APPENDIX 13.3 SITE ASSESSMENT REPORT

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GRAHAM GROUP

Commission *for the* New Towns

Shelton Road, Corby Northamptonshire Site Contamination Assessment Report

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Project Title : Willowbrook Industrial Estate, Shelton Road
Corby, Northants

Reference : CKG/590196/000

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Contents

Executive Summary

General

Frank Graham Consulting Engineers Limited were commissioned by the Commission *for the* New Towns (CNT) to undertake a soil and groundwater investigation at a site that was previously part of an area involved in ironstone mining and steel making. It is understood that the site is proposed to be sold for development.

Walkover Survey

The walkover survey confirmed the main features of the site, including the moated naphthalene pit area, and the Willowbrook stream flowing to the north of the site.

Environmental Setting

The site is shown to be underlain by Northampton Sand Ironstone which is classified as a minor aquifer. The potential also exists that this material emits radon. Reworked Boulder Clay is found overlying the ironstone and is found to depths of up to 20m.

History

The site once formed part of a larger area of Corby involved in ironstone quarrying, associated with the steelworks industry and coke production. The site itself had been previously worked for Northampton Ironstone using opencast methods during the thirties and forties. Over some areas of the site sludge lagoons were formed in the depression left by the ironstone workings. The site had been subsequently levelled by backfilling with opencast spoil including Boulder Clay.

Investigation Methodology

Five previous investigations have been carried out in the immediate vicinity of the site. These investigations were summarised in the Desk Study Report (FGCEL, Oct 1995). The investigations pertaining to the site are those by Voelcker and Sons, 1985 and EAU, 1983, which assess contamination in the near surface soils. In addition details of the soils at depth were investigated by Nicholls, Colton and Partners, 1983 and Contest Melbourne Weeks, 1993 by undertaking borehole investigations on the site.

In order to assess the nature of soil and groundwater quality at the site, a field investigation comprising 13 trial pits and 22 boreholes was undertaken. The objectives of the investigation were threefold:

1) to assess the nature of ground conditions in areas potentially affected by former uses,
2) to assess the extent of vertical and lateral mobilisation of chemical compounds through soil and groundwater beneath the site, and
3) to review the general ground conditions on the site.

Groundwater was encountered in only one of the trial pits during the ground investigation as a perched water table within the Made Ground. Occasionally water was encountered in the boreholes as seepages originating from the very soft black steelworks waste. Soils samples were analysed for compounds relating to the former and present uses of the site and its environs, where appropriate.

Contamination Issues

An assessment of the history, geology and contamination issues at the site has concluded that the site is of low sensitivity to the transmission of pollutants arising from the steelworks waste. The identified source of contaminants on the site was the former sludge lagoons which contained elevated concentrations of heavy metals, primarily zinc. The glacial clays surrounding and covering the sludge lagoons indicate low contamination levels. It is considered that the migration of compounds off-site is highly unlikely due to both the presence of the low permeability boulder clays and the results of NRA leaching tests which showed that the contaminants are of low solubility.

Proposed Remedial Action Programme

Providing any future development does not seriously alter the 'stable' regime at the site, it is likely that development can take place in a relatively straightforward manner. Gas protection measures in the form of a vented underslab void and gasproof membrane will have to be incorporated in the building design, which must also be suitable for ventilation of radon as well as the common landfill gases. The largest constraint to development is the poor engineering properties of the sludge lagoons.

1 Introduction

1.1 Brief

Commission *for the* New Towns (CNT) are proposing to sell a site which is located at the end of Shelton Road, Corby, Northants. Prior to selling the site, CNT wished to investigate the potential for soil and/or groundwater contamination which may have resulted from its former use as an ironstone quarry and former British Steel sludge lagoon site. CNT also wished the investigation of the site to facilitate the evaluation of the cost for remediation of the site for a number of proposed end uses.

Frank Graham Consulting Engineers Limited (FGCEL) were commissioned by CNT to supervise the investigation comprising a soil and groundwater survey at the site. The objective was to assess the baseline level of compounds in soil and groundwater before the proposed sale of the site. FGCEL were requested to provide a report of the findings from the environmental investigation including recommendations as necessary.

This report incorporates the findings of the desk study carried out by FGCEL during October 1995. It also incorporates the results of the site investigation undertaken between February - March 1996 which comprised the excavation of trial pits, boreholes and sampling of soil and groundwater for chemical laboratory testing. In addition, selected samples were scheduled for geotechnical testing to obtain parameters for slope stability analyses to determine the safety of the slope along the northern site boundary.

The findings are discussed in relation to the former land uses at the site, and the nature and distribution of compounds are assessed against the proposed future end-use of the site.

1.2 Objectives

The four principle objectives of the site investigation, were:

- to assess the levels of hydrocarbons, PAHs, heavy metals and phenol concentrations within the deeper groundmass and groundwater at the site;
- to characterise the leachate potential of the soil materials and the potential for off-site migration of contaminants;
- to measure the potential for landfill gas generation at the site, or migration onto the site from surrounding landfills;
- to investigate the stability of the slope along the northern site boundary

This report summarises the work undertaken at the Shelton Road site, and makes recommendations based on the findings of the chemical and physical laboratory analytical results.

2 Desk Study Summary

2.1 Site Location

The site is located at the end of Shelton Road, Willowbrook Industrial Estate, Corby, Northamptonshire. The National Grid Reference for the approximate centre of the site is SP 909 908. This site location is shown in Figure 1.

2.2 Site Description

The following site description has been compiled from a number of sources including:

- an examination of available Ordnance Survey maps and retrieved from the Bodleian Library of Oxford University
- a walkover survey of the site undertaken on 9th February 1996.

Details of the site layout are shown on Figure 2.

The site is approximately rectangular in shape, covers an area of some 6.7ha and is generally level at an elevation of about 100m AOD. The site is bounded to the north by a stream, the Willowbrook, which lies at an elevation approximately 13m lower than the site. The angle of the slope between the stream and the site at the northern boundary varies between 20° and 24° (1in 2.7 to 1 in 2.2)

The site is bounded to the west by a large car park for fleet vehicles and to the south by industrial units on Shelton and Pywell Roads. There is a post and wire security fencing on the western and northern boundaries with the eastern boundary fronted by a low landscaped mound and trees and Shelton Road. However, there is no security or protection along the southern boundary.

Within the south-western corner of the site there is a 55m x 55m square area which is bunded and has a post and wire fence with barbed wire on the top and danger signs. This structure is known as the 'naphthalene pit'. A moat lies on the inside of the fence with a concrete bund surrounding a square central area. This area is accessed by a concrete bridge.

Discussions with former British Steel personnel have revealed that this area was once used for the storage of naphthalene originating from the adjacent

Dene Coke Works. It is believed that the pit may have been stripped out and backfilled with material taken from the Shelton Road Site.

2.3 Environmental Setting

2.3.1 Geology

The geology at the site has been identified from following sources:

- published maps (BGS, 1976)
- geological memoirs of the region (IGS 1969)

The site is shown to be underlain by Glacial Till, overlying Northampton Sand Ironstone. The area is indicated to have been extensively worked for ironstone, and substantial earthmoving has taken place on and around the site in the past. The depth of Made Ground on the site has been confirmed from previous investigations undertaken on and around the site, which indicate fill to depths of up to 20m.

The Soil Map of England and Wales (SSEW, 1983) indicates the site to be restored ironstone workings, mainly fine loamy over clayey soils.

2.3.2 Hydrogeology

The groundwater conditions at the site have been assessed from the published hydrogeological and groundwater vulnerability maps for the region.

The hydrogeology at the site is indicated on the Hydrogeological map, (IGS, 1977), which shows the site underlain by Inferior Oolite of the Jurassic Period, identified as a locally important aquifer. The Inferior Oolite series includes the Northampton Sand Ironstone (IGS, 1969) and the NRA Regional Appendix (NRA, 1994a) defines this formation as a minor aquifer. A minor aquifer is described as fractured or potentially fractured but without high intergranular permeability and only capable of supporting locally important abstractions.

(Note: The National Rivers Authority, NRA, has now been absorbed within the Environment Agency, EA.)

Undisturbed glacial clays would also be classified as a minor aquifer but the clays on the site are known to be reworked, and this is confirmed by the

Groundwater Vulnerability Map of North Northamptonshire and West Fens (NRA, 1994b) which indicates that site is restored mineral workings. Due to a lack of data and variable ground conditions, a worst case vulnerability classification i.e. high soil leaching potential, is assumed for areas such as these until proved otherwise. This nominal classification can be shown to be inapplicable for this site, as leaching test results indicate the reworked boulder clay material to have a very low leaching potential.

2.3.3 Hydrology

The hydrology at the site and the surrounding area has been assessed from the historical maps, current Ordnance Survey maps and the walkover survey.

The nearest water course is the Willowbrook, which has been re-routed such that it now runs along the northern boundary of the site. The stream is fast flowing and there is no debris, flora or fauna visible in the water. The stream may have been cleaned upstream of the site, as there are some piles of debris on the bank. However, there was no evidence of tyre tracks along the stream bank and the debris may be flotsam deposited during flood conditions.

It was observed that the site has numerous surface ponds due to the lack of infiltration into the surface clays. There is no dedicated surface water drainage system at the site at the present time. The 'ditch' which runs east-west across the site is boggy but does not carry any running water.

2.3.4 Surrounding Site Uses

The fleet car park to the west of the site covers a large area for storing cars on a tarmacadam surface. The slope down to the Willowbrook from this site is gently sloping and has been recently cleared, grassed and tree planted.

To the south of the site there are a variety of industrial units. Beyond the Willowbrook to the north, and to the east of the site, are derelict areas of land, that once formed part of the steelworks and associated industries.

2.3.5 Environmental Sensitivity

The stratigraphy beneath the site comprises low permeability stiff silty reworked clays, occasionally sandy and with chalk gravel to depths between

1.70m to >14.30m, overlying soft to very soft black silty steelworks waste. Below the steelworks waste lies reworked clays with sand and ironstone pockets. There is a low potential for the vertical migration of contaminants into any underlying water bearing strata due to the reworked glacial till surrounding the sludge, preventing lateral and vertical migration. The site can therefore be described as having a low environmental sensitivity with the possible exception of surface water run-off into the local water course.

2.4 Site History

2.4.1 Summary

The site is indicated as open fields until 1958 when sludge lagoons are identified on the site. The surrounding area has extensive ironstone mining and spoil heaps, with the Corby Steelworks to the south of the site.

After 1964 the site is shown to have no particular features, however the surrounding areas have coke ovens which extend onto the western edge of the site. The stream to the north of the site has been diverted to flow to the south of ponds (possibly settling ponds) that have been created as part of the sludge lagoon system. In addition, a railway has been constructed to the east of the site, which later becomes the route of Shelton Road.

Between 1964 and 1973 the area now known as the naphthalene pit has been constructed as part of the coke works, with the rest of the site remaining undeveloped.

2.4.2 Potential Contamination from Past Usage

It is considered that the former activities at the site and in its surroundings may have resulted in contamination from several sources. It must be noted, however, that the migration of contaminants from potential off-site sources to the site is only possible where a pathway exists. In Section 2.3.5 it is noted that the site is considered to have a low environmental sensitivity with respect to the migration of contaminants through the groundmass, although the potential exists for surface water run-off into the local water courses. This is considered in the following discussion of potential contamination at the site from its past usage and the past usage of its environs.

Railway Land

The site was adjacent to the tracks of various mineral railways. The following potential hazards are associated with railway land such as that formerly present adjacent to the site (CIRIA, 1993):

- Potential contamination from cargo, diesel or ethylene glycol (anti-freeze) spillage or accidents.
- Waste ash and clinker, high in toxic metals and sulphate, may have been used in the construction of track.
- Creosote used as a preservative for railway sleepers.
- Herbicides used to control vegetation along tracks.
- Ground contaminated by the spillage of oils, diesel or solvents may be combustible.
- Ferrous residues from rail tracks.

Steelworks

A large area surrounding the site was involved in ironstone quarrying, steel making and coke production, and the following contaminants may be associated with these activities:

- Steelworks sludge may contain heavy metals such as lead and zinc
- Slags from all processes involving molten metal may contain a wide range of heavy metals
- Oils/grease from foundry wastes

Steelworks may be associated with coke production sites:

- Ash, clinker, coal and coke residues, spent oxides, by-products (PAH's and other organics)

Due to the former activities at the site, it was considered that there was a potential for contamination in the ground at the site, particularly given the presence of sludge lagoons within the site boundary. A further field investigation was therefore seen to be necessary to assess the ground conditions and to allow the measurement of concentrations of compounds in the soils at the site. The scope of the investigation is outlined in Section 3.

2.5 Mineral Extraction

Reference to historical Ordnance Survey (OS) maps, available geological maps and available geological memoirs indicates that the entire site has been quarried in the past for Northampton Sand Ironstone using opencast methods between 1904 and 1948.

2.6 Known Landfill Sites

An examination of available historical maps and published geological information identifies the presence of infilled quarries within 250m of the site. Correspondence with Northamptonshire Waste Regulation Authority (now the Environment Agency, EA) has indicated that there are five known closed or open landfill sites in the immediate vicinity of the site. Based on the ground conditions, i.e. impermeable boulder clay, it is considered that there is negligible possibility for on-site migration of landfill gases from these landfills.

2.7 Previous Investigations

There have been numerous investigations undertaken on the site, primarily concentrating on a geotechnical interpretation of the site and contamination assessment of the near surface soils up to 3m depth. The results of these were summarised in the FGCEL Desk Study Report, October 1995. As a result of the above findings, this investigation concentrated on assessing the nature of the deeper materials and the potential for off-site migration of the observed contaminants.

2.8 Liaison with Building Control

Due to the potential for Radon being present on the site (BRE, 1991), the Building Control Officer (BC) at Corby District Council has been consulted.

Generally the area around Corby is recognised as having a potential radon problem. There has been little radon monitoring carried out and although relatively low levels have been measured within Corby, there have been high levels of radon recorded in the outlying villages. Therefore, all new dwellings are required to incorporate secondary protection measures under the Building Regulations, (HMSO,1991). These Regulations are not mandatory for industrial buildings, but, nevertheless, BC recommend that secondary protection measures are provided in all new buildings in order to comply with the health and safety regulations (HMSO, 1974).

Typically the type of protection favoured by BC consists of a capping system with sumps or provision of a vented underfloor slab. Details of typical radon protection systems are provided by the BRE, (BRE, 1991). It should be noted that radon protection can be incorporated in protection measures designed for other gaseous contamination e.g. methane or carbon dioxide.

3 Investigation Programme and Field Methodology

3.1 Scope

This Section of the report outlines the scope of works and methodology used during the investigation carried out under the supervision of a FGCEL specialist between 9th February and 8th March 1996. The field investigation consisted of a trial pit and borehole investigation across the site. This focused on identifying the nature of potential contamination from former usage of the site outlined during the desk study and is in accordance with the criteria recommended in the current Department of the Environment Guidelines (DoE, 1994) regarding sampling strategy. The investigation also served to prove the nature, consistency and depth of the various strata below the site. Exploratory holes were excavated and samples were taken in locations that allowed the confirmation of the location and nature of the former sludge lagoons.

3.2 Field Investigation

3.2.1 General

The investigation was carried out between 9th February and 8th March 1996 and consisted of the excavation and sampling of 13 trial pits to a maximum depth of 4.3 metres below ground level (mbgl). In addition, 22 no. boreholes were drilled to depths between 8 and 17.00m below ground level. Surface water and sediment samples were also collected from the Willowbrook and the moat located in the south western corner of the site.

Chemical testing of the soil samples was scheduled according to the location of the exploratory hole and initial visual/olfactory (odour) assessment. Groundwater was encountered in only one of the trial pits (TP4), and in Boreholes BH9 and BH10. The locations of the trial pits (TP) and boreholes (BH) are shown on the site plan (Figure 2) and described below.

Some of the exploratory holes were located in specific positions, for example trial pits were situated around the naphthalene pit to determine any contamination present and migration of potential contaminants arising from this area. In addition, boreholes were located along the northern boundary of the site to assess the ground conditions and slope stability.

Generally, trial pits were excavated in the southern area of the site, where there was no historical evidence of previous sludge lagoons, and boreholes were excavated in the north of the site to determine the extent and depth of the sludge. Additional boreholes were located across and around the site in order to install monitoring wells to obtain data on the groundwater regime.

3.2.2 Trial Pits

Excavation Methods

Trial pits were excavated using a JCB 3CX Sitemaster to depths between 1.2m and 4.3m. The pits were logged by Mentor's representative by visual inspection of the pit walls up to a depth of 1.2m and thereafter by inspection of the arisings. All trial pits were reinstated by recompacting the arisings from the pit with the bucket of the JCB. Trial pit logs for the investigation are presented in Appendix A.

Soil Sampling Procedures

Samples were generally taken at one metre intervals in each trial pit on the following basis. A sample was taken at shallow depth from within the Made Ground or surface deposits where it was anticipated that contamination, if present, would be at its greatest level. Additional samples were taken at depth in the reworked glacial clay where it was considered that the level of contamination would be lower or non-existent. Where appropriate, further samples were taken near the base of the pits where, on occasion, the top of the steelworks sludge was encountered.

Soil samples were obtained from the excavation arisings using a stainless steel trowel and transferred immediately to suitable plastic containers for transfer to the laboratory. Between the excavation of each trial pit the bucket was washed down using a jetwash to minimise cross contamination between pits.

3.2.3 Boreholes

The 22 no. boreholes were drilled to depths of between 8 and 17m using a light cable percussion boring rig. In those boreholes along the northern boundary, regular disturbed and undisturbed sampling, together with Standard Penetration Testing, was carried out to obtain geotechnical data with respect to the ground conditions adjacent to the slope. The remaining boreholes were

used to identify the presence and extent of the sludge material. Ten of the boreholes also incorporated the installation of groundwater and soil gas monitoring wells to provide data to assess the groundwater regime and any potential gas generation on the site. The down hole equipment was pressure washed between drilling locations to minimise the potential for cross contamination.

Details of the strata encountered in each of the boreholes is presented in the borehole logs, Appendix C, together with details of the in situ testing and sampling carried out.

3.2.4 Surface Water & Sediment

In order to obtain data on off-site migration of contamination, the Willowbrook was sampled for water and sediment, from locations both upstream and downstream of the site. Similarly the water and sediment found in the moat surrounding the naphthalene pit were sampled to obtain data relating to contamination migration from the 'pit' area.

During sampling, the surface water samples were collected first prior to disturbance of the sediment. Within the stream, the downstream samples were collected prior to the upstream samples, again to avoid impacting the nature of the samples collected.

3.2.5 Groundwater

Very little groundwater was encountered other than localised seepages from the wet steelworks waste. Therefore the boreholes were left for a couple of weeks prior to sampling to enable accumulation of water in the boreholes. However, very little groundwater was present, and as a result, purging of the wells was not possible. This resulted in the collection of a grab sample for analysis.

Care was taken to fill the sample containers completely to minimise headspace. Samples were kept as cold as possible, ~~nominally~~ @ 4°C, until their transfer to the laboratory.

Sampling and decontamination procedures used in the course of the site investigation were designed to allow the collection of representative samples and to minimise the potential for cross-contamination between samples. Samples were tracked from acquisition through analysis and reporting by means of 'Chain of Custody' travel documents.

3.2.6 Gas

Gas monitoring has been undertaken during the field work and at two subsequent occasions to assess the nature of gas generation from the steelworks waste. During monitoring, the gas was analysed in the field for methane, carbon dioxide and oxygen. In addition, one sample was collected on each visit for confirmatory laboratory analysis. Due to anomalies in the initial set of gas readings, the second gas sample was subjected to analysis for a wide range of gases to fully determine its constituents.

No monitoring has been carried out for radon during this investigation as this is a specialist procedure carried out in-situ because of the short half-life of the element. Confirmation of its presence could be carried out but radon protection measures are likely to be required by Building Control whether or not radon is detected, due to the geographic location and geology of the site.

3.3 Laboratory Testing

3.3.1 Geotechnical Testing

Selected samples of the soils encountered within boreholes BH21, BH23, BH24, BH26 and BH27 were tested in the laboratories of Mentor to determine geotechnical parameters for analysis of the slope stability along the northern boundary of the site. The soils test were carried out in accordance with BS 1377;1990 to determine classification and effective stress parameters and comprised the following:

- Natural moisture content
- Atterberg limits
- Particle size distribution
- Consolidated undrained triaxial

The results are presented and discussed in Appendix D.

3.3.2 Contamination Testing

The soil and water samples collected for chemical analysis were tested by Robertson Laboratories for a range of the following compounds:

- ICRCL suite including: arsenic, cadmium, chromium (hexavalent), chromium (total), lead, mercury, selenium, water soluble boron, copper, nickel, zinc, total PAH's, monohydric phenols, free cyanides, complex cyanides, thiocyanate, total sulphate, sulphide, total sulphur, pH
- Total Petroleum Hydrocarbons (TPH)
- Total Organic Carbon (TOC)

In order to assess the potential for migration of contamination from the soils into the groundwater or surface water, a number of samples were subjected to the NRA procedure for leachate testing. This enables measurement of the amount of soluble compound within a sample and hence the potential for leaching and migration of contamination.

The final analytical suite was determined by field observations and the requirement for analysis of the range of strata encountered.

3.4 Quality Assurance/Quality Control (QA/QC) Procedures

All samples taken during the field investigation, from the trial pits and boreholes, were collected in accordance with rigorous quality assurance protocols using labelled, pre-prepared sample containers. Samples were, subsequently transported to the laboratory in cooler boxes.

The samples were sealed in laboratory-supplied storage containers and couriered to the designated laboratory, Robertson Laboratories in Llandudno, Wales. Chain-of-Custody travel documents were completed for each sample, to allow for tracking of the samples from collection through analysis to reporting. These forms were enclosed with the samples during shipment.

4 Observations of Soil and Groundwater Conditions

4.1 General

This section summarises the details of ground conditions at each sample location and describes the site-specific soil and groundwater conditions observed at the site. A summary of the visual and olfactory (odour) observations is also provided.

4.2 Ground Conditions

Detailed descriptions of the conditions found during the ground investigation are outlined in the trial pit records in Appendix A and the borehole logs in Appendix B. This information supplements the geological structure outlined in the Desk Study section of the report (Section 2.3.1). The ground investigation has confirmed the geology of the upper soil layers beneath the site outlined in the desk study. Made Ground, comprising reworked natural clay and steel works waste, covers the entire site to depths greater than 17m.

Information obtained from the desk study and the site investigation has been combined to summarise the ground conditions at the site as described in Table 4.2a.

Table 4.2a: Site Specific Ground Conditions

Depth to top of strata(mbgl)	Thickness of strata (m)	Horizon	Description
0	0 - 1.40	Coke production waste	Medium dense to loose sandy fine to coarse slag cobbles and boulders, occasional brick fragments
0 - 1.40	0.65 - 11.00	Reworked Glacial Till	Stiff grey/brown silty clay with occasional chalk gravel and fossils
1.70 - 8.30	0 - 8.70	Steelworks waste	Firm to very soft black silt with occasional fine rootlets
4.90 - 16.70	0.10-4.20	Reworked Glacial Till	Stiff grey silty clay with bands of orange sand and fragments of ironstone