



Plate 1- Millgate Gas Works fully developed for retail outlet.

Development:	Retail Outlet
Client:	Arrowcroft Northwest Ltd
Consultant Engineer:	Gifford & Partners Ltd
Principal Contractor:	Eric Wright Construction Ltd
Civils Contractor:	Mowlem Remediation

Site Overview

The site in Millgate, Stockport occupies an area of 4 acres and was formerly part of the Millgate Gas Works. The site is bounded by the River Goyt to the south and west, with the existing Millgate Gas Works site to the east, which is still functional today.

The site was deemed to be sensitive due to its close proximity to the River Goyt, which was the designated receptor for the identified on-site groundwater contamination, and its proximity to the town centre. The groundwater was found to be contaminated with both heavy metals and organic contaminants, including Benzene, Toluene, Ethylbenzene and Xylene (BTEX) and Polycyclic Aromatic Hydrocarbons (PAH's). This type of contamination is typically found at gas works sites.

Giffords were responsible for evaluating remediation options. Envirotreat were recommended on the basis that the proposed Soil Mixed Reactive Barrier System (SMRBS) was able to treat all the contaminants identified within the groundwater including both the organic and inorganic / heavy metal elements. Envirotreat were also able to install

and work within the narrow corridor of land available, in such close proximity to the river and river wall. Another consideration that had to be taken into account was the location of the site in relation to Stockport town centre.

Objective

The remediation strategy for the site was to install a SMRBS at the site with the intention to protect the adjacent River Goyt, whilst preventing recontamination risks to the groundwater from adjacent facilities.

Methodology

The SMRBS was designed with 3 passive and 2 reactive sections of barrier (Figure 1). The reactive sections incorporated the E-clay® with the treatment capability to chemically absorb and immobilise organic contaminants, along with the cationic and anionic metallic species. The adsorption and immobilisation of contamination occurs as the groundwater passes through the reactive sections of barrier, which remain permeable.

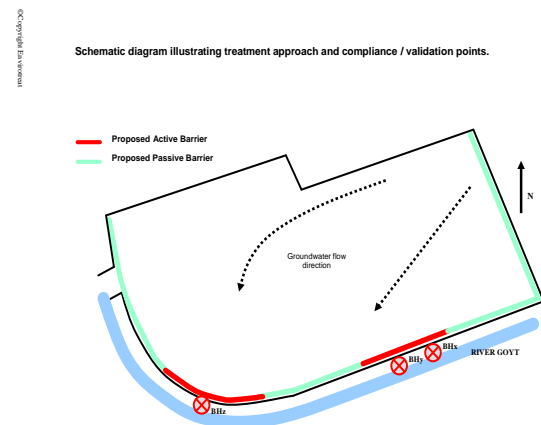


Figure 1 – Schematic diagram showing SMRBS layout

The passive, relatively impermeable sections of barrier comprised a combination of bentonite and Ordinary Portland Cement (OPC) in varying ratios and were positioned to protect other critical areas from further contamination. The north-eastern section of barrier also served to prevent the ingress

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of contaminated groundwater from entering the site from the adjoining gas works site.

The SMRBS (Figure 1) was installed using continuous flight auger technology based on advanced soil mixing techniques. The soil mixed columns for both the active and passive sections comprised a double row of overlapping columns to ensure the integrity of the barrier system.

A purpose designed E-clay[®] treatment slurry was produced using batching plant facilities and injected under pressure down the hollow stem of the CFA. The E-clay[®] slurry and passive materials were mixed in situ with the ground material to form soil mixed columns of treated material (Plate 2).



Plate 2 Installation of soil mixed columns using a continuous flight auger

The use of soil mixing using CFA was restricted across two sections of the passive barrier due to the presence of a live gas main, which supplied a large area of Stockport with domestic gas. In order to maintain the integrity of the SMRBS it was a requirement to use box excavations around the gas main and manually remove each section of the barrier to full depth. The recovered material from these two sections was treated ex situ and reinstated within the box excavation.

The works were conducted over a 3 month period using Envirotrear's Mobile Process Licence (MPL). Specialist Technology, materials and supervision were supplied by Envirotrear, whilst Mowlem Remediation supplied all the required plant and labour for the process.

Validation

On completion of the project, three monitoring boreholes were installed downstream of the reactive

sections (Figure 1). Groundwater samples were collected monthly for the first year and quarterly for the subsequent year. The samples were analysed for the contaminants of concern on behalf of Envirotrear by an accredited laboratory.

Results

The remediation target values for the site were agreed with the Environment Agency prior to the commencement of on-site works and are shown in Table 1.

Contaminant of Concern	Target Value (mg ^l ⁻¹)	% contaminant reduction of groundwater		
		BHx	BHy	BHz
Ammoniacal Nitrogen	1.0	99	99	98
Arsenic	0.05	98	98	94
Copper	0.01	95	98	98
Phenol	2.0	99	99	99
Thiocyanate	1.5	98	98	99
Benzene	0.03	99	99	99
Toluene	0.05	99	99	99
Ethylbenzene	0.15	99	99	99
Xylene	0.03	99	99	99
Benzo(a)pyrene	0.00005	99	99	99
Fluoranthene	0.001	99	99	99
Naphthalene	0.005	99	99	99

Table 1 Summary of % reduction of groundwater results from monitoring boreholes

The results demonstrated that the quality of groundwater had improved within the corridor of made ground between the barrier and the river. All of the contaminants of concern had been consistently removed from groundwater to below the identified target levels, illustrating the efficiency of the barrier system.



Plate 3 SMRBS along the river wall, landscaped following site development

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