



PlumeStop treatment of chlorinated solvents in a bedrock

CASE STUDY

Successful pilot study uses colloidal activated carbon to protect nearby surface waters, United Kingdom

INTRODUCTION

REGENESIS was asked to provide a remediation solution for a **Trichloroethylene (TCE)** plume in the UK. We worked closely with **Golder** to design and implement a novel solution that combined Plumestop, HRC and BDI+ to sorb and biologically degrade the contamination, rapidly and effectively reducing contamination downstream to non-detectable levels.



Fig. 1 pre-installed well

SITE HISTORY

The contaminated site has a varied industrial history. Since the 1960's it has been an active design and engineering site. Before this, the land was used as farmland and saw the development of bombers and light aircraft during the Second World War. The site is bordered by two rivers and gently slopes towards one of the rivers.

The initial site investigation was completed in 1998, which found evidence of TCE. Further site investigations delineated the source and plume and built a comprehensive three-dimensional understanding of the contamination.

In some areas the plume was found to be co-mingled with low concentrations of BTEX and MTBE contamination from elsewhere on the Site. However, based on conversations with the regulator the initial focus of remediation was to be TCE.

The geology of the site comprises interbedded sandstone and mudstone layers with mudstone becoming more dominant with depth. This results in highly variable hydraulic conductivity with some areas having very little flow to other of $1.9 \times 10^{-4} \text{m/s}$. The aquifer is classed as a Principal aquifer.



SITE TYPE

Former engineering site for light and military aircraft



GEOLOGY

Fractured Bedrock: Interbedded sandstone and mudstone



CONTAMINANTS

TCE
cis-1,2 DCE
VC



PROJECT DRIVER

Betterment/ Protection of the nearby river



TREATMENT

In Situ Sorption and Enhanced Natural Attenuation



TECHNOLOGIES

PlumeStop®, HRC® and BDI Plus®

REMEDIAL APPROACH AND PLANNING

Golder consulted with the **Environment Agency** to agree on a remediation outline that enhanced the natural attenuation processes occurring within the sub-surface.

The source was treated via excavation of the shallow soils followed by treatment of the groundwater using enhanced bioremediation. REGENESIS were asked to implement a rapid and effective technology to intercept the plume close to river.

After assessing the site data, we highlighted contaminant flux and subsurface concentrations as key factors that could influence remediation success. Our

recommendation was to combine sorption with biological degradation in an *in situ* permeable reactive barrier comprising of **Plumestop** with our long-term electron donor **HRC** and bioaugmentation using **BDI Plus**.



Fig. 2 Excavation in the source area (by others) © Golder



PlumeStop[®] – Liquid form of Colloidal Activated Carbon to provide proven, fast and cost-effective achievement of stringent targets for widespread contaminant plumes.



HRC[®] – Low-volume, controlled-release electron donor for anaerobic biological degradation in low-permeability settings.



BDI Plus[®] – Robust and proven enriched microbial consortium for anaerobic bioaugmentation.

For more information, visit regenesisc.com/eur/products

DESIGN METHODOLOGY AND APPLICATION

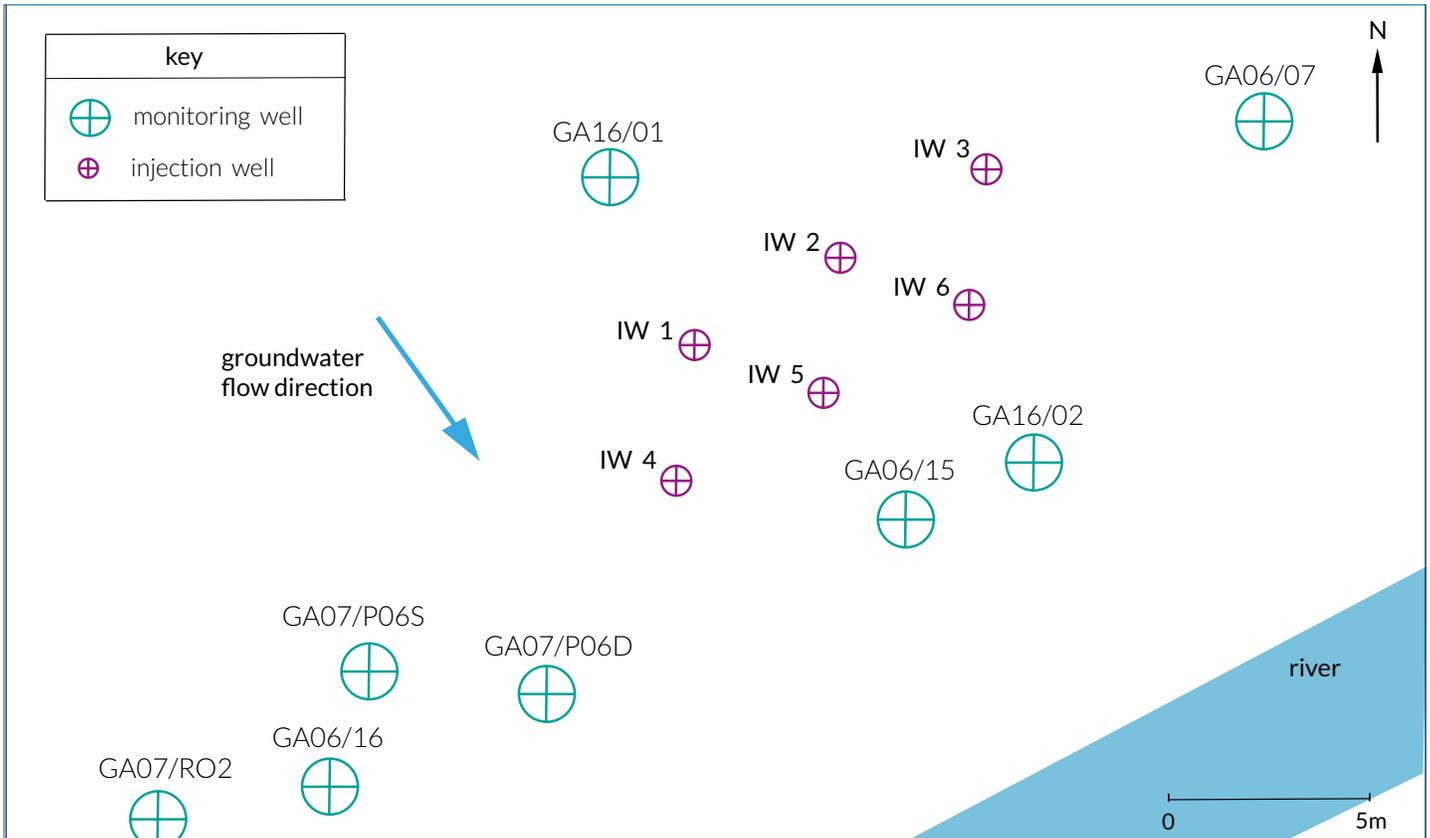


Fig 3 Pilot treatment area, showing injection wells and monitoring wells

Plumestop was injected by REGENESIS using pre-installed wells arrayed in two rows of three wells. A double packer injection system was used to ensure even distribution of the product through the entire target zone.

Once the Plumestop injections were completed, HRC was warmed and then applied into the sub-surface via the double-packer system, before a final round of BDI Plus, an enriched, microbial consortium containing *Dehalococcoides* sp., was administered into the same wells.



Fig 4 Double packer assembly



Fig 5 bioaugmentation (BDI Plus) setup for injection



Fig. 6 Treatment Area

PILOT TEST RESULTS

Contamination levels were measured from monitoring wells upstream and downstream of the injection locations. Figure 7 shows concentration levels upstream of the remediation over a nine-month period. It shows the presence of TCE, cis-1,2-Dichloroethene (DCE) and Vinyl Chloride (VC) in the ground water with an uncharacteristic trough occurring in late-January which has been attributed to the fresh water flush of the well drilling works in the vicinity.

Figure 8 and 9 (overleaf) show both historic concentration levels of TCE and daughter products downstream of REGENESIS' remediation solution (from 2006 onwards), up until the most recent nine-month period in which the pilot study took place.

Fig. 7 Upstream contaminant concentrations (GA16/01)

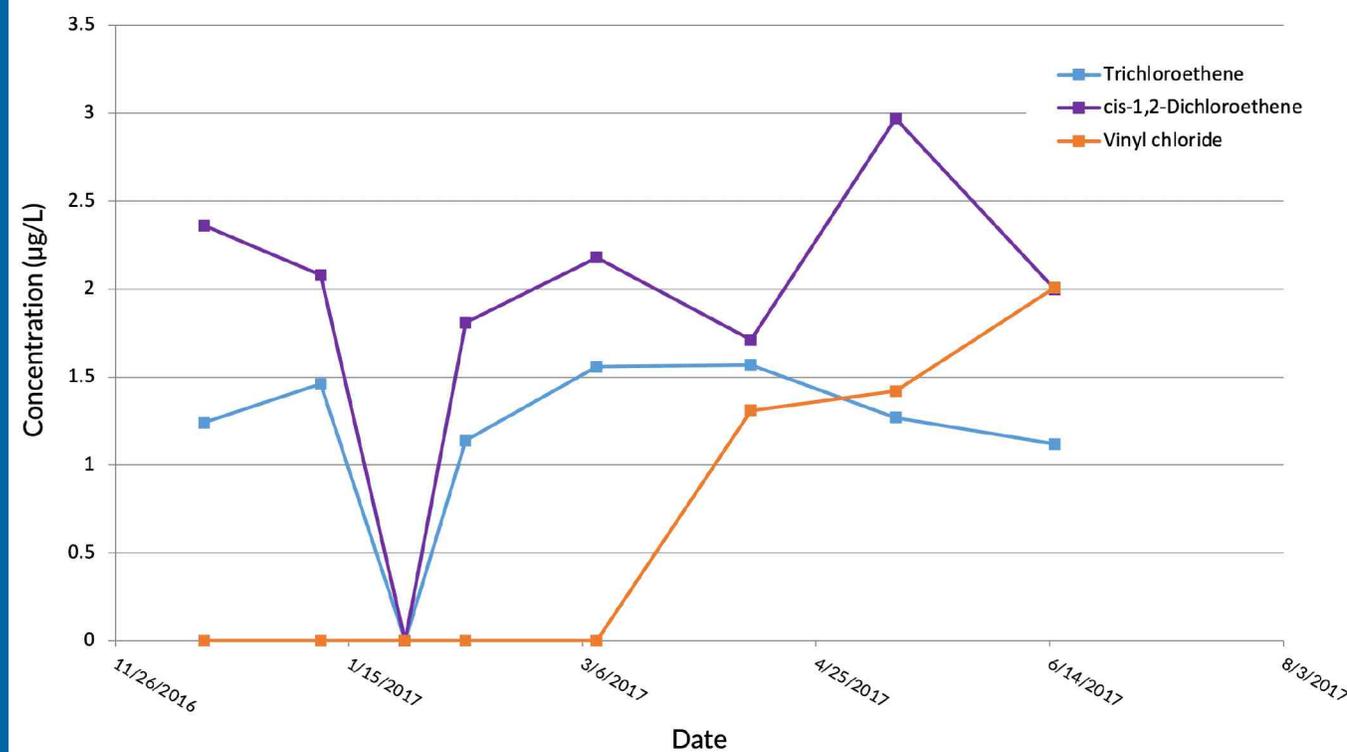


Fig. 8 Downstream Contaminant Concentrations (GA06/15)

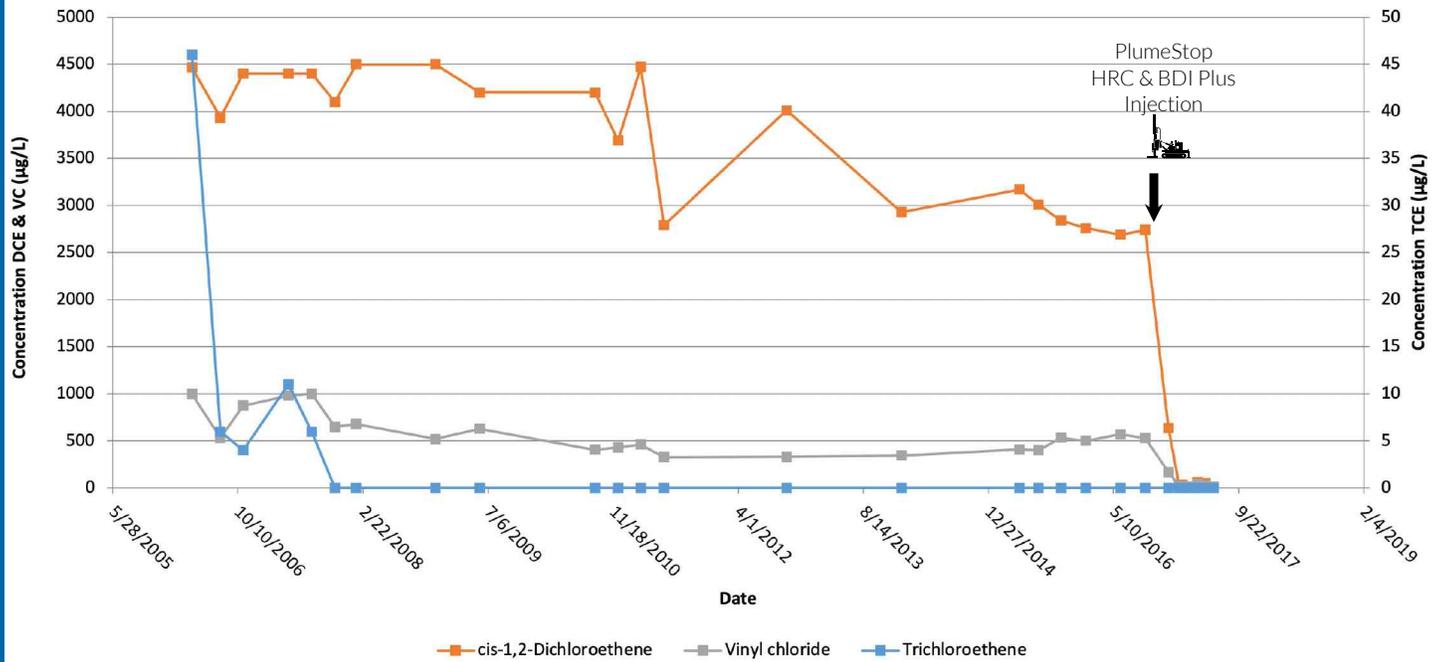
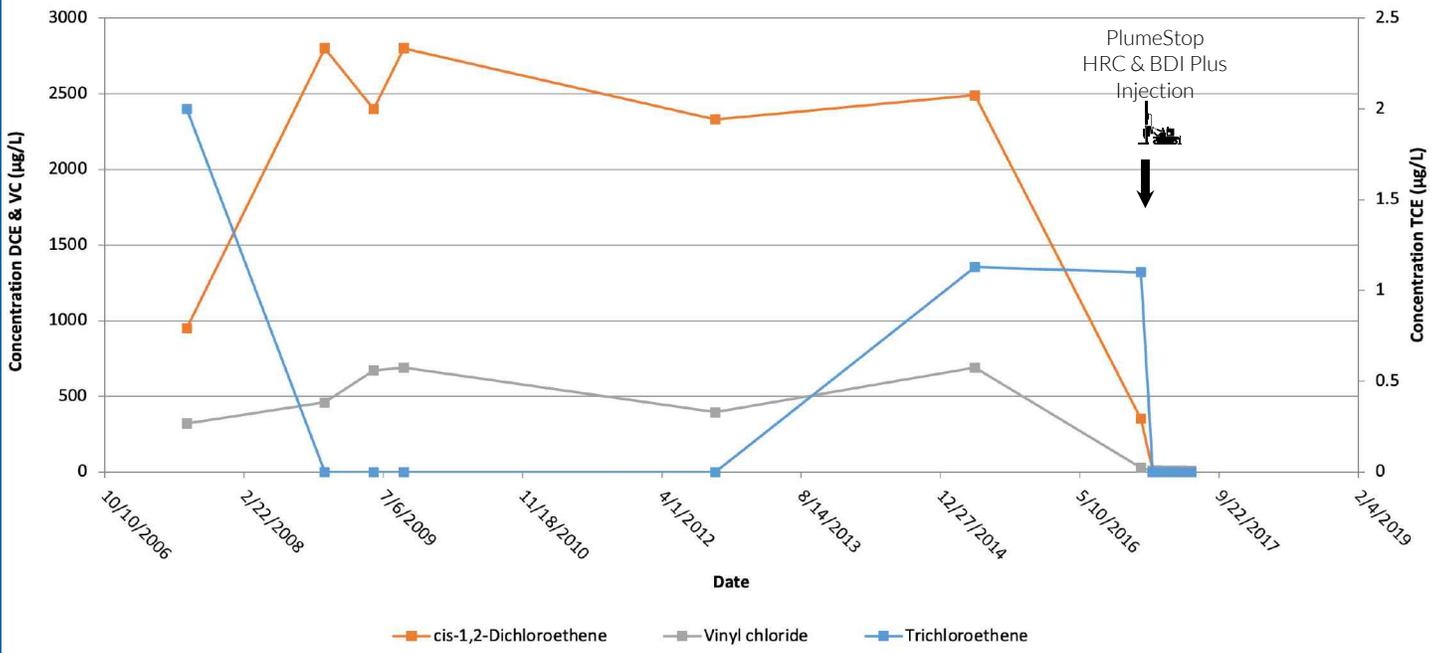


Fig. 9 Downstream Contaminant Concentrations (GA07/PO6S)



All three compounds are reduced to non-detectable levels shortly after treatment, through sorption to the PlumeStop. The downgradient levels were sustained at below detection for the entire validation period (6 months) indicating that biological degradation on the surface of the activated carbon is degrading the sorbed contamination, regenerating sorption sites, which then sorb further contaminant influx.

CONCLUSION

The pilot study showed that treatment of chlorinated solvent plumes is possible using PlumeStop even with challenging conditions such as a co-mingled plume, a fractured bedrock setting and a highly variable hydraulic conductivity.

The PlumeStop in situ permeable reactive barrier rapidly reduced downgradient contaminant concentrations and maintained these through a combination of sorption and biological degradation, protecting the adjacent surface water receptor.



“ We were pleased with how effective the PlumeStop treatment regime was within a short space of time.

Protection of the river receptor was achieved through the successful collaborative technical approach taken between Golder and REGENESIS.

REGENESIS were helpful throughout the process and provided technical support when required. ”

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