



The petrol station prior to redevelopment is shown in Figure 1 below.

Figure 1 – Petrol Station Prior to Redevelopment



CGL considered a number of remediation options including pump and treat, chemical treatment, monitored natural attenuation (MNA) and the installation of an activated clay barrier. After due deliberation it was decided to progress the remediation of the site utilising a combination of source and groundwater [pathway] treatment as an integrated treatment approach – the preferred remediation strategy was a combination of E-Clay Stabilisation for the source treatment requirement and the installation of an E-Clay ‘Activated’ Permeable Reactive Barrier to treat potentially contaminated groundwater migrating from the site.

The remediation strategy was considered to be commercially viable and provided a remediation solution which addressed the identified remediation requirements in an acceptable timeframe for the development. The other remediation options were precluded on the basis of cost and / or inability to achieve site remediation within the required timeframes.

The necessary approvals for the proposed remediation strategy were obtained from Waltham Forest Borough Council and the Environment Agency.

### Site Background & History

The site was formerly a petrol filling station situated in Chingford, London. The client [Anderson Group / Constable Homes] had previously obtained planning permission to develop the site for the construction of eight residential units.

The site is relatively small occupying an overall area of 0.12 hectares. Previous site investigations undertaken by Card Geotechnics Limited [CGL] identified the presence of significant hydrocarbon contamination in both soil and groundwater consistent with the previous usage of the site as a petrol station. The prime contaminants of concern were Total Petroleum Hydrocarbons [TPH], BTEX and Naphthalene. CGL carried out a risk assessment which identified significant risk to both human health and controlled water receptors.

CGL also identified the presence of five underground fuel storage tanks.

### Remediation Objectives

Enviro-treat was commissioned by Anderson / Constable Homes to undertake the following:

1. Implementation of the approved remediation strategy to satisfy planning and EA requirements
2. Management and validation of all on-site soil excavations
3. Management of underground storage tank removals / excavations and associated cleaning / subsequent disposal including validation of surrounding soils
4. Design, management and implementation of the approved source treatment strategy involving the excavation, treatment and subsequent reuse on-site (as a substitute for imported fill) of contaminated soil and associated groundwaters utilising E-Clay Stabilisation
5. Design, management and implementation of the approved groundwater [pathway] treatment by the installation of an E-Clay Permeable Reactive Barrier
6. Necessary compliance with the Site Material Management Plan
7. Preparation and submission of a comprehensive Validation Report to satisfy the requirements of the Council and the EA
8. Discharge of relevant planning conditions

### Methodology

Enviro-treat produced a Method Statement & Remediation Strategy Document summarising the site history and contamination issues, the approved remediation strategy & technical rationale, the necessary environmental protection measures required during the remediation works and the agreed validation protocols for the treatment element of the works.

It was agreed that Enviro-treat would adopt the validation / verification protocols and remediation target criteria previously established by CGL for the remediation works.

The first phase of the works involved the demolition of the existing building together with the excavation of the concrete pads and the crushing of concrete. The demolition works were undertaken by DDS Demolition [DDS]. The underground storage tanks were then identified and removed - this phase included the excavation of contaminated soils and subsequent validation of the excavations. The excavated soils were stockpiled pending treatment. It was necessary to carry out intensive environmental monitoring during this phase of the works (undertaken by Enviro-treat).

Based on the conclusions from the site investigation it was anticipated that five underground fuel storage tanks would need to be identified and removed. In practice eleven underground fuel storage tanks were identified - most had been rendered safe by infilling with a cement slurry. Two of the tanks were partially full of contaminated water and free product.

The excavation associated with the largest underground storage tank removal is shown in Figure 2 below.

Figure 2 – Excavation Associated With Removal of Largest Tank



Enviro-treat were able to pump out the liquid tank contents and incorporate into the treatment process. All the tanks were subsequently excavated, cleaned and removed for offsite disposal. The cement slurry filled tanks were emptied and the contents were treated.

The second phase of the remediation works involved the *ex-situ* treatment of the contaminated soils utilising E-Clay Stabilisation. Following successful validation, the treated materials were reused [redeposited] on site. Approximately 275m<sup>3</sup> of contaminated soils were excavated, treated and re-used on site.

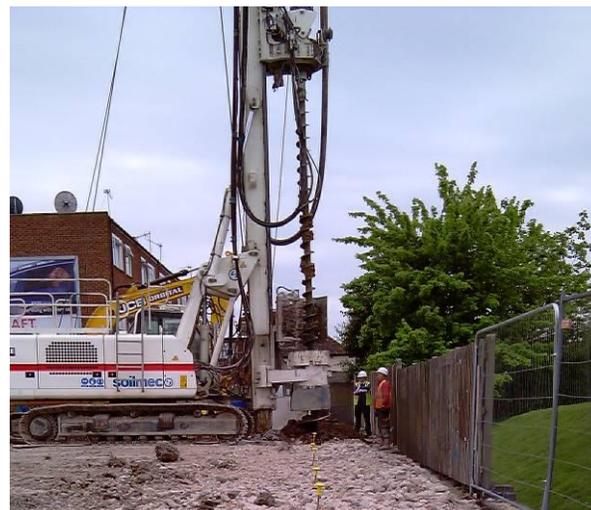
The permeable reactive barrier was installed along the western and northern site boundaries to intercept and treat the natural flow of potentially contaminated groundwater migrating from the site. The purpose of the barrier was to protect off site receptors (specifically the River Lea) from the risk of pollution from residual groundwater contamination. The barrier was installed by McGee using a secant piling technique to install a continuous row of overlapping soil mixed columns – the soils were mixed with a slurry of the designated pillared E-Clay to produce the permeable reactive barrier. The barrier was installed to a depth of 7m keying into the underlying impermeable London Clay.

The installation of the permeable reactive barrier is shown in Figure 3 below.

The remediation works were undertaken within a three week timescale (working in close conjunction with both the demolition and piling contractors).

VOC, noise and dust monitoring was undertaken throughout the remediation works.

Figure 3 – Installation of E-Clay Permeable Reactive Barrier



### Validation

The works were undertaken in accordance with the approved Method Statement and Remediation Strategy.

Samples of the sides and bases of the excavations were taken (following the removal of the individual tanks) – these samples were tested to demonstrate the removal of gross contamination.

It was agreed that the suitability of treated material for reuse on site would be determined by compliance with designated leachate target values. The treated materials were seen as a necessary part of the works - the material would replace the requirement to utilise imported fill to return the site to pre-remediation formation levels. The material was identified as having a specific purpose with any deficit of material resulting in the necessity to import fill.

Following a suitable period of “curing” representative samples of treated soils were leach tested and compared with the derived leachate target criteria for TPH, BTEX and Naphthalene.

A total of 6 samples were tested and all leachate values were compliant with the remediation criteria. The treated material was therefore considered suitable for reuse on site and re-emplaced in the void spaces created by the validated excavations as a substitute for imported fill.

Two boreholes were installed downstream of the barrier to monitor groundwater quality post remediation. The results have demonstrated satisfactory compliance with the designated remediation target criteria.

The site redevelopment is shown in Figure 4 below.

Figure 4 – Site Redevelopment



### Conclusions

Enviro-treat successfully demonstrated, through a comprehensive Validation Report, that the overall remediation strategy had been successfully implemented.

The prime drivers for the remediation works were the protection of human health and controlled waters.

The Validation Report was approved by the NHBC, Waltham Borough Council and the Environment Agency. The relevant planning conditions relating to contamination issues were discharged enabling the development to proceed.