Hydrogeology of Wales: Management and regulation of groundwater - groundwater pollution

> **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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Diffuse pollution is a significant source of groundwater pollution, and it is estimated that 35 per cent of groundwater bodies in Wales are at risk of failing Water Framework Directive objectives because of it (**Environment Agency, 2009**). Nitrate is the most common diffuse pollutant in Wales, but pollution is also caused by phosphates, pesticide and herbicides. Pollution is predominately a result of agricultural activities including land spreading, fertiliser application and poor land and stock management practices. Heavy industry, mining, sewerage networks and atmospheric deposition also contribute to the nitrate problem.

Diffuse and point source pollution in Wales is also caused by historic land contamination and waste disposal operations (landfills). Due to the lack of mains sewerage and mains gas connection in rural Wales, discharges from poorly maintained private sewerage systems, and leaks from domestic heating oil tanks are also common sources of point source groundwater pollution.

It is estimated that 24 200 ha of land in Wales could be contaminated (**Environment Agency, 2009**). The industrial legacy of contaminated land, particularly in parts of south Wales, is both extensive and costly to remediate. Much work has been focused on the Swansea, Neath and Port Talbot areas (**Waters et al., 2005**) investigating the transport of pollutants along discrete geological horizons. One specific problem is the discharge of polluted water into rivers from glacial gravels along valley sides. In the Tawe valley the potentiometric surface cuts through made ground including ash and slags from former metalliferous ore smelting activities generating polluted base flow. Remedial action has required the removal of considerable volumes of made ground for contained disposal.

Wales also has over 100 closed landfills, many in redundant quarries, and were designed as ‘dilute and disperse’ sites without any lining. Waste generation in Wales continues to have a high proportion of mineral wastes and residues (see **Industrial and commercial waste table**).

Industrial and commercial waste produced in Wales (tonnes x 10^3) – data compiled by Environment Agency Wales

Waste type	Industry	Commerce	Total	% of total for all England and Wales
Inert	129	9	138	5.8
Paper and card	150	106	256	4.9
Food	105	18	123	4.8
General industrial and commercial	572	853	1425	5.0
Other general and biodegradable	370	80	450	5.1
Metals	393	22	415	8.7

Contaminated general	198	33	231	5.8
Mineral wastes and residues	2654	1	2655	20.7*
Chemical and other	418	19	437	7.4
Total	4989	1141	6130	8.2

*This percentage reflects the high level of activity in the minerals sector in Wales.

At the end of 2007 there were 34 permitted landfill sites 254 transfer stations, 65 treatment facilities, 148 metal recycling facilities and 5 waste incinerators. During 2007 these sites managed a total of over 7.2 million tonnes (see http://www.environmentagency.gov.uk/research/library/data/98033.aspx):

- 3.2 million tonnes of waste were landfilled
- 2.3 million tonnes of waste were transferred
- 1.2 million tonnes of waste were treated
- 500 000 tonnes of waste were handled through metal recycling facilities
- 36 000 tonnes of waste were incinerated.

At the end of 2007 there were:

- 41 Mm^3 of available landfill capacity, 73 per cent of this was available at commercial nonhazardous sites
- 200 000 m^3 was available at private hazardous waste only sites
- 7.8 years of landfill capacity at commercial nonhazardous waste sites in Wales, at current input rates.

During 2007 in Wales almost 300 000 tonnes of hazardous waste was produced with:

- less than 1 per cent landfilled at restricted user sites
- 10 per cent transferred
- 25 per cent treated
- 61 per cent recycled, recovered or re-used
- 2 per cent sent for incineration with energy recovery and a further one per cent incinerated without energy recovery.

All licensed landfill operators are required to ensure that aqueous pollution does not leave their facilities. To this end a great deal of effort is maintained in monitoring sentinel boreholes strategically sited around such facilities.

Wales has a long history of mining activity which has left a legacy of contamination to soils, groundwater and surface water. The Coal Authority are responsible for managing polluting discharges from abandoned coal mines and have installed 11 treatment plants in south Wales.

In 2002 Environment Agency Wales developed the *Metal Mines Strategy for Wales* to provide a framework for tackling pollution left by the legacy of non-coal mines. Due to the significant number

of abandoned sites the strategy aimed to identify the fifty highest priority sites for further investigation, assessment and remediation. The majority of these are concentrated in Ceredigion, west Wales and include the Fron Goch, Cwmystwyth, and Cwm Rheidiol lead and zinc mines.

In the mid 1990s some 60 km of river were adversely affected by 90 ferruginous sources from disused coal mines in north and south Wales. Thirty-three mine water and spoil drainage sites in south Wales were described by **Rees et al. (2002)** in which the time since first emergence ranged up to 40 years, and total iron concentration ranged up to 256 mg l^{-1}, although most were typically less than 10 mg l^{-1}. Most discharges were only slightly acidic with pH values ranging from 5.2 to as high as 7.9. The main hazard from the discharges is iron generated by the oxidation of iron sulphides, but the discharges are better classified according to pH and source (see **Chemical properties of mine and spoil discharges table**). Most of the Welsh coalfield discharges are from flooded and free draining workings.

Chemical properties of types of mine and spoil discharges (after **Rees et al., 2002**)

Source	pH	Net alkalinity $CaCO_3$ (mg l^{-1})	Type
Flooded workings	<5–8	0 to >500	Ca-Mg-SO_4/HCO_3
Spoil tip	<5	-2500 to 0	Ca-Mg-SO_4
Free-draining workings	5–7	+80 to +180	Ca-Mg-SO_4
Flooded and free-draining workings	>5 <8	-350 to +200	Ca-Mg-SO_4
Pumped mine discharge	6.5–7.5	+500 to +1000	Na-HCO_3/SO_4

With the closure of coal pits culminating in north Wales when Point of Ayr closed in 1997, and in south Wales when Tower Colliery ceased to work in January 2008, there has been recovery of water levels and free drainage to subhorizontal day adits and other low elevation discharge points. Pits that have since reopened have not impacted this recovery. Tower continues to recover, while two drift mines were reopened in the Vale of Neath. Elsewhere many of the discharges have been ameliorated with chemical dosing and reed bed treatment to ensure least contamination of the surface-water environment. There is a proposal to develop a new mine at Margam and investigations are ongoing into in situ degasification.

The Point of Ayr colliery in north Wales never made much water and prognoses indicated that it would take 80 years to flood. As a consequence the mine was flooded with sea water and an element of flushing allowed with each tide. In south Wales solutions were less easy and at Pelenna, for example, three large wetland schemes were needed to capture and treat all major mine water discharges into the Pelenna catchment (**Younger et al., 2004**). Other major remediation schemes in south Wales include Ynysarwed in the Neath Valley, Taff Merthyr (**Plates P802438, P802436 and P802435**) in the Taff Bargoed River valley, Six Bells in the Ebbw Fach valley, and Morlais, some 7 km east of Llanelli.

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  Taff Merthyr Colliery prior to closure in 1992. P802438.

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  Ferruginous mine water discharged from Taff Merthyr Colliery shaft after closure. P802436.

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  Mine water from Taff Merthyr after treatment emerging from the reed bed treatment area. P802435.

Metal mine abandonment is also of concern. The longstanding legacy in the Afon Rheidol above Aberystwyth has been investigated (**Younger et al., 2004**) and proposals for remediation of some

sources prepared. Mynydd Parys on Anglesey (**Plate P802437**) has received extensive work which focused on the two main discharges, one to the north and one to the south, to produce one discharge point into a single treatment facility before allowing the discharge access to the sea. At Gwynfynydd in Afon Mawddach, the last active gold mine in Wales, which only closed in 1999, tests showed that the mine discharge both during working and since abandonment had little impact on the Mawddach.

The abandoned Parys Mountain copper mine seen in 2004, Anglesey. P802437.

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