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CASE STUDY

Soil Mixed Permeable Reactive Barrier

Sixfields and Harvey Reeves Road Landfill Site, Northampton

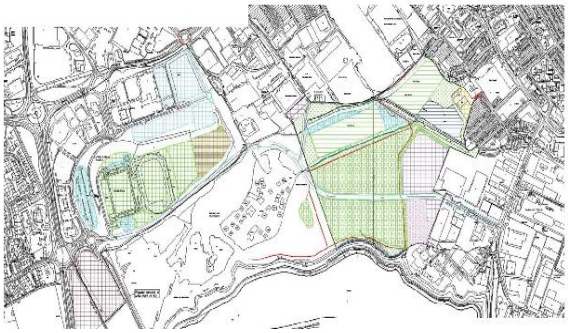
Client:	English Partnerships
Consultants:	Halcrow
Contractor:	Mowlem (now Carillion)

Site Overview

Northampton is within one of four major growth areas identified in the Government's 2003 "Sustainable Communities Plan". The two former landfill sites of Sixfields and Harvey Reeves Road had been identified as key areas for redevelopment. Remediation of the sites was necessary to protect the local surface waters and groundwater from the impact of landfill leachate.

The site is essentially a combination of two former landfill sites located to the west of Northampton city centre. The two sites are shown in Figure 1 below.

Figure 1 – Sixfields and Harvey Reeves Road Sites



Halcrow carried out comprehensive site investigations on both sites and identified serious groundwater contamination which was considered to be a significant risk to controlled waters (in particular the River Nene which is in close proximity to the landfill sites as shown in Figure 1 above.

Remediation Objectives

Groundwater contamination was considered to be the largest challenge facing the development of the Sixfields and Harvey Reeves Road sites. The site contamination was very diverse in nature reflecting the historical landfilling activities – the contaminants of concern included ammoniacal nitrogen, arsenic, iron, manganese, nickel, total petroleum and polyaromatic hydrocarbons. The surface water contamination on the site is shown in Figure 2 below.

Figure 2 – Surface Water Contamination

Removal of the source contamination was considered to be impractical and prohibitively expensive. A pump and treat system was also considered – this would have necessitated sealing off the sites with a low permeability barrier in order to ensure that water ingress was prevented – this option was also considered to be impracticable and would have adversely affected the natural groundwater regime in the area.

The preferred remediation solution was the installation of reactive barrier systems designed to intercept groundwater contamination migrating from the site in the direction of the River Nene. The barrier system for each landfill site was designed to have a minimal impact on the natural groundwater regime.

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The barrier systems comprised of permeable reactive barrier [active] sections to intercept groundwater and low permeability [passive] sections to channel groundwater in the direction of the permeable reactive sections.

Methodology

Following extensive site-specific laboratory treatability trials and contaminant flux calculations in accordance with Environment Agency Guidelines and using MODFLOW groundwater simulation modeling Envirotreat were able to design, demonstrate and warrant the design of the barrier for 50 years.

The barrier installation was carried out by Mowlem (now Carillion) under supervision by Envirotreat. The barrier was installed by a soil mixing process utilising continuous flight auger rigs [CFA] as shown in Figure 3 below. It was necessary to utilise CFA rigs as the barrier needed to be installed to a significant depth (circa 14m bgl).

A total of 3300 soil columns were installed over a total barrier length of 1500m. The active sections of the barrier system comprised of a double row of overlapping soil mixed columns - the passive sections comprised of a single row of columns. The depth of the barrier ranged from 6m to 14m - the toe of the barrier had to be installed to a sufficient depth to ensure that groundwater did not underflow the barrier - this was achieved by keying the barrier into either the Upper Lias Clay or Glacial Lacustrine deposits to a minimum depth of 1m.

The active sections were installed using a site-specific formulation of a porous pillared reactive E-Clay and a zeolite. The passive sections were installed using a site-specific formulation of bentonitic and cementitious materials. The installed barrier system is shown in Figure 4 below.

Figure 3 – Barrier Installation Using CFA Auger

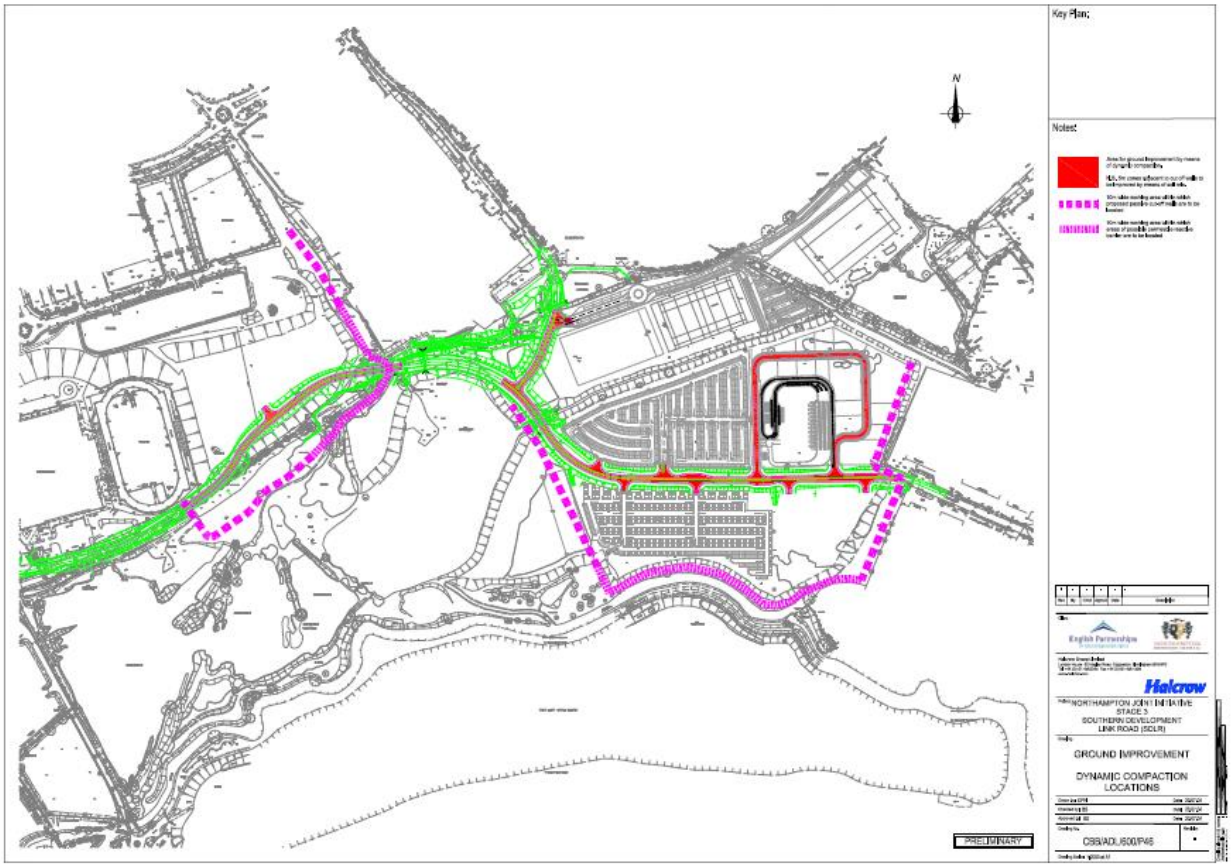
Numerous obstacles and large concrete blocks were encountered during the barrier installation – the shallow obstacles were excavated – the deeper obstructions were left in place and the barrier alignment was amended to reflect the location of the obstructions.

The barrier installation was regulated by the Environment Agency under the auspices of Envirotreat's Mobile Treatment Licence.

Validation

The effectiveness of the barrier system was confirmed by a systematic and comprehensive groundwater monitoring programme. The results confirmed that the barrier system had effectively treated and reduced the concentrations of identified pollutants in groundwater to acceptable levels.

Figure 4 – Barrier Installation



Passive Sections (Impermeable)

Active Sections (Permeable)