Investigating Organic Micropollutants in a Peri-Urban Flood Plain Aquifer

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Aims

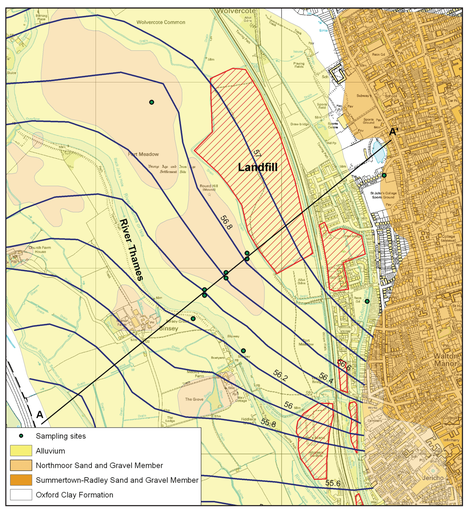

Figure 1 BGS Oxford Observatory on the Port Meadow.

A pilot study was designed to develop the sampling methodology required to investigate the occurrence and distribution of 'emerging organic contaminants' (EOC's) in groundwater in an area of anticipated contamination. Such samples are notoriously easily contaminated by plasticisers in the sampling equipment or personal care products used by the sampling team. To date there are very few studies in the UK which have investigated the occurrence of EOC's in groundwater.

Site

The study site selected was the peri-urban BGS Oxford Observatory on the Port Meadow, an area of ancient grassland on the flood plain of the River Thames to the northwest of Oxford **(Figure 1)**. The hydrogeological setting of this site is already well-characterised and the site is instrumented. Groundwater is present in river terrace gravels below the alluvium which in turn overlie low permeability Oxford Clay **(Figure 2)**. Groundwater levels suggest that the flow in the gravels is from northeast to southwest in this area passing under the main Thames channel and discharging to the Seacourt Stream. There is some evidence of leakage from the river to the west of the main channel. The site is periodically inundated and groundwater is predominantly reducing.

The meadow is flanked on its eastern edge by a closed landfill which accepted all categories of waste from 1937 up to 1980. The leachate plume can be identified across the site by high conductivity, Cl, HCO_3, SO_4 and DOC. Part of the area of made ground is now used as allotments.

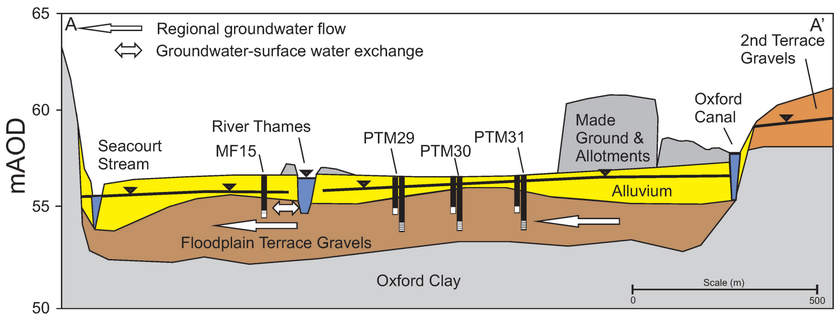

Figure 2 Cross section of study site.

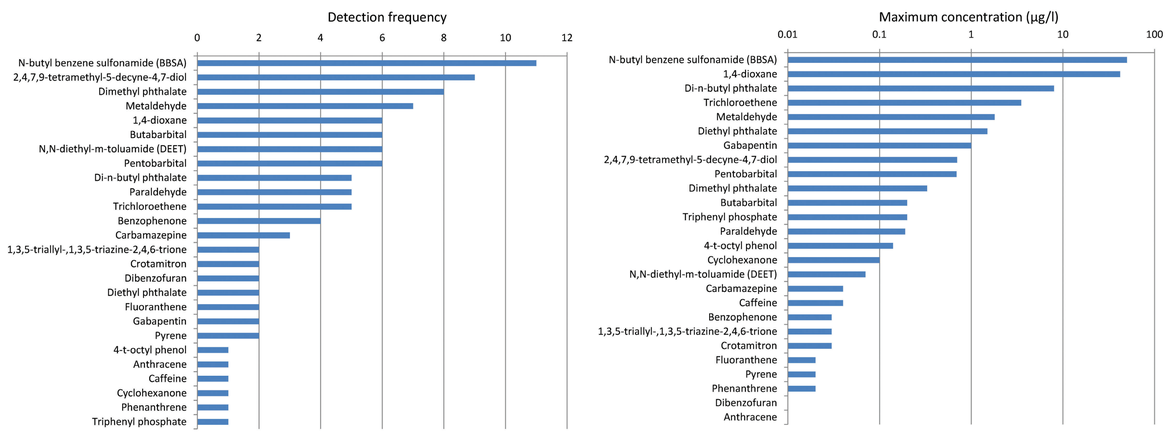

Figure 4 Detection frequency and maximum concentration of organic micropollutants detected by GCMS.

Conclusions and future work

The study was successful in obtaining samples which did not appear to be contaminated during collection and which were able to identify contaminants from multiple sources within the peri-urban study area.

The next phase of the project will aim to investigate changes in organic micropollutants as a result of higher groundwater levels in the winter as well as floodplain inundation processes.

A subsequent pilot study will investigate the occurrence of organic micropollutants in a groundwater dominated agricultural Chalk catchment in southern England.

Sampling

Figure 3 Collecting a pumped groundwater sample.

The site is equipped with a number of shallow piezometers in the gravel aquifer. A selection were sampled in July 2011 for organic micropollutants: from 3 pairs of nested piezometers in the plume, 1 up-gradient in the meadow, 2 towards the urban area of west Oxford, 1 across the river and 1 from the river **(Figure 1)**. Samples were collected using a small peristaltic pump equipped with new PTFE tubing **(Figure 3)**.

A blank sample comprising laboratory ultra-pure water was passed through the pump in the same way as the samples. Great care was taken to flush the pumping system with copious amounts of sample and to avoid contamination of the pump. Sampler's hands, bottle tops and bottle screw threads were washed under the pump outflow before a sample was collected. Samples were collected in 1-litre glass bottles and kept refrigerated in the dark before analysis where possible.

Samples were analysed by the Environment Agency NLS using the semi-quantitative GCMS and LLMS broad-screening methods developed for their organic micropollutant monitoring programme.

Results

A satisfactory blank was obtained containing only a low concentration of dimethyl phthalate. At least 1 organic micropollutant was detected at each site and both priority pollutants and emerging contaminants were found. A total of 26 compounds were detected by GCMS with BBSA being both the most frequently detected compound and with the highest maximum concentration **(Figure 4)**. Four priority pollutants were detected, trichloroethene, octyl phenol, anthracene and fluoranthene, and one pesticide, metaldehyde.

Some discrimination was evident with the Thames and urban areas showing a different fingerprint from the landfill plume **(Figure 5)**:

- Urban sites upgradient of the landfill: phthalate and BBSA plasticisers, PAH, triphenyl phosphate, anti-epileptic drugs
- Port Meadow site upgradient from the landfill and a considerable distance from the River Thames and urban areas: BBSA only
- Sites in the plume: trichloroethene, 1, 4-dioxane, barbiturates, phthalate and BBSA plasticisers, metaldehyde, crotamitron
- Site across the river: 1, 4-dioxane, phthalate and BBSA plasticisers, metaldehyde
- River Thames: phthalate and BBSA plasticisers, caffeine, anti-epileptic drugs, PAH

The LCMS results were non-quantitative but showed the β-blockers atenolol, sotalol and celiprolol to be present in the Thames and pesticides including carbetamide, carbendazim, diuron, simazine and terbutryn predominantly at the site across the river and at the urban sites and the Thames. These compounds were not present in the landfill plume.

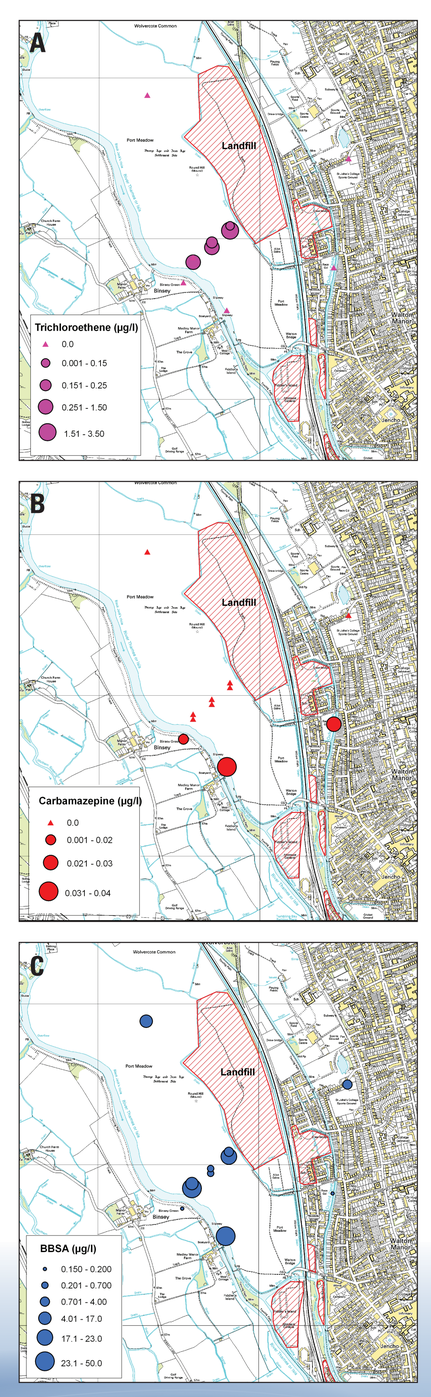

Figure 5 Distribution of: a) Trichloroethene; b) Carbamazepine; and c) BBSA, in groundwater.

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http://www.bgs.ac.uk/research/groundwater/quality/emerging_contaminants.html