



# An emerging picture of organic micropollutants in groundwater in the London area

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## Improving analytical techniques bring new insights

Groundwater samples can now be analysed for a broad range of organic compounds at low concentrations due to improved analytical methods.

## Over 10 years of data

BGS have analysed data from the Environment Agency's groundwater monitoring programme, which has been running for more than a decade.

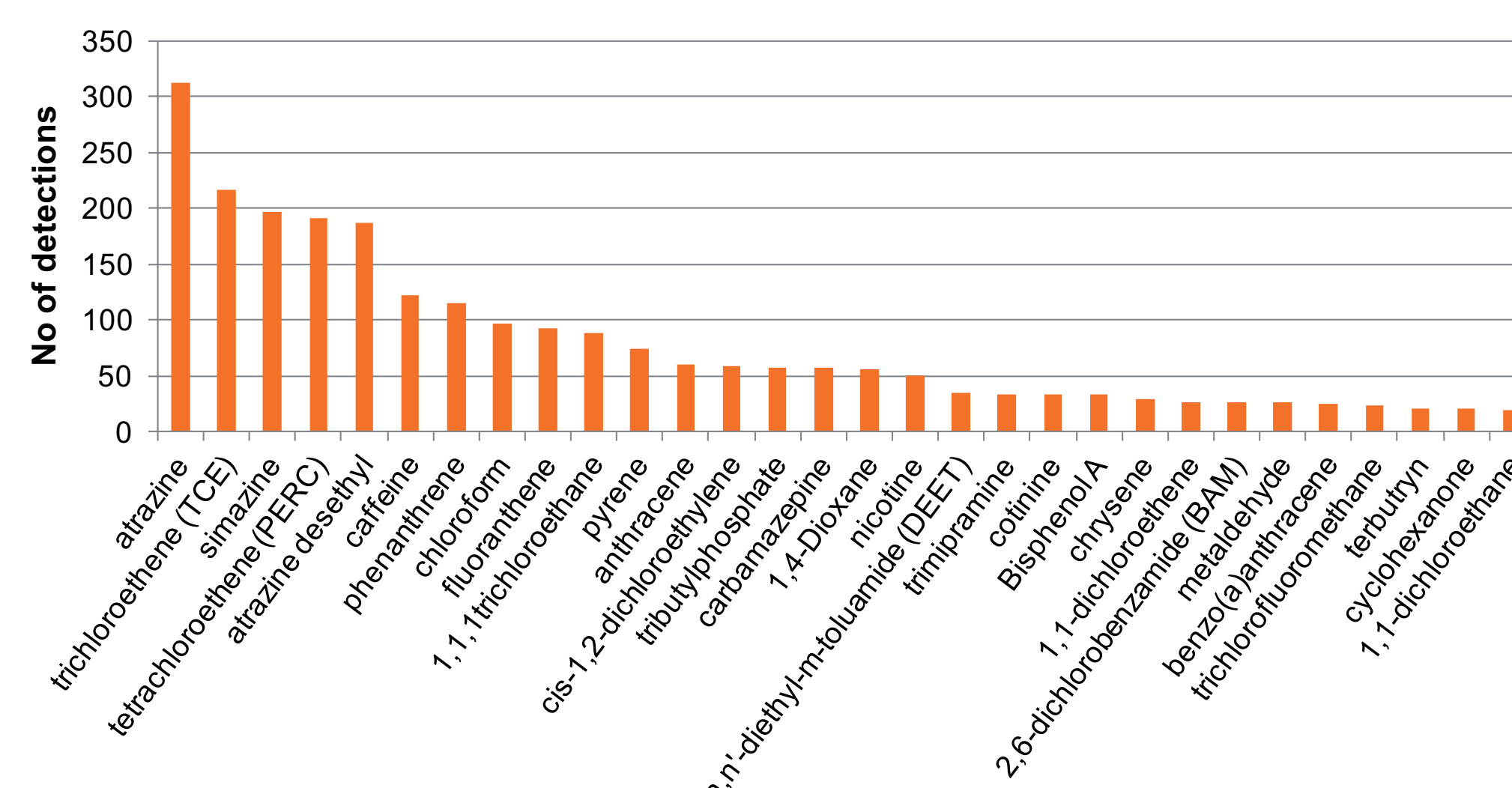
The GCMS screening method employed enables hundreds of substances, including VOCs and SVOCs, to be identified from a single sample.

The data set covers England and Wales but here we focus in and around London.

## Detecting a wide range of contaminants

Many different types of organic micropollutants are now being detected in groundwater from the London area, with multiple compounds at some sites. These include categories of compounds such as:

- Lifestyle: e.g. caffeine, nicotine
- Pharmaceutical: e.g. carbamazepine (epilepsy treatment)
- Personal care: e.g. DEET (insect repellent)
- Pesticides (herbicides) and their metabolites: e.g. atrazine, 2,6-dichlorobenzamide (BAM) — a metabolite of the herbicide dichlobenil, metaldehyde (slug pellets)



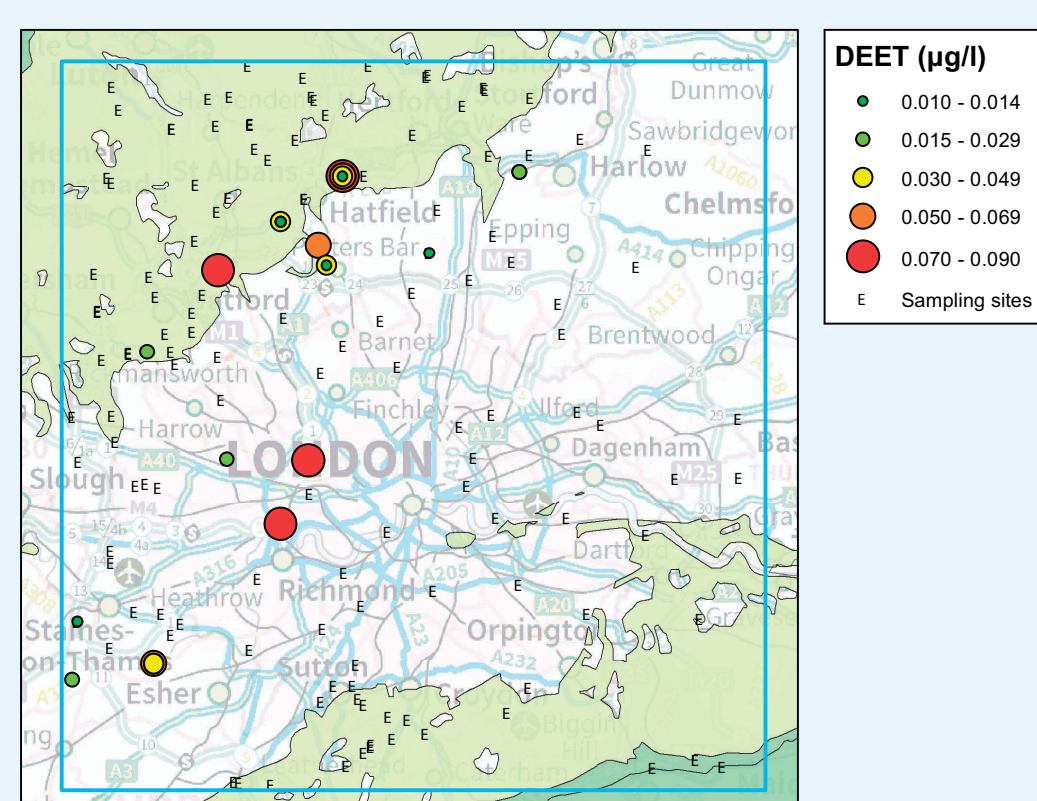
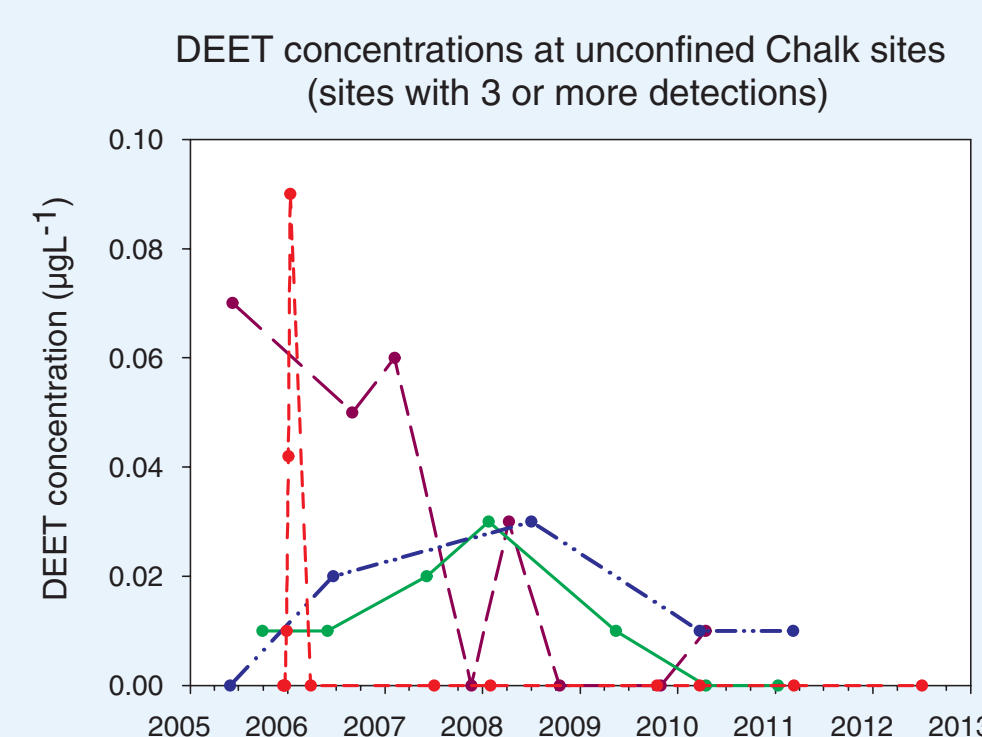
## Existing issues and new concerns

Some of the substances encountered are recognised groundwater contaminants which are already regulated. For example, use of the herbicide atrazine was restricted in the UK in 1993 and banned across the EU in 2004. Others, such as caffeine and DEET, are emerging contaminants, i.e. not previously considered or known to be significant to groundwater.

### DEET: insect repellent

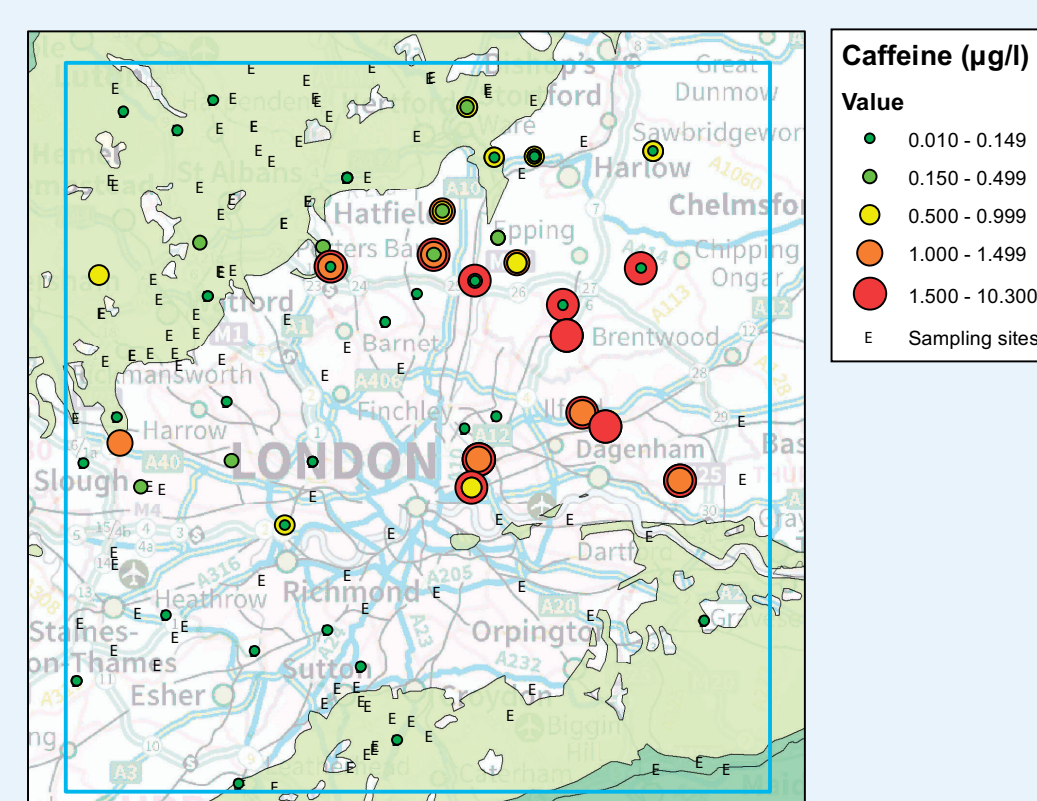
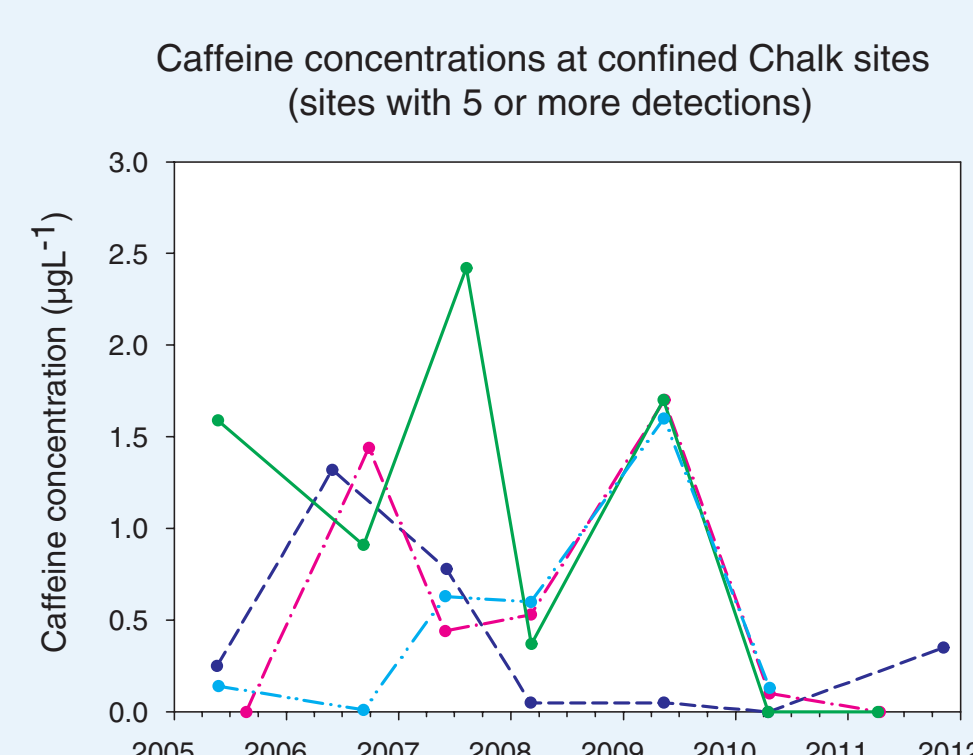
The spatial distribution of DEET concentration does not show a clear relationship with geology or land use.

DEET has been consistently detected over time at several sites in the unconfined Chalk.



### Caffeine

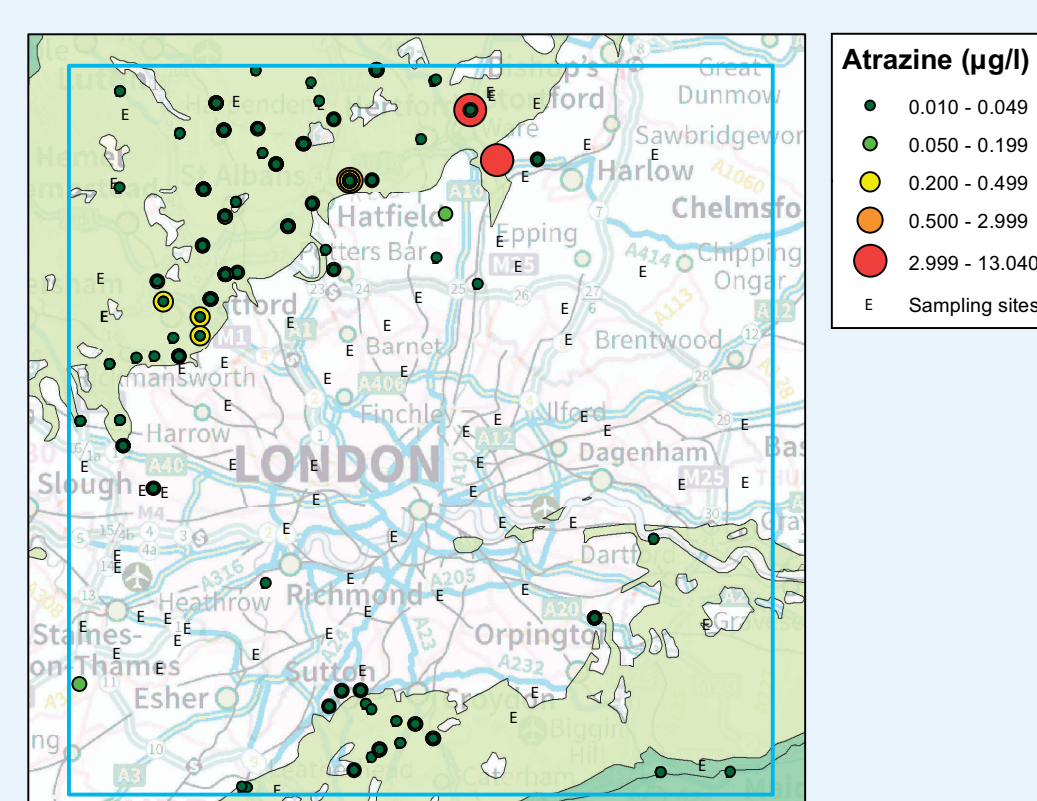
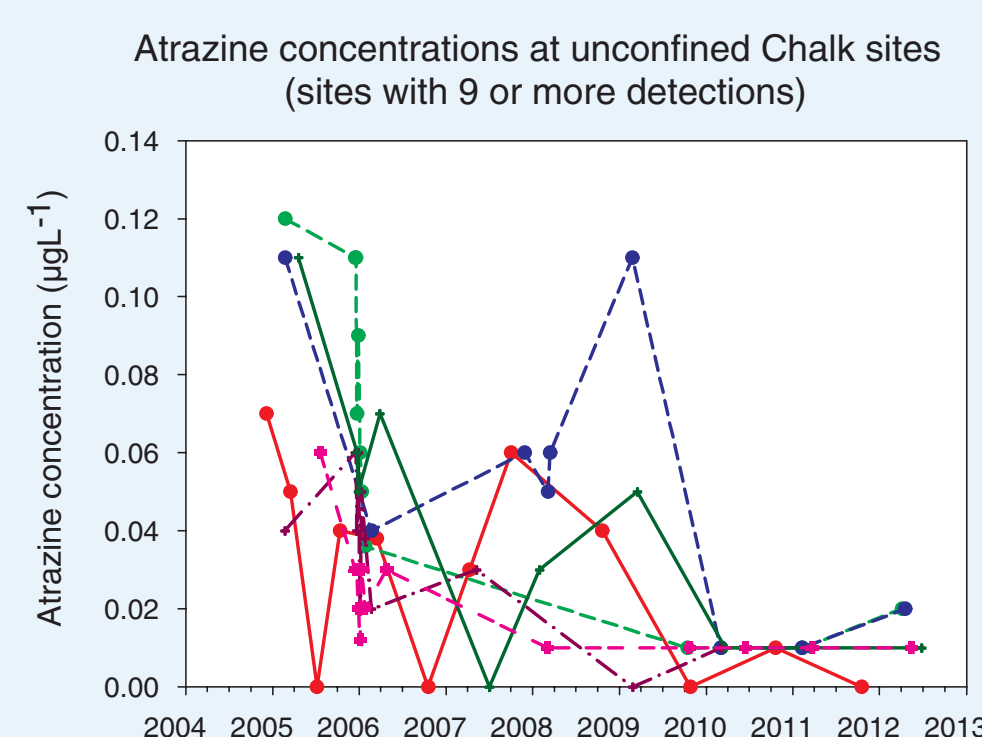
Caffeine concentrations are typically low in the unconfined Chalk. The highest concentrations are seen in the confined Chalk. Time series data for selected confined Chalk sites indicate a consistent pattern of detections over time, but no clear trend.



### Atrazine: herbicide

Atrazine concentrations are typically higher on the unconfined Chalk.

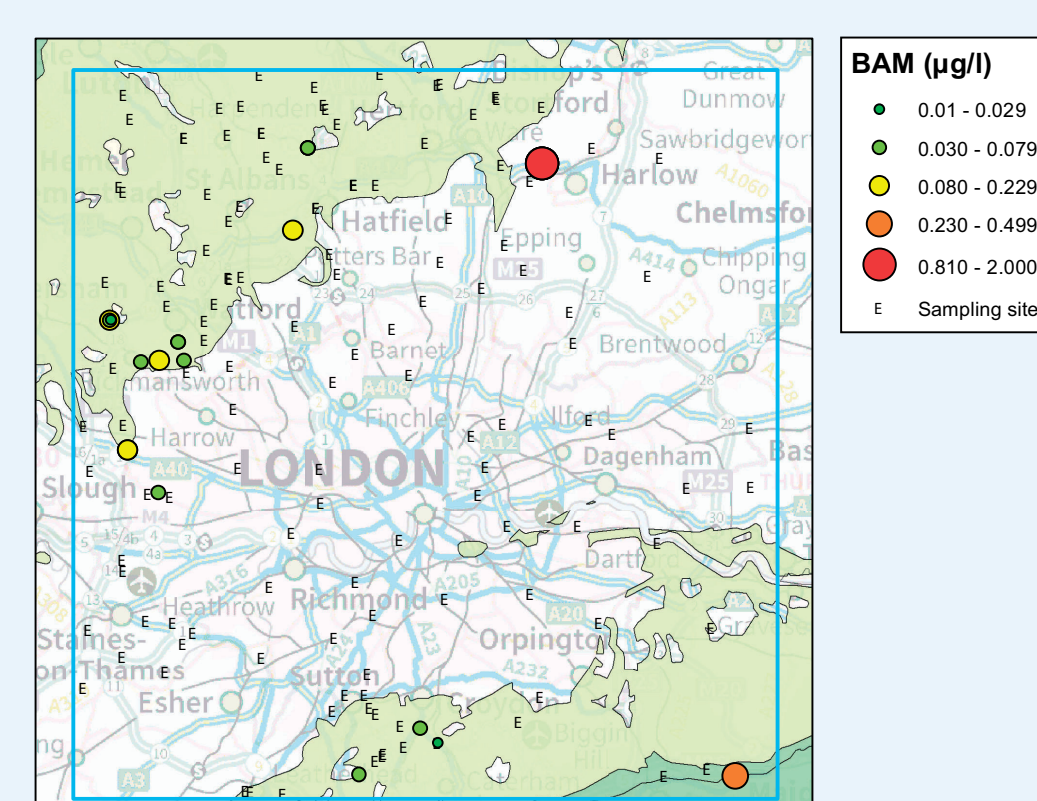
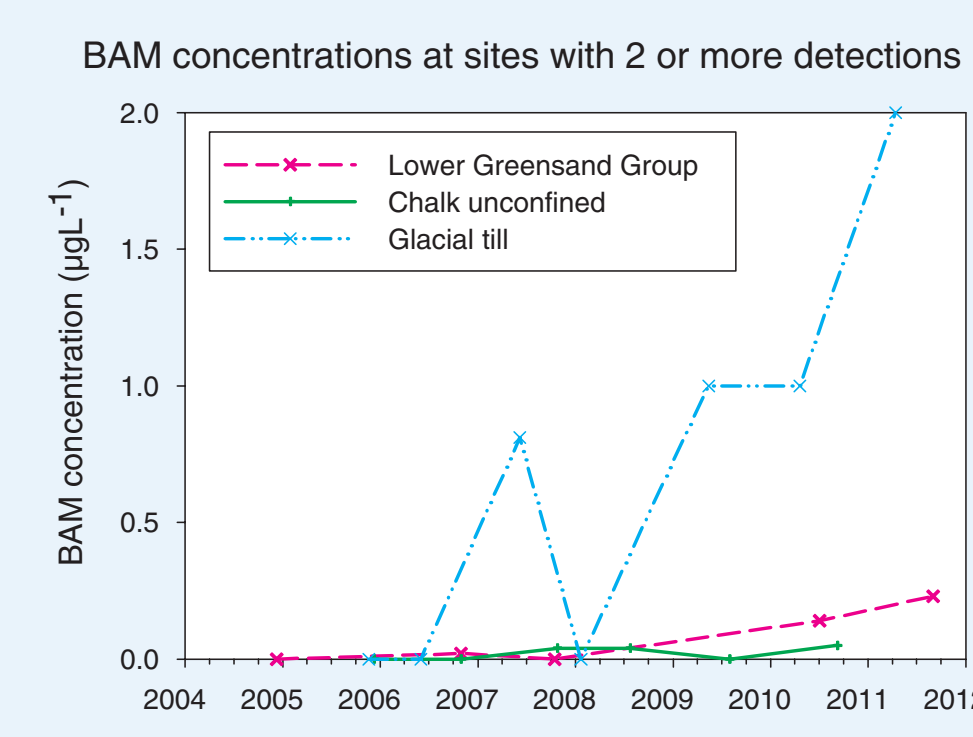
The time series plots show that atrazine is being detected consistently at some sites. Concentrations appear to be decreasing over time.



### BAM: herbicide metabolite

BAM is not as widely observed as atrazine, but the spatial distribution is similar. The highest concentrations are seen in rural areas in unconfined aquifers.

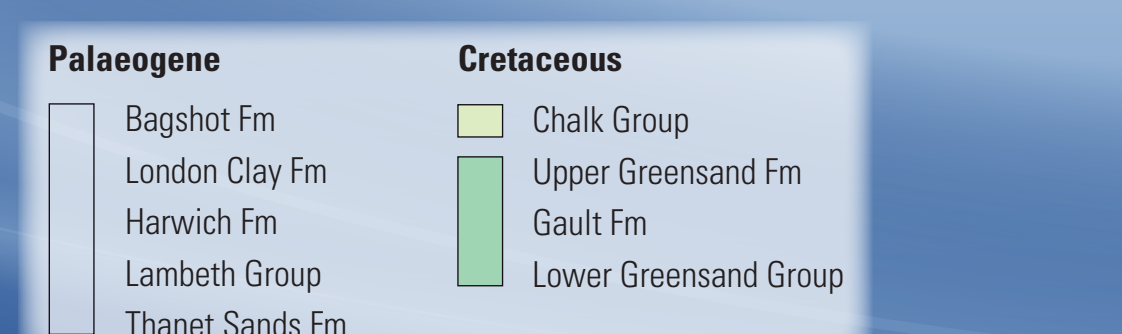
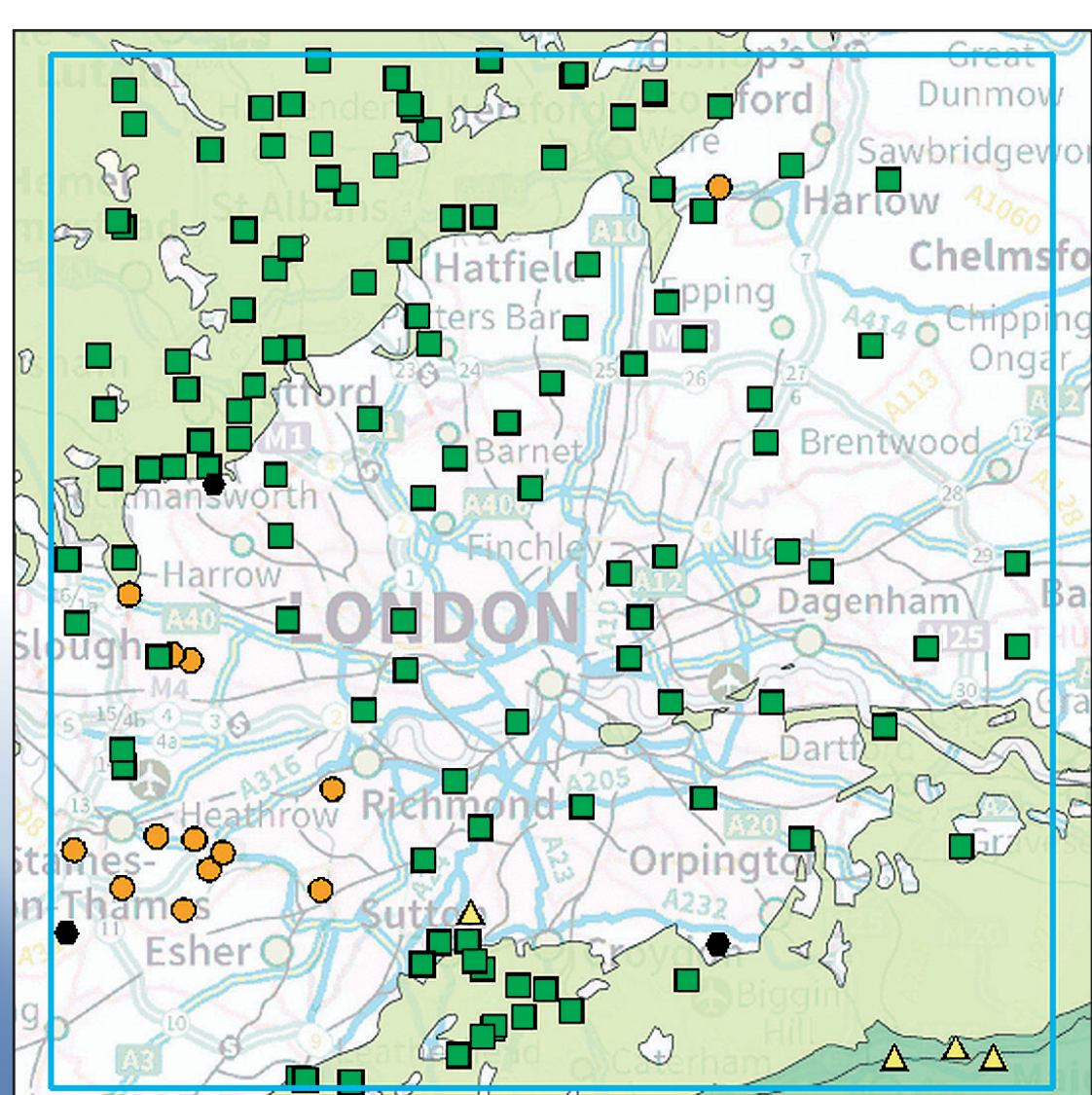
Unlike atrazine, the data suggest that concentrations in groundwater in this area are not decreasing.



## Hydrogeology of the London area

**Sampling site aquifer geology**

- Superficial deposits
- Palaeogene
- Chalk
- Lower Greensand Group



Groundwater in the Chalk Group beneath much of London is protected by the overlying low permeability London Clay Formation. Further out, where the Chalk is at outcrop, groundwater is more vulnerable to more rapid infiltration of contaminated water.

### Groundwater residence time

Groundwater flows from the unconfined to the confined Chalk, so the Chalk groundwater under central London is older than that in the outlying areas.

### Redox

Groundwater in confined aquifers is more likely to be reducing.

## Factors influencing observed concentrations

The concentration of an organic micropollutant observed in a sample will depend upon several factors, which may include:

- **Urban vs rural:** (including land use and the amount of compound being used in each setting), e.g. compounds entering groundwater through leaking sewers are detected more frequently in London than surrounding areas
- **Confined vs unconfined:** e.g. atrazine and BAM concentrations are higher (more frequent detections) on the unconfined Chalk. However, applications may have been higher in the more rural (unconfined) areas
- **Mobility and persistence in the environment:** water solubility, attenuation by degradation, sorption
- **Antecedent rainfall:** dilution reduces concentrations, but recharge can also flush contaminants from the unsaturated zone into the saturated aquifer

## What next?

This work forms part of a BGS project studying emerging contaminants in groundwater. Ongoing work includes:

- Sampling of Oxford and Boxford field observatories
- Correlating determinands to identify suites of contaminants related to factors such as land use (rural/urban) and sample depth

See our website [www.bgs.ac.uk/gw](http://www.bgs.ac.uk/gw) to find out more about our research.

## Contact information