British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Profiling micro-organic contaminants in groundwater using multi-level piezometers

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Introduction

The presence of micro-organic pollutants, including 'emerging contaminants' within groundwater is of increasing interest. Robust protocols are required to minimise the introduction of contamination during the sampling process. Below we discuss the sampling protocols used to reduce inputs of plasticisers during the sampling process, as well as the techniques used to characterise the distribution of micro-organic pollutants in the subsurface.

In this study multi-level piezometers installed into the Sherwood Sandstone aquifer in the suburban area of Doncaster, Yorkshire, were used to look at the changes in micropollutants with depth and lithology. Two different methods of pumping groundwaters were employed, and sampling campaigns were undertaken in February and July 2014, under contrasting hydrological conditions.

Multi-level piezometers: The window into the subsurface

The multi-level used were bundled narrow piezometers of differing lengths with short screened sections. This is contrast to fully-penetrating boreholes or piezometers that usually have one 'tube' and a longer screened sections. They are the best method of obtaining a detailed snap-shot of the vertical changes in piezometric head and water quality; their low volumes make them ideal for rapidly obtaining a representative groundwater sample.

Each multilevel had 7 ports or separate tubes with the shallowest and deepest being constructed of PVC and the others 5 of HDPE tubing (Figure 1). Each port has 30 cm screened sections and a cap at the bottom. All levels are hydraulically separated to stop leakage (Morris et al 2006). The multi-levels at the three sites were approximately 10 years old when they were sampled in 2014.

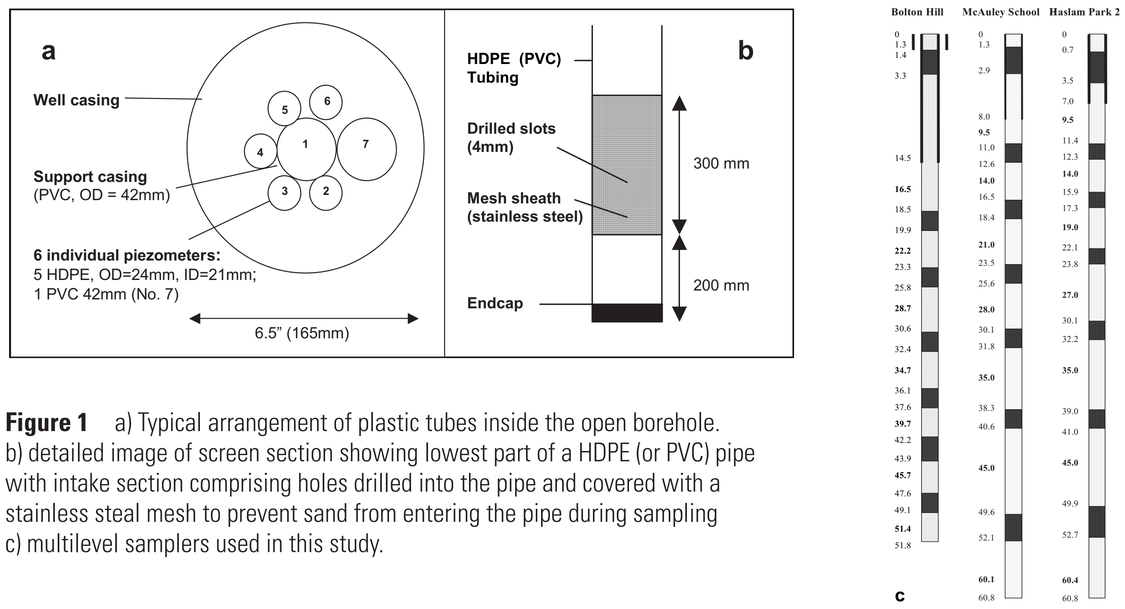


Figure 1 a) Typical arrangement of plastic tubes inside the open borehole. b) detailed image of screen section showing lowest part of a HDPE (or PVC) pipe with intake section comprising holes drilled into the pipe and covered with a stainless steal mesh to prevent sand from entering the pipe during sampling c) multilevel samplers used in this study.

Sampling methodology

Previous projects had made use of the Doncaster multi-levels and inertial pumps (Waterra) had been left in-situ in some of the ports. In these cases the port was sampled using the installed pump (a long thin HDPE tube with a ball-valve on the end) and a Waterra Powerpack™ system (Figure 2) to reduce cross-contamination and test the difference between the two methods.

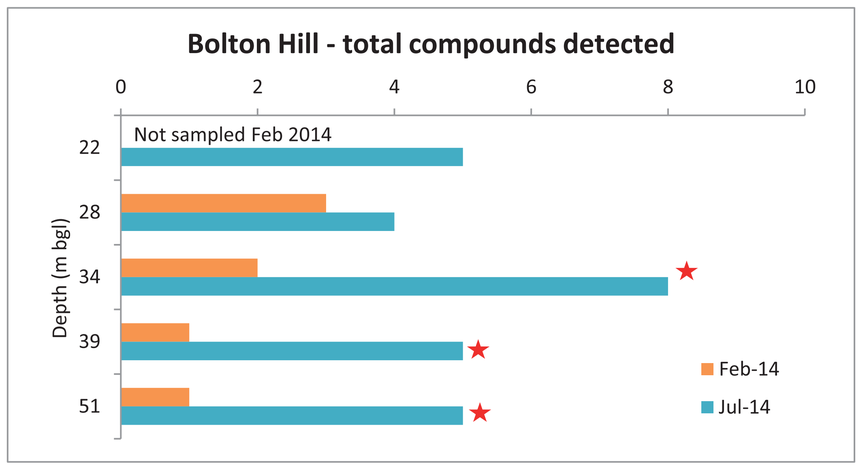
All other ports were sampled using a Solinst® Model 410 peristaltic pump with Pt cured silicon pump tubing and PE tubing was inserted into the port. The PE tubing was washed with Virkon®, to sterilise, and rinsed well with plenty of ultra-pure water prior to the beginning of the sampling round. Between ports the PE tubing was emptied using the peristaltic pump and the next port was fully purged before sampling.

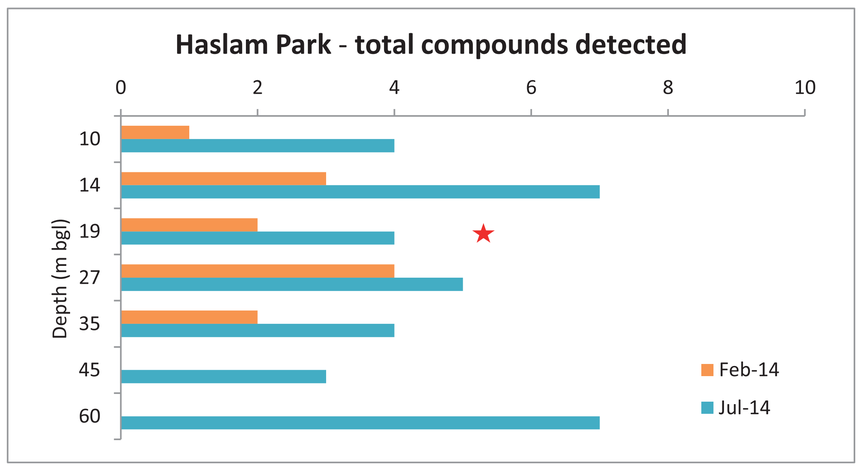
Equipment blanks were also taken to check for inputs of pollutants from the tubing.

The sampling team and environment are a further potential source of contamination. To reduce this personal care products were kept to a minimum and sampling tubing was kept on a plastic sheet away from grass and potential surface contaminants.

Samples were analyzed at the UK Environment Agency National Laboratory Service (NLS) using a multi-residue GC-MS method which screens for over 1000 organic compounds.

Results: Micropollutants





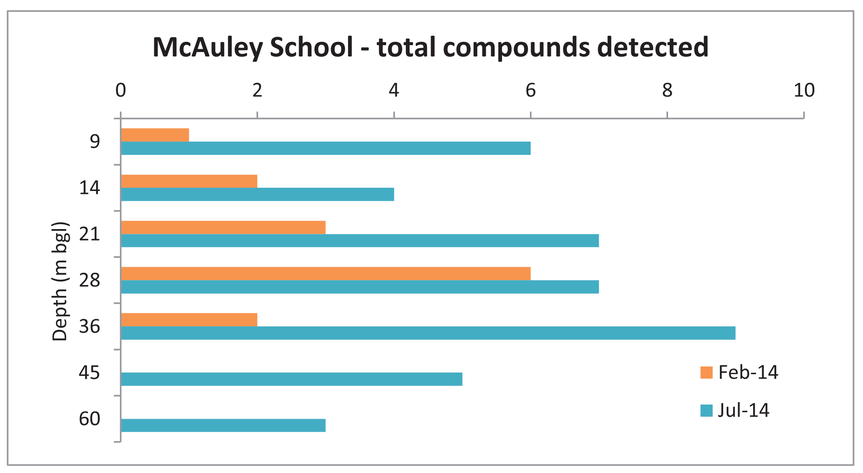


Figure 3 Total compounds detected at each port at the three sites during February and July 2014. ★ ports with inertial pumps installed, all other ports were pumped using a peristaltic pump.

- The data show that there is no evident difference caused by the different sampling methods but there is variability with depth at each site.
- Using multi-levels we are able to characterise in detail the change in concentration of a particular contaminants with depth within the aquifer and therefore infer with more certainty hydrogeological processes and controls.
- Changes in hydrologic conditions between the two sampling rounds, there were significantly higher water levels in July, and the lithological controls from marl beds, providing rapid pathways to depth, are important in controlling rapid changes in water quality at depth within this groundwater system.

Ongoing Work

We are carrying out a study from multi-levels across a range of urban groundwater systems on the Permo-Triassic sandstone in Doncaster, Nottingham and Birmingham. We are preparing a paper on the Doncaster study.

Contact information

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