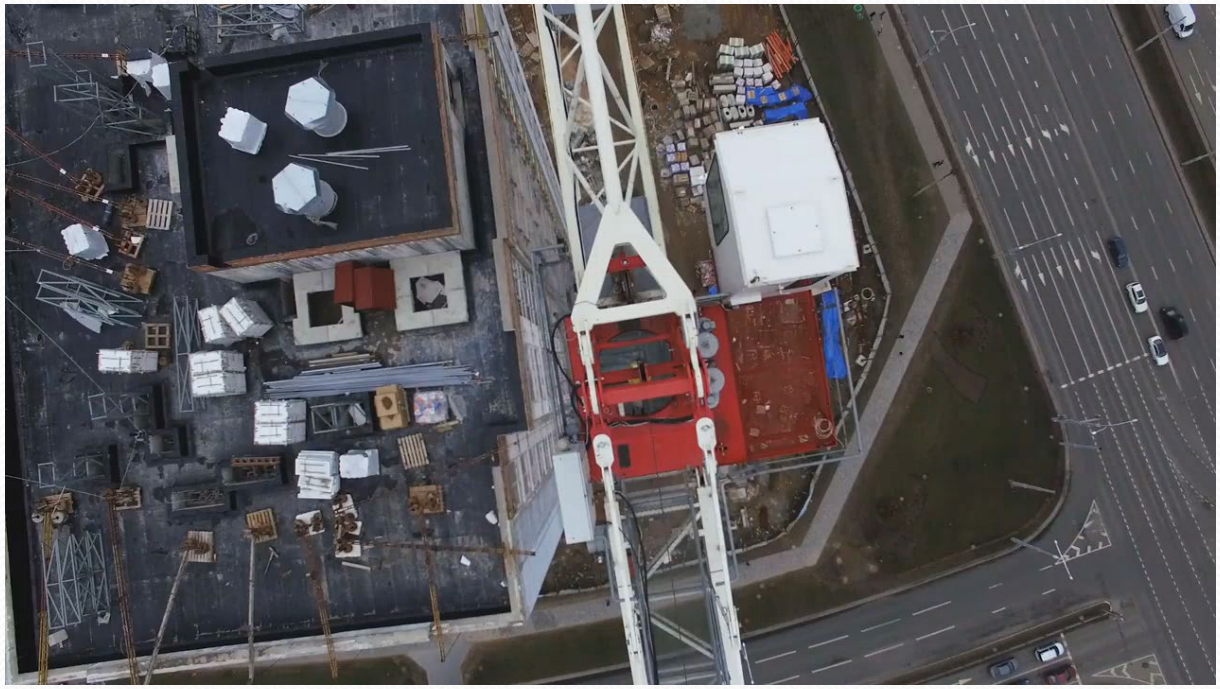
# Site Application of PFASorb & E-Clay Remediation of PFOS Soil & Groundwater Contamination



Yorkshire Contaminated Land Forum

**Presentation by**
**Simon Farr & David Slater**
**1st March 2024**

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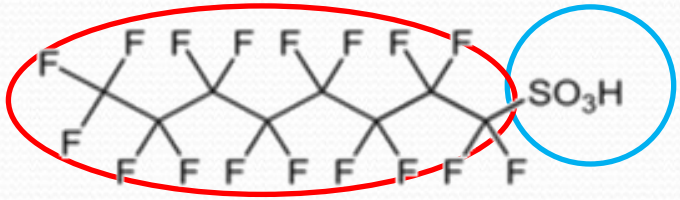
# PFAS

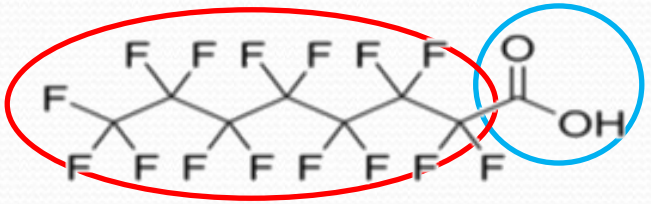
**AND VERY STABLE**

The key to understanding the chemistry and environmental fate / transport of PFAS compounds is their surface-active behaviour.

The fluorinated backbone 'tail' is both hydrophobic (water repelling) and oleophobic / lipophobic (oil/fat repelling) while the functional group 'head' is hydrophilic (water loving).



Perfluorooctanesulfonic Acid (PFOS)



Perfluorooctanoic Acid (PFOA)

This means that PFAS compounds tend to accumulate at the soil / groundwater interface. This is why groundwater only treatment strategies are not always effective as the PFOS / PFOA readily exchanges between the soils and water. An analogy often given is they are the "*never-ending gobstopper*"

The PFAS partitioning behaviour also is affected by the alkyl chain length and the charge on the terminal functional group. In general, PFASs with shorter alkyl chain length are more water soluble than those with longer lengths. Adsorption to soil surfaces has been shown to be greater for PFASs with longer alkyl chain length. Equally pH / TOC play a major role in overall sorption and solubility.

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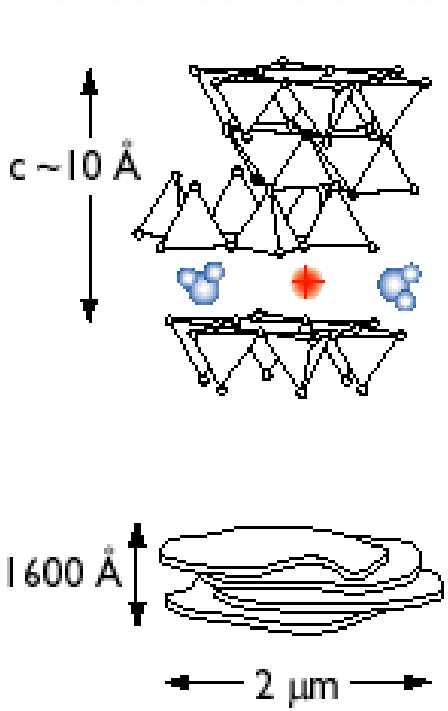
# E-Clay




E-Clays have been utilised in the remediation of circa **200** contaminated land projects over the last **27** years. The technology has been successfully applied in both stabilisation, barrier (Permeable Reactive Barrier) and integrated treatment strategies.

That is a vast wealth of experience and knowledge in applying the technology in real world scenarios.

Envirotreat E-Clay is derived from the modification of naturally-occurring clays using selected chemical reagents. A reactive treatment medium is produced (a modified organo / inorgano clay) capable of chemically absorbing and immobilising a range of pollutants present within soils and water.

The key is the experience and knowledge in the application of this technology

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# Real Application of Technology

Envirotreat was commissioned by the client to provide an outline remediation proposal and recommendations for supplementary site investigative works on the development area (a parcel of land adjoining an existing fire station and th
the existing fire station.

**Significantly higher concentrations were encountered during baseline monitoring ~5,500ng/l**

Previous site investigations had already highlighted th
soils and groundwater. Supplementary site investigation by Envirotreat indicated the presence of evaluated PFOS contamination in soils (684 ug/kg) and groundwater (3,030 ng/l EQS 0.64 ng/l) predominantly under the fire station car park.



https:/redditchstandard.co.uk/news/video-redditch-fire-station-drill-tower-demolished/

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# Real Application of Technology

Based on the supplementary site investigative report, Envirotreat carried out a Remediation Options Appraisal, prepared a Remediation Strategy and a Remediation Method Statement.

The prime controlled water receptor was identified as the Batchley Brook (located ~15m from site boundary in the direction of projected groundwater flow).

The potential risks to human health will be addressed through pathway breaks (capping layer) and by the implementation of suitable gas membranes within the buildings.

These were agreed with the client, the client's consultants (LQM) and the appropriate regulatory bodies.

The following criteria were applied:

- A soil source treatment threshold of 5ug/kg (5,000ng/kg). Continuing treatment of soils with less than 5ug/kg was not considered to be commercially or environmentally sustainable. Reducing the RC from 5ug/kg to 1ug/kg would have seen the treatment volume increase by 250%, with treated PFOS mass increasing by only 3.5%.
- Leachate criteria based on a 95% reduction of anticipated PFAS concentrations (plus normal contingency factors including a worst-case assumption of a non-depleting source). The leachate criteria was determined by the PRB Design (integrated treatment design).
- A nominal groundwater treatment target value of 50ng/l subject to establishing background concentrations. The prime objective being to protect the brook.


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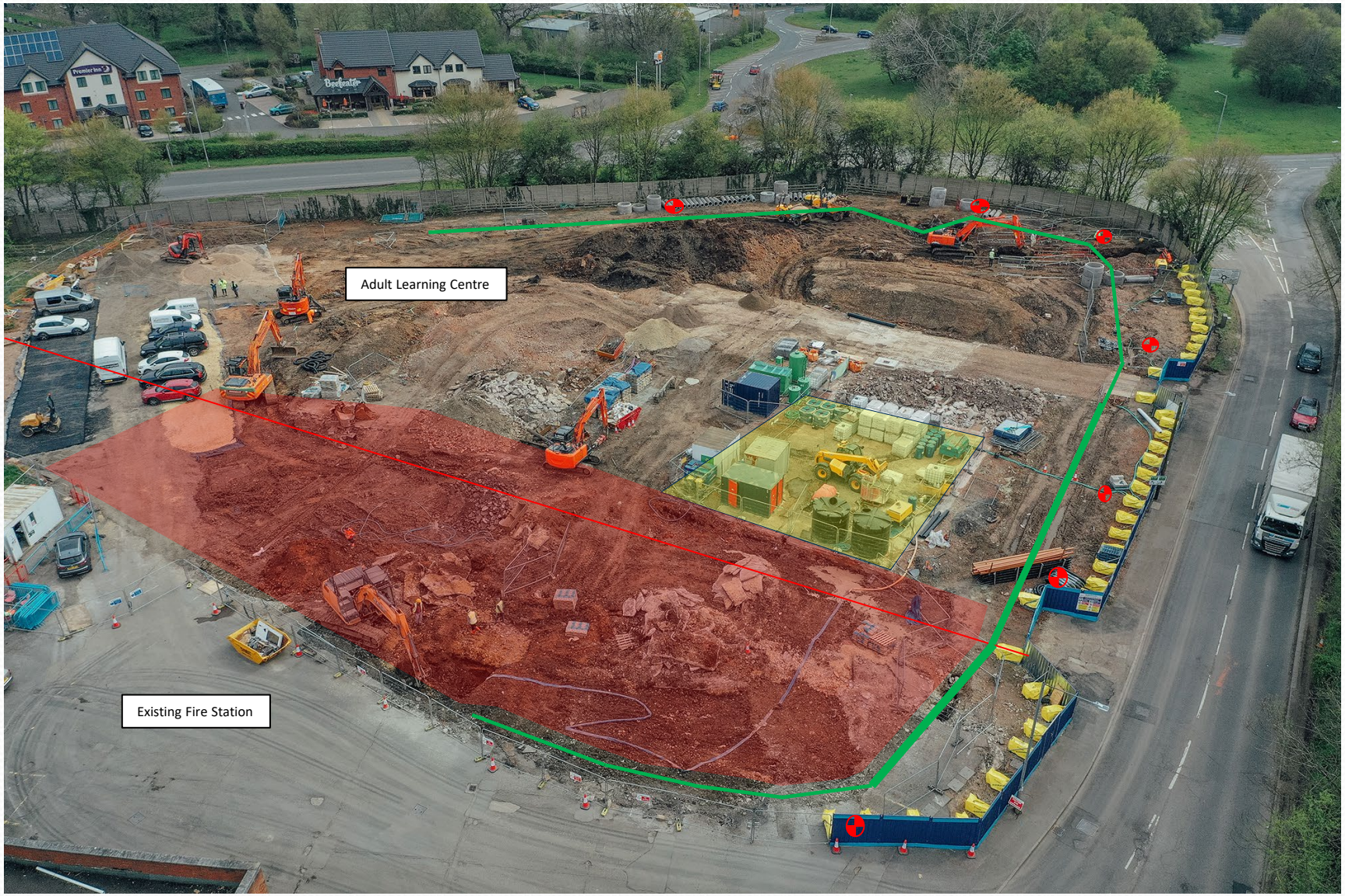
# Real Application of Technology



# Real Application of Technology

| Sample | Leachable Total PFOS (ug/kg) * |
|---|---|
| Treated 22-1 | 0.47 |
| Treated 22-2 | 0.52 |
| Treated 23A | 4.3 |
| Treated 23B | 2 |
| Treated 24A | 4.58 |
| Treated 24B | 3.27 |
| Treated 27-1 | 0.17 |
| Treated 27-2 | 0.18 |
| Treated 28-1 | 0.49 |
| Treated 12-4 | 4.77 |
| Treated 13-4 | 23.3 |
| Treated 30A | 2.5 |
| Treated 30B | 10.7 |
| Treated 31-A | 7.2 |
| Treated 31-B | 2.9 |
| Treated 3A | 11 |
| Treated 3B | 28 |
| Treated 4A | 2.7 |
| Treated 4B | 25.3 |
| Treated 5A | 3.6 |
| Treated 5B | 6.6 |
| Treated 6A | 0.8 |
| Treated 6B | 6.9 |
| Treated 7A | 2.7 |
| Treated 7B | 2.9 |
| Treated 11/4/23C | 2.9 |
| Treated 11/4/23D | 3.8 |
| Treated 12/4/23C | 15.9 |
| Treated 12/4/23D | 6.7 |
| Treated 13/4/23C | 1.76 |

* Sum of branched, 6:2 & sulphonate

- Well within anticipated values
- Within design criteria for PRB
- No direct comparisons between untreated / treated samples (due to heterogeneity of soils)
- Average PFOS leachate of 6.3ug/kg (*)
- MAX PFOS leachate of 28ug/kg (*)
- Based on Total PFOS concentration of 684ug/kg anticipated PFOS leachate would be 275ug/kg (*)
- Groundwater down gradient of PRB - monitoring is ongoing

| Date | MBH201 | MBH202 | MBH203 | MBH204 | MBH205 | MBH206 | WS101 | WS102 |
|---|---|---|---|---|---|---|---|---|
| 13/04/22 | - | - | - | - | - | - | 14.4 | 33.2 |
| 28/04/23 | 1370 | 126 | 63.3 | - | <65 | - | 17.1 | 80.8 |
| 01/06/23 | 470 | 264 | 8.75 | - | 16.5 | - | 17.6 | 38.4 |
| 07/07/23 | 8360 | 181 | 6.17 | 121 | - | 14.9 | 67.9 | 36.7 |
| 03/08/23 | 7770 | 63.9 | <6.5 | 98.9 | 10.3 | | 110 | <6.5 |
| 06/09/23 | 4770 | 88.9 | 23.4 | 120 | <6.5 | 2530 | 141 | 35 |
| 09/10/23 | 7140 | 60.9 | 15 | 489 | - | 2580 | 309 | 35.6 |
| 08/11/23 | 2910 | 48.1 | 16 | 22.3 | 23.6 | 1710 | 2080 | 18.2 |
| 14/12/23 | 2470 | 11.6 | 6.46 | 6.79 | - | 20.9 | 58 | 14 |
| 10/01/24 | 2060 | 10.7 | <6.5 | 11.6 | | 35.4 | 36.6 | 25.6 |

## Real Application of Technology

**Thank you for listening.**
**Any questions?**