

# OR/15/048 Foreword

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Bearcock, J M, Smedley, P L and Milne, C J. 2015. Baseline groundwater chemistry: the Corallian of the Vale of Pickering, Yorkshire. *British Geological Survey Internal Report*, OR/15/048.

Although groundwater has long been seen as a relatively pure natural resource stored in subsurface aquifers, its quality is under an ever-increasing threat from human influences. Changes in chemical quality occur through direct inputs of anthropogenic substances, through groundwater abstraction and resultant change in groundwater flow regimes and through artificial recharge. Groundwater is an important resource for drinking, agricultural, industrial and domestic supply. About 35% of public water supply in England and Wales and more than 70% in south and east England is provided by groundwater resources. Groundwater flows and seepages are also vital for maintaining summer flows in rivers, streams and wetland habitats, some of which rely solely on groundwater. Monitoring, management and protection of groundwater quantity and quality are therefore important economic and environmental priorities.

Characterisation and monitoring of groundwater chemistry is a critical component of management and protection. This provides the basis for defining the suitability of groundwater for its intended purpose, identifying pollution inputs and assessing any temporal change. The main European driver for the characterisation and monitoring of groundwater quality is European Union legislation in the form of the Water Framework Directive, Groundwater Directive, EC drinking-water regulations and environmental-quality standards. A key starting point for aquifer protection is defining the natural or 'baseline' chemistry of the groundwater body concerned. This sets the framework against which anthropogenic impacts and trends can be measured.

The concept of 'baseline' in the context of groundwater quality is difficult to define in detail and opinions differ on the meaning and application of the term. The presence of purely anthropogenic substances such as pesticides or CFCs indicates a departure from the natural condition, but for many solutes which can be derived either from pollution or natural sources, for example nitrate, phosphorus or arsenic, the distinction is less clear-cut. In addition, specific chemical constituents in a given groundwater body may be identified as pollutants while other component solutes may be entirely naturally-derived. For the purposes of this study, baseline is defined as:

*"the range in concentration (within a specified system) of an element, species or chemical substance present in solution which is derived by natural processes from natural geological, biological, or atmospheric sources".*

The baseline chemistry of groundwater varies widely as a function of the many complex geological, geochemical, hydrogeological and climatic factors. These give rise to large spatial and temporal variations in chemical quality, at a range of scales. Hence, the baseline for a given element or compound will vary significantly both between and within aquifers. It is, therefore, scale-dependent and should be considered as a range rather than a single value.

Attempting to define the natural baseline chemistry of groundwater from a number of defined aquifers or aquifer regions in England and Wales has been the objective of the project 'Baseline'. The project involves the characterisation of spatial and temporal variations in groundwater chemistry and interpretation of the dominant controlling processes within a given area, aquifer or

aquifer block. For each study area, this has been achieved through collation of existing reliable groundwater, rainfall, land-use and host-aquifer mineralogical and geochemical data, as well as new strategic sampling of typically 25–30 groundwater sources for a comprehensive suite of inorganic constituents. Selected analysis of stable-isotopic compositions (e.g. O, H, C) and atmospheric tracers (CFCs, SF<sub>6</sub>) has also been undertaken where appropriate. Statistical methods, including statistical summaries (medians, arithmetic means, percentiles), together with box plots and cumulative-probability diagrams, provide some of the most valuable analytical tools for the assessment of chemical data and have been used in the Baseline report series. The Baseline reports provide a summary of the inorganic chemical status of groundwaters in a given study area and key pressures on water quality which should provide useful background information of value to water regulators and managers, environmental scientists and water users.

The current series of Baseline reports has been produced by the British Geological Survey with funding from the Natural Environment Research Council. This follows on from a previous series which was produced in collaboration with, and with co-funding from, the Environment Agency.

### **Previous published reports in the Baseline Series (British Geological Survey – Environment Agency):**

- The Triassic Sandstone of the Vale of York
- The Permo-Triassic Sandstones of West Cheshire and the Wirral
- The Permo-Triassic Sandstones of South Staffordshire and North Worcestershire
- The Chalk of Dorset
- The Chalk of the North Downs
- The Chalk of the Colne and Lee River Catchments
- The Great and Inferior Oolite of the Cotswolds District
- The Permo-Triassic Sandstones of Manchester and East Cheshire
- The Lower Greensand of southern England
- The Chalk of Yorkshire and North Humberside
- The Bridport Sands of Dorset and Somerset
- The Devonian aquifer of South Wales and Herefordshire
- The Great Ouse Chalk aquifer
- The Corallian of Oxfordshire and Wiltshire
- The Palaeogene of the Wessex Basin
- The Granites of South-West England
- The Ordovician and Silurian meta-sedimentary aquifers of central and south-west Wales
- The Millstone Grit of Northern England
- The Permo-Triassic Sandstones of Liverpool and Rufford
- The Permo-Triassic Sandstone aquifer of Shropshire
- The Chalk and Crag of North Norfolk and the Waveney Catchment
- The Carboniferous Limestone of Northern England
- The Lincolnshire Limestone

Synthesis: The natural (baseline) quality of groundwater in England and Wales

### **Reports in the current series:**

The Carboniferous Limestone aquifer of the Derbyshire Dome  
The Chalk aquifer of Hampshire  
The Magnesian Limestone of County Durham and north Yorkshire  
The Palaeogene of the Thames Basin  
The Sherwood Sandstone of Devon and Somerset

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