



Water, water everywhere!

The Geological Society theme event for 2016 is the Year of Water. The Geological Society state that: "...An understanding of groundwater and hydrogeology is crucial to addressing a wide range of societal challenges, from securing fresh water supplies and mitigating flood risk to extracting shale gas and other hydrocarbons and safely disposing of our nuclear waste..."

At MJCA our hydrogeologists and engineers are highly experienced in groundwater investigation, monitoring, risk assessment and modelling associated with a range of planning issues, permitting and dealing with pollution incidents. This newsletter includes a range of topical articles and current news with regard surface water and groundwater quality issues.

Environment Agency consultation news

It is understood that the Environment Agency are considering their position with regard to consultation matters for planning applications for the development of contaminated land. It is understood that the Environment Agency will no longer provide comments on planning applications where the development site is located in a low sensitivity setting with respect to the potential risks to the quality of controlled waters (groundwater and surface water) from land contamination. We understand that the Environment Agency will continue to be involved with the consultation process for the development of higher risk contaminated sites. Although the criteria for higher risk sites has not as yet been confirmed it is likely to be the development of sites located on a principal aquifer or within the catchment of a source protection zone for public drinking water supply.

In accordance with the National Planning Policy Framework and the Environment Agency Guiding Principles for Land Contamination it is necessary for a developer to ensure that the proposals for the development of a contaminated site result in a site that is suitable for the intended use and does not present an unacceptable risk to site users or the quality of controlled waters. In such circumstances it is expected that the Environmental Services Department of the Local Authority will need to review any risk assessment reports for controlled waters

together with the reports prepared for the assessment of risks to human health (future site users) which they are consulted on currently. It is understood that the Environment Agency may provide training to Local Authority Contaminated Land Officers although even with basic training the Contaminated Land Officers may not have sufficient knowledge and experience to assess complex risk assessment models for consideration of impacts on controlled waters. There have been suggestions in the sector that assessments which are prepared following a National Quality Mark Scheme whereby the assessment process is overseen and 'signed off' by a Suitably Qualified Person may be a suitable solution to the situation of reduced Environment Agency consultation input to planning applications and provide confidence that an appropriate level of investigation and assessment has been carried out and checked technically.

The potential risk to the quality of groundwater and surface water from land contamination can be a key factor for land remediation and often the remedial target criteria determined by risk assessment to protect the quality of controlled waters can be significantly lower (i.e. tighter) than the generic protection of human health criteria for soil for the protection of human health.

Inside this issue:

Environment Agency
consultation news 1

Environmental Quality
Standards updated 2

A history of
groundwater protection 4

Groundwater data
sources 8

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Environmental Quality Standards updated



The [Water Framework Directive](#) (WFD) (2000/60/EC) sets out objectives that include preventing the deterioration of the status of all surface water and groundwater bodies and to protect, enhance and restore all bodies of surface water and groundwater with the aim of achieving good surface water status and good groundwater status by 2015. The Directive requires that Environmental Quality Standards (EQS) for polluting substances are prepared by Member States. These standards are thresholds which, if exceeded, could result in adverse effects on ecosystems

[UKTAG](#) is a partnership of UK environment and conservation agencies which was set up by the UK-wide Water Framework Directive policy group consisting of UK government administrations. It was created to provide coordinated advice on the science and technical aspects of the European Union's WFD. The WFD and [Groundwater Daughter Directive \(2006/118/EC\)](#) (GWDD) require Member States to prevent inputs of hazardous substances into groundwater and to limit the input of non-hazardous pollutants to ensure that groundwater does not become polluted. The Joint Agencies Groundwater Directive Advisory Group ([JAGDAG](#)) are preparing proposed revisions to the Methodology for the determination of hazardous substances for the purposes of the Groundwater Directive (2006/118/EC) and are seeking currently feedback from consultation with industry.

[The Water Environment \(Water Framework Directive\) \(England and Wales\) \(Amendment\) Regulations 2015](#) which came into force at the end of last year amend certain provisions of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 to transpose aspects of Directive 2013/39/EU ("the Priority Substances Directive"). The Priority Substances Directive itself amends the Environmental Quality Standards Directive ("the EQS Directive"), which is a Daughter Directive of the WFD which identifies and sets EQS in surface waters for a list of priority substances identified under the WFD as presenting a significant risk to or via the aquatic environment.

The value of some EQS have been changed and new ones published and the current standards are presented in [The Water Framework Directive \(Standards and](#)

[Classification\) Directions \(England and Wales\) 2015](#) (the directions). The EQS are listed in Schedule 3 for ecological and chemical status of surface waters which include rivers, lakes and transitional waters. Part 1 of Schedule 3 sets out the physico-chemical EQS which include dissolved oxygen, biological oxygen demand (BOD) pH, acid neutralising capacity (ANC), phosphorus, ammonia and temperature. Part 2 of Schedule 3 sets out the standards for specific pollutants which includes the metals arsenic, chromium (III and VI), copper, iron, manganese and zinc, a range of organic compounds, for example phenol, toluene and tetrachloroethane and other substances such as chloride and cyanide. Part 3 of Schedule 3 lists the priority substances which includes a range of pesticides, polycyclic aromatic hydrocarbons (PAH) and chlorinated hydrocarbons together with the metals cadmium, lead, mercury and nickel. There are also a further eleven substances included in the EQS priority substance table which need to be applied by the Appropriate Agency from December 2018

Schedule 5 lists threshold values for groundwater. Where any threshold value for groundwater is failed, the Appropriate Agency must undertake an investigation in order to determine whether or not the applicable conditions for good groundwater chemical status are met in accordance with the procedure set out in Article 4 of the Groundwater Directive. Threshold values are presented in Schedule 5 for a scenario where groundwater can have an impact on the quality of a surface watercourse ('groundwater impacts on surface water'), for groundwater use for drinking water in Protected Areas and for the general quality of the groundwater body. The threshold values are only intended to be used as part of the assessment of the status of groundwater bodies and are not intended to be used for site specific assessment although it is likely that the values will be used generally as screening criteria for a receptor when assessing if a groundwater risk assessment and remediation is necessary.

For Scotland the EQS are addressed in [The Scotland River Basin District \(Standards\) Amendment Directions 2015](#). The thresholds values are presented as Resource Protection Values (RPV). A list of RPV are presented in the SEPA document entitled "[Position Statement \(WAT-PS-10-01\)](#)

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Environmental Quality Standards updated

Assigning Groundwater Assessment Criteria for Pollutant Inputs

EQS and threshold values for groundwater are used typically as criteria for a point of compliance in a risk assessment when assessing the potential risk from contaminated groundwater on a receptor. For example the point of compliance may be a nearby surface watercourse or at the point of the site boundary or a point between the site boundary and a surface watercourse. Guidance on selecting compliance points for use in land contamination risk assessments is set out in the Environment Agency [GP3 document](#).

Some of the EQS are quite low, for example the Annual Average EQS for benzo (a) pyrene (BaP) is 0.00017µg/l although the maximum allowable concentration (MAC) is 0.27µg/l. Groundwater threshold values for BaP for the groundwater impacts on surface water range between a minimum value of 0.000089µg/l and a maximum value of 0.000328µg/l and threshold values for groundwater for Drinking Water Protected Area is 0.0075ug/l whereas the Drinking Water Standard published by the Drinking Water Inspectorate for BaP is 0.01µg/l. The EQS value for BaP has been determined based on the risk to human health via consumption of fishery products and the Annual Average EQS for BaP of 0.00017µg/l is based on a back calculation using a bio concentration factor (BCF) value for molluscs. The same assessment using the BCF value for fish gives and Annual Average EQS of 0.015 µg/l. The relevance of using an EQS for either fish or molluscs needs to be considered as part of a conceptual site model although for many sites it is likely not to be relevant to carry out a risk assessment for these biota as they are unlikely to be present in the surface water receptor. Even if they were present, the contaminants may not realistically accumulate in the food chain. Using an EQS Annual Average for BaP for

the compliance point criteria in a risk assessment is likely to generate remedial targets for soil that are extremely low and may not be possible to achieve through cost effective treatment.

A [Metal Bioavailability Assessment Tool](#) (M-BAT) has been prepared for use as part of a tiered assessment for predicting the potential risk posed by metals in the freshwater aquatic environment. It has been developed for the assessment of copper, zinc, manganese and nickel. The tool is based on estimates made from original biotic ligand models. It is necessary to feed in analytical data for the surface water receptor for pH, dissolved organic carbon and calcium in order to apply M-BAT. The concentrations of copper, zinc, manganese and nickel recorded in the surface water can be included in the model. If the concentrations are not included the model output will provide a site specific Predicted No Effect Concentration (PNEC) which is the concentration of a chemical below which no adverse effects of exposure in an ecosystem are measured. PNEC values are intended to be conservative and predict the concentration at which a chemical will likely have no toxic effect.

MJCA is highly experienced in undertaking hydrogeological risk assessments for a wide range of legacy, current and proposed industrial and waste management facilities. We use a range of computer based risk assessment models for hydrogeological risk assessments from simple models which are applied to identify groundwater flow direction to more sophisticated groundwater models used to model changes to the hydrogeology and plume migration scenarios. Such models are critical to understanding the significance of collected environmental data, to assess the nature and magnitude of chemical exposure, to assess contaminant fate and transport and to minimise the impact of sites on the aquatic environment.



Groundwater protection: Principles and practice (GP3)
August 2013 Version 1.1

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A history of groundwater protection



“In 1935 central government established the Inland Water Survey for Great Britain and a Central Advisory Water Committee was appointed in 1937 to advise the government on general water policy...”

Groundwater source protection zones (SPZ) are intended to safeguard sensitive groundwater abstraction such as public water supplies. Protecting the environment including groundwater resources is often thought to be associated with government policy issued over the last few decades, but in the UK there has been a National Water Policy for over 70 years.

In 1935 central government established the Inland Water Survey for Great Britain and a Central Advisory Water Committee was appointed in 1937 to advise the government on general water policy. Following the publication of a paper entitled 'A National Water Policy' [the Water Act 1945](#) was introduced setting out for the first time a legal framework for water management. The Water Act 1945 empowered the Minister of Health to acquire land and water rights to protect water resources against misuse, pollution and waste and introduced licensing to control groundwater abstraction in areas recognised as being over used or in which there was a possibility of this occurring. The responsibility for abstraction licensing was later passed to the Ministry of Housing and Local Government with technical support provided by the Geological Survey Water Department who had an active role in the management of groundwater resources and was influential on the development of hydrogeological practice and scientific development during this period. The Geological Survey advised on policy, resources and major licence applications, they kept records of all new boreholes drilled deeper than 15m and tested all new major public supplies and industrial wells to assess an appropriate sustainable yield before a licence was issued. In the late 1950's the Geological Survey carried out regional Hydrological Surveys.

The Water Act 1945 was later refined and the [Water Resources Act 1963](#) enacted. The River Boards became the River Authorities with the responsibility for the planning and control of water resources and to prevent pollution. The Water Resources Board was established in 1964 to advise government and the River Authorities on national water policy and they published a National Plan in 1973 which included the role of groundwater in water resource planning although dealing with

water quality issues in abstraction licensing remained the function of the River Authorities. The Water Resources Act 1963 introduced a charging system according to the amount and type of use of the water through the licence scheme. Groundwater quality issues were raised in the National Plan including considering the potential risks to the quality of groundwater specifically arising from landfills, the use of fertilizers and pesticides and the storage and transport of hydrocarbons and it reviewed some of the problems of restoring the quality of polluted aquifers and the importance of avoiding pollution of groundwater.

[The Water Act 1973](#) introduced a major reorganisation of the water industry, establishing ten Regional Water Authorities which replaced statutory water supply organisations, local authorities and river authorities. The Regional Water Authorities were responsible for the operational aspects of water supply, sewage disposal, prevention of pollution and land drainage as well as regulation and undertaking studies to assess water resources and water quality having a duty to provide a 'wholesome supply of water'. A Central Water Planning Unit was established with the responsibility for policy associated with the development of water resources and water quality, effluent disposal and the prevention of pollution.

Consideration of the risks to groundwater quality associated with contaminants first were addressed by the Royal Commission on Environmental Pollution (RCEP) which was set up in 1970 to 'advise on matters, both national and international, concerning the pollution of the environment; on the adequacy of research in this field; and the future possibilities of danger to the environment.' In their [first report](#) published in February 1971, the RCEP presented a review of the state of the environment and identified the areas of environmental pollution which they regard as priorities for action by Government, local authorities, industry or the public. The principal sources of environmental pollution identified in this report reflect the national knowledge and the evidence presented to the committee by specialists and regulators from a wide range of technical fields. Reference was made to the potential for the

A history of groundwater protection - continued

contamination of groundwater by the disposal of toxic wastes.

The Control of Pollution Act 1974 (COPA) sought to draw together the earlier separate legislative strands and to treat pollution and waste together as a unified concept and the basis of regulatory technical liaison on waste and groundwater matters between the Water Authorities and local authorities. [Part II of COPA](#) dealt with the pollution of water and Section 31(1) made it an offence for anyone to:

“ cause or knowingly permit any poisonous, noxious or polluting matter to enter any stream or controlled waters or any specified underground waters; or any matter to enter a stream which was likely to impede its proper flow, leading to a substantial aggravation of pollution due to other causes; or any solid waste to enter a stream or restricted waters”.

The need to protect groundwater from pollution was becoming a key consideration in water sector and in 1976 Severn Trent Regional Water Authority implemented an Aquifer Protection Policy and which was adopted by a number of other Water Authorities, notably Southern Water Authority. The Severn-Trent Water Authority policy established the principle of four aquifer protection zones covering the whole of the groundwater catchment area and used these zones to assess and oppose developments in the zones or to approve development if suitable protective measures were incorporated. The four zones comprised the following:

- Zone 4 – area where the underlying strata are not normally regarded as aquifers or provide for small local domestic supplies or where aquifers are confined beneath impermeable strata.
- Zone 3 – covers the minor aquifers, those normally only used for local domestic or agricultural supplies
- Zone 2 – covers the outcrop of major aquifers in the Severn-Trent region identified as the Triassic Sandstone, Magnesian Limestone and Carboniferous Limestone, which together make up 25% of Severn-Trent

area.

- Zone 1 – is not geologically based but is applied as a one kilometre radius circle around the major water supply sources. The 1km radius was based the approximate 50 to 100-day saturated flow travel times associated with abstractions from the Triassic Sandstone.

There were 350 public water supplies in the Severn Trent Water Authority region which had this Zone 1 rating.

In 1980 the first European Groundwater Directive was agreed with the objective to control the release of dangerous substances from activities such as discharge and disposal to ground of pollutants. The relevant parts of the EU Groundwater Directive 1980 initially were implemented through existing legislation in the UK. The Directive was used in the waste management sector where it was used by regulators to implement standards to protect groundwater quality from potentially polluting landfills although not progressed in other areas such as the storage of fuel and chemicals until the directive was fully implemented in 1998.

Certain sections regarding water pollution presented in Part II COPA were retained in The [Water Resources Act 1991, Section 161](#). The Water Resources Act 1991 incorporated the [Water Act 1989](#), which led to the creation of the National Rivers Authority (NRA), the forerunner to the Environment Agency. The NRA had a duty under the 1989 Water Act (sections 106 and 125) to protect the quality of groundwater and conserve its use for water resources as well as the regulatory powers to take action against polluters.

The Water Resources Act 1991 contained a provision (Section 93) allowing protection zones to be made by regulation. The NRA published their Policy and Practice for the Protection of Groundwater series in 1992 and the first National (England and Wales) Groundwater Protection Policy and national vulnerability maps were published. In their assessment of policy the NRA considered the practices used by the former Water Authorities such as the zoning used by

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“The WFD requires that Environmental Quality Standards (EQS) for polluting substances...”

A history of groundwater protection - continued

Severn Trent and reviewed practices applied in Europe, the USA and Canada and used computer models to develop and refine the source protection zones. This eventually led to over 2000 protection zones for groundwater sources such as wells, boreholes and springs used for public drinking water supply being defined to support the application of the policy. There are [groundwater vulnerability maps](#) available for viewing via the Environment Agency [website](#) and new maps are being prepared currently which will be

The NRA technical framework recognised the threats to groundwater as substantial and widespread and examples given were the redevelopment of contaminated land and the storage of industrial materials and a NRA policy states that “...the NRA will seek to pursue, and influence others to pursue, in the interest of protecting this vital and threatened part of our water resources...”.

The [Environment Act 1995](#) provided for the establishment of the Environment Agency for England and Wales and the Scottish Environment Protection Agency ([SEPA](#)) and a transfer of functions from the NRA, waste regulation authorities and Her Majesty's Inspectorate of Pollution (HMIP) to these agencies. The Environment Agency was formed in 1996 with responsibilities relating to the protection and enhancement of the environment in England and until 2013 also Wales. Throughout the remainder of the 1990's and 2000's the Environment Agency continued to prepare technical guidance to implement government policy including the development of groundwater risk assessment software. Advice and guidance was issued for the investigation, assessment and remediation of contaminated land under planning development and associated with pollution incidents and guidance for the assessment of site condition for the operation of certain activities authorised under environmental permits and licences. In recent years much of the guidance has been withdrawn and archived, fewer updates of technical guidance have been prepared and the Environment Agency have cut back on their consultation process for certain lower risk activities. However, SEPA have in recent years prepared quite detailed and prescriptive technical guidance not least for regulated

process activities.

The [Water Framework Directive](#) (WFD) (2000/60/EC) was established with the purpose of providing a framework for the protection and to prevent the deterioration of the status of inland surface waters, estuaries, coastal waters and groundwater. Importantly for groundwater quality protection, one of the objectives of the WFD was to reduce progressively the releases to the aquatic environment of priority substances and the phasing out of releases of priority hazardous substances thus ensuring a progressive reduction of pollution of groundwater and to prevent its further pollution. The WFD requires that Environmental Quality Standards (EQS) for polluting substances which has been addressed most recently in [The Water Environment \(Water Framework Directive\) \(England and Wales\) \(Amendment\) Regulations 2015](#) which came into force at the end of last year.

The [Groundwater Directive](#) (GD) [80/68/EEC](#) covered the protection of groundwater against pollution via controls over the release of substances listed within the GD. The GD was repealed in December 2013 although it had been effectively superseded by the WFD and later by the [Groundwater \(Daughter\) Directive](#) (GWDD) (2006/118/EC). The GWDD did not add to the objectives of the WFD but clarified the requirements for assessing groundwater chemical status, identifying significant and sustained upward trends in pollutants and for the definition of starting points for trend reversal and measures to prevent or limit inputs of pollutants into groundwater. The GWDD required threshold values for assessing good groundwater chemical status to be determined.

The [Groundwater Regulations 1998](#) were implemented in the UK in 1999 to address certain European legislation concerning the prevention of risks to groundwater from particular substances, labelled List I and List II and associated with authorised activities. The potential for the discharge of a [List I](#) or [List II](#) substances needed to be the subject of a prior investigation to facilitate authorisation. Some examples of the



A history of groundwater protection - continued

activities requiring authorisation included deliberate disposal, unless under a Waste Management Licence or subject to specified exemptions, septic tanks for isolated dwellings in the vicinity of a groundwater abstractions in a Groundwater SPZI, cemeteries and highway drains. A direct discharge of List I substances was not permitted subject to possible minor exceptions where groundwater is demonstrated as permanently unsuitable for use, or for passive activities that may have resulted in unintentional discharge for example from manufacturing and storage facilities which may not necessarily be authorised activities.

The discharge of List II substances could be authorised provided it was demonstrated that there would be no pollution otherwise a disposal activity that might result in an indirect discharge required authorisation.

The [Groundwater Regulations 2009](#) transpose certain elements of the WFD, the GD and GWDD, as they related to groundwater, incorporated originally in the 1998 Groundwater Regulations and carried over to the 2009 Groundwater Regulations. The purpose of the regulations was to prevent the entry into groundwater of “hazardous substances” (previously List I substances) which are defined as substances which are persistent, bio-accumulative or toxic and the pollution of groundwater by “non-hazardous pollutants” (previously List II substances) which were all other substances liable to cause pollution. The 2009 Groundwater Regulations covered the discharge of pollutants directly into groundwater (direct) and after percolation through soil and strata (indirect). A discharge of pollutants directly into groundwater was already an offence under section 86 of the Water Resources Act 1991.

The GD, WFD and GWDD were transposed in England and Wales via the [Environmental Permitting \(England and Wales\) Regulations 2010 \(EPR\)](#) which also replaced those parts of the Water Resources Act 1991 that relate to the regulation of discharges to controlled waters including groundwater. The EPR which have been amended a number of

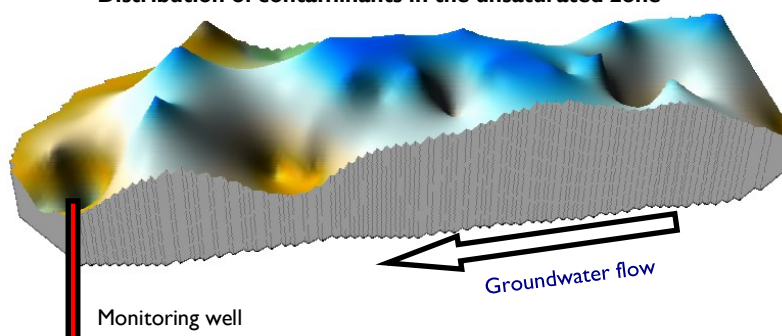
times since 2010 include dealing with pollution incidents that are “...causing or knowingly permitting a water discharge activity or groundwater activity without a permit...” for example this could include pollutants from a leaking fuel tank.

However, there are a range of environmental regulations which cover the protection of groundwater and need for the remediation of polluted groundwater, not least Section 57 of the Environment Act 1995 which created [Part 2A of the Environmental Protection Act 1990](#) (‘Part 2A’) and the [Contaminated Land \(England\) Regulations 2006 \(as amended in 2012\)](#) whereby the definition of contaminated land is a risk based approach based on the assessment of significant pollutant linkages (SPL) and groundwater contamination associated with “...significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused..”. A qualitative or quantitative risk based assessment is often applied to assess ‘significant pollution’.

Understanding how legislation and guidance associated with groundwater protection and quality developed is often important for legal cases where it is necessary to understand what regulations and guidance were in place and when, and how it was applied. Senior MJCA personnel have provided expert opinion as evidence on a range of waste and contaminated land matters in arbitration and litigation cases. Our expertise in this practice area comes from senior MJCA personnel having a working and practical knowledge of the environmental legislation and often at the time when the events being considered took place.

“The 2009 Groundwater Regulations covered a discharge of pollutants directly into groundwater (direct) and after percolation through soil and strata (indirect).”

Distribution of contaminants in the unsaturated zone



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ABOUT MJCA

MJCA provides independent advice on environmental issues to the public and private sectors. Delivering our services to high technical standards and commercial awareness enables us to provide practical, cost effective advice and sustainable solutions. Further information regarding our services can be found on our website www.mjca.co.uk

CONTACT US

Please contact [Kevin Eaton](#) for more information on any of the issues raised in this newsletter, or on any other Contaminated Land issues.

Groundwater data sources

A range of hydrogeological information, groundwater protection and quality is available online. The British Geological Survey (BGS) [website](#) has an online viewer portal with access to various maps including the UK Hydrogeological Map at 1:625 000 scale indicating aquifer potential together with 23 scanned [maps](#) originally published between the late 1960's and late 1980's. Although these smaller scale maps do not provide total coverage across the UK they show a range of information on surface water features, the three dimensional geometry of aquifers, groundwater levels, abstractions and quality including saline intrusion in varying amounts of detail.

The Environment Agency has a database accessed via the website '[What's in my backyard](#)' which includes groundwater source protection zones (SPZ), BGS Aquifer Maps for superficial and bedrock deposit designation and groundwater vulnerability zones. It is

understood that the Environment Agency are currently updating their groundwater vulnerability maps to reflect improvements in data mapping and understanding of the factors affecting vulnerability.

The Scottish Government operate a website 'Scotland's Environment' which has an on-line [map viewer](#) which includes over 200 map layers from 13 partner organisations across Scotland including information about geology and aquifer classification. The Scottish Environment Protection Agency also have information about groundwater on their [website](#).

There is general information on the UK Groundwater Forum website and it provides a portal for a number of useful [links](#) to other websites covering groundwater issues.

UKTAG is a partnership of the UK environment and conservation agencies. It was created to provide coordinated advice on the

science and technical aspects of the European Union's Water Framework Directive (2000/60/EC). The technical guidance and recommendations made by UKTAG can be found in the resources section on their [website](#). The Joint Agency Groundwater Directive Advisory Group (JAGDAG) is set up to peer review the Agencies' assessments of specific substances and advise the UK Administrations on their classification as either hazardous substances or non-hazardous pollutants under the Groundwater Daughter Directive/ Environmental Permitting Regulations.

CL:AIRE has prepared a Water and Land Library (WALL) which is freely available. This includes a list of links to past and present water and land references published by a range of agencies and industry. A section on '[Assessing risks to the water environment](#)' is included.

