

**Client**



**Environmental Consultants**



The site is being developed by Barratt London for a mixed end use (residential and commercial). The proposed development is shown in an artist's impression – see Figure 2 below.

Figure 2 – Artist's Impression of Proposed Development



**Site Background & History**

The Wandle Park Village Site occupies an area of 5.3 hectares bounded to the south by the Purley Way Retail Park, to the north by large retail outlets, to the east by the Croydon Light Railway and to the west by Purley Way and residential properties.

The site historically formed part of the Croydon Gas Works – the gas works infrastructure was decommissioned and removed from site during the late 1980's / early 1990's. The site prior to remediation is shown in Figure 1 below.

Figure 1 – Site Prior to Remediation



**Initial Site Investigations**

Extensive site investigations were undertaken in the 1990s by Mott MacDonald, Harrison & Co and Atkins. The investigations identified the presence of widespread contamination across the site reflecting the historical use of the site as a gasworks – the prime contaminants of concern included BTEX, polyaromatic hydrocarbons (PAHs), phenols, total petroleum hydrocarbons (TPH), total / free cyanide, metals and ammonia.

**Initial Remediation Works**

Remediation works were subsequently undertaken during the period 1998 – 2001. These remediation works were carried out by Atkins / Erith, Atkins / VHE and Atkins / Remedex and comprised of source removal with associated groundwater treatment, removal of concrete / brickwork foundations (and associated contaminated soils) and groundwater remediation respectively.

Remedex identified additional contamination areas including the presence of a DNAPL plume in the northern area of the site.

### **Subsequent Site Investigations**

Further site investigations were undertaken in 2001 / 2002 and 2005 by Geotechnical Developments / Sinclair Knight Merz and WYGE respectively. These site investigations were primarily designed to determine the ground quality following the initial remediation works and in relation to the proposed development. The investigations were also designed to provide supporting information in relation to the proposed diversion of the River Wandle.

### **Subsequent Remediation Works**

Further remediation works were carried out to address an additional localised contamination area – these remediation works were undertaken by Frankis Solutions and Cognition Land and Water.

Enviro-treat was engaged in 2006 / 2007 as a specialist remediation contractor to design and install a permeable reactive barrier system in the north western corner of the site to address the potential risks associated with contaminated groundwater migrating off the site and to address the risks of potentially contaminated groundwater migrating onto the site from properties to the north of the site.

The prime residual contamination source in the north western area of the site was the previously identified DNAPL plume which was contaminating the underlying aquifer located in the River Terrace Gravels and the Thanet Sands (WYGE measured groundwater levels between 1.7mbgl and 4.7mbgl across the site). The prime contaminants of concern were the more mobile pollutants and in particular benzene which had been identified in groundwater samples taken at the site boundary and on the other side of Purley Way (migrating in the direction of the River Wandle located 850m from the site in a westerly direction).

### **Reactive Barrier Design**

Enviro-treat designed a Soil Mixed Permeable Reactive Barrier System utilising proprietary reactive pillared clay technology [E-Clay®] to treat contaminated groundwater as it migrates off-site (by a combination of sorption and chemically immobilisation within the clay matrix).

Extensive in-house laboratory treatability trials were undertaken to confirm the suitability of the proposed E-Clay formulation for the treatment of the identified contaminants of concern, with a particular emphasis on the more mobile pollutants (in particular benzene and naphthalene which were also considered to be risk indicators by WYGE for petroleum hydrocarbons and lighter PAHs respectively). These tests comprised of batch testing followed by column testing. The potential impact on the groundwater regime was assessed by means of a MODFLOW groundwater simulation model – the potential impact was considered to be negligible and accordingly the barrier design was considered to be satisfactory.

### **Barrier Installation**

The proposed barrier system comprised of one permeable reactive barrier section (65m in length) and two low permeability ‘passive’ sections (130m and 100m in length respectively).

The barrier installation works were carried out in two phases as required by the developer’s programme of works. The low permeability sections were installed initially over a 6 week period. The permeable reactive barrier section was installed a few months later over a 3 week period. The barrier was installed under the auspices of Enviro-treat’s Mobile Treatment Licence (MTL) regulated by the Environment Agency.

The barrier was installed by soil mixing techniques utilising a continuous flight auger rig as shown in Figure 3 below.

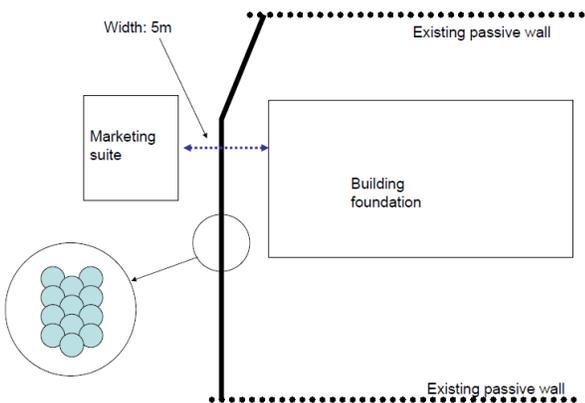


Figure 3 – Barrier Installation Utilising a Continuous Flight Auger (Soil Mixing)



The reactive barrier section comprised of a triple row of overlapping columns as shown in Figure 4 below.

Figure 4 – Reactive Barrier Installation – Triple Row of Overlapping Columns



### Validation

WYGE has produced a summary Groundwater Report dated September 2014.

Groundwater monitoring was undertaken in 2008, 2010 and 2011.

New boreholes were installed by WYGE which were utilised in combination with existing boreholes to validate the efficacy of the reactive barrier system.

WYG summarised the results as follows:

‘For all of the contaminants of concern, with the exception of phenanthrene, results in 2011 are lower than they were showing a marked improvement in groundwater quality downstream of the permeable reactive barrier. Despite the limited change in phenanthrene concentration for the area is 2 orders of magnitude less than the target criteria’.

The levels of benzene and naphthalene were significantly elevated in 2008 – the mean concentration values were 1701ug/l and 218ug/l respectively. The mean values had reduced by 2011 to ≤5ug/l (i.e. below the LOD) and 0.64ug/l respectively.

The comparison between the mean values for the prime contaminants of concern in 2011 and the remediation target values is shown in Table 1 below.

The results demonstrate that the barrier has been installed successfully and is performing satisfactorily with significant reductions in pollutant concentrations downstream of the barrier.

The reactive barrier installation is shown schematically in Figure 5 below. The development is shown in Figure 6 below.

Table 1 – Comparison of 2011 Mean Values with Remediation Target Criteria

Prime Contaminant of Concern	Remediation Target Criteria (ug/l)	Mean 2011 Value (ug/l)
Benzene	350	≤5
Toluene	580	≤5
Ethylbenzene	230	≤5
Xylene	350	≤5
Naphthalene	120	0.6
Phenanthrene	120	3.2
Benzo(a)Pyrene	5	0.3

Figure 5 – Reactive Barrier Installation



- Culverted River Wandle
- Site boundary
- Passive groundwater barrier
- Active groundwater barrier



envirotreat®

Delivering land you can develop

# CASE STUDY

## Permeable Reactive Barrier

**New South Quarter, Purley Way, Croydon**

Figure 6 – New South Quarter Development



Sole Providers of E-CLAY® Technology

Stabilisation • Bioremediation • Reactive Barriers • In-situ / Ex situ Remediation