Geology of the Bath area: Applied geology: geological hazards

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This topic provides a summary of the geology of the Bath area – covered by the British Geological Survey 1:50k geological map sheet 265.
Authors: A J M Barron, T H Sheppard, R W Gallois, P R M Hobbs and N J P Smith (BGS).

Knowledge of ground conditions is a prerequisite when identifying land suitable for development, and it underpins cost-effective design. Engineering ground conditions vary depending upon the physical and chemical properties of materials, the topography, behaviour of groundwater and surface water, and the nature of past and present human activity. The most significant problems likely to be encountered within the district are due to the weathering of the solid rocks and their disturbance on slopes. These can be effectively dealt with by obtaining adequate information, including properly designed site investigations, to confirm the characteristics of individual sites.

Limestones within the district, including those of the Carboniferous Limestone Group and the Cornbrash and Forest Marble formations, tend to have high load-bearing capacities associated with a great degree of cementation and/or recrystallisation. The ooidal limestone units of the district, including the Inferior Oolite and Chalfield Oolite, tend to be weaker as they lack strong cementation between individual grains. All limestones within the district are susceptible to the ingress of water via fractures, and the formation of voids at depth may significantly reduce the load-bearing properties of the rock. High load-bearing capacities are also shown by sandstone formations of late Carboniferous and Triassic age, except where mudstone interbeds are present.

In contrast, muddy and silty sandstones, including the Bridport Sand, Dyrham Formation and Kellaways Sand, tend to have moderate load-bearing capacities, and their geotechnical properties vary considerably with saturation and they may be susceptible to significant deformation or collapse where the water table is high. The increased susceptibility of mudstone units to deep weathering and chemical breakdown drastically reduces their load-bearing capacity in the near-surface zone. This particularly affects the Mercia Mudstone, Charmouth Mudstone, Oxford Clay, Kellaways Clay, Forest Marble and Fuller's Earth, and some mudstone-rich units may also be prone to shrink-swell behaviour.

River terrace deposit gravels typically have moderate to high load-bearing capacities, and alluvium may also be load-bearing, although lenses of sand may give rise to running conditions in excavations and beds of peat may produce compressible ground. Shear surfaces in deposits of head can become unstable if loaded and artificial ground is highly variable and may include contaminated land requiring remediation.

Special consideration must be given to engineering ground conditions in areas where landslide deposits **(Table)** have been identified because these present a significant geological hazard. They may be very variable in composition, with intermixed materials of differing load-bearing capacities and strengths. They are invariably underlain by one or more shear planes and movement on these may be reactivated by excavation or loading, or by changes in the groundwater regime. If engineering works are planned for landslide areas it is imperative that adequate site investigations are undertaken to define their nature, extent and stability.

Gulls produced by cambering (see Superficial structures and mass movement deposits) present a further hazard (Hobbs and Jenkins, 2008)[1] and may be either air-filled or contain an admixture of sand, clay, limestone and superficial debris. Rubble-filled gulls may sometimes express themselves at surface as a linear depression. Air-filled gulls are commonly bridged by intact limestone beds, making them difficult to distinguish from rubble-filled ones, and in many cases there is no surface expression of either type of fissure. Foundations which cross debris-filled gulls may suffer differential settlement, and those which cross air-filled gulls may lack sufficient support. In areas where gulls are suspected, development should always be preceded by adequate site investigations.

The distribution of alluvial deposits as shown on the geological map provides an indication of those areas that are prone to river flooding. However, low terraces may also suffer flooding, and other areas may be inundated during anomalously high rainfall, by groundwater flooding, or as a result of drains and culverts becoming blocked. Areas regarded as at risk of flooding are shown on Environment Agency maps. Periods of enhanced catchment discharge may increase the pollution potential of ground and surface waters. At these times, leachate, soluble contaminant or contaminative sediments from areas of artificial ground, including poorly lined landfill sites, agricultural waste-disposal sites and active or former industrial sites (such as sewage works, pits and quarries) may enter surface water, groundwater or alluvial sediments.

Within the district, gas emissions represent a hazard in areas associated with the accumulation of methane or radon. Methane may accumulate in coal mine voids and shafts, and may also be generated by decomposition of material in landfill sites and organic deposits such as peat. It is toxic, an asphyxiant, and explosive in high concentrations. Methane is less dense than air, is capable of migrating through permeable strata, and accumulating in poorly ventilated spaces such as basements, foundations or excavations. Although methane emissions are unlikely to pose a significant hazard in the district, the risk can be further mitigated through correct design of landfills and developments in the vicinity of 'at risk' sites. Radon is a natural radioactive gas produced by the radioactive decay of radium and uranium, and is found in small quantities in all rocks and soils, although the amount varies from place to place. Geology is the most important factor controlling the source and distribution of radon (Miles and Appleton, 2005)[2], and approximately a third of the Bath district is classified as a radon affected area (Miles et al., 2007). The government recommends that houses in radon affected areas should be tested for radon. Radon protective measures will be required in new buildings, extensions, conversions and refurbishments in parts of the district (Scivyer, 2007)[3]. A study of geological radon potential indicates that the radon affected areas include the crop of the following units: Carboniferous Limestone Group; Quartzitic Sandstone Formation; sandstones in the Coal Measures formations; Mercia Mudstone Marginal Facies; Blue Lias Formation; Dyrham and Bridport Sand formations; Inferior Oolite Group, and Chalfield Oolite Formation. Advice about radon and its associated health risks can be obtained from the Health Protection Agency–Radiological Protection Division, Chilton, Didcot, Oxfordshire, OX11 0RQ.

Former coal mining in the west of the district may induce a risk of subsidence. Mining activities include the construction of shafts, adits and galleries and, in the case of ancient and commonly undocumented shallow mining, the extraction of coal by means of bell-pits and pillar and stall workings. Any of these activities can give rise to voids at shallow or intermediate depths. Settlement into such voids has the potential to cause fracturing, general settlement or the formation of crown-holes in the ground above, as well as more significant collapses. For further information regarding underground and opencast coal mining, the location of mine entries (shafts and adits), and matters relating to subsidence or other ground movement induced by coal mining, please contact The Coal Authority. Subsidence is also associated with some of the freestone mines, notably those at Combe Down, which are currently undergoing remediation works. For information, please contact the Combe Down Stone Mines Project Team, Bath & North East Somerset Council, 10 Palace Yard

Mews, Bath, BA1 2NH.

References

1. ↑ Hobbs, P R N, and Jenkins, G O. 2008. Bath's 'foundered strata' — a re-interpretation. British Geological Survey Open Report, OR/08/052.
2. ↑ Miles, J C H, and Appleton, J D. 2005. Mapping variation in radon potential both between and within geological units. *Journal of Radiological Protection*, Vol. 25, 257–76.
3. ↑ Scivyer, C. 2007. Radon: guidance on protective measures for new buildings (including supplementary advice for extensions, conversions and refurbishments). *Building Research Establishment Report*, BR 211.

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