liaison
Ministry of Agriculture and Fisheries (MAFF)	Nitrate Sensitive Areas	Water Resources Act 1991	Direct Liaison
	Control of Pesticide Regulations	Food and Environmental Protection Act 1985 S.I. 1510 1986	Consultee
	Code of Good Agricultural Practice	Water Resources Act 1991	Consultee
	Natural Mineral Water Regulations	S.I. 1985 No. 71	No formal contact
English County Councils, Metropolitan Borough Councils, Welsh District Councils	Development control over waste management	Town & Country Planning Acts,	Statutory Consultee
	Competent Authority for redevelopment of contaminated land	EC Groundwater Directive (80/68/EEC)	None
County Councils, Metropolitan Borough Councils, National Parks Authorities	Development control over mineral extraction	Town & Country Planning Act 1990	Statutory Consultee
District Council and Unitary Authorities	Development planning	Town & Country Planning Act 1990	Statutory Consultee
	Storage of Hazardous Substances	Planning (Hazardous Substances) Act 1990	Statutory Consultee for new consents
	Identify, investigate and remediate contaminated land (to be enacted)	Environmental Protection Act 1990	Statutory Consultee
	Competent Authority	EC Mineral Water Directive (80/777)	No formal contact
	Private water supply register/ monitoring	Private Water Supply Regulations	Advisory contact
Local and Regional Regional Planning Authorities	Forward Planning Policies Local, Structure and Subject Plans (Minerals/Waste Disposal)	Town & Country Planning Acts 1990 (Planning & Compensation) 1991	Statutory Consultee
National Park Authorities	Development control Local and Structure Plans	Town & Country Planning Acts National Parks Acts	Statutory Consultee
English Nature and Countryside Commission for Wales	Consultee on issue of licences to abstract and consents to discharge with conservation implications	Water Resources Act 1991	Direct Contact

Table 2
Bodies with responsibility for aspects of groundwater protection in England and Wales

4. Concepts of Vulnerability and Risk

The operation of a chemical works can pose a significant risk to groundwater

Wherever groundwater is present there is the potential for it to be affected by human activity. No soil or rock is completely impermeable, no pollutant completely immobile. The concept of groundwater vulnerability recognises that risks of pollution from a given activity are greater in certain hydrological, geological and soil situations than others.

Many human activities present a potential **hazard** to groundwater. In trying to assess the level of **risk** of contamination from any given activity in order to make judgments about its acceptability, it is necessary to assess the total **exposure** of the groundwater system to that hazard. Exposure of groundwater to hazard may be mitigated by preventative measures (such as bunding of storage tanks, lining of landfills or by specific management practices). However, in most cases, a significant element of the total exposure to hazard will depend on the natural geological and soil conditions. These define the **vulnerability**, that is the susceptibility of the groundwater to pollution.

Vulnerability depends upon the natural characteristics of a site and is assessed on the physical, chemical and biological properties of the soil and rocks beneath the site which control the ease with which an unprotected hazard can affect groundwater.

Risk arises when an activity is proposed at a given location. Risk is assessed by taking account of the nature of the hazard, the natural vulnerability of the groundwater and the scale of preventative measures proposed.

The possibility of accidental spillage on transport systems must be considered in planning new routes

Vulnerability of Groundwater The factors which together define the vulnerability of groundwater resources to a given pollutant of activity are the:

- presence and nature of overlying soil;
- presence and nature of Drift;
- nature of strata;
- depth of unsaturated zone.

Any or all of these factors can be relevant in assessing a specific risk to groundwater resources. Criteria have been developed based on soil, geological and hydrogeological characteristics to identify vulnerability in each of the above factors. The vulnerability of groundwater resources at any location can be inferred from known nearby circumstances and can be mapped with varying precision depending on the availability of relevant data. However, it can only be established with confidence by direct site investigation.

The above factors define the vulnerability of all underground waters, whether they are exploited or not. Both European and national legislation require that all groundwater should be afforded protection, regardless of whether, or how, it is currently used. Since these measures relate to the whole of the groundwater resource they are referred to as **Groundwater Resource Protection**. The concepts are further described in Section 5.

A distinction needs to be made between the general protection of the groundwater resource and the specific protection which may be appropriate for individual sources. The abstraction of groundwater modifies the natural flow regime in the aquifer. Depending upon the amount of data available on the aquifer, it is possible to define the source catchment area. This is the area of land needed to sustain the groundwater abstraction by natural recharge. These considerations lead to the separate definition of **Groundwater Resource Protection** zones, which is discussed in Section 6. Source Protection Zones are to be regarded as additional to the general consideration of overall resource protection.

5. Description of Vulnerability of Groundwater Resources

In this section the vulnerability of groundwater resources is described in terms of the four variables which have been listed above: presence and nature of overlying soil; presence and nature of drift; nature of strata; depth of unsaturated zone.

Presence and Nature of Overlying Soil

Risk of pollution by activities such as spreading of sludges and manures and from many types of diffuse pollution depends upon the attenuating characteristics of the soil. For this purpose the soil is taken to be the weathered zone affected by living organisms and undergoing seasonal change in moisture, temperature and gaseous composition. In the UK it may be up to two metres in depth. Variations in soil vulnerability can be recognised on the basis of the physical properties of the soil, which affect the downward passage of water, and on the ability of the soil to attenuate three types of pollutant:

- diffuse source pollutants which under certain circumstances can be retained in the soil layer (eg pesticides);
- diffuse source pollutants which can readily pass through the soil layer (eg nitrate);
- liquids (eg from slurries and manures).

The Soil Survey and Land Research Centre have developed a three-fold classification of soil types for the Agency that is based on physical soil properties. The physical properties include soil texture, structure, soil water regime and the presence of distinctive layers, such as raw peaty topsoil and rock or gravel at shallow depth. The variety of soils and possible pollutants is wide and classification is necessarily generalised. This means that individual circumstances will require more detailed evaluation. Appendix 2 gives examples of soil series which fall into the three soil vulnerability classes described below.

Soils of High Leaching Potential, H:

These soils have little ability to attenuate diffuse source pollutants. Non-adsorbed diffuse source pollutants and liquid discharges will percolate rapidly through them. Three sub-classes are recognised:

H1 soils which readily transmit liquid discharges because they are either shallow, or susceptible to rapid by-pass flow directly to rock, gravel or groundwater;

H2 deep, permeable coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential;

H3 coarse textured or moderately shallow soils which readily transmit non-adsorbed pollutants and liquid discharges but which have some ability to attenuate adsorbed pollutants because of their large organic matter or clay content.

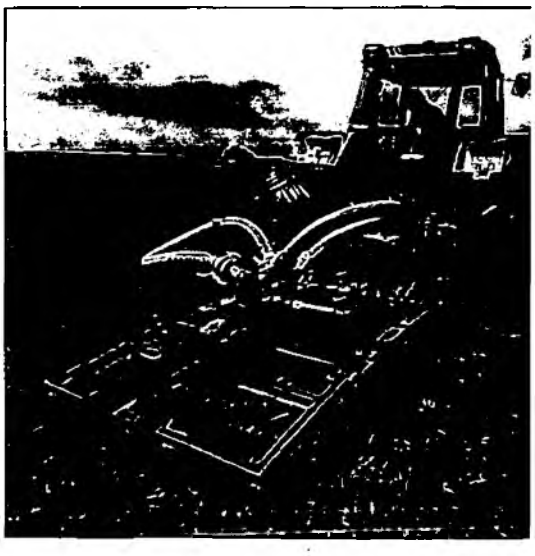
Soils of Intermediate Leaching Potential, I:

These are soils which have a moderate ability to attenuate diffuse source pollutants or in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer. Two subdivisions are recognised on the vulnerability maps:

11 soils which can possibly transmit a wide range of pollutants; and

12 soils which can possibly transmit non- or weakly adsorbed pollutants and liquid discharges, but which are unlikely to transmit adsorbed pollutants.

The injection of sewage sludge into grassland
Courtesey Severn Trent Water



Large diameter sewer being constructed at depth
Courtesey Severn Trent Water

Soils of Low Leaching Potential, L:

These are soils in which pollutants are unlikely to penetrate the soil layer because water movement is largely horizontal or which have a large ability to attenuate diffuse source pollutants. Generally, these are likely to be soils with a high clay content. It must be recognised that run-off from these soils may contribute to groundwater recharge elsewhere in the catchment.

The nature of the overlying soil need not be considered where the soil layer has been removed (eg landfill, quarrying). For the purposes of the groundwater vulnerability maps the soils overlying Minor and Non-Aquifers have not been differentiated.

Presence and Nature of Drift

In many areas Drift deposits are present overlying the solid geology. These deposits are variable vertically and horizontally in both thickness and lithology. Where the Drift is of substantial thickness and of low permeability it can provide an effective barrier to surface pollutant migration. It is relevant to the assessment of vulnerability, but in all cases investigations are necessary to assess the local characteristics of the Drift deposits because detailed mapping has seldom been carried out. Permeable drift is classified as a Minor Aquifer except where it occurs in probable hydraulic continuity with a Major Aquifer (defined below). In such cases it is regarded as part of the underlying Major Aquifer unless specific studies prove otherwise.

Nature of Strata

Geological strata which contain groundwater in exploitable quantities are called aquifers, whereas rocks which are largely impermeable and which do not readily transmit water are called non-aquifers. Aquifers vary in their general and hydraulic characteristics (fissured, fissure-porous and porous) and in the unsaturated zone this variation determines the vulnerability of the groundwater to pollution. The distribution of the outcrop of aquifers and non-aquifers over England and Wales is approximately half and half.

All groundwaters are controlled waters, but it is convenient to subdivide permeable strata into the categories of Major Aquifers and Minor Aquifers, the former having generally less capacity for attenuating contaminated recharge entering at their surface. This division is to a considerable extent also co-incident with their water resource potential.

Major Aquifers: These are highly permeable formations usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes.

Minor Aquifers: These can be fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Although these aquifers will seldom produce large quantities of water for abstractions, they are important both for local supplies and in supplying base flow for rivers. In certain local circumstances minor aquifers can be highly vulnerable to pollution.

Non-Aquifers: These are formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities. However, groundwater flow through such rocks, although imperceptible, does take place, and needs to be considered when assessing the risk associated with very slowly degrading pollutants.

For the purposes of mapping, the aquifers are defined as they outcrop at the land surface, but in many cases a Major Aquifer will be present beneath Minor or Non-Aquifers. In certain locations Non-Aquifers may be present as a thin covering layer or even be totally removed by quarrying. In these situations the vulnerability of the groundwater will be related to that of the underlying strata.

Rocks with the same geological classification can give rise to different groundwater vulnerability because of differences in hydrogeology in different parts of the country. Appendix 3 gives the standard national classification produced by the Agency on information provided by the British Geological Survey, but this may be varied in detail from region to region of the Agency to reflect local circumstances.

Depth of Unsaturated Zone

The unsaturated zone is the part of the aquifer which lies above the water table. It can play an important role in both attenuating the concentration of pollutants through physical, chemical and biochemical processes, and by acting as a delay mechanism. Travel times through the unsaturated zone can vary depending on the geology and the rainfall recharge. Fissures in the aquifer will allow faster movement whilst rocks where intergranular flow is predominant may act as an impediment to a significant degree. Low permeability horizons, such as clay layers, can also play an important part in inhibiting infiltration. In these latter cases a deep unsaturated zone may help to protect groundwater quality, whilst in fissured limestone strata for example, little benefit will be gained. For nondegradable pollutants the delay mechanism may only be effective in allowing a longer period for

remedial action to be developed. The unsaturated zone in fissured aquifers can also act as a means of delaying and smoothing out the effects of severe rainfall events. These would otherwise be reflected in higher surface water flows through rapid spring discharge.

Assessing Total Vulnerability

Figure 2 illustrates two situations of differing vulnerability. The fissured limestone aquifer with a permeable soil cover, no drift and high water table is an example of very high vulnerability, whereas the sand and gravel aquifer, overlain by low permeability clay drift and soil, is much less vulnerable. Not all the above factors are relevant in all circumstances. For example the type of soil is very important in assessing risk from diffuse pollution. It is not relevant when assessing risk from most types of landfilling which takes place below or in the absence of a soil layer. The different factors should only be considered when relevant. Their cumulative effect will give an assessment of the total vulnerability of the resource.

Vulnerability Maps

A full assessment of groundwater resource vulnerability can only be achieved by local studies which, in many cases, will involve hydrogeological and soil investigations. However the Agency considers that it is valuable, especially in the context of strategic land use planning, to take advantage of the existing geological and soil databases held by the BGS and SSLRC to produce groundwater vulnerability maps of England and Wales. The availability of these maps will also help to increase general public awareness of the location of the groundwater resources at risk.

The maps are based upon the geological and soil vulnerability classification. Figure 3 shows the way in which the soil and geological elements combine to give the various resource vulnerability categories.

A national map at a scale of 1:1,000,000 is included with this document. At this scale the sub divisions of the high vulnerability soil class are not differentiated. The presence of drift is shown but because of local variability in permeability and thickness it is not possible to illustrate reliably these differences which will need to be established on the basis of detailed local knowledge or investigation. The map should only be used for broad indicative purposes.

The Agency has published groundwater vulnerability maps at a scale of 1:100000 in both paper and CD Rom formats. These show the greater detail in soil classification. They do not show the depth of the unsaturated zone since it is variable both seasonally and from place to place. Specific local information may be available from the Agency. The maps also do not show the effect of drift locally as there is no distinction made for the nature and thickness that is present.

It must always be recognised that the use of vulnerability maps relates mostly to activities taking place on the surface. Many development activities result in the partial or total removal of the soil layer, whereby the vulnerability classification will be made irrelevant. Further information on the use of the maps can be found in the Guide to Groundwater Vulnerability Mapping (NRA 1995).

*Boxed aspects are incorporated in vulnerability maps.

Figure 2
Examples to illustrate vulnerability

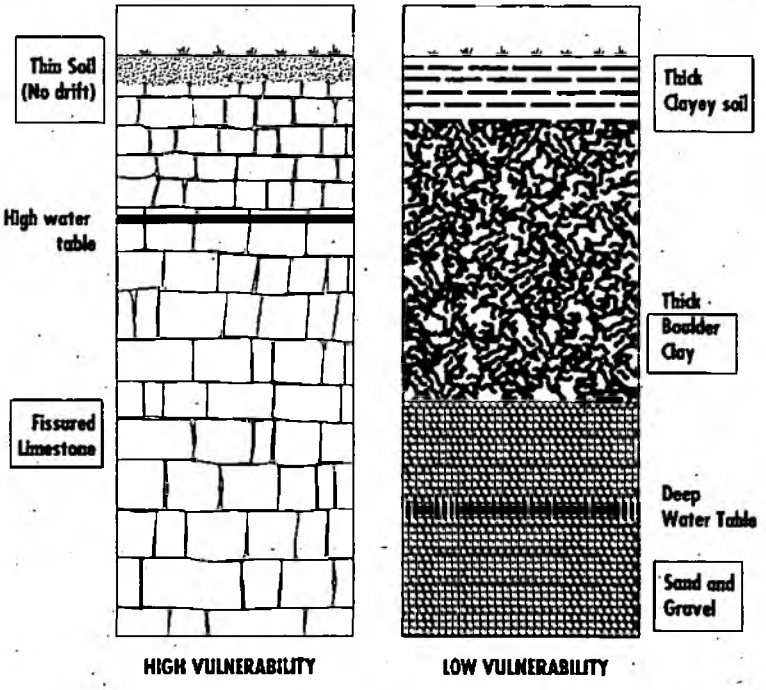
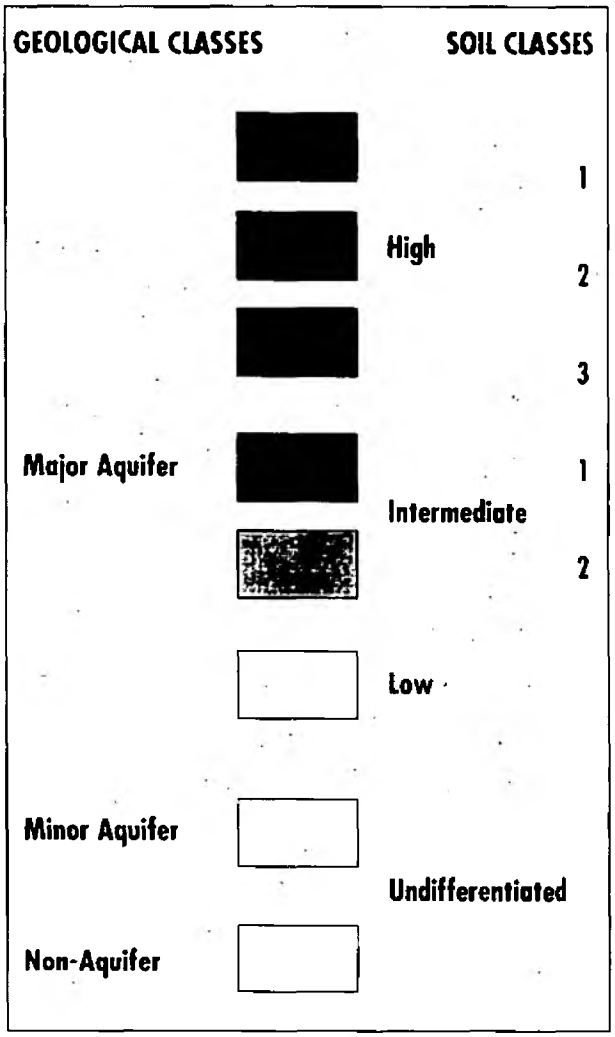
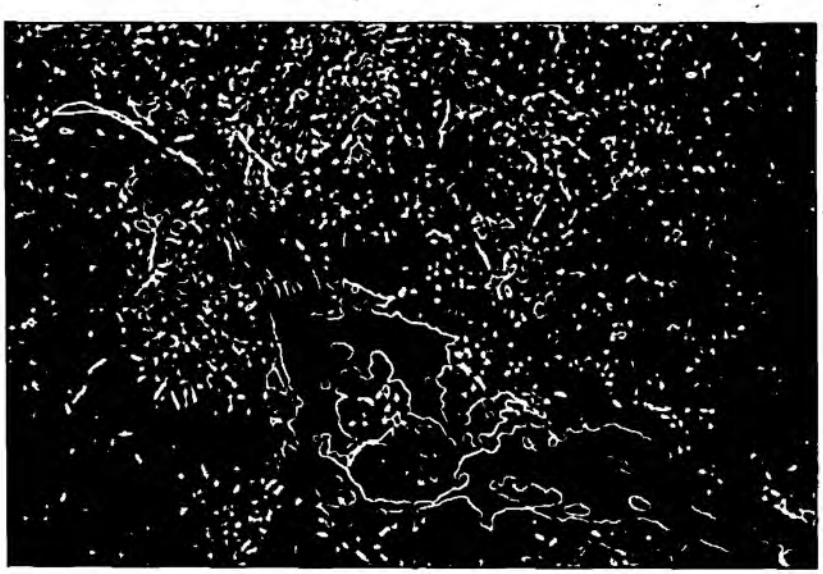


Figure 3
Groundwater vulnerability classification





Leachate from a waste disposal site discharging via a spring to surface water

6. Definition of Source Protection Zones

The proximity of an activity to a groundwater abstraction is one of the most important factors in assessing the risk to an existing groundwater source. All sources, including springs, wells and boreholes, are liable to contamination and need to be protected.

Three groundwater **Source Protection Zones** are recognised:

- Zone I (Inner Source Protection)
- Zone II (Outer Source Protection)
- Zone III (Source Catchment).

The orientation, shape and size of the zones are determined by the hydrogeological characteristics of the strata and the direction of groundwater flow. The sources for which it is appropriate to define zones are those which are used for public supply, other private potable supply (including mineral and bottled water) or in commercial food and drink production.

The total number of groundwater abstractions in England and Wales is estimated to be in excess of 100,000. There are nearly 2,000 major public supply sources and a larger number of licensed private sources. The remainder are unlicensed sources used for private domestic water supply. These will be listed in the private water registers to be set up by District Councils unitary Authorities and Metropolitan Boroughs.

Zone I (Inner Source Protection)

This zone is designed to protect against the effects of human activity which might have an immediate effect upon the source. The area is defined by a 50-day travel time from any point below the water table to the source and as a minimum of 50 metres radius from the source. This 50-day travel time zone is based on the time it takes for biological contaminants to decay. It is an established standard used in many other countries. The zone is not usually defined where the aquifer is confined beneath substantial and continuous covering strata of very low permeability since in such cases the cover will prevent infiltration. There must be no risk of short-circuiting, such as by solution features.

In situations where there is a deep unsaturated zone or thick Drift cover, the attenuating properties of the strata or the time of travel to the water table may be sufficient to prevent contamination from minor hazards. However, due to the uncertainties of unsaturated flow (for example the presence of fissuring) this has not been taken into account in defining the limits of Zone I.

The land immediately adjacent to the source and controlled by the operator of the source is included within this zone. Operating procedures designed to minimise pollution should be in force. The lack of good housekeeping by source owners/operators is one of the commonest sources of pollution to groundwater. The Agency has set out best practice which source owners should apply in this operational area.

Zone II (Outer Source Protection)

This zone is larger than Zone I and is the area defined by a 400 day travel time from any point below the water table to the source. The travel time is based upon that required to provide delay and attenuation of slowly degrading pollutants. It is necessary to define further the Outer Source Protection Zone in high storage aquifers such as sandstones to be the larger of either the 400 day travel isochron or the recharge catchment area calculated using 25 per cent of the long term abstraction rate (usually the licensed rate) for the source. This will ensure an adequate Zone II in all situations.

This zone is not generally defined for confined aquifers.

Zone III (Source Catchment)

This zone covers the complete catchment area of a groundwater source. All groundwater within it will eventually discharge to the source. It is defined as an area needed to support an abstraction from longterm annual groundwater recharge (effective rainfall). For wells and boreholes the area will be defined on the authorised abstraction rate whilst, for springs, it will be defined by the best known value of average annual total discharge. In areas where the aquifer is confined beneath impermeable cover, the source catchment may be some distance from the actual abstraction.

Drilling rig engaged in borehole construction
Courtesy Severn Trent Water

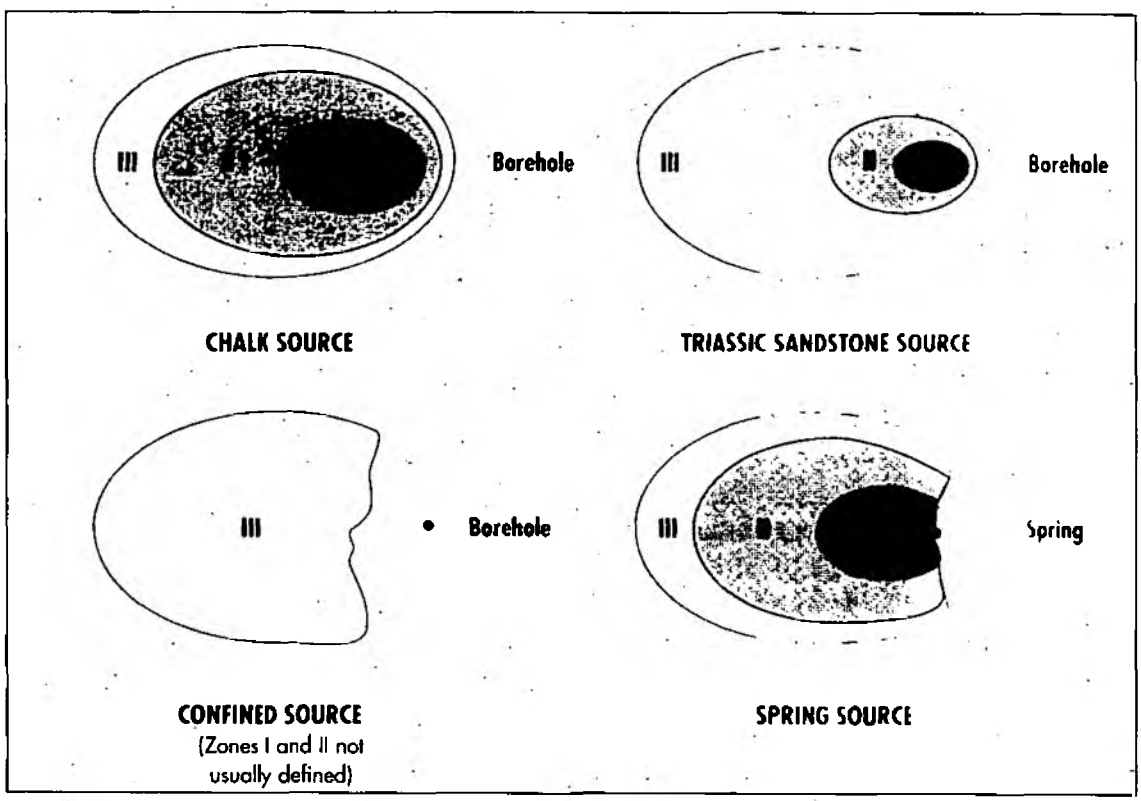


Figure 4
Schematic diagrams of the relationships between source protection zones

The relationship between the three zones and the groundwater source is shown in Figure 4. The diagram illustrates the variation in the relationship of the zones in four situations. These are abstractions from a low effective porosity Chalk aquifer, a high effective porosity Triassic sandstones aquifer, a confined aquifer and a spring. These situations show a range of possible relationships and are necessarily idealised cases. In reality, the size, shape and relationship of the zones will vary significantly depending on the soil, the geology, the amount of recharge and the volume of water abstracted. It is unlikely that any two abstractions will have the same shaped zones but the broad differences indicated in the diagram will still hold true. For example the catchment area for a given abstraction will be greater if effective rainfall is less. The area drawn on by a pumping borehole in an aquifer with relatively low effective porosity or storage, like the Chalk, is greater (and the travel times faster) than in an aquifer with higher storage capacity like the Triassic sandstones. This will have the effect that in a sandstone aquifer Zone II is likely to be significantly smaller than Zone III whereas in a Chalk aquifer the areas will be more comparable.

The area of Zone III will largely depend on the volume abstracted and the effective rainfall. It will vary from tens to a few thousands of hectares. The shape will be variable as outlined above. The outer edge of Zone III will be a few kilometres from an average source in the Triassic sandstones but will be significantly greater than this for a large borehole in the Chalk situated in the drier eastern part of the country.

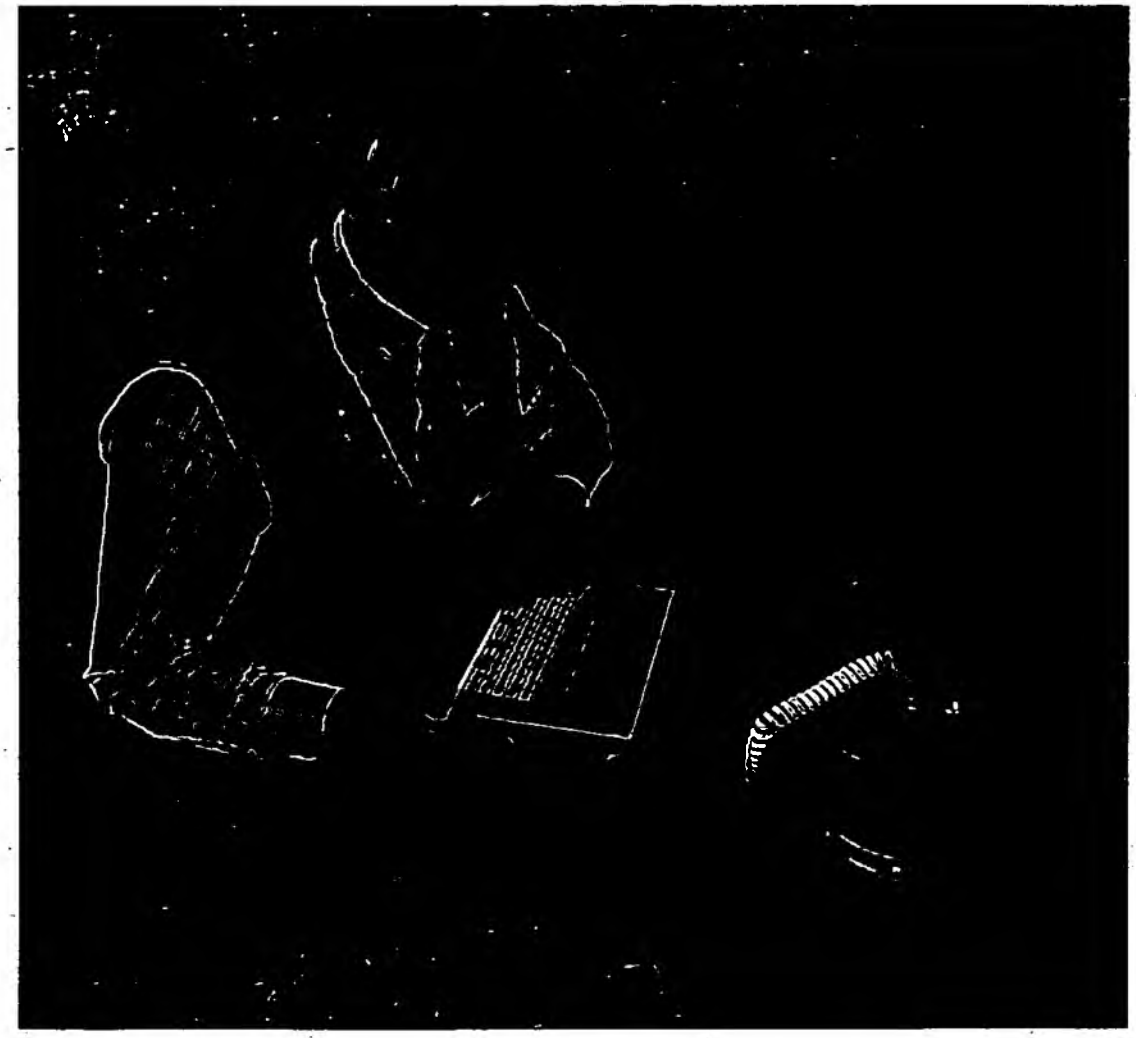
Defining Source Protection Zones

The Agency has developed a methodology to define Source Protection Zones using steady-state groundwater models which are readily available. The general principles and procedures are described in 'Guide To Groundwater Protection Zones in England and Wales' (NRA 1995) and the details described in 'Manual of Standard Zone Delineation Methodologies' (Envrionment Agency 1996). The Agency will be willing to consider any technically valid method for defining Source Protection Zones in any particular case. Zones have been prepared using the best information available at the time of drafting. The Agency recognises that any method is limited by the sufficiency of the data on the aquifer and its hydraulic characteristics. It is, therefore, willing to consider the redefinition of zone boundaries in the light of additional investigations carried out prior to particular developments or land use changes. In addition, it must be appreciated that, especially in heavily used aquifers, protection zones boundaries for one source may vary as a consequence of the hydraulic impacts of a new or changed abstraction in the vicinity. Source Protection Zones can therefore rarely be regarded as definitive and will be subject to regular reappraisal in the light of new knowledge or changed circumstances. For this reason the Agency does not propose to publish definitive Source Protection Zone maps in the same manner as the vulnerability maps, although maps at a sub-regional scale of the currently defined zones for individual, or groups of, sources will be made publicly available. Agency staff will also be able to advise on current or anticipated revisions.

Zones have now been produced to over 1,500 public supply sources and other sensitive abstractions and are available for consultation at Regional Offices.

It will be some years before zones have been defined for all smaller sources which are not perceived to be subject to current pollution risks. There will be consultation on the definition of the zones with the source owners. When new sources are developed the urgency to define zones will be determined by the vulnerability of the source and the potential impact on any adjacent zones previously determined.

In heavily exploited aquifers, the Source Catchment Zones of adjacent sources will coalesce and may, in some cases, occupy most, if not all, of the aquifer outcrop. Otherwise, outside the Source Catchment, the resource protection concepts described in Section 5 will apply. In most cases the protection criteria in the Source Catchment Zone and for vulnerable major aquifers will be similar. This reflects both the importance of resource protection and the scope for periodic redefinition of the Source Protection Zones.



Collecting groundwater level and quality information from a datalogger

Groundwater Protection Policy Statements

7. Groundwater Protection Policy Statements

Groundwater resources, both in quality and yield, are put at risk by a wide range of human activities. Quality effects can range from specific point sources of potential pollution to diffuse pollution spreading over a wide area. Yield is affected by physical interference with the aquifer. These activities are controllable to varying degrees by legislation, which is either operated by the Agency or by other bodies. They may also be subject to guidelines and codes of practice which will have varying degrees of statutory force.

The following sections set out the policy objectives of the Agency with respect to different types of threat to groundwater resources.

The policy statements are divided into eight:

A. Control of groundwater abstractions;

B. Physical disturbance of aquifers and groundwater flow;

C. Waste disposal to land;

D. Land Contamination;

E. Disposal of liquid effluent, sludges and slurries to land;

F. Discharges to underground strata;

G. Diffuse pollution of groundwater;

H. Additional activities or developments which pose a threat to groundwater quality.

Some of the policy statements are supported by "Acceptability Matrices". These relate the activities to Source Protection Zones and Groundwater Resource Vulnerability. These apply the concepts of vulnerability so that more stringent controls or protection measures will be sought in situations of greatest risk.

Where the protection of an existing use is important, then the Source Protection Zones are paramount and for this reason these are shown in the upper part of the matrix.

The Agency will seek to achieve the objectives in the statements either through its own authorisations or by statutory and non-statutory consultation with other agencies. Where objectives cannot be met through existing provisions the Agency may, in appropriate cases, seek additional powers; for example under Section 93 of the Water Resources Act 1991, to establish statutory water protection zones.

A. Control of Groundwater Abstractions

The Agency is responsible for the granting of authorisations to abstract groundwater under the Water Resources Act 1991. The grant of new authorisations should not detract from the rights of existing authorised abstractors and abstraction from the groundwater resource should be both sustainable and environmentally acceptable. These powers have existed in their present form since the enactment of the Water Resources Act 1963. In addition the Environment Act 1995 places a duty on the Agency to take action to conserve; redistribute or otherwise augment water resources and secure their proper use. Within the scope of a policy for Groundwater Protection the Agency must ensure that abstractions are managed to prevent:

- the loss of future water resources by over-abstraction;
- damage to environmental features which are dependent upon the presence or level of the groundwater table, including the unacceptable depletion of river base flows;
- the deterioration of groundwater quality.

A.1 The Environment Agency will only authorise abstractions of groundwater within the scope of the Water Resources Act 1991 which will ensure that:

A) Total abstraction from any groundwater resource area does not exceed the long-term annual average rate of replenishment.

The Agency wishes to ensure that groundwater levels are stable at an acceptable level in the long-term and that groundwater resources are not depleted at rates that cannot be sustained by recharge.

B) There is, in the view of the Environment Agency no unacceptable detriment to any watercourse or other environmental feature dependent upon groundwater.

The need to preserve groundwater levels or groundwater baseflows to rivers for general environmental benefit, or to meet Minimum Acceptable Flows or Water Quality Objectives, will often result in the practical limit on abstractions being less than the long term average rate of replenishment. In some cases the optimum use of water resources may be achieved by artificial support of rivers or wetlands.

C) Any abstraction does not cause a deterioration of groundwater quality through the intrusion of saline or polluted waters.

In the interests of the conservation of water resources, and to maintain compliance with Water Quality Objectives, the Agency will not authorise abstractions if there is evidence that they will unacceptably introduce saline waters, from either the sea or from natural connate waters, or water from existing polluted surface waters or groundwaters, into an aquifer.

Where existing groundwater abstractions conflict with these policy objectives the Agency will not issue any new permanent licences in the relevant groundwater catchment and will take opportunities as they arise to reduce authorised abstraction.

B. Physical Disturbance of Aquifers and Groundwater Flow

The Agency has an interest in the range and intensity of activities which physically disturb aquifers and groundwater flow. In some cases there is a consequential effect on springs, streamflow, ponds and wetlands.

The Agency's powers under the Water Resources Act 1991 are limited to the control of licensable abstractions (Section 32) and to a limited range of other activities which may disturb aquifers and affect groundwater flow under Sections 30 and 199. Activities which may affect groundwater and which are not covered by the Agency's own powers include:

- all forms of groundwater abstraction outside those controlled by abstraction licences;
- quarrying and gravel extraction above and below the water table whether worked wet, or dry by dewatering
- mining;
- construction of highways, railways, cuttings and tunnels;
- landfill using low permeability materials and any other activities likely to impede groundwater flow;
- borehole construction (and abandonment);
- any activity which interconnects naturally separate aquifers;
- field drainage that intercepts recharge water.

The Agency recognises the economic importance of many of these activities. The major raw materials of the minerals industry often come from major aquifers and there are therefore potential conflicts of interest. The Agency, in its advice to Mineral Planning Authorities, will have regard to its duties under the Water Resources Act 1991 to conserve and protect water resources and to preserve and, where appropriate enhance, conservation of the water environment. The Agency is a statutory consultee under the Town and Country Planning Acts for most relevant activities and will make appropriate representations to the determining authority.

The following policies will be applied:

B.1 For any proposal which would physically disturb aquifers, lower groundwater levels, or impede or intercept groundwater flow, the Environment Agency will seek to achieve equivalent protection for water resources and the water environment as if the effect were caused by an abstraction controllable under the Water Resources Act 1991

The remit of the Agency is to achieve the management and protection of water resources on a sustainable basis. Policy Statement A1 of this document sets out those policies to be applied to preserve existing abstraction rights, the quality and quantity of water resources and to prevent consequential effects upon the water environment. Where this cannot be achieved through the Authority's own powers under the Water Resources Act 1991, the Agency will, through representations under planning and other appropriate legislation, seek to achieve an equivalent level of protection of water interests. Where it is not feasible or realistic to prevent effects occurring, the Agency will object unless satisfactory measures can be taken in mitigation.

Mining, quarrying and other below-ground engineering and construction operations often involve dewatering, sometimes for substantial periods of time. Such dewatering can lead to the loss of water supply from wells and boreholes, the removal of natural groundwater discharges to ponds and steams, and can affect wetlands. All of these may require protection or the loss to be mitigated in some way. The water table may in some cases be permanently lowered, leading to irretrievable reduction or loss of spring and stream flows.

Where the effects of dewatering can be mitigated by measures enforceable under the planning controls, the Agency will seek the use of agreements under Section 106 of the Town and Country Planning Act 1990 to put such measures into effect. In addition the Agency may serve a Conservation Notice under Section 30(2) of the Water Resources Act 1991 to require reasonable conservation measures to be taken to protect water resources.

Activities such as mining, the construction of highways and railways with their associated tunnels, cuttings and borrow pits, the construction of impermeable barriers below the water table and exploration drilling for oil and minerals can, in certain circumstances, cause problems by draining groundwater from an aquifer, diverting groundwater, or by interconnecting two separate aquifers. They should, therefore, also be subject to

planning controls, unless they constitute "permitted development" under the General Development Order. The use of Conservation Notices for the control of exploratory drilling would be paramount in such cases.

B.2 The Environment Agency will object to a new proposal for mineral extraction where there will be demonstrable harm to water resources and the water environment, unless measures to mitigate any effects can be agreed within planning controls.

The paramount concern is for water resources within Source Protection Zones, although in fissure flow aquifers the concern could apply to the whole of the relevant aquifer.

It is therefore essential that applicants consult the Agency at the earliest possible stage so that any potential impact upon water interests can be identified and appropriate investigations initiated. The Agency will require that any Environmental Assessment includes an adequate hydrogeological study to meet its concerns, covering any resultant impacts upon the water environment. Of specific concern are operations below the water table where dewatering takes place. The hydrogeological study should include details of proposed water management and reuse.

The unsaturated zone is vital to both the quality and quantity of water resources. Water percolating through this zone can be purified by the filtration of suspended solids and the breakdown of pollutants by oxygenation and biological action. The unsaturated zone can act as a buffer which delays and attenuates flood peaks and makes an important contribution to dry weather flows. The Agency will require a developer to demonstrate that removal of mineral from the unsaturated zone and any subsequent restoration will not lead to a significant reduction in the quality of quantity of water resources. Where low-level restoration which permanently reduces the thickness of the unsaturated zone is proposed, the proposals should have regard to impacts upon groundwater quality and the Agency may seek restrictions on subsequent agricultural practices or other land uses.

B.3 The Environment Agency will normally object to proposals where the obstruction of groundwater flow is likely to cause undesirably high groundwater levels or cut-off groundwater flow, unless measures to mitigate any effects can be agreed.

Impermeable constructions below the water table, such as bentonite/concrete slurry walls and lined landfills can impede groundwater flow and cause the water table to rise further up the groundwater gradient. This may lead to flooding or put subterranean structures at risk. Similarly the cutting-off of groundwater flow can cause serious problems to abstractors and groundwater dependent features down the groundwater gradient.

B.4 The Environment Agency will encourage best practice regarding the backfilling of any abandoned shaft, well, borehole, tunnel or adit in order to prevent pollution or loss of water resources.

There are preferred methods for dealing with these, largely dependent upon geology. The Agency will offer guidance on the correct method of filling or sealing disused boreholes, shafts and tunnels.

The Agency will also exercise its powers under Section 71(6) of the Water Industry Act 1991 to prevent the waste of water resources from uncontrolled artesian overflow of any borehole or shaft.

C. Waste Disposal to Land

The Agency is responsible for the issue and enforcement of Waste Management Licences (WML) under the Environment Protection Act 1995, and the Waste Management Licensing Regulations 1994. The Regulations also exempt a wide range of activities from Licensing. The Agency is also a statutory consultee of the Planning Authorities under the Town & Country Planning Acts. A valid Planning Permission or a Certificate of Lawfulness of proposed use or development is required before a WML can be issued. Exemption from licensing does not confer exemption from Planning legislation. The WML will regulate the landfill in its post-operative phase until the hazard and the risk of pollution has reduced to a minimum and the surrender of the Licence can be accepted by the issue of a Certificate of Completion. The Licence will require that financial provision is made to ensure the restoration and aftercare of the site in the event of liquidation of the company holding the Licence.

A wide range of waste disposal activities require a Waste Management Licence. These include scrap yards, transfer stations, incinerators, waste storage and treatment etc. However, the greatest threat to groundwater from waste disposal operations is posed by landfilling activities. In view of this major pollution risk the following policy statements relate mainly to waste disposal to land. The matrix following the policy statements refers only to landfill. Decisions on individual proposals will have regard to a site specific risk assessment and must comply with Regulation 15 of the Waste Management Licensing Regulations, 1994.

C.1 The Environment Agency will liaise with Planning Authorities and others to entourage the location of new landfill sites in areas where groundwater is least vulnerable to pollution.

The Agency wishes to encourage developers and planning authorities to consider Non-Aquifers preferentially for new waste disposal activities. In some areas above-ground landfills will need to be considered where sufficient below ground void space is not available. The Agency will seek to include suitable maps in Structure and Waste Local Plans.

C.2 The Environment Agency will normally object to all activities requiring a Waste Management Licence within Zone I (Inner Source Protection)

The risk of contamination to groundwater sources by waste handling activities is greatest within Zone I. Besides landfilling, other activities which require a waste management licence, (such as incinerators, transfer stations, civic amenity sites, waste chemical treatment plants, storage of special wastes or scrapyards) can present a significant threat to groundwater quality. The variable nature of these operations means they will be considered on a case by case basis, but are unlikely to be acceptable unless a negligible risk to the source can be demonstrated.

C.3 The Environment Agency will normally object to landfilling within Zone 2 (Outer Source Protection) unless it is satisfied that the waste materials do not contain significant biodegradable or other potentially polluting matter and that the site will have acceptable operational safeguards.

There is a presumption against landfilling in Zone 2 unless it can be demonstrated that the waste itself is nonpolluting. This covers essentially inert, naturally occurring excavated materials, but construction and demolition waste may be acceptable depending on its origin, the local conditions and the proposed method of operation of the landfill.

C.4 The Environment Agency will not object to the landfilling of wastes with a high or medium pollution potential within Zone 3 and on Major and Minor Aquifers if it is satisfied that the risk of pollution to groundwater tan be adequately mitigated by engineering measures and operational management controls.

The scale of engineering measures will be mainly dependent upon the waste type, the local vulnerability of the groundwater and the proximity of any abstractions. Engineering measures for wastes which could produce leachate of significant polluting potential must provide for total containment and the collection and disposal of leachate in an approved management scheme.

If the nature of the waste and the hydrogeological conditions are such that the Agency judges that its deposit does not pose a threat to groundwater, then the Agency may agree to a site being operated on noncontainment principles, providing acceptable operational safeguards are implemented.

C.5 The Environment Agency will not normally object to the landfilling of waste on non-aquifers for groundwater pollution reasons but the protection of surface water quality, flood defence and fisheries interests must be considered.

This refers to Non-Aquifers where groundwater protection issues may not be of paramount concern, but the infrastructure and control for leachate management will need to be rigorous at any site where controlled waters other than groundwater may be placed at risk of pollution.

C.6 The Environment Agency will normally object to waste disposal activities which extend to or below the water table in Source Protection Zones. Elsewhere the presence of an unsaturated zone will normally be required but a landfill operated on containment principles, may be considered on a site specific basis.

Wastes deposited below the water table will quickly generate leachate if groundwater ingress is not impeded. This may present operational difficulties and lead to rapid contamination of groundwater. The presence of an unsaturated zone gives an opportunity for attenuation to occur and leads to a delay in any impact on the water environment. The engineering of quarries excavated significantly below the water table will be difficult and expensive to achieve successfully in permeable strata. In such cases the Agency is likely to object to the deposition of potentially polluting wastes below the water table unless the hydrogeological conditions are suitable and the engineering measures are considered effective.

C.7 The Environment Agency will ensure that, as part of the Waste Management Licence, adequate provision is made for monitoring and preventing pollution of controlled waters. Adequate provision must also be made for long-term maintenance and monitoring of leachate control and disposal systems and for the integrity of any top, basal or side seals.

This policy objective will be achieved through the Agency's own Licensing duties.

The operator must agree monitoring facilities and programmes with the Agency.

C.8 The Environment Agency will review Waste Management Licences at intervals according to advice from DETR (currently every five years).

This allows the update of licence conditions in line with best current landfilling practices.

C.9 The Environment Agency will not accept the surrender of a Licence unless and until it is satisfied (by the results of monitoring or site investigation) that the landfill is unlikely to cause pollution of the water environment.

This statement addresses the long term problems which are likely to arise after the active operation of the site has ended and when daily supervision and control have ended.

Matrix 1
Landfill acceptability

Source Protection			
Site Type	**1 Inner Zone**	**2 Outer Zone**	**3 Catchment Zone**
1. High pollution potential (landfills accepting domestic commercial and industrial waste either individually or on a co-disposal basis)	Not acceptable	Not acceptable	Only acceptable with engineered containment and operational safeguards
2. Medium pollution potential (landfills accepting construction, demolition industry wastes and similar	Not acceptable	Acceptable subject to evaluation on a case by case basis and adequate operational safeguards	Acceptable subject to evaluation on a case by case basis and adequate operational safeguards
3. Low pollution potential (landfills accepting inert, uncontaminated waste)	Not normally acceptable	Acceptable only with adequate operational safeguards	Acceptable only with adequate operational safeguards
Resource Protection			
Site Type	**Major Aquifer**	**Minor Aquifer**	**Non-Aquifer**
1. High pollution potential (landfills accepting domestic commercial and industrial waste either individually or on a co-disposal basis)	Acceptable only with engineered containment and operational safeguards	Acceptable only with engineered containment and operational safeguards	Acceptable only with adequate operational safeguards. Engineering measures may be necessary in order to protect surface waters
2. Medium pollution potential (landfills accepting construction, demolition industry wastes and similar	Acceptable only with adequate operational safeguards	Acceptable only with adequate operational safeguards	Acceptable only with adequate operational safeguards
3. Low pollution potential (landfills accepting inert, uncontaminated waste)	Acceptable	Acceptable	Acceptable

Footnotes

1) This matrix refers specifically to groundwater protection. In case of Non-Aquifers, operational safeguards will relate mainly to the protection of surface water resources.
2) Operational safeguards will include, inter alia, appropriate site management, leachate control and management and monitoring controls.
3) Mono disposal of hazardous industrial wastes will only be acceptable in non-aquifer areas.
4) For sites which accept wastes of mixed pollution potential, the comments relating to the highest category of site type will apply.
5) All decisions on a site-specifications basis must be subject to an appropriate risk assessment.

This matrix is a summary only and must be read in conjunction with the policy statements.

D. Land Contamination

The Agency is concerned about the pollution risks associated with land which has been contaminated whether in a derelict state, as a result of the disturbance caused during redevelopment or from active industrial sites.

The Agency will seek appropriate controls to protect the water environment from the redevelopment of contaminated sites by liaising with Local Planning Authorities under the Town and Country Planning Acts.

Contaminated sites may include land currently or previously used in connection with various activities including for example:

- coal-gas manufacture
- landfill sites and other waste disposal activities, waste lagoons
- chemical manufacture
- heavy industry
- sewage treatment works
- metal refining
- oil refining and hydrocarbon storage.

A new regime for the identification, investigation and remediation of contaminated land is introduced in Pt IIA of the Environment Protection Act 1990. This is to be implemented by the Local Authorities and the Agency and is subject to statutory guidance. Until the new regime is implemented contaminated land will continue to be dealt with through Planning and Pollution Control Legislation, or voluntary action.

The following policies apply in dealing with this issue until the new legislative regime is in place:

D.1 The Environment Agency will entourage the implementation of effective remedial measures to prevent pollution of groundwater by existing direct or indirect discharges from any contaminated site. Where pollution occurs the Agency will prosecute in appropriate cases under Section 85 of the Water Resources Act 1991.

The Agency will always seek to co-operate with landowners and occupiers to encourage investigation and a programme of remedial measures which will prevent continuing pollution. Where co-operation is not forthcoming the Agency will use its powers of prosecution in appropriate cases under Section 85 of the Water Resources Act 1991. The Agency has powers under Section 161 of the Water Resources Act 1991 to carry out remedial works to remedy or forestall pollution. However, these powers have seldom been used due to the uncertainty of cost recovery after works are done. A revised Section 161A–D is to be implemented, giving the Agency powers to serve notice on the appropriate person requiring them to take action to remedy or forestall pollution.

D.2 The Environment Agency will seek to be consulted by Local Planning Authorities about any application for development or other works on sites likely to be contaminated.

To ensure that groundwater quality interests are covered on sites where redevelopment is proposed, it is essential that consultation takes place between the developer and the Agency as early as possible before any site investigations commence. The possibility of contamination should be clearly indicated by the Local Planning Authority or the applicant.

D.3 The Environment Agency will recommend to the Local Planning Authority that it refuse Planning Permission for the redevelopment of contaminated sites where water resources could be adversely affected unless it is satisfied that the proposals include effective measures for the protection of groundwater and surface water quality. It will advise Local Planning Authorities where insufficient or technically weak information has been provided so that they can require the applicant to supplement the details provided.

On sites where contamination of the ground and groundwater pollution is highly likely, a thorough site investigation should take place prior to any application for Planning Permission. Investigations should include an assessment of the leaching characteristics of contaminants in the ground and of the geology/hydrogeology of the site, including existing groundwater quality. This information should support subsequent Planning Applications. These should include a strategy for dealing with contamination and minimising water pollution. Where the site investigation reveals significant groundwater pollution the development proposals should include details of the proposed remedial action.

D.4 The Environment Agency will seek to ensure that Planning Permissions contain conditions designed to protect water resources. The Agency will strongly entourage the Local Planning Authorities to enter into planning obligations with developers under Section 106 of the Town and Country Planning Act, 1991 (as substituted by Section 12 of the Planning and Compensation An, 1991) to control and monitor ground and groundwater contamination during and after redevelopment.

Planning obligations should require a remediation plan/method statement to be submitted for the approval of the local planning authority in consultation with the Agency. They should include details of further site investigation, chemical analysis, criteria and standards for removal or treatment of contaminated soil and final restoration. Details of foundations, covering material, drainage and groundwater quality monitoring programmes should also be included.

D.5 The Environment Agency will wish to ensure that any discharge, seepage or drainage resulting from the redevelopment of a contaminated site will be of a quality and quantity that will not pollute groundwater.

When contaminated sites are remediated, and where groundwater resources are at risk, the Agency will advocate the removal or suitable treatment of material with a significant water pollution potential. Target concentrations for key contaminants should be specified. These should relate to the soluble or mobile fraction and, not total concentrations. An estimate of the quantity and quality of any continuing discharge from the developed site should be made.

D.6 In areas where historical industrial development is known to have caused widespread groundwater contamination, the Environment Agency will review the merits and feasibility of groundwater remediation depending upon local circumstances and available funding.

In some areas where historical groundwater pollution has resulted from a number of possible sources it would be extremely difficult to pinpoint individual sites or incidents. Where long urbanised industrial areas are located on aquifer outcrop, groundwater pollution is almost inevitable. In these situations the benefits and feasibility of any groundwater remediation operation must be carefully considered. In many cases the situation may be beyond repair and efforts should then be directed towards the removal of any remaining source and the monitoring of groundwater quality to ensure that any redevelopment does not cause further deterioration. Containment of polluted groundwater by engineering methods or sacrificial pumping may also be appropriate.

D.7 The Environment Agency will encourage the manufacturing industry and others to improve operational practices to eliminate unauthorised discharges to land. Where contamination of groundwater or of surface water through contaminated groundwater flow is apparent the Agency will require remedial measures to be undertaken to prevent further pollution.

Manufacturing industry involves the storage and use of chemical compounds which may, over time, contaminate the land surface at many locations through accidental spillage, leakage and poor management practices. The resultant groundwater pollution can affect surface water quality where the opportunity for shallow sub-surface flow exists.

For existing sites in areas vulnerable to groundwater pollution (and where pollution is known, suspected or anticipated), the Agency will seek to discuss with the local management the need for improved operational practices and remedial measures, where necessary, on a progressive basis. The Agency has recommended further Regulations are made under Section 92 of the Water Resources Act 1991 to prevent pollution at source from oil storage facilities. The storage of other potentially polluting substances is also being examined in the context of Regulations under Section 92 of the Act.

D.8 The Environment Agency will by liaison with Planning Authorities and industry, seek to influence the preferential location of new industrial development in areas which are not vulnerable to groundwater pollution.

The Agency will ensure that IPC authorisations granted to industry prevent future contamination of land and groundwater.

It is important to recognise that even today land may be at risk of being contaminated. The Agency wishes to ensure that affected areas are minimised in the future, especially where new industries are located in green field sites. Through consultation on Draft Development Plans, the Agency will indicate areas vulnerable to groundwater pollution.

The Agency seeks to influence any new proposal involving the significant use, storage or manufacture of Lists I and II chemicals whether in raw or waste

form, so that they are preferentially located on Non-Aquifers .

Proposals for the siting of such activities within Source Protection Zones or on Major Aquifer areas would only meet with approval subject to adequate measures to prevent the migration of pollutants to groundwater. Such measures would include:

- minimisation of underground storage of List I substances (prohibited within Zone I);
- no open storage areas for List I substances;
- secure bulk storage of potentially polluting substances with impermeable bunding;
- adequate containment and safe disposal for spillages;
- above ground pipework in positions not vulnerable to accidental damage.

E. The Application of Liquid Effluents, Sludges and Slurries to Land

A significant proportion of all liquid and semiliquid wastes are disposed of by spreading them onto land. Some of these wastes can be beneficial to agricultural land, but this activity can present a risk to groundwater quality. The risk is dependent upon the chemical and microbiological content of the waste, the rate, method and timing of application and the groundwater vulnerability.

Soils can play an important role in mitigating the impact of many potential pollutants and the groundwater vulnerability map series will be a valuable aid to decision-making when choosing suitable locations. However, where groundwater is least vulnerable, surface waters are likely to be most vulnerable and the interaction of this policy with the protection of surface water is particularly relevant.

The Environmental Protection Act 1990 and the Waste Resources Act 1991 from the primary legislation controlling the deposit of waste on land. The Waste Management Licensing Regulations 1994 define the categories of waste which are a) controlled and b) exempted from licensing. Schedule 3 identifies exempt activities and these include the deposit of certain wastes onto land, provided that:

- above a specific tonnage the activity must result in some benefit to agriculture or ecological improvement;
- in the case of agricultural land, prior notification is given to the Agency and;
- in all cases the activity will not endanger human health or harm the environment.

Sewage sludge deposited directly onto land for agricultural purposes is exempt from licensing provisions (Schedule 6 of the 1994 Regulations). Sewage sludge deposition is also addressed by The Sludge (Use in Agriculture) Regulations 1989 (No 1263). The control of these is vested in the Agency.

The disposal of agricultural wastes is presently exempt from any controls other than those relating to their storage (The Control of Pollution (Silage, Slurry & Agricultural Fuel Oil) Regulations 1991 (No 324)) and general guidelines within the Ministry of Agriculture Code of Good Agricultural Practice for the Protection of Water. The Groundwater Regulations, due to be brought into force during 1998 will extend control to certain agricultural wastes, such as spent sheep dip and pesticide washings.

The wastes considered below can be divided into three categories depending upon the degree of control the Agency can influence in each case and the industry from which they originate:

- Controlled wastes (industrial effluent sludges, both organic and inorganic in nature and including cesspool contents).
- Sewage sludges (produced exclusively at sewage works and disposed of by Sewerage Undertakers or their contractors).
- Agricultural wastes (produced from various farming activities, including animal wastes and silage liquors).

E.1 The Environment Agency will seek to ensure that it receives sufficient information in support of notifications of sludge or liquid waste disposal to land to permit a proper assessment. Where the Agency considers that such a deposit will give rise to a significant risk of polluting groundwater (or surface water), it will require that the operation is subject to the provisions of Section 36 of the Environmental Protection Act 1990.

E.2 The Environment Agency will curtail the disposal of any sludge or liquid waste which contains significant concentrations of list I (Appendix 1) substances to land within Source Protection Zones or on Major and Minor Aquifers, unless prior investigation shows, to the satisfaction of the Agency, that pollution of groundwater will not occur.

The disposal of spent sheep dip, and dilute solutions of pesticides from the cleaning of spraying equipment onto uncropped land which, supports only poor vegetation, is of minimal wildlife value and has no hedges, trees or bushes nearby, should be used in preference to soakaways (see policy statement F4). However, these areas must be located with due regard to soil and aquifer conditions and proximity to sources of water supply.

To avoid undue leaching of nitrate, controlled wastes, agricultural wastes which have a significant nutrient content and sewage sludges must be applied according to the nutrient requirement of the crop and take account of other sources of nitrogen. In any case, the total nitrogen content must not exceed 250kg/ha (or less in some circumstances) in any 12 month period (see also Section G).

E.3 The Environment Agency will liaise with sewerage undertakers and recipient farmers over the disposal of sewage sludge to land. It will seek to influence the location, quantity and timing of applications in order to prevent pollution of water resources.

The Agency will make groundwater vulnerability maps available so that Water Companies and others may plan disposal areas in relation to groundwater vulnerability. Areas of Non-Aquifer or Minor Aquifer are likely to be preferable to Major Aquifers. However, disposal plans will also have to take account of surface water vulnerability. Where there is little option other than to spread sludge on Major Aquifers, the soil vulnerability classification must be considered to minimise any impact on groundwater. The development of new areas of dedicated land will be discouraged by the Agency.

E.4 The Environment Agency will liaise with farmers and seek to encourage them in the preparation of waste management plans for their farms. These should include the drawing up of a map identifying land available for spreading.

The Agency recognises the beneficial effects of applying sludges and slurries, (whether for fertilisation or soil conditioning), but this must be carried out without causing contamination of water resources, including contributing to excessive leaching of nitrate. Best practice for the management of farm wastes in relation to the protection of water is given in the MAFF Code of Good Agricultural Practice for the Protection of Water and should be followed at all times.

E.5 The Environment Agency will advise local Planning Authorities to refuse permission for proposed, relevant agricultural developments which could lead to the disposal of sludges and slurries, unless it is satisfied that sufficient, suitable land is available for disposal purposes.

The rate and method of application of farm wastes and sewage sludge to land must take account of the risks of water pollution and be determined by the crop requirements and soil characteristics. Farm waste and sewage sludge applications to land should be beneficial to agriculture and should not be carried out for waste disposal purposes. Whether the land is suitable depends upon its proximity to abstractions, the soil type, the degree of slope, etc. The Code of Good Agriculture Practice for the Protection of Water and the groundwater vulnerability maps will provide some guidance. This will need to be supplemented by local information.

Matrix 2
The application of liquid effluents, sludges and slurries to land

Source Protection			
Nature/Origin of Sludge	**1 Inner Zone**	**2 Outer Zone**	**3 Catchment Zone**
Inorganic or non-biodegradable			
Containing significant concentrations of List I substances	Not acceptable	Not acceptable	Not acceptable
Containing significant List II substances and other persistent chemicals	Not acceptable	Not acceptable	Only acceptable subject to evaluation and constraints (presumption against)
Strong Organic and Biodegradable			
Low nutrient content/ industrial	Not acceptable	Not acceptable	Only acceptable subject after full investigation and subject to strict control (presumption against)
Sewage sludge	Not acceptable	Acceptable subject to evaluation	Acceptable subject to evaluation
Farm wastes	Not acceptable	Acceptable subject to evaluation	Acceptable subject to evaluation
Low Pollution Potential/ High Dilution	Not acceptable	Acceptable subject to evaluation	Acceptable

Resource Protection			
Nature/Origin of Sludge	**Major Aquifer**	**Minor Aquifer**	**Non-Aquifer**
Containing significant concentrations of List I substances	Not acceptable	Not acceptable	Only acceptable subject to evaluation and constraints (presumption against)
Containing significant List II substances and other persistent chemicals	Only acceptable subject to evaluation and constraints (presumption against)	Only acceptable subject to evaluation and constraints (presumption against)	Acceptable subject to evaluation
Strong Organic and Biodegradable			
Low nutrient content/ industrial	Only acceptable subject to evaluation and constraints (presumption against)	Only acceptable subject to evaluation and constraints (presumption against)	Acceptable subject to evaluation
Sewage sludge	Acceptable subject to evaluation	Acceptable subject to evaluation	Acceptable subject to evaluation
Farm wastes	Acceptable subject to evaluation	Acceptable subject to evaluation	Acceptable subject to evaluation
Low Pollution Potential/ High Dilution	Acceptable	Acceptable	Acceptable

Footnotes

1) Sludges containing significant concentrations of nitrogen compounds must be evaluated in the context of the existing crop requirement for nutrients and also take other sources of nitrogen into account. There may be a requirement to deposit sludges generated within NSA's and NVZ's outside the designated area. Advice given in the MAFF Code of Good Agricultural Practice for the Protection of Water should be followed in all cases.
2) Evaluation of the acceptability of wastes at locations where there are low-permeability soils and/or strata should take account of potential run-off into surface waters. This may mean that situations considered acceptable for groundwater protection are unacceptable for surface water reasons.
3) Where disposal of sludges on Major Aquifers is unavoidable the relevant groundwater vulnerability map should be used to determine locations where soil is least permeable and/or affords a degree of protection. These areas should be used in preference to other, more vulnerable, areas.
4) The injection of sludges in such a way that it can by-pass the protective features of the soil layer is an increasing practice. The proposed method of sludge application will be taken into account in evaluating the risks of disposal to groundwater in any location.
5) Where waste treatment sludges containing significant concentrations of List I (Appendix 1) substances are mixed with sewage sludge prior to spreading on land, restrictions will relate to the most polluting component.

This matrix is a summary only and must be read in conjunction with the policy statements.

F. Discharges to Underground Strata

The Agency has powers under the Water Resources Act 1991 and the Groundwater Regulations to exert considerable influence over discharges to underground strata. Such discharges normally reach underground strata via a soakaway system. There are three main areas of concern:

- Sewage effluent discharges which include septic tank and sewage treatment plant effluents from individual properties, small housing estates and commercial developments.

- Trade effluent discharges which include dewatering and cooling waters, and process effluents.

- Surface water discharges which include contaminated run-off from roofs and impermeable areas, such as major roads, amenity areas, car/lorry parks, storage areas etc.

The Agency often becomes aware of activities which may result in a discharge to ground through the planning consultation process or through referrals from Local Authorities under Building Regulations. These discharges are controlled by issuing consents to discharge or prohibition notices supported by monitoring and appropriate enforcement.

A consent may be issued under Section 85 of the Water Resources Act 1991 including appropriate conditions for quality and quantity so that a discharge of sewage or trade effluent does not pollute controlled waters. A relevant prohibition notice may be served on a person under Section 86 of the Water Resources Act 1991 to prohibit new or existing discharges which may (or are currently) causing pollution. The need for consents or prohibition notices in respect of the three main areas of concern is summarised below:

- sewage and trade effluents discharged directly to groundwater will always need consents;

- sewage and trade effluents discharged to soakaway from fixed plant or a building may be controlled either by the serving of prohibition notices or issuing of consents dependent upon the pollution potential of the effluent;

- surface run-off discharged directly to groundwater, or via pipe to soakaway, may be controlled by the serving of prohibition notices.

The impact of urban surface water run-off on river water quality has led to encouragement of Best Management Practices (BMP's) for surface water disposal which primarily involve discharge to ground. BMP's are in principle favoured by the Agency, but individual proposals should comply with the following policies, and may not be acceptable in all locations.

F.1 The Environment Agency will seek to prevent any discharge into underground strata which may result in pollution of water resources.

F.2 The Environment Agency expects to be consulted by local and other authorities to identify any proposal involving discharge of sewage, trade effluent or contaminated surface water into underground strata. The Agency will object if water resources are judged to be at risk.

The Agency may become aware of a proposed discharge to soakaway via a number of different routes. These include consultation procedures with Local Authorities (District and Borough Councils) under the Town and Country Planning Act 1990 and Building Regulations 1985 (amended regulation 1990). Others arise through direct consultation between the Agency and the person proposing to make a discharge, their agent or consultant.

At the preplanning or planning application stage the Agency will identify, where possible, whether the discharge requires control. For discharges from multiple dwellings or commercial developments there is seldom enough information accompanying the application to enable a detailed assessment to be made. The Agency will not be able to assess an application until sufficient information has been provided. This will include use of its powers under the Water Resources Act 1991. An objection will avoid creating a situation where construction can take place but it is only subsequently found out that discharge consent conditions cannot be met or the discharge is not allowable.

F.3 The Environment Agency will control discharges into underground strata within areas where groundwater is judged to be at risk in accordance with Sections 85 and 86 of the Water Resources Act 1991.

Discharges of sewage effluent to ground from new septic tanks or sewage treatment plants which discharge less than 5 m^3/d are only controlled by the Agency in designated areas where groundwater is at risk of pollution. All discharges of sewage effluent to ground greater than 5 m^3/d will be controlled. Storm sewage overflows can vary considerably in flow and quality and discharge to ground is only acceptable where prior investigation proves favourable.

All discharges of trade effluent to ground will be controlled. Applications for consent to discharge trade effluent will be assessed according to the potential impact of the proposal. This will depend upon the characteristics of the effluent and the local soil and aquifer conditions.

Surface water run-off (with the exception of clean roof drainage) will be controlled whenever possible in areas where groundwater is at risk. It will generally be subject to standard conditions, such as installation of petrol/oil interception where applicable. Where control is necessary, the Agency will require a hydrogeological assessment to be carried out to identify the potential impact of the discharge on water resources.

F.4 The Environment Agency will refuse to consent the discharge of list I substances into underground strata and will limit the entry of list 11 substances in accordance with the EC Groundwater Directive (80/68/EEC).

These substances are present within some industrial and agricultural effluents. Disposal of toxic and persistent contaminants to ground poses a significant risk of groundwater pollution and alternative acceptable disposal arrangements should be found. Exceptions may be made where the quality and concentration of the substances will not pollute groundwater; eg for discharges of domestic effluent from an isolated dwelling; for the purposes of aquifer recharge of water used for geothermal purposes; where the groundwater is found to be permanently unusable for other uses.

F.5 The Environment Agency will normally refuse to consent the discharge of sewage or trade effluent below the water table. A direct discharge will only be considered where the groundwater is permanently unsuitable for any use and is isolated from the water cycle.

Within all Source Protection Zones and Major and Minor Aquifers the Agency will seek to control the depths of soakaway systems used for the disposal of sewage and/or trade effluent by means of the consent to discharge procedure. A limit on the depth of a soakaway system will be imposed. This will be based on the information provided on the quality and quantity of the effluent to be disposed, the thickness of the unsaturated zone, the geological conditions and the proximity of existing water resource interests.

This policy statement also covers deep well injection of trade effluents and other matter.

F.6 The Environment Agency will seek to control the depths of all boreholes, wells and deep soakaway systems for the discharge of surface-water drainage.

The Agency is concerned that boreholes, wells and deep soakaways designed for clean water disposal could offer a conduit for the rapid transport of contaminants to groundwater. The Agency will seek to control the depths of these soakaway systems by recommending maximum penetration depths and a requirement that the water table should not be intersected. In general, groups of shallow soakaways are preferable to one or two deep boreholes.

F.7 Where access to a main sewer is unavailable, the Environment Agency will only agree to the disposal of domestic sewage effluent within Zone I providing it is to properly managed sealed effluent storage tanks (cess pits/pools).

The Agency opposes the use of septic tank systems for the disposal of domestic sewage effluent in Zone I. Close liaison between the Local Planning Authority, the building control Inspectorate and the Agency is needed to control these installations. Within Zone I the only system of disposal acceptable to the Agency, where access to main sewer is unavailable, is the use of sealed effluent storage tanks (cess pits/pools). These are often poorly constructed and maintained and discharge polluting effluent to groundwater, and often, indirectly, to adjacent surface waters. The Agency will request the local planning authority to include conditions on any planning permission requiring the construction of a sealed system to approved standards. Where possible, via Section 106 obligations, there should a requirement for adequate records to be kept of maintenance and emptying records (date, volume and contractor used). The Agency will wish to see and encourage the proper disposal of tank effluent to a sewage treatment works or approved disposal site and, for properties in Zone I, subsequent connection to mains drainage if such facilities become available.

Matrix 3a
Dischargers of sewage effluent to underground strata

Source Protection			
Activity	**1 Inner Zone**	**2 Outer Zone**	**3 Catchment Zone**
A. Discharges of Septic Tank or Treated Sewage Effluent into Underground Strata			
<2m³/d (single dwelling)	Not acceptable (R1)	Acceptable (R3/4) (subject to investigation and standard conditions	Acceptable (R4) (subject to standard conditions)
2m³/d to 5m³/d	Not acceptable (R1)	Only acceptable after investigation and assessment (R3)	Acceptable (R3/4) (subject to investigation/ standard conditions
>5m³/d (see note 2)	Not acceptable (R1)	Presumption Against (R2) (subject to investigation)	Only acceptable after investigation and assessment (R3)
Storm Sewage Overflows to Soakaway	Not acceptable (R1)	Not acceptable (R1)	Presumption Against (R2) (only acceptable in exceptional circumstances)

Resource Protection			
Activity	**Major Aquifer**	**Minor Aquifer**	**Non-Aquifer**
A. Discharges of Septic Tank or Treated Sewage Effluent into Underground Strata			
<2m³/d (single dwelling)	Acceptable (R4) (subject to standard conditions)	Acceptable (R4) (subject to standard conditions)	Acceptable (R4) (subject to standard conditions)
2m³/d to 5m³/d	Acceptable (R3/4) (subject to investigation/ standard conditions)	Acceptable (R3/4) (subject to investigation/ standard conditions)	Acceptable (R4) (subject to standard conditions)
>5m³/d (see note 2)	Acceptable (R3) (subject to investigation)	Acceptable (R3) (subject to investigation)	Acceptable (R4) (subject to standard conditions)
Storm Sewage Overflows to Soakaway	Presumption Against (R2) (only acceptable in exceptional circumstances)	Presumption Against (R2) (only acceptable in exceptional circumstances)	Acceptable (R4) (subject to standard conditions)

Footnotes

1) Direct discharge of sewage effluent to groundwater is normally not acceptable.
2) More significant discharges of sewage effluent to ground (for example >25m³/d) will be subject to detailed site investigations and risk assessment.

This matrix is a summary only and must be read in conjunction with the policy statements and the key on page 46.

Matrix 3b
Discharges of trade effluent to underground strata

Source Protection			
Activity	**1 Inner Zone**	**2 Outer Zone**	**3 Catchment Zone**
B. Discharges of Trade Effluent into Underground Strata			
Cooling Water-Free from additives	Presumption Against (R2) (acceptable only if investigation favourable)	Acceptable (R3) (subject to investigation)	Acceptable (R3) (subject to investigation)
Dewatering Water - subject to analysis	Not acceptable (R1)	Acceptable (R3) (subject to investigation)	Acceptable (R3) (subject to investigation)
Process Effluent - via soakaway or Permeable Lagoons	Not acceptable (R1)	Presumption Against (R2) (acceptable only if investigation favourable)	Presumption Against (R2) (acceptable only if investigation favourable)

Resource Protection			
Activity	**Major Aquifer**	**Minor Aquifer**	**Non-Aquifer**
B. Discharges of Trade Effluent into Underground Strata			
Cooling Water-Free from additives	Acceptable (R3) (subject to investigation)	Acceptable (R3) (subject to investigation)	Acceptable (R4) (subject to standard conditions)
Dewatering Water - subject to analysis	Acceptable (R3) (subject to investigation)	Acceptable (R3/4) (subject to investigation/standard conditions)	Acceptable (R4) (subject to standard conditions)
Process Effluent - via soakaway or Permeable Lagoons	Presumption Against (R2) (acceptable only if investigation favourable)	Acceptable (R3) (subject to investigation)	Acceptable (R3) (subject to investigation)

Footnotes

3) Direct discharge of trade effluent to groundwater is not acceptable with the exception of some cooling water and geothermal return waters, subject to investigation.

4) Where the cooling water is discharged to an aquifer where the natural groundwater has a similar chemical composition the Agency will have no objection subject to standard conditions. (R4)

This matrix is a summary only and must be read in conjunction with the policy statements and the key on page 46.

Matrix 3c
Discharges of surface water to underground strata

Activity	Source Protection 1 Inner Zone	2 Outer Zone	3 Catchment Zone
C. Discharges of Surface Water to Soakaway:			
Roof Drainage	No objection (R5) (provided for sole use of roof drainage)	No objection (R5)	No objection (R5)
Impermeable Areas			
- public/amenity	Not acceptable (R1)	Acceptable (R4)	Acceptable (R4)
- large car parks	Not acceptable (R1)	Acceptable (R3/4) (with interceptor)	Acceptable (R4) (with interceptor)
- lorry parks	Not acceptable (R1)	Presumption Against (R2)	Acceptable (R3/4) (with interceptor)
- garage forecourts	Not acceptable (R1)	Presumption Against (R2)	Acceptable (R4) (with interceptor)
- major roads	Not acceptable (R1)	Presumption Against (R2) Acceptable only in exceptional circumstances	Acceptable only if investigation favourable and with adequate precautions (R4)
Industrial Sites	Not acceptable (R1)	Presumption Against (R2)	Acceptable only if investigation favourable and with adequate precautions (R3/4)

Activity	Resource Protection Major Aquifer	Minor Aquifer	Non-Aquifer
C. Discharges of Surface Water to Soakaway:			
Roof Drainage	No objection (R5)	No objection (R5)	No objection (R5)
Impermeable Area			
- public/amenity	Acceptable (R4)	Acceptable (R4)	Acceptable (R4)
- large car parks	Acceptable (R4) (with interceptor)	Acceptable (R4) (with interceptor)	Acceptable (R4) (with interceptor)
- lorry parks	Acceptable (R4) (with interceptor)	Acceptable (R4)) (with interceptor)	Acceptable (R4) (with interceptor)
- garage forecourts	Acceptable (R4) (with interceptor)	Acceptable (R4) (with interceptor)	Acceptable (R4) (with interceptor)
- major roads	Acceptable (R4) (subject to investigation and with interceptor)	Acceptable (R4) (subject to investigation and with interceptor)	Acceptable (R4) (with interceptor)
Industrial Sites	Acceptable only if investigation favourable and with adequate precautions (R3/4)	Acceptable (R4) (subject to investigation) with interceptor	Acceptable (R4) (subject to investigation) with interceptor.

Footnotes
5) Direct discharge into groundwater of surface water run-off is normally not acceptable

This matrix is a summary only and must be read in conjunction with the policy statements and the key on page 46.

Discharges to underground strata Key to Matrices 3a, b and c.

Response 1 (R1) **Prohibit/object in principle** - The Agency will normally object in principle to such activities which would involve a high risk of contamination to controlled waters or a source.

Response 2 (R2) **Presumption against** - The Agency will seek to prohibit this activity by serving an absolute prohibition notice wherever possible. An objection will only be withdrawn in exceptional circumstances or where detailed investigation can demonstrate that the activity does not represent a high risk of contamination to controlled waters and can be adequately controlled by conditions that form part of a statutory consent or agreement.

Response 3 (R3) **Prohibition notice/Consent to discharge** - The Agency will normally have no objection in principle to this type of discharge, providing it is controlled through the use of a prohibition notice with conditions and a consent to discharge is obtained where appropriate.

Initial screening of a consent application will identify whether further investigation and assessment is required prior to consent being determined. Consent conditions may restrict the quality and quantity of effluent discharged and where assessment identifies a potential for significant change in groundwater quality, long term monitoring of both the discharge and remote observation points may be required. principle to this discharge which it considers will have no discernible impact on water resources or quality. No conditions or monitoring are likely to be required.

Response 4 (R4) **No objection subject to standard conditions** - The Agency will normally have no objection in principle to this discharge subject to standard conditions on a prohibition notice or planning permission to protect the quality of controlled waters or a source. An investigation may be required to determine the risk of contamination and the formulation of appropriate conditions. Long term monitoring of controlled waters in the vicinity of such activities may be required.

Response 5 (R5) **No objection** - The Agency will normally have no objection in principle to this discharge which it considers will have no discernible impact on water resources or quality. No conditions or monitoring are likely to be required.

G. Diffuse Pollution of Groundwater

Diffuse pollution is pollution spread over space and time which is not caused by local and specific discharges or events. It is caused by the areal spread of pollutants or by the cumulative effect of many individual and ill-defined events. Examples of the former are the deposition of atmospheric pollutants and the leaching to groundwater of fertilisers and pesticides. Examples of the latter are the combined effects within a catchment of bad management practices involving potential pollutants, such as industrial solvents or farm wastes, which individually are small and hard to detect but which cumulatively have a significant impact on water quality.

Diffuse pollution is a problem for both surface waters and groundwater. It is hard to detect and it is hard to relate cause to effect. Both because of this, and because a specific identifiable discharge is often not involved, control under normal pollution control legislation is seldom possible.

For groundwater, the problem is greater because long residence times in aquifers result in diffuse pollutants accumulating for many years before being detected. Once detected the cause may be remote in time and space. A good example is the problem of high and rising nitrate concentrations in groundwater, where current land management practices may have no relation to the quality of water in the aquifer beneath. The groundwater may have been polluted by action taken in a different location many years previously.

Where new developments are proposed which, in the Agency's experience, are likely to give rise to the risk of diffuse pollution, the Agency has often been successful in getting controls imposed through the Town and Country Planning Act 1990, depending on the degree of support the Local Planning Authority is prepared to offer.

Under Section 93 of the Water Resources Act 1991 the Agency may request Government to make an order designating a water protection zone and prohibiting or restricting specific activities within that zone. No orders have yet been made under this section of the Act to protect groundwater. Although the orders could be used to cover any risk of pollution, from point or diffuse sources, powers of this type are one means of establishing statutory control over potential sources of diffuse pollution.

Section 94 of the Water Resources Act 1991 makes similar provision to Section 93 but only in relation to practices leading to contamination by nitrate, which is excluded from Section 93. Designated areas under Section 94 are called Nitrate Sensitive Areas (NSA) and a number of designations have been made. Farmers within these areas are encouraged to enter into agreements to follow a defined scheme of agricultural management practices.

The EC Nitrate Directive (91/676/EEC) also seeks to control nitrate in controlled waters from diffuse agricultural sources. Unlike NSA's, land that is designated as a Nitrate Vulnerable Zone (NVZ) will be subject to regulatory control of agricultural practices.

The classification of groundwater vulnerability and the definition of Source Protection Zones in this policy have been drawn up to provide a technical basis for the definition of areas to implement Sections 93 and 94. The NSA's and NVZ's have been defined according to the same principles as the definition of the Source Catchment Zone.

The classification by the Agency of groundwater vulnerability and the identification of Source Protection Zones is to assist the Agency and other regulatory agencies in the use of current legislative powers. The application of powers under Sections 93 and 94 would be a further step and subject to the procedure for implementation set out, respectively, in Schedules 11 and 12 of the Water Resources Act 1991.

Types of Diffuse Pollution

Diffuse pollution varies in character between urban and rural areas. It affects groundwater resources used for potable supply and also has an impact upon the environment through baseflow into rivers.

There are considerable overlaps between diffuse pollution and contaminated land issues. The policies of Section D are therefore also relevant.

Urban

Most urban pollution of groundwater is due to individual point discharges. However, some problems are diffuse in character because of the number of discharges and the uncertainty over their location. The two most notable examples are pollution from industrial solvents used in the metal finishing, engineering and dry cleaning industries and discharges from sewerage systems which can cause increased nitrate concentrations. Many of the problems are historic and even though the sources of the problem have been reduced through better design and better management practices, the legacy of the past remains.

Rural

Nitrate is a significant diffuse source pollutant. In areas of low effective rainfall (the east, south and midlands of England) upon vulnerable aquifers it is difficult, if not impossible, to have intensive arable and livestock husbandry and avoid leaching from the soil to groundwater resulting in concentrations in excess of the drinking water limit for nitrate. The application of best practice to minimise nitrate leaching is a basic requirement to sustain groundwater quality in vulnerable areas and in many cases, particularly in Source Catchment Zones, restrictions going beyond "best practice' will be required. These measures will be driven by the EC Nitrate Directive.

Pesticide pollution of groundwater has some of the characteristics of nitrate contamination but there are significant differences. Since the term "pesticides" encompasses a wide and diverse range of chemical compounds, the interaction of these compounds with different soils and aquifers will vary. Hence some will be less mobile than others and have little impact on groundwater other than by a direct discharge. There is little evidence from the UK at present to suggest that the application of pesticides and herbicides to agricultural land at recommended rates poses a threat to groundwater quality. However, research is continuing in this area and a degree of caution must be used, especially in the most vulnerable situations. The Code of Practice for the Safe Use of Pesticides on Farms and Holdings, issued by MAFF and the Health & Safety Executive (SE), contains advice on how to avoid water pollution and should be followed where appropriate.

The localised, repeated application of pesticides which are water soluble and persistent (eg atrazine and simazine) has given rise to groundwater contamination. Such instances arise in nonagricultural use (railways, roads, car-parks) particularly where the soil layer is non-existent (railway and road cuttings). The use of soakaways for drainage from treated surfaces or as a disposal route for sprayer washings present a similar risk.

The Agency will seek to ensure that the use of pesticides/herbicides for non-agricultural purposes is restricted within Source Catchment Zones. Wherever possible, non-persistent, degradable compounds should be used. In areas of high groundwater vulnerability the Agency will co-operate with pesticide users over the choice of pesticide and method of application.

Policies on Diffuse Pollution

G.1 The Environment Agency, in making requests for orders under Section 93 and 94 of the Water Resources Act 1991 will:

1) Follow the principles of resource and source protection established in this polity document.

2) In consultation with abstractors, have regard for the priorities for resource protection.

3) Have regard for the results of research on the effectiveness and timing of the impact which land management changes tan have on groundwater quality.

The strategy for managing diffuse pollution must be to protect all resources in vulnerable areas. This can only be achieved by prohibiting or controlling those practices or use of those substances which will lead to a failure of the relevant quality standard over the whole of the area concerned. However, because of slow response times in groundwater systems, control measures should be targeted on sources of water supply, that is within Source Catchment Zones. Even where a need has been identified, it may not be immediately practical to formulate proposals because of the considerable complexity of the technical information required. The imposition of controls may cause considerable hardship to organisations or individuals who have to change their established and previously acceptable practices. The measure must, therefore, be seen to be both necessary and soundly based. Proposals for control of diffuse pollution from nitrate will be governed by the programme for implementation of the EC Nitrate Directive.

G.2 The Environment Agency will directly and indirectly, by seeking the support of other bodies, promote practices which protect groundwater resources in general from diffuse pollution through minimising the leaching of potential pollutants within vulnerable areas.

This policy will be fulfilled by:

- preparing and making available national and regional groundwater vulnerability maps, so that areas of risk can be made known,
- directly promoting awareness of the risks to groundwater among industry and agriculture,
- seeking the support of Government, other regulatory bodies and trade associations to incorporate the concepts of groundwater vulnerability in their own regulations and guidelines, and providing technical support and research advice to make this possible.

G.3 The Environment Agency will use its own powers under Section 85 and 86 of the Water Resources Act 1991 and seek the support of Local Planning Authorities to use powers under the Town and Country Planning Act 1990 to support, where appropriate, controls on diffuse pollution.

Where an area has been designated for the control of certain practices then the Agency will seek to ensure that parallel controls are put in place through other legislation so that complementary practices which frustrate its objectives, are not allowed . As an example, the Agency would expect the controls on agricultural practices in Nitrate Sensitive Areas to be supported by controls on non-agricultural activities which release nitrate. The Agency's own direct powers of prevention are limited and the most appropriate method in many cases will be through development controls.

G.4 Where appropriate, the Environment Agency will seek general controls or prohibitions on practices or processes which might lead to groundwater pollution.

The localised nature of groundwater sources and vulnerable aquifers makes the control or prohibition of practices within a given area a practical management proposition. Where these practices present a general threat to the water environment the only realistic course of action may be to recommend Regulations under Section 92 of the Water Resources Act 1991.

H. Additional Activities or Developments which pose a threat to Groundwater Quality

In addition to the threats to the quality of groundwater resources identified in Sections C to F, there are many other activities which can pose a risk to groundwater quality through their operational impact or initial development. Because of the general point source nature of these activities they pose the greatest threat to individual abstractions. Hence the degree of control sought will increase with increasing proximity to any groundwater source.

Some of these activities are controlled through the planning legislation and others through various Codes of Practice and Regulations. The Groundwater Regulations will provide a mechanism for the control of all activities which can give rise to pollution of groundwater by List I & II chemicals (Appendix I) by direct or indirect means.

The Production, Storage and use of Chemicals (Raw and Waste)

Abandoned and operating chemical manufacturing plants, or manufacturing industrial premises where chemicals are widely used, are a major category of contaminated land: Many instances of groundwater pollution and surface water pollution by diffuse seepage due to shallow groundwater flow have arisen as a result (see Section D).

Where significant quantities of specified hazardous substances are stored the provisions of the Planning (Hazardous Substances) Act 1990 may be relevant (Regulations S1 1992 No. 656). The Agency is a statutory consultee of the Hazardous Substances Authority (Local Planning Authority) over the issuing of new consents which may be refused or granted with conditions. However, deemed consents for existing, established facilities (prior to 1.12.92) are not subject to consultation.

The manufacture and use of organic liquid chemicals, particularly chlorinated solvents and acid metallic solutions, present a significant hazard, but the use of any chemical under Lists I and II of the EC Groundwater Directive (see Appendix I) could give rise to groundwater pollution if not subject to proper control. Hence, for new sites, the use of planning legislation is important. For existing sites the Agency advocates a proactive approach of prioritising sites posing the greatest risk and cooperating with industry to rectify deficiencies. The Agency would normally object to proposals relating to these activities within Source Protection Zones I and II and would encourage new development in areas of low vulnerability to groundwater.

The storage of waste materials may require the issue of a waste management licence. The Agency will influence the operation of waste chemical storage in such instances through the conditions imposed.

Guidance is available for certain aspects of chemical storage, although not targeted specifically at groundwater pollution prevention. Health and Safety Executive Guidelines on the storage of flammable liquids in containers HS(G)51 and in fixed tanks HS(G)50 and HS(G)52 are relevant.

For prescribed processes the handling of raw materials, waste and products to prevent the pollution of all media, including groundwater, is controlled by the Agency which may place conditions on authorisations in order that groundwater quality is preserved.

Storage of Farm Wastes and Intensive Livestock Housing

In vulnerable locations the leachate from stored wastes or the effluent from livestock units managed on an intensive basis can be highly polluting to groundwater. Apart from the nutrient content, the high organic loading and microbiological content can threaten individual groundwater sources.

Farmers must comply with the control of Pollution (Sileage, Slurry and Agricultural Fuel Oil) Regulations. They should also abide by the Code of Good Agricultural Practice for the Protection of Water (Ministry of Agriculture, Fisheries & Food) where guidance is given on storage and disposal of wastes and effluent.

The Agency wishes to discourage the establishment of farm waste storage areas and substantial livestock housing within the Inner Source Protection Zone of any borehole (Zone I) unless adequate measures can be agreed to minimise the risk of pollution. For the larger public supply abstractions on fissured aquifer this is likely to exceed the 50m distance from the borehole set out for the prohibition of waste disposal in the Code of Good Agricultural Practice, but the Agency would welcome discussion on a case by case basis.

Graveyards and Animal Burial Sites

Large graveyards can be a potential threat to groundwater quality and as such the establishment of new sites or extensions within Zone I areas would be opposed through the planning process. Similarly the Agency would object to animal burial sites within Zone I areas. Guidance with respect to the latter is given in the Code of Good Agricultural Practice for the Protection of Water, 1991 and should be followed. Restrictions may also be likely

within Zone II (Outer Source Protection) subject to evaluation and assessment.

Sewage Works, Foul Sewers and Storm Overflows

The presence of sewage works and the associated sewerage system present a risk of both bacteriological and chemical contamination to groundwater sources. The Agency would object to the creation of new works within both Source Protection Zones I and II. It would also oppose the laying of new main sewerage systems within Zone I, although the use of pipework which is less vulnerable to leakage would be considered on a case by case basis. There must be no storm overflow facility to the aquifer within either Zones I or II. Indeed such a proposal would only be permitted in other areas in exceptional circumstances (see policy statements F1 to F4).

Oil and Petroleum Storage and Transport Via Pipelines

Oil and petroleum storage has resulted in many instances of groundwater pollution, both from leakage from (underground) storage tanks and the accidental rupturing of tanks and pipework.

Subject to the outcome of consultation the Government intends to make Regulations under Section 92 of the Water Resources Act 1991 relating to industrial oil storage, on a basis similar to those relating to farm wastes.

The Agency will normally object to the siting of new hydrocarbon storage tanks within Zone I which are located underground. Underground storage of hydrocarbons is discouraged within Zone II (Outer Source Protection) and III (Source Catchment) and on Major Aquifers in general. Where necessary they must conform to the requirements in the Regulations and be subject to rigorous periodic testing. Guidance issued by the Health & Safety Executive should also be followed. (Petrol Filling -Stations: Construction and Operation HS(G)41).

The Agency will object to oil pipelines for the strategic transfer of hydrocarbons within Zone I areas and will discourage them within Zones II and III. The Agency would wish to liaise at an early stage with the relevant agencies regarding pipeline routes with a view to discouraging construction over major aquifer areas.

Major Infrastructure Developments

The Agency will seek to ensure that the line of new major communication routes avoids Zone I areas. Where new major roads or railways are located within Zone II (and Zone III on fissured strata) it will discourage the discharge of roadside or track drainage to underground strata via soakaway systems because of the risk of spillage after accidents (see Matrix 3c). Early discussion over new routes is encouraged.

Other new infrastructure development where there is the possibility of drainage from large areas of hardstanding used for vehicle loading/unloading, maintenance etc or where there may be significant storage of hydrocarbons, solvents or other potentially contaminating substances will be opposed within Zone I and resisted within Zone II unless the Agency can be satisfied over the provision and maintenance of adequate safeguards. Such developments include airfields, industrial parks and large areas of vehicle parking.

Any agreement to discharges in the Source Protection Zones would be subject to site specific evaluation, depth restrictions on soakaways and the provision of large oil interception facilities equipped with cut-off valves.

Appendix 1

List 1 and List II Substances as defined by EC Groundwater Directive (80/68/EEC)

List 1 of Families and Groups of Substances

These substances should be prevented from being discharged into groundwater.

List 1 contains the individual substances which belong to the families and groups of substances specified below, with the exception of those which are considered inappropriate to List I on the basis of a low risk toxicity, persistence and bioaccumulation.

Such substances which with regard to toxicity, persistence and bioaccumulation are appropriate to List II are to be classed in List II.

1 Organohalogen compounds and substances which may form such compounds in the aquatic environment.

2 Organophosphorus compounds.

3 Organotin compounds.

4 Substances which possess carcinogenic, mutagenic or teratogenic properties in or via the aquatic environment (1).

5 Mercury and its compounds.

6 Cadmium and its compounds.

7 Mineral oils and hydrocarbons.

8 Cyanides.

List II of Families and Groups of Substances

Discharges of these substances into groundwater should be minimised.

List II contains the individual substances and the categories of substances belonging to the families and groups of substances listed below which could have a harmful effect on groundwater.

1 The following metalloids and metals and their compounds:

1 Zinc	11 Tin
2 Copper	12 Barium
3 Nickel	13 Beryllium
4 Chrome	14 Boron
5 Lead	15 Uranium
6 Selenium	16 Vanadium
7 Arsenic	17 Cobalt
8 Antimony	18 Thallium
9 Molybdenum	19 Tellurium
10 Titanium	20 Silver

2 Biocides and their derivatives not appearing in List I.

3 Substances which have a deleterious effect on the taste and/or odour of groundwater and compounds liable to cause the formation of such substances in such water and to render it unfit for human consumption.

4 Toxic or persistent organic compounds of silicon and substances which may cause the formation of such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances.

5 Inorganic compounds of phosphorus and elemental phosphorus.

6 Flourides.

7 Ammonia and nitrates.

(1) Where certain substances in List II are carcinogenic, mutagenic or teratogenic they are included in category 4 of List 1.

Appendix 2

High Vulnerability			Intermediate Vulnerability		Low Vulnerability
H1	H2	H3	I1	I2	L
Andover	Bearsted	Aberford	Batcombe	Adventurers	Beccles
Blackwood	Bridgnorth	Anglezarke	Blacktoft	Altcar	Brickfield
Downholland	Bromsgrove	Badsey	Bromyard		Cegin
Elmton	Cuckney	Eardiston	Burlingham		Clifton
Fladbury	Fyfield	Munslow	Carstens		Denchurch
Halstow	Newport	Neath	Coombe		Dunkeswick
Longmoss	Wick	Panholes	Curtisden		Foggathorpe
Newchurch		Rivington	Denbigh		Hafren
Sherbourne		Shirrel-Heath	East Keswick		Ragdale
Sollom		Sonning	Evesham		Salop
Wallasea		Swaffham Prior	Hanslope		Wickham
Wisbech		Waltham	Ludford		Wilcocks
			Manod		Windsor
			Milford		Winter Hill
			Whimple		
			Worcester		

Appendix 2
Commonly occurring soil series within soil vulnerability classes

Footnote
The vulnerability classification of soil is based on specific physio-chemical properties of soil. Some of the properties used to define class limits can vary with land use or other local factors because of this, the correlations with soil series given in the table above are examples and should not necessarily be considered definitive.

Appendix 3

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 with 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
Chalk and Upper Greensand Jurassic Limestones Permo-Triassic Sandstones Magnesian Limestones Carboniferous Limestones Lower Greensand	Coal Measures Millstone Grit Old Red Sandstone Some igneous and metamorphic formations	River gravels Glacial sands and gravels Tertiary sands and gravels	All clays, shales, marls and siltstones. Most igneous and metamorphic formations. Mercia Mudstones

Appendix 3
Classification of types of strata

Footnote
This may be subject to minor variations in some Agency Regions to reflect local circumstances and the relative importance of different strata. More detailed guidance is available from the series of Groundwater Vulnerability maps.

Appendix 4

Glossary of terms used throughout the Document

Abstraction removal of water from surface water or groundwater, usually by pumping.

Abstraction Licence licence issued by the Agency under the Water Resources Act 1991 S.38 to permit water to be abstracted.

Adsorption process by which a thin layer of a substance accumulates on the surface of a solid substance.

Artesian Flow overflow of groundwater where water rises under pressure above the top of the aquifer.

Attenuation break down or dilution of a contaminant in water.

Baseflow that part of the flow in a watercourse made up of groundwater and discharges. It sustains the watercourse in dry weather.

Cess pit/pool sealed tank used to collect sewage. It has no outlet and requires periodic emptying.

Confined where permeable strata are covered by a substantial depth of impermeable strata such that the cover prevents infiltration.

Conservative Pollutants pollutants which can move readily through the aquifer with little reaction with the rock matrix and which are unaffected by biodegration (eg chloride).

Controlled Waste defined by Environmental Protection Act 1990, S.75. It includes household industrial and commercial waste.

Controlled Waters defined by Water Resources Act 1991 S.104. They include all groundwaters and inland waters and estuaries.

Dedicated Land land used for spreading sewage sludge above the normal requirements for agricultural use.

Degradable Pollutants pollutants which readily break down.

Derogation term used for loss of water resources or deterioration in water quality (usually relating to a particular source).

Diffuse Source Pollution pollution from widespread activities with no one discrete source.

Discharge Consent consent issued by Agency under Water Resources Act 1991, Sch. 10.

Drift Deposits term used to include all unconsolidated superficial deposits (eg. fluvioglacial, alluvium etc) overlying solid rocks.

Effective Porosity that part of the total porosity which can transmit water

Effective Rainfall proportion of rainfall that can infiltrate to an aquifer after evapotranspiration.

Formation term used to describe a sequence of rock layers.

Fractures/Fissures natural cracks in rocks that enhance rapid water movement.

Hydrogeological Characteristics characteristics relating to flow of water through rock eg. permeability, transmissivity, porosity etc

Hydrological Cycle circulation of the earth's water in atmosphere, surface water, oceans and groundwater and their relationship.

Intergranular Flow groundwater flow between individual grains of rock.

Intergranular Permeability see primary permeability

Landfill site used for waste disposal into/onto land.

Leachate liquor formed by the act of leaching.

Leaching removal of soluble substances by action of water percolating through soil, waste or rock.

List I and II Substances defined by EC Groundwater Directive (see Appendix 1).

Non-degradable Pollutants pollutants that do no readily break down.

Outcrop where strata are at the surface, even through they may be obscured by soil cover.

Sheet No cont.	Name	ISBN
31	Bedfordshire	0 11 885856 4
32	North Essex	0 11 885834 3
33	East Suffolk	0 11 885848 3
34	Pembrooke	0 11 885873 4
35	West Glamorgan	0 11 885861 0
36	Gwent, S. and Mid Glamorgan	0 11 885864 5
37	Southern Cotswold	0 11 885853 X
38	Upper Thames and Bedfordshire Downs	0 11 885854 8
39	West London	0 11 885831 9
40	Thames Estuary	0 11 885855 6
41	North West Devon	0 11 885866 1
42	Somerset Coast	0 11 885858 0
43	East Somerset and SW. Wiltshire	0 11 885883 1
44	North West Hants	0 11 885835 1
45	West Sussex and Surrey	0 11 885851 3
46	East Sussex	0 11 885860 2
47	East Kent	0 11 885829 7
48	East Cornwall	0 11 885878 5
49	South Devon	0 11 885884 X
50	East Devon and S. Somerset	0 11 885885 8
51	Dorset	0 11 885845 9
52	Southern Hampshire	0 11 885859 9
53	West Cornwall	0 11 885874 2

Guide to Groundwater Protection Zones in England and Wales; edited by Keating T. and Packman M.J.; NRA 1995.

Manual of Standard Zone Delineation Methodologies; edited by Keating T. and Packman M.J.; Environment Agency 1996.

Printed in the United Kingdom for The Stationery Office
J40899 4/98 (24503)

Perched Water Table water level supported by low permeability layer above main water table.

Permeability measure of the ability to transmit water.

Point Source Pollution pollution from a discrete source eg. petrol station, septic tank, landfill.

Porosity ratio of volume of void space to the total volume of the rock.

Porous having microscopic pores between the rock grains (not necessarily interconnected).

Potable Water water of suitable quality for drinking.

Prescribed Processes/Substances related to Integrated Pollution Control defined in Environmental Protection Act 1990, S.2.

Primary Permeability permeability related to flow between grains within the aquifer.

Prohibition Notice notice served by Agency under Water Resources Act 1991, S.86 to prevent or control a discharge of effluent.

Recharge water which percolates downward from the surface into groundwater.

Rehabilitation restoring good quality by natural or artificial means.

Saturated Zone zone of aquifer where all fissures and pores contain water (ie below water table).

Secondary Permeability permeability related to groundwater flow within fissures rather than between grains (see Primary Permeability).

Septic Tank small tank receiving and treating sewage by bacteria where effluent overflows.

Soakaway system for allowing water or effluent to soak into the ground, commonly used in conjunction with septic tanks.

Source point of abstraction of water eg. well, borehole, spring.

Spring natural emergence of groundwater at surface.

Strata layers of rock, including unconsolidated materials such as sands and gravels.

Trade Effluent effluent derived from a commercial process/premises.

Transfer Station waste disposal facility where waste is collected prior to transport to final disposal point.

Unsaturated Zone zone of aquifer between soil and watertable which is partly saturated (ie that part of the aquifer above the water table).

Water Cycle see hydrological cycle.

Water Table top surface of the saturated zone within the aquifer.

Weathered Zone vertical zone within soil/rock affected by weathering from the action of water, heat, ice etc.

Yield quantity of water able to be removed from an abstraction source.

Appendix 5

List of Documents published in association with the Policy Document.

Guide to Groundwater Vulnerability Mapping in England and Wales; Palmer R.C., Holman I.P., Robins N.S. and Lewis M.A., NRA 1995.

53 Groundwater Vulnerability Maps at a scale of 1:100000; paper format (folded; flat) and CDRom.

Sheet No.	Name	ISBN
1	West Northumberland	0 11 885865 3
2	Coastal Northumberland	0 11 885877 7
3	North West Cumbria	0 11 885879 3
4	North Pennines	0 11 885870 X
5	Tyne and Tees	0 11 885876 9
6	South West Cumbria	0 11 885882 3
7	Yorkshire Dales	0 11 885871 8
8	Central North Yorkshire	0 11 885846 7
9	North East Yorkshire	0 11885836 X
10	Central Lancashire	0 11 885862 9
11	South Pennines	0 11885872 6
12	Vale of York	0 11 885850 5
13	Humber Estuary	0 11 885830 0
14	Anglesey	0 11 885880 7
15	North Wales Coast	0 11 885881 5
16	West Chesire	0 11 885832 7
17	Derbyshire and N. Staffordshire	0 11 885863 7
18	Nottinghamshire	0 11 885839 4
19	Lincolnshire	0 11 885852 1
20	Meirionnydd	0 11 885875 0
21	West Shropshire	0 11 885849 1
22	South Staffordshire – E. Shropshire	0 11 885869 6
23	Leicestershire	0 11 885868 8
24	North Northants	0 11 885838 6
25	West Suffolk	0 11 885837 8
26	East Norfolk	0 11 885886 6
27	Dyfed	0 11 885823 7
28	Powys	0 11 885867 X
29	Worcestershire	0 11 885847 5
30	Northern Cotswold	0 11 885857 2

MANAGEMENT AND CONTACTS:

The Environment Agency delivers a service to its customers, with the emphasis on authority and accountability at the most local level possible. It aims to be cost-effective and efficient and to offer the best service and value for money.

Head Office is responsible for overall policy and relationships with national bodies including Government.

Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BS32 4UD
Tel: 01454 624 400 Fax: -1454 624 409
Internet World Wide Web www.environment-agency.gov.uk

ENVIRONMENT AGENCY REGIONAL OFFICES

ANGLIAN
Kingfisher House
Goldhay Way
Orton Goldhay
Peterborough PE2 5ZR
Tel: 01733 371 811
Fax: 01733 231 840

MIDLANDS
Sapphire East
550 Streetsbrook Road
Solihull B91 1QT
Tel: 0121 711 2324
Fax: 0121 711 5824

NORTH EAST
Rivers House
21 Park Square South
Leeds LS1 2QG
Tel: 0113 244 0191
Fax: 0113 246 1889

NORTH WEST
Richard Fairclough House
Knutsford Road
Warrington WA4 1HG
Tel: 01925 653 999
Fax: 01925 415 961

SOUTHERN
Guildbourne House
Chatsworth Road
Worthing
West Sussex BN11 1LD
Tel: 01903 832 000
Fax: 01903 821 832

SOUTH WEST
Manley House
Kestrel Way
Exeter EX2 7LQ
Tel: 01392 444 000
Fax: 01392 444 238

THAMES
Kings Meadow House
Kings Meadow Road
Reading RG1 8DQ
Tel: 0118 953 5000
Fax: 0118 950 0388

WELSH
Rivers House/Plas-yr-Afon
St Mellons Business Park
St Mellons
Cardiff CF3 0LT
Tel: 01222 770 088
Fax: 01222 798 555

For general enquiries please call your local Environment Agency office. If you are unsure who to contact, or which is your local office, please call our general enquiry line.

ENVIRONMENT AGENCY GENERAL ENQUIRY LINE
0645 333 111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

ENVIRONMENT AGENCY EMERGENCY HOTLINE
0800 80 70 60

ENVIRONMENT AGENCY