Hydrogeology of Wales: Introduction

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This page is part of a category of pages that provides an updated review of the occurrence of groundwater throughout Wales.

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Wales receives wet westerly winds and is consequently well-endowed with water resources. In addition to its surface waters, Wales also has a wide range of aquifers that reflect its diverse geology, and although groundwater cannot compete with the surface water resources in terms of volume, it does offer a valuable alternative or supplementary source, particularly in rural areas. Groundwater has stable physical and chemical properties, which are beneficial to a number of industries including brewing, distilling, fish farming and dairy processing and it provides a source of alkalinity when blended with the often-acidic surface waters derived from upland gathering grounds. Groundwater is not only an important resource but it also maintains low river flows during drier periods with continued discharge of groundwater base flow into surface waters. Groundwater is also a potential hazard — mine dewatering has taxed Welsh mining engineers ever since the Industrial Revolution. Coal production in south Wales peaked at the start of World War One only to decline during hostilities; recovery to full production was achieved by 1926, the year of the General Strike, but has declined steadily since (**Brabham, 2004**).

Groundwater is available throughout Wales, the more productive aquifers being the Carboniferous Limestone of north and south Wales and the Triassic sandstones in the Vale of Clwyd, the only aquifers designated as Principal type by Environment Agency Wales, and the Devonian age sandstones bordering Herefordshire and to the north of the South Wales Coalfield. There are, however, abundant surface water resources. Approximately 91 $Mm^3 a^{-1}$ or about 8 per cent of the total water in public supply in Wales derives from groundwater and a further 34 $Mm^3 a^{-1}$ is abstracted for private consumption from about 21 000 boreholes, wells and springs (**EA Wales, 2009**). The main water undertaking is Dŵr Cymru — Welsh Water. The estimated annual abstraction against likely overall annual renewable resource potential, based on an analysis by the then Welsh Water Authority undertaken in the mid 1970s when abstraction for industrial use was at its peak is shown in the **resource potential and annual abstraction table** (**Monkhouse, 1982**). This analysis shows that only about 10 per cent of the estimated groundwater resource potential was then used. However, the total estimated abstraction in the 1970s (111 $Mm^3 a^{-1}$) was only slightly less than that estimated for today (125 $Mm^3 a^{-1}$) and the groundwater resource potential remains to this day underutilised.

Estimated annual renewable groundwater resource potential and annual abstraction in 1977 (after **Monkhouse, 1982**).

Aquifer	Annual renewable resource potential ($Mm^3 a^{-1}$)	Annual abstraction ($Mm^3 a^{-1}$)
Quaternary deposits	206	11
Permo-Triassic age sandstones	27	12
Coal Measures facies	412	37
Basal Grits	22	1
Carboniferous Limestone facies	376	46
Devonian	379	5

Total	1421	111*

*In 2009 the overall likely estimate by the Environment Agency Wales was 125 Mm^3 a^{-1}.

Private abstraction is largely of a limited and local-scale because of the indurated and fractured nature and modest permeability of many of the aquifers. It is nevertheless of significant social and economic importance and is used for drinking water, farming, and light industry. There are several reasons why groundwater is important even in areas where surface water is abundant. Groundwater offers consistent and generally favourable quality and is readily accessible at least in small quantities. It is also inexpensive to develop and is largely abstraction license exempt. Overall development of groundwater is patchy, partly due to a perception that groundwater is unlikely to be present in usable quantities in areas such as the hard rock terrains typical, for example, of much of central and west Wales.

High rainfall and recharge coupled with low transmissivities, promote shallow water tables in many areas with a consequent complex relationship between surface water and groundwater **(Robins, 2009)**. Karst conditions in the Carboniferous Limestone have created pathways between sinks and risings in which surface water may be diverted underground to emerge in an adjacent catchment. Contamination of groundwater by acid mine drainage in parts of south Wales, west Wales and north-east Wales, coupled with risks from contaminated land, the latter a legacy of the heavy industry that used to be prevalent in the valleys of the south and north-eastern Wales, may have an adverse impact on groundwater (and surface water) quality. Diffuse pollution from agriculture and forestry is also a problem in some areas. Nevertheless, the potential exists for abstraction of good-quality groundwater in much of Wales, particularly in remote areas where pollution risks are low.

Groundwater has also fostered a number of high-profile industries. At one time brewing relied on groundwater for make-up water, as the mineralisation of the water not only offset the need to add brewing salts but also provided a unique product flavour. Today there are still a few brewers using groundwater including the Felinfoel Brewery Company near Llanelli and the Penderyn Distillery near Aberdare, both drawing groundwater from Carboniferous strata. Welsh groundwater is also bottled at various locations and sold as Natural Mineral Water, and at a price significantly in excess of that of an equivalent volume of petrol or diesel.

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