The Upper Cretaceous Chalk of southern England is the UK’s most important aquifer, providing more than 75% of the public supply for southeast England, including London. The aquifer also sustains rivers and wetlands, and their associated groundwater dependent ecosystems. However, the aquifer is facing a multitude of threats including over-abstraction, nitrate pollution, and climate change.

The Chalk is a complex aquifer in which groundwater flow is through the matrix, fractures and karstic dissolitional voids. The Chalk matrix has a porosity of around 35% (Bloomfield et al., 1995[1]). The matrix is thought to provide an important contribution to storage, although the size of the pore throats is very small, and therefore the permeability is very low (Price et al., 1993[2]). The average permeability of 977 core samples was only 6.3 x 10⁻⁴ m/day (Allen et al., 1997[3]). The matrix is particularly important in solute transport, because solutes move between the matrix and the more permeable parts of the aquifer via diffusion (Foster 1975[4]). The unmodified fracture network provides an important contribution to storage and flow, and has a hydraulic conductivity of about 0.1 m/d, and a transmissivity of about 20 m²/day (Price, 1987[5]). However, it is the dissolitional enlarged fissures and conduits that make the Chalk such a good aquifer. The median transmissivity from 2100 pumping tests is 540 m²/day, and the 25th and 75th percentiles are 190 and 1500 m²/day respectively (MacDonald and Allen, 2001[6]). Borehole packer testing, logging and imaging have shown that most of this transmissivity comes from a small number of dissolitional voids (e.g. Tate et al., 1970[7]; Schurch and Buckley, 2002[8]). Laterally extensive lithostratigraphical horizons including marl seams, bedding planes, sheet and tabular flint bands, and hard-grounds have an important influence on these groundwater flows. They are all horizons where downward percolation of water may be impeded. Dissolution often occurs where flow is concentrated along these horizons, creating conduits or fissures, especially where they are intersected by joint sets.

Across much of the UK, the Chalk has not traditionally been considered or managed as a karst aquifer, perhaps because caves are rare. However, it has been recognised for some time that karst processes and conduit flow may be common in many areas of the Chalk aquifer. Although not renowned for its caves, the Chalk does contain some significant cave systems. The largest chalk cave in Britain is Beachy Head Cave, near Eastbourne which is approximately 400 m long. Caves are more common in northern France where some are several kilometres long. As in more classical karst regions, surface karst features such as sinking streams, springs, dolines and dry valleys can be very common in the Chalk (Cooper et al., 2011[9]). There are also many fossil sediment filled karst features associated with the Chalk-Palaeogene unconformity when the climate was warmer and wetter (Newell, 2014[10]).

Locally the Chalk may host a greater density of surface karst features than other more classic karst aquifers such as the Carboniferous limestones of Derbyshire, yet it is rarely treated as a karstic aquifer. There is a rather simplistic tendency to equate karstic groundwater flow with the occurrence of extensive cave systems. Yet subsurface dissolution features are frequently encountered in the Chalk during construction projects (Edmonds, 2008[11]), and tracer testing has demonstrated rapid groundwater flow over distances of up to 20 km (e.g. Harold, 1937[12]; Atkinson...
and Smith, 1974). Even where there is little evidence of surface karst, the Chalk often has high transmissivity due to the solutional enlargement of fractures to form fissures and conduits. Given the evidence for karstic features, rapid groundwater flow, and considerable spatial heterogeneity, the Chalk is perhaps better described as a weakly cavernous karst aquifer rather than weakly- or non-karstic.

The Pang and Lambourn catchments in Berkshire are good examples of chalk catchments with a high density of surface karst features (Figure 1). These catchments provide an excellent location in which to discuss the extent to which Chalk can be viewed as a karstic aquifer, and the importance of such features to water resource management.

During this field trip we will visit some of the stream sinks and one of the major springs in the Pang catchment (Figure 2). We will also look at the contact between the Chalk and the overlying Palaeogene deposits in a quarry, and observe some sub-surface dissolutorial fissures and conduits via a borehole CCTV camera system.

![Figure 1](image1)

**Figure 1** Surface karst in the Pang and Lambourn catchments, UK. Geology based on 1:50 000 scale DigMapGB data. Contains Ordnance Survey data © Crown copyright and database rights 2015. Hill-shaded topography is NEXTMap Britain elevation data from Intermap Technologies.
Figure 2 Field trip sites in the Pang catchment. Contains Ordnance Survey data © Crown copyright and database rights 2015. Geology based on 1:50 000 scale DigMapGB data.

References


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