envirotreat®

Delivering land you can develop

CASE STUDY

E-Clay Permeable Reactive Barrier
E-Clay Stabilisation

Residential Development, Chelmsford

Client / Developer

ANDERSON GROUP

Site Background & History

The site was formerly a petrol filling station situated in Chelmsford, Essex. The site is relatively small occupying an overall area of 0.1 hectares. In 2006 the petrol station was closed and subsequently demolished.

The developer [Anderson Group / Constable Homes] had previously obtained planning permission to develop the site for the construction of three residential units.

In 2003 there was a petrol overfilling incident which resulted in a significant release of petrol into the underlying soils and groundwater. Extensive site investigations have been undertaken by Arcadis over the period 2003 – 2009. The underground storage tanks were removed in 2006 by Liquid Cargo Management Limited under the supervision of Arcadis. A Remediation Implementation Plan [RIP] was developed by Arcadis in 2007 to address the identified soil and groundwater contamination – the RIP proposed the excavation of impacted soils in combination with the use of Vacuum Enhanced Recovery (VER) and an Oxygen Release Agent to address the residual groundwater contamination. The impacted soils were removed in 2009 by Toureen Mangan supervised by Arcadis. In 2010 it was concluded that the site remained contaminated with a groundwater contamination plume (including free product) migrating off the site in a northerly direction.

Arcadis recommended the implementation of VER to address the residual contamination. The major disadvantage of this recommended treatment approach was the envisaged 24 month remediation timescale for effective remediation. The VER remediation approach was not implemented.

In 2012 the developer invited Envirotreat to submit remediation proposals prior to purchasing the site – this was to assess the commercial viability of the scheme taking into account the identified residual soil and groundwater contamination issues and the essential requirement to obtain necessary regulatory approvals for the proposed development. The developer needed the confidence that the site could be effectively remediated and that planning conditions could be discharged prior to purchase.

The developer invited Envirotreat to attend site and reassess the site contamination issues prior to submitting remediation proposals – this reflected the time period from 2010 – 2012 during which no further site investigations or remediation had been carried out. The existing boreholes were utilised for this purpose (where accessible) - the findings of this further site investigation confirmed that both soil and groundwater contamination (including free product) was still evident on the site. The presence of free product is illustrated in Figure 1 below.

Envirotreat subsequently provided a remediation proposal which addressed the remediation requirements on a commercially acceptable basis. The developer progressed the purchase of the site and instructed Envirotreat to progress the remediation strategy for the site.

envirotreat®

Delivering land you can develop

CASE STUDY

E-Clay Permeable Reactive Barrier
E-Clay Stabilisation

Residential Development, Chelmsford

Figure 1 – Existing Borehole Sampling – Presence of Free Product

The proposed development is shown in Figures 2 and 3 below.

Figure 2 – Proposed Development (Plan View)

Figure 3 – Proposed Development (Front View)

Remediation Objectives

The Envirotreat remediation strategy combined source and pathway treatment to provide an integrated treatment approach and essentially comprised of the following:

- Free product removal
- Treatment of source contamination (soils and associated groundwater) by E-Clay Stabilisation
- Installation of an E-Clay Permeable Reactive Barrier to remediate contaminated groundwater (pathway treatment)

Envirotreat were additionally commissioned by the client to undertake the following:

- Obtaining necessary regulatory approvals and discharge of relevant planning conditions relating to contamination issues
- Derivation of remediation target criteria [RTC] utilising CLEA and Remedial Targets Methodology [RTM] / P20 modelling to determine acceptable RTC values for the protection of human health and controlled waters respectively
- Validation of excavations to demonstrate effective removal of the contamination source (in accordance with the derived RTC)
- Validation of treated material to demonstrate compliance with the derived RTC and to enable reuse on-site

envirotreat®

Delivering land you can develop

CASE STUDY

E-Clay Permeable Reactive Barrier
E-Clay Stabilisation

Residential Development, Chelmsford

- Design of capping layer in garden / landscaping areas for the protection of human health
- Assistance on the design of the protective Damp Proof Gas Membrane within each property and necessary VOC monitoring to confirm suitability (for the protection of human health)
- Assistance with waste classification requirements
- Preparation and submission of a comprehensive validation report to satisfy the requirements of the NHBC, Chelmsford City Council [CCC] and the Environment Agency [EA]

Methodology

Envirotreat produced a Method Statement & Remediation Strategy Document summarising site history and contamination issues, the proposed 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.

The necessary approvals for the proposed remediation works were obtained from CCC and the EA.

The first 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 410m^3 of contaminated soils were excavated, treated *ex-situ* and re-used on site. Contaminated groundwater was utilised in the treatment process when encountered – the recovery and reuse of contaminated groundwater in the slurry mixing process is shown in Figure 4 below.

No distinct free phase product was encountered during the excavations – hydrocarbon smearing of the underlying soils above the groundwater level – the smear zone is shown in Figure 5 below.

The *ex-situ* treatment operation is shown in Figure 6 below.

Figure 4 – Recovering Potentially Impacted Groundwater from Excavations for Reuse

Figure 5 – Hydrocarbon Smearing of Underlying Soils

Figure 6 – Ex-Situ Treatment of Contaminated Soils

The permeable reactive barrier was installed along the majority of the northern site boundary 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 a drain to the north of the site which feeds into an unnamed pond) from the risk of pollution from residual groundwater contamination.

Site constraints prevented the use of specialist soil mixing plant (e.g. soil cutters / augers) – a conventional excavator was therefore employed for the barrier installation. The barrier installation involved a combination of *ex-situ* treatment of the shallower soils (which were excavated and re-emplaced following treatment) and *in-situ* (in-place) treatment of the deeper soils to the required depth of circa 4.5m bgl keying into the underlying impermeable layer – this was demonstrated by the presence of relatively impermeable clay (London Clay) at the base of the barrier installation.

The barrier medium was created by the addition of a pillared E-Clay slurry used in isolation – the slurry was mixed with the surface soils in the above ground treatment mixing unit (*ex-situ* treatment).

The E-clay slurry was pumped into the excavation created by temporary removal of the shallow soils for subsequent soil mixing (*in-situ* treatment) with the deeper soils.

The *in-situ* installation of the permeable reactive barrier is shown in Figure 7 below.

Figure 7 – Installation of E-Clay Permeable Reactive Barrier – *In-Situ* Mixing

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

The remediation works were completed within a two week timescale.

Validation

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

Samples of the sides / bases following contaminated soils removal 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 (RTC).

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 Total Petroleum Hydrocarbons, BTEX and Polycyclic Aromatic Hydrocarbons. A total of 9 samples were tested and all leachate values were compliant with the RTC. 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.

An existing borehole located immediately downstream of the barrier installation in the adjoining footpath was used to monitor groundwater quality post remediation. The results have demonstrated satisfactory compliance with the designated RTC.

The site following completion of the remediation works is shown in Figure 8 below. The site redevelopment is shown in Figure 9 below.

Figure 8 – Site Following Completion of Remediation Works

Figure 9 – Site Redevelopment

Conclusions

Envirotreat were able to demonstrate 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.