

THE SALVATION ARMY

32 Queen's Road, Barnsley

**Phase II Environmental
Assessment**

September 2008



Wardell Armstrong

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32 Queen's Road, Barnsley
Phase II Environmental Assessment

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1. INTRODUCTION

1.1 Instruction

This report is prepared in accordance with instruction from Mr. J White of Fowler Sandford, on behalf of The Salvation Army, Yorkshire Division, 1 Cadman Court, Morley, Leeds. LS27 0RX dated 17th July 2008 and in accordance with our standard terms and conditions as attached at Appendix I. This follows a proposal dated 14th April 2008 by Wardell Armstrong.

1.2 Site Location

The site comprises land to the rear of 32 Queen's Road, Barnsley, and is located as shown on the site location plan, Drawing No. SH10209/01 (1:50,000 plan), more detailed site plan SH10209/02 (1:500 plan). The site comprises approximately 0.12ha of vacant small workshops and garages with the remainder of the site being entirely surfaced with concrete and tarmacadam. The site is bounded by residential properties to the north, a new residential development to the east, private garages and an access road to the west, and 32 Queen's Road to the south. The site is located to the east of Barnsley Town Centre.

1.3 Purpose and Basis of Report

The purpose of this report is to present the findings of an intrusive site investigation that was carried out to identify and examine potential contamination issues, identified in a previous third party desk study report, which may arise in connection with present use or proposed use of the site.

1.4 Proposed Site Use

It is understood that planning permission for residential land use has been granted for the site. However, it is proposed that the site is redeveloped as a Salvation Army hall. As there is no standard land use scenario for a meeting hall, a commercial land use scenario is considered most appropriate. Analytical results are also compared to a residential land use scenario, in case there are planning issues with the hall use.

2. PREVIOUS INVESTIGATIONS

The history of the site has been described in a Phase I desk study completed by Eastwood & Partners (Job No. 29782, dated 05 February 2007). A summary of findings from this report is presented below.

2.1 General History

The report indicated that the site was developed from farmland to be occupied by a cluster of buildings of unknown use from 1892 until 1962. The report noted that the site comprised a number of small industrial workshops and garages, with a brick wall dividing the site in two. The site was reported to be surfaced with concrete and tarmac.

2.2 Geology

The assessment of the geology of the site is based on the desk study report and published geological mapping sheet (Sheet 274NE, Barnsley, 1:10,560 scale) supplemented by the geological memoir, topographical plans and site visit. A typical summary section is provided in Table I below along with other geological data.

TABLE I – Geological Summary	
Strata	Description
Made ground.	Made ground of an unknown nature and thickness across the site.
Natural superfcials.	None identified.
Solid strata.	Sandstones and mudstones of the Middle Coal Measures. The Two Foot Coal is seen to outcrop close to the western site boundary and is likely to be present at shallow depth. The Abdy and Top Beamshaw seams are also likely to be present at shallow depth beneath the site.
Dip and dip direction.	5° east.
Evidence of faulting.	No evidence.
Landslides.	No evidence

2.3 Hydrogeology

The site is indicated to be underlain by Middle Coal Measures which is classified as a minor aquifer.

These formations are generally fractured or potentially fractured and do not have a high primary permeability. Although not producing large quantities of water for abstraction, they are important for local supplies and in supplying base flow to rivers.

Two active groundwater abstraction licences were identified within a 2km radius of the site. The closest was 1.3km west (NGR: 433700 406000) and was operated by Sheldale Developments Ltd which was licensed to abstract an unspecified amount of groundwater per year for Food and Drink: Water Bottling purposes. A further groundwater abstraction licence was listed within 2km of the site but had been revoked.

The report indicated that the site does not lie within a source protection zone.

2.4 Hydrology

The Landmark Report dated identifies the nearest surface water feature to be located 389m north of the site. However, from previous work in the area, we are aware of the existence of a culverted water course (Sough Dyke) located approximately 200m south of the site.

The nearest graded surface watercourse was identified as the River Dearne, approximately 730m north of the site. The Environment Agency had given the River Dearne a General Quality Assessment (Chemistry) rating of D (Fair).

The Environment Agency indicative flood risks map indicated that the site is not on an identified flood plain. This means that the chance of flooding each year from rivers or the sea is 0.1% (1 in 1000) or less.

One surface water abstraction licence was identified within 2km of the site. The closest was 870m north east (NGR: 435710 406850) and was operated by Barnsley Metropolitan Borough Council, which was licensed to abstract an unspecified amount of surface water per year for Municipal Grounds: Make-Up or Top Up Water purposes. A further 2 surface water abstraction licences were listed within 2km of the site but had been revoked or lapsed.

2.5 Mining

2.5.1 Surface Workings

Research of topographical, geological and other archive mining records indicated no evidence of surface extraction at the site.

2.5.2 Deep Mining

Deep mining is generally defined as that mining undertaken at depths greater than about 30m below rockhead.

The Coal Authority report (29 January 2007) attached in the Eastwood Phase I report indicates that the site is in the likely influence from workings in 3 seams of coal at 150m to 360m depth and last worked in 1939. Any ground movement from these coal workings should by now have ceased.

2.5.3 *Shallow Underground Workings*

The Coal Authority report indicated that the site is in an area where the Coal Authority believes there is coal at or close to the surface. This coal may have been worked in the past. The Phase I report indicated that the Two Foot Coal seam is expected to lie at a minimum depth of 8mbgl under the west of the site with the Abdy Coal seam expected to lie at a minimum depth of 19mbgl.

2.5.4 *Mine Entries*

The Coal Authority report indicated that there were no recorded mine entries on or within influencing distance of the site.

2.6 Preliminary Conceptual Site Model

A preliminary conceptual site model is presented below in Table I and is based on the Phase I report (February 2007). The table outlines potential sources, pathways and receptors and was based on information provided by statutory sources and a preliminary site investigation. As the Phase I report was largely based on desk study information, a number of uncertainties existed in the conceptual model. These have been updated and a revised conceptual site model is presented in Section 8.

TABLE II		
SOURCE (CONTAMINANT)	PATHWAY	RECEPTOR
No.1 Industrial workshops, offices and private garages (Heavy metals, SVOCs, TPH, asbestos)	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Surface runoff. 5. Groundwater migration. 6. Direct contact (aggressive attack). 7. Gas migration.	1. Current occupiers. 2. Future occupiers. 3. Construction workers. 4. Groundwater. 5. Surface water. 6. Subsurface building materials and plastic service pipes 7. Flora and Fauna.
No.2 Made ground present across the site. (heavy and phytotoxic metals, PAH, asbestos)	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Surface runoff. 5. Groundwater migration. 6. Direct contact (aggressive attack). 7. Gas migration.	1. Current occupiers. 2. Future occupiers. 3. Construction workers. 4. Groundwater. 5. Surface water. 6. Subsurface building materials and plastic service pipes 7. Flora and Fauna.
No.3 Coal seams. (radon ground gas)	1. Inhalation. 7. Gas migration.	1. Current occupiers. 2. Future occupiers.
No. 4 Possible asbestos within existing buildings	1. Inhalation	1. Current occupiers 2. Construction workers

3. SITE INVESTIGATION

3.1 Introduction

The current investigation was designed around the preliminary conceptual site model that identified all potential sources, pathways and receptors. This allowed a targeted sampling approach to be undertaken as well as providing general coverage of the site. Results of the investigation are used to revise the conceptual site model, establish whether linkages identified are plausible and establish the level of risk associated with the site.

The preliminary conceptual site model is presented in Section 2 (Table II).

3.2 Scope

The investigation was designed as a series of tasks that are summarised below in Table III.

TABLE III – Summary of Tasks		
Task	Summary	Date(s)
Preparatory Work	Setting up site investigation contract, services enquiries, contractor health & safety document, Coal Authority permission and site meeting with contractor/client.	July 2008
Intrusive site investigation	11 No. window sample boreholes to a nominal depth of 4m. Installation of 2 monitoring wells for gas.	23 rd -24 th July 2008
Intrusive site investigation	2 No. rotary boreholes to a nominal depth of 15m.	07 August 2008
Laboratory analysis	Chemical / geotechnical testing in accredited laboratory – 15 soil samples.	July 2008
Monitoring	Gas and water level monitoring.	29 th July to 22 nd Sept 2008

The investigation was completed in accordance with Construction (Design and Management) (CDM) Regulations 2007 and a site specific Health & Safety plan. Contractors used during this project include; Ground Support Services (drillers), Leger Site Investigation (windowless sampling) and ALcontrol Laboratories (geochemical analysis). Drilling was completed using a variety of methods and these are discussed in more detail below.

3.3 Rotary Open-hole Boreholes

Rotary open-hole drilling was completed under the part-time supervision of a Wardell Armstrong engineer. Two rotary open-hole boreholes BH1 to BH2 were drilled to 15 below ground level (bgl). Locations (see Drawing No. SH10209/02) were positioned to identify the presence of any potential shallow coal mine workings.

Rotary open-hole borehole logs are attached at Appendix II.

3.4 Window Sampling Boreholes

Window sampling was completed under the full-time supervision of a Wardell Armstrong engineer. Eleven window sampling boreholes (WS101-WS111), were drilled to depths of between 2.70m and 4.00m below ground level (bgl). Excavations beyond these depths were not possible due to shallow Rockhead and hole collapse. Locations (see Drawing No. SH10209/02) were positioned to provide widespread coverage of the site.

Window sampling borehole logs are attached at Appendix III.

3.5 Ground Gas Monitoring Standpipes

Two gas monitoring standpipes were installed by the windowless sampling contractor at locations WS104 and WS107.

The standpipes were completed with 50mm diameter screen and casing between 3.50m and 4.00mbgl, with the screened section extended from the base to 1.00mbgl. A filter pack of 4-6 mm washed gravel was placed in each well annulus to just above the screened section. Thereafter the annulus was sealed to the surface with bentonite. Installations were completed with concreted headworks to protect the inner casing and gas valves. All installations were supervised by a Wardell Armstrong engineer on a full time basis.

Newly installed monitoring boreholes were left for four days to allow gas levels to equilibrate. Data for methane, carbon dioxide, oxygen and flow rate was collected using a portable infrared gas analyser. Atmospheric pressure was recorded at the time of monitoring. Soil gases were analysed and assessed following guidance from CIRIA C665, *Assessing Risks Posed by Hazardous Ground Gases to Buildings*, 2007.

3.6 Sampling and Testing

3.6.1 Sampling and Chemical Analysis of Soils

Fifteen disturbed samples of material from beneath the site were collected for laboratory analysis. Samples were taken at regular depths, changes in strata and any discrete horizons with a high potential to retain contaminants and logged in

general accordance with BS14686:2002. Samples were obtained using a fresh pair of nitrile gloves.

Samples scheduled for analysis of organic contaminants were placed in amber bottles with a minimum of headspace. The bottles were immediately sealed with polytetrafluoroethylene (PTFE) lined caps and labelled. The remaining small samples were placed in polypropylene tubs with a minimum of headspace, sealed with airtight polypropylene 'snap-on' lids and labelled. The labels detailed individual sample number, location, depth and sampler identity.

Collected samples were stored away from sunlight in temperature controlled conditions and transported by courier to ALcontrol Laboratories. Chain of custody forms were completed for all samples sent to the laboratory. The forms detailed individual bottle identification number and sample location. The forms were signed on release by the Wardell Armstrong field engineer and upon receipt by the laboratory.

The laboratory analyses scheduled were selected to establish the type, level and distribution of the possible harmful contaminants that may be present on the site given its past and current uses. In order to provide cost effective analysis, solid samples were analysed for a number of determinands depending on depth, matrix and a visual assessment of ground conditions. The analysis scheduled is presented in Table IV.

TABLE IV – Summary of Sample Analysis	
Substance	No. Soil Samples
A standard suite of industrial pollutants including common metals (arsenic, water-soluble boron, cadmium, chromium, chromium ^{VI} , copper, lead, mercury, nickel, selenium, and zinc), pH, total Polycyclic Aromatic Hydrocarbons (PAH), sulphate, sulphide, sulphur, thiocyanate, total cyanide and phenols.	11
Petroleum hydrocarbons (C ₅ – C ₄₀ with aliphatic/aromatic class separation and carbon banding), BTEX, MTBE and speciated PAH (USEPA 16).	4
Total Petroleum Hydrocarbons (TPH).	4
Volatile Organic Compounds (VOCs).	1
Semi-Volatile Organic Compounds (SVOCs).	1
Soluble Sulphate (2:1)	4
Total Organic Carbon (TOC).	4
Asbestos.	4

The results of the chemical analyses are attached at Appendix IV.

3.7 Quality Assurance and Quality Control

The soil and groundwater samples were collected, transferred to the laboratory under chain of custody and analysed to ensure traceability and reliability of analytical results. Based on the laboratory QA data, the analytical results are considered acceptable for interpretative use.

3.8 Limitations of Site Investigation

It should be noted that the interpretation of the results of the physical site investigation is based on a limited number of investigation points. The locations and numbers of the drilled boreholes and windowless sampling boreholes were governed by the physical state of the site and the location of known services at the time of the investigation. Although reasonable inferences have been made during the interpretation, it is possible that variances in the thickness, distribution and physical/chemical characteristics of the strata present will exist.

4. RESULTS OF SITE INVESTIGATION

4.1 Ground Conditions

4.1.1 *Made Ground*

Made Ground was present in 8 window sampling borehole locations on the site (WS103 to WS108 inclusive, WS110, WS111). The made ground on site was present in two horizons and varied in thickness from 0.15m and 0.6m where present. The first horizon of made ground was described as a loose light brown/grey sandy gravel of fine-medium grained sandstone. The second horizon of made ground was described as a loose black sandy gravel which in one location (WS108) was slightly clayey and in another location (WS104) was described as a soft black sandy gravelly clay. The gravel fraction consisted of a number of constituents including brick, concrete, cement, tarmac and clinker. Several of the locations (WS104, WS106, WS107 and WS108) contained ash with occasional traces of coal.

Areas of hardstanding were surfaced completely with rolled tarmac, underlain by concrete, made ground or natural materials.

4.1.2 *Natural Strata*

The natural materials encountered during the intrusive investigation comprised two distinct horizons. The upper layer consisted of a soft to firm, orange mottled grey clay which on occasion was slightly gravelly with the gravel fraction consisting of coal and/or mudstone. This was underlain in all window sampling borehole locations by a very firm to stiff, thinly laminated dark brown/grey clay which was also slightly gravelly on occasion with the gravel fraction comprised of coal and/or mudstone. This was underlain by a weak brown/orange/grey mudstone or a very weak black coal, interpreted as the onset of bedrock.

Rockhead was encountered at all window sampling borehole locations with the exception of WS108. Coal seams were encountered in a number of locations and are described in Section 4.2.

A summary of the strata beneath the site is shown in Table V.

Table V – Summary of strata beneath the site				
Depth to base of strata (mbgl)			Mean Thickness (m)	Typical Description
Max.	Min.	Mean		
0.30	0.10	0.15	0.15	HARDSTANDING
0.70	0.30	0.51	0.40	MADE GROUND
3.40	1.40	2.25	1.80	WEATHERED BEDROCK
*	*	*	*	BEDROCK
* Base of strata not always proven.				

4.2 Shallow Underground Mining

Several window sample boreholes and the two rotary boreholes to 15m bgl encountered an intact coal seam (interpreted as the Two Foot Coal seam) from between 3.40m and 4.60m bgl. The Abdy seam was not identified and no evidence for shallow coal mining was observed. The Eastwood and Partners desk study report indicated that Abdy seam is unlikely to have been worked beneath the site due to stability problems with the overlying shaley mudstones.

4.3 Groundwater

Groundwater was not encountered during the intrusive investigation works.

4.4 Ground Gas

There are several regulatory authorities that require the assessment of ground gas on potentially contaminated sites. The main stakeholders are Building Control, Local Authority Planning and Environmental Health (Contaminated Land Officers). CIRIA have published guidance (C665, 2007) on risk assessment for new buildings and existing structures on ground with potentially hazardous gassing regimes. This guidance indicates that a semi-quantitative risk assessment for ground gas can be completed using Gas Screening Values (GSV) and consideration of the conceptual site model.

Six gas monitoring rounds have been completed over a two month period. Results are discussed in Section 6.6.

4.5 Observations of contamination

No olfactory evidence of contamination was noted in any location during the site investigation. Ash material was present in the made ground in a number of locations and details are presented on the borehole and window sample logs (Appendices II and III).

5. GUIDANCE ON CONTAMINATION RISK ASSESSMENT

The following section aims to assess the potential risk to human health, surface water, groundwater, ecosystems and buildings from contaminated soil and groundwater. The assessment provides information that is fit for purpose given the regulatory context and completed in accordance with UK best practice. A summary of the risk assessment process is presented below. More detailed information on risk assessments is contained in various reports published by the Environment Agency and DEFRA.

5.1 General Soil Contamination Guidance

The Environment Agency (EA) has duties and powers to ensure the protection of groundwater and the remediation of contaminated land and groundwater. In order to achieve this, the EA employs the principle of risk assessment - the risk of a contaminant source causing harm or pollution via a given pathway to an identified receptor. If one of the source-pathway-receptor linkages is not considered to be present then there is no risk. However, if a contaminant source is present and there is a pathway for that contaminant to reach a receptor then there is a risk of harm to the receptor. Therefore, if the source-pathway-receptor linkages are complete, there is a requirement to undertake a risk assessment related to the receptor of concern, be it human health, surface water, groundwater, buildings or other property or ecological issues.

The first stage in the assessment of a site is development of a conceptual model. This is a consideration of all possible sources of contamination on the site, the potential receptors and whether there is a plausible pathway between the two. This allows evaluation of whether further risk assessment for an identified receptor is necessary. The preliminary conceptual model developed for this site has already been discussed in Section 6.

Once plausible receptors have been identified a number of risk assessment models are available including:

- Contaminated Land Exposure Assessment (CLEA) - Human Health;
- Remedial Targets Methodology - Hydrogeological Risk Assessment for Land Contamination;
- ASTM Risk Based Corrective Action (RBCA) - Human Health, Surface Water, Groundwater.

In March 2002 the Environment Agency and the Department of Environment, Food and Rural Affairs (DEFRA) released a package of guidance to assess the health risks posed by contaminated land as part of the statutory framework for contaminated land. The Contaminated Land Exposure Assessment (CLEA) model is a framework for estimating the likely exposure to contaminants in soil as part of the wider approach of the UK's assessment of risk and suitability for use.

The methodology adopted for CLEA builds upon the source-pathway-receptor model for the assessment of risk. Following the CLEA model, generic Soil Guideline Values (SGVs) were developed to act as triggers for intervention in a number of end-use scenarios. The Environment Agency commenced a programme looking at 55 contaminants. The CLEA methodology has been very recently updated and the SGVs have been withdrawn from use (August 2008). New values are not due to be published until early 2009. For the purposes of risk assessment in this report and in the absence of more appropriate screening criteria we have continued to use the SGVs as a measure of significance for contamination.

The CLEA methodology uses a statistical evaluation of all the data collected in order to give an overall impression of the site rather than using individual contaminant values, which may vary dramatically across the site. The statistical tests calculate a normalised upper bound value for the site as a whole and also give an idea of whether a particular value is a statistical outlier (hotspot) or whether it is part of the whole population of samples.

The Soil Guideline Values derived from the CLEA model are intended for use in assessing the risk to long term human users of the site. There is also a requirement to consider the potential for harm from short-term exposure to contaminants at the site, e.g. to construction workers who may be exposed to risk via inhalation of dust or dermal contact with the contaminated material.

Where CLEA guidelines do not encompass contaminants of concern many practitioners rely upon published international screening values such as: the Generic Assessment Criteria (GAC) published by the Chartered Institute for Environmental Health and Land Quality Management; the corrected Dutch Intervention Values (cDIV); United States Environment Protection Agency Preliminary Remediation Goals (USEPA PRG); and the Ecological Soil Screening Levels (Eco-SSL) published by the USEPA. These values also have no legal standing in the UK but, in the absence of more appropriate guidelines, they may give an indication of significance.

6. RESULTS

6.1 Soil Contamination Results

Soil samples taken from the site have been tested for potential chemicals of concern appropriate to the former land uses. As the proposed redevelopment is a Salvation Army meeting hall, the most appropriate end use for assessment is that of 'commercial/industrial'. However, the assessment has also been carried out for residential end use as this use has planning permission and may be required. It is assumed that gardens will not be present. Results from the chemical testing have been evaluated with reference to each of the plausible receptors identified in the conceptual model. The results are evaluated differently for each receptor.

6.2 Human Health - occupiers

As the receptor is human health, the most relevant risk assessment model is the CLEA model. The model estimates child and adult exposures to soil contaminants for those potentially living, working and/or playing on contaminated sites over long time periods and has been used to produce the SGVs for the United Kingdom. Although these SGVs are now withdrawn they are used as a measure of significance in the absence of more relevant guideline values.

The principal pathways of concern for human health are dermal contact, ingestion, and inhalation. Generally, in the assessment of risk to site users, only samples taken in the top 1m are considered as contact with deeper samples is unlikely.

6.2.1 Metals, Semi-metals and Non-metals

Statistical analysis for arsenic, cadmium, copper, chromium, lead, mercury, nickel selenium and zinc was carried out to identify the 95% confidence limits of the measured mean and to compare the upper 95th percentile with the respective SGV/GACs using the mean value test, as outlined in the Environment Agency's R&D Publication CLR7 (now superseded).

Commercial Land Use

The upper bound values (US₉₅) for arsenic, cadmium, copper, chromium, lead, mercury, nickel selenium and zinc were below their respective SGV and GAC. Therefore, it may be considered that the concentrations of these substances in soil on site do not present a significant possibility of significant harm to long-term human health in context of Part IIA of the Environmental Protection Act 1990.

Residential Land Use

The upper bound values (US₉₅) for arsenic, cadmium, chromium, lead, mercury, nickel, selenium and zinc were below their respective SGV/GACs. Therefore, it

may be considered that the concentrations of these substances in soil on site do not present a significant possibility of significant harm to long-term human health in context of Part IIA of the Environmental Protection Act 1990.

The upper bound value (US₉₅) for copper was above its GAC for residential use. Therefore, it may be considered that the concentrations of copper in soil on site may present a significant possibility of significant harm to long-term human health in context of Part IIA of the Environmental Protection Act 1990.

One sample in WS106 (0.2m) recorded elevated arsenic, lead and copper concentrations of 25mg/kg, 550mg/kg and 370mg/kg respectively which slightly exceeded the respective residential screening values of 20mg/kg, 450mg/kg and 111mg/kg.

CLR7 statistical analysis of the laboratory results is attached at Appendix V.

6.2.2 Total Petroleum Hydrocarbons (TPH)

Commercial Land Use

TPH fractions have been compared with GAC values and the maximum recorded concentrations are below their respective screening values for commercial land use. Therefore, TPH contamination of soil is considered unlikely to pose a significant risk to human health given a commercial land use scenario.

Residential Land Use

TPH fractions have been compared with GAC values for residential land use and the maximum recorded concentrations of aliphatic hydrocarbons (C5-C35) and short chain-length aromatic hydrocarbons (C6-C12) are below their respective screening values for commercial land use. However, elevated concentrations of medium chain-length aromatic hydrocarbons (C12-C16) have been recorded in samples WS104 (0.5m), WS105 (0.3m) and WS107 (0.6m) at 13mg/kg, 18mg/kg and 18mg/kg which exceed the GAC of 5.39mg/kg. In addition, elevated concentrations of long chain-length aromatic hydrocarbons (C21-C35) have been recorded in samples WS104 (0.5m) and WS105 (0.3m) at 310mg/kg and 420mg/kg which exceed the GAC of 161mg/kg. Therefore, TPH contamination of soil presents a potentially significant risk to long term human health given a residential land use scenario.

6.2.3 Polycyclic Aromatic Hydrocarbons (PAH) and Semi-Volatile Organic Compounds (SVOC)

Commercial Land Use

None of the samples tested contained concentrations SVOC above the limit of detection (LOD) of 0.1mg/kg. In addition, no visual or olfactory evidence of SVOC contamination was recorded during site investigation works. Therefore,

SVOC contamination is considered unlikely to pose a significant risk to future commercial site occupiers.

The majority of the samples tested contained concentrations of PAH below their respective screening criteria. An exception to this was a sample of made ground from WS104 (0.5m) that contained a slightly elevated total PAH concentration of 48mg/kg, but no speciated data for specific PAH compounds. Although the total PAH concentration is slightly elevated, speciated PAH results from soil samples in the vicinity indicate that the concentration of the most toxic PAH compounds such as benzo(a)pyrene are relatively low and below their respective screening values. Therefore, the PAH concentration recorded in WS104 (0.5m) is not considered to pose a significant risk to long term human health given a commercial land use scenario.

Residential Land Use

None of the samples tested contained concentrations SVOC above their respective screening criteria. In addition, no visual or olfactory evidence of SVOC contamination was recorded during site investigation works. Therefore, SVOC contamination is considered unlikely to pose a significant risk to future residential site occupiers.

The majority of the samples tested contained concentrations of PAH below their respective screening criteria. Exceptions to this are samples of made ground from WS104 (0.5m) that contained a slightly elevated total PAH concentration of 48mg/kg, but no speciated data for specific PAH compounds. Also a sample from WS105 (0.3m) contained an elevated concentration of benzo(a)pyrene at 8.4mg/kg which exceeds its GAC of 1.3mg/kg. These elevated concentrations present a potentially significant risk to long term human health given a residential land use scenario.

6.2.4 Volatile Organic Compounds (VOC)

Commercial Land Use

All samples tested for VOC recorded concentrations at or below their respective limits of detection (LOD) or generic screening criteria. Therefore, these compounds are considered unlikely to present a significant risk to human health given a commercial land use scenario.

Residential Land Use

All samples tested for VOC recorded concentrations at or below their respective limits of detection (LOD) or generic screening criteria. Therefore, these compounds are considered unlikely to present a significant risk to long term human health given a residential land use scenario.

6.2.5 Other Substances

Commercial Land Use

The maximum values for phenol, total cyanide and sulphide were below their respective screening values. Therefore, it is considered unlikely that these substances present a significant risk to human health given a commercial land use scenario.

Residential Land Use

The maximum values for phenol, total cyanide and sulphide were below their respective screening values. Therefore, it is considered unlikely that these substances present a significant risk to long term human health given a residential land use scenario.

6.3 Human Health – Construction Workers

The CLEA Soil Guideline Values only apply to the protection of health for long term chronic exposure. Construction workers are more likely to be at risk from a high single exposure, i.e. an acute dose, which can result in contaminant poisoning. Suggested values for acute lethal doses of arsenic, cadmium, chromium, inorganic mercury, nickel and selenium are outlined in the Environment Agency R&D SGV reports.

None of the samples contained concentrations of cadmium, chromium, inorganic mercury, nickel or selenium that are elevated with respects to an acute lethal dose. No acute lethal dose value is given for lead.

No acute lethal dose value is given for lead. Concentrations of up to 550mg/kg recorded in WS106 0.2m may be significant in terms of an acute lethal dose to construction workers, and as such Appropriate Personal Protective Equipment (PPE) to minimise soil ingestion should be employed when working in these areas.

6.3.1 Asbestos

Four samples were screened for asbestos and no fibres were detected. In addition, no visual evidence of asbestos was recorded during site investigation works. Therefore, asbestos contamination in the ground is considered unlikely to present a significant risk to human health.

It is possible that asbestos containing materials may be present within existing buildings. A Type III asbestos survey should be carried out prior to any demolition of buildings.

6.4 Groundwater and Surface Water

No groundwater was encountered during the investigation. However, it is considered unlikely that a significant risk will be posed to controlled waters from contamination on site. This is due to the distance of the watercourse from the site, the impermeable nature of the underlying strata and the likely existing poor quality of the groundwater as a result of historic industrial activity and coal mining activities.

6.5 Ecology – Future Landscaped Areas

Ecological Soil Screening Levels (Eco-SSL) have been published by the USEPA for a range of metals. The Eco-SSLs present indicative values for assessing potential risk to plants and other ecological receptors. As no relevant UK guidance exists for assessing risk to ecology, the recorded metal concentrations have been compared to Eco-SSLs.

The upper bound values (US₉₅) for arsenic, cadmium, lead and nickel were below the Eco-SSLs for plants. Therefore, it may be considered that these metals do not present a significant risk to plant growth.

The upper bound value (US₉₅) for copper was above the Eco-SSLs for plants. Therefore, it may be considered that the concentrations of copper in soil on site may pose a risk to sensitive plant growth in future garden or landscaped areas.

6.6 Ground Gas

Six gas monitoring rounds have been completed.

No methane was detected at any location during the monitoring visits. High concentrations of carbon dioxide (up to 17.6 %) were detected at one location (WS104). This is considered to be linked with coal seams and/or made ground encountered beneath the site. Flow rates for the boreholes were typically 0.1 l/hr with a peak reading of 3.4 l/hr and barometric pressures ranging from 983mb to 1015mb. Based on the monitoring results a worst case GSV of 0.6 l/hr has been calculated.

Table VI							
Bore-hole	Response Zone/Strata	No. Tests	CO ₂ (%)	CH ₄ (%)	Flow (l/hr)	Atmospheric Pressure (mb)	Depth of Water (m bgl)
WS104	1-3.5m	6	11.4 – 16.9	0	0 – 3.4	983-1015	2.50 – 3.31
WS107	1-4m	4	1.4 – 2.1	0	0 – 0.1	983-1015	1.85 – 1.97

The conceptual site model and gas monitoring data indicates classification as Characteristic Situation 2 (low risk). Therefore, based on results to date the general scope of gas protection measures required is likely to include:

Residential (not low-rise traditional housing with a beam and block floor)

- a) Reinforced concrete cast *in situ* floor slab (suspended, nonsuspended or raft) with at least 1200 g DPM; or
- b) Beam and block or pre-cast concrete and 2000 g DPM reinforced gas membrane; and
- c) All joints and penetrations sealed.

Office / Commercial / Industrial

- a) Reinforced concrete cast *in situ* floor slab (suspended, non-suspended or raft) with at least 1200 g DPM; or
- b) Beam and block or pre cast concrete slab and minimum 2000 g DPM/reinforced gas membrane; and
- c) Possibly underfloor venting or pressurisation in combination with a) and b) depending on use; and
- d) All joints and penetrations sealed.

Gas monitoring results are included at Appendix VI.

6.7 Radon Gas

An initial assessment for radon gas has been carried out. The determination follows the two-stage procedure outlined in *BR211 Radon: Guidance on protective measures for new dwellings (2007 edition)*. The need for basic radon protection measures has been confirmed through the assessment.

Guidance on the installation of protective measures against radon is provided within the *BR211* publication, but is likely to be similar to the ground gas protection measures above.

6.8 Building Materials

6.8.1 Concrete

Concentrations of total sulphate were measured in order to indicate the potential for concrete attack. Concentrations of total sulphate on site ranged between 0.014% and 0.29% indicating that there is potential for concrete attack on site. Results from sulphate (2:1 extract) for materials on site ranged between 0.007g/l and 0.12g/l. These results indicate that a design sulphate class of DS-2 and Aggressive Chemical for Concrete (ACEC) class of AC-2 may be appropriate for

the site. Relevant guidelines are given in BRE Special Digest 1: Concrete in Aggressive Ground.

6.8.2 Water Supply Pipes

Permeation and accelerated deterioration of pipe material can occur due to chemical reactions between the pipe and contaminants in the ground in which it is laid. This can lead to premature failures resulting in leakage and loss of water quality.

The Water Supply (Water Fitting) Regulations 1999 in England and Wales, the Byelaws 2000 in Scotland and the Northern Ireland Water Regulations include a requirement to use only suitable materials when laying water pipes and the laying of unprotected water supply pipes through contaminated land is not permitted.

Based upon recommendations of the Foundation for Water Research guidance notes (FR 0448: Laying potable water pipelines in contaminated ground, 1994), a table of threshold values for various contaminants has been produced. Where soil concentrations exceed these threshold values, it is likely that special consideration of material selection will be required.

Due to the presence of the potentially corrosive and organic contaminants arsenic, PAHs and TPH it is recommended that wrapped iron or polythene/aluminium/polythene (PE/Al/PE) pipe material be used should water supply pipework be installed as part of the redevelopment works.

Further information regarding the selection of materials for water supply pipes is given in the Water Regulations Advisory Scheme Information and Guidance Note No 9-04-03.

7. REVISED CONCEPTUAL SITE MODEL

A preliminary conceptual site model was presented in Section 2. This outlined potential sources, pathways and receptors and was based on information provided by statutory sources and observations during the site visit. As this conceptual model was largely based on desk study information a number of uncertainties in the conceptual model existed. These have been revised and an updated CSM is presented below for potential commercial or residential land use.

7.1 Residential Land Use

TABLE VIII		
SOURCE (CONTAMINANT)	PATHWAY	RECEPTOR
No.1 Made ground present across the site. (minor heavy metals, TPH and PAH compounds)	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Direct contact (aggressive attack).	1. Current occupiers. 2. Future occupiers. 3. Construction workers. 4. Subsurface building materials and plastic service pipes 5. Flora and Fauna.
No.2 Coal seams. (mine gas)	1. Inhalation. 5. Gas migration.	1. Current occupiers. 2. Future occupiers.
No.3 Possible asbestos present in existing buildings	1. Inhalation	1. Current occupiers 2. Future occupiers. 3. Construction workers

7.2 Commercial Land Use

TABLE VII		
SOURCE (CONTAMINANT)	PATHWAY	RECEPTOR
No.1 Made ground present across the site. (minor heavy metals and PAH compounds)	1. Inhalation. 2. Dermal contact. 3. Ingestion. 4. Direct contact (aggressive attack).	3. Construction workers 4. Subsurface building materials and plastic service pipes. 5. Flora and Fauna.
No.2 Coal seams. (mine gas)	1. Inhalation. 5. Gas migration.	1. Current occupiers. 2. Future occupiers.
No.3 Possible asbestos present in existing buildings	1. Inhalation	1. Current occupiers 2. Future occupiers. 3. Construction workers

8. CONCLUSIONS

8.1 General

The site history summarised from a Phase I report dated February 2007 indicates that the site was developed from farmland to be occupied by a cluster of buildings of unknown use from 1892 until 1962. The report noted that the site comprised of a number of small industrial workshops and garages, with a brick wall dividing the site in two. The site was reported to be surfaced with concrete and tarmac.

A total of 11 window sample boreholes (to approximately 4m bgl) and two rotary open-hole boreholes (to a maximum depth of 15mbgl) were completed as part of this Phase II investigation. Observations from the intrusive work have confirmed the presence of made ground between 0.30m and 0.7m thick over the majority of the site, underlain by weathered mudstone.

Eleven soil samples from across the site were tested for a suite of potential chemicals of concern comprising: volatile and semi-volatile organic compounds; aliphatic, aromatic and polyaromatic hydrocarbons; metals and other inorganic elements.

8.2 Human Health

Analytical results were analysed using CLEA methodology to assess the risk to human health.

Commercial Land Use

No concentrations are elevated with respect to human health assessment criteria and there is considered to be no risk to long term human health for commercial land use.

Residential Land Use

There are elevated concentrations of benzo(a)pyrene, long chain-length aromatic hydrocarbons and some heavy metals with respect to human health assessment criteria and there is considered to be a potential risk to long term human health for residential land use.

Construction Workers

Lead was detected at elevated levels. Where possible the groundworks on site should be designed and planned to minimise the exposure of workers to contaminated soil. This should be taken into account in the Health and Safety plan under the CDM regulations. Where risks can not be removed entirely at this planning stage, mitigation measures should include the use of personal protective clothing (PPE) including gloves and respiratory facemasks. Dust suppression measures should also be incorporated into the works to reduce ingestion and

inhalation of contaminated dust. Decontamination facilities should be provided during the site works.

8.3 Surface Water and Groundwater

No groundwater was encountered during the investigation. However, the risk to controlled waters from contamination on site is considered to be low. This is due to the distance of the nearest watercourse from the site, the impermeable nature of the superficial deposits and the likely existing poor quality of the groundwater due to historic industrial activity and mining in the area.

8.4 Buildings and Property

Results from sulphate (2:1 extract) testing indicate that a design sulphate class of DS-2 and Aggressive Chemical for Concrete (ACEC) class of AC-2 may be appropriate for the site.

Six gas monitoring visits have been conducted at the site. No methane was detected during any of the monitoring rounds. However, moderate to high concentrations of carbon dioxide were recorded (up to 17.6% by volume). Based on results, CIRIA C665 indicates that the site should be classified as Characteristic Situation 2. Some gas protection measures will be required as outlined in section 6.6.

An initial assessment for radon gas has been carried out. The assessment indicates that basic radon protection will be required for new residential dwellings. Gas precautions for dealing with carbon dioxide emissions from the ground should also be sufficiently protective against radon.

A Type III asbestos survey will need to be carried out prior to demolition of any buildings.

8.5 Ecology

The phytotoxic metals arsenic, cadmium, copper, nickel and lead were analysed against the ECO-SSL values for risk to plants. The results indicated that numerous samples from across the site contain elevated metal concentrations which may hinder sensitive plant growth in planned areas of landscaping.

8.6 Coal Mining

An intact shallow coal seam corresponding to the Two Foot seam was encountered in both rotary boreholes and in nine window sampling boreholes. There was no evidence of voids or broken ground, such as loss of flush, which may have indicated the presence of shallow workings. The Abdy seam is deeper than 15m bgl and is considered unlikely to have been worked in the vicinity. It is also considered that the Abdy seam (and Top Beamshaw) are likely to be sufficiently deep not to have a physical effect on the surface of the site should it

have been worked. Given the historical evidence, limited thickness and quality of the Two Foot Coal, very shallow depth over parts of the site and nature of the seam in the boreholes, we are satisfied that no significant old workings are present and no surface instability is likely to occur. Therefore shallow coal mining is not considered to present a significant risk.

Should coal be encountered in any shallow foundation excavations it should either be excavated out or adequately blinded with limestone chippings and/or concrete to reduce the risk of spontaneous combustion.

9. RECOMMENDATIONS

9.1 Commercial Land Use (Salvation Army Hall)

No further site investigation work is considered necessary. Precautions should be taken to protect construction workers from low levels of contamination in the soils during redevelopment works.

Minimal gas protection measures will be required as discussed in section 6.6. These measures will also provide protection against radon gas.

Should landscaped areas be proposed it would be prudent to supply clean topsoil to ensure adequate plant growth.

Consideration of ground conditions will be required when selecting concrete materials and any new service pipes.

Should coal be encountered in any shallow foundation excavations it should be excavated out or adequately blinded with limestone chippings and/or concrete to reduce the risk of spontaneous combustion.

A Type III Asbestos survey will be required prior to demolition of buildings.

9.2 Residential Land Use Without Gardens

Results from the investigation indicate isolated 'hot-spots' with elevated TPH, benzo(a)pyrene and heavy metal concentrations. The recorded concentrations may pose a significant risk to long term human health if the site were redeveloped for residential use.

In the first instance, it is recommended that further site investigation is carried out to try and constrain areas of contamination. Depending on the sizes of the areas the most cost effective remediation method can be determined. The results could be utilised to increase the value of the screening criteria used by carrying out a Detailed Quantitative Risk Assessment to obtain a site specific screening value. This is unlikely to remove the need for remediation at the site but may reduce the volumes of soil to be treated.

Alternatively, it may also be possible to simply remove the pathway between the contamination and site users by capping the made ground with significant hardstanding cover. This would be subject to approval by the local planning authority and would need to demonstrate that no risk to other receptors (ecology, controlled waters etc) remains.

It should be noted that the assessment was carried out assuming gardens would not be present. If gardens are proposed the assessment would have to be re-visited.

Minimal gas protection measures will be required as discussed in section 6.6. These measures will also provide protection against radon gas.

Should landscaped areas be proposed it would be prudent to supply clean topsoil to ensure adequate plant growth.

Consideration of ground conditions will be required when selecting concrete materials and any new service pipes.

Should coal be encountered in any shallow foundation excavations it should be excavated out or adequately blinded with limestone chippings and/or concrete to reduce the risk of spontaneous combustion.

A Type III Asbestos survey will be required prior to demolition of buildings.



APPENDIX I

Standard Terms and Conditions and Limitations to Reports

STANDARD TERMS AND CONDITIONS AND LIMITATIONS TO REPORTS

This report is provided for the stated purpose and for the sole use of the client. It is confidential to the client and his professional advisors and cannot be shown to any other party without prior written consent. Wardell Armstrong LLP accepts no responsibility whatsoever to any person other than the client.

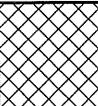
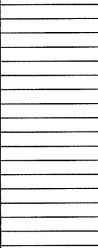
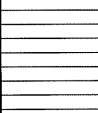
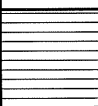
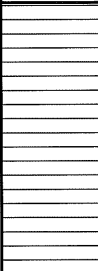
The findings of this report are based upon information relating to the property supplied by the client or their agents. The information has been accepted and used in good faith and unless otherwise stated, no attempt has been made to verify the information supplied. Should any of these factors or information change then the conclusions of the report may need to be amended. The information supplied is detailed at Appendix III along with details of the other published and archive sources of information used in the preparation of the report.

The opinions and findings of this report are given without the benefit of any physical site investigation, sampling and testing. A walk over site visit has been carried out.

The findings and recommendations are considered to be valid and appropriate at the time of preparation and for the specific purpose or purposes intended. Wardell Armstrong LLP will not be liable if any findings are used by third parties, without the written agreement of the company, or if an interpretation is made and action taken without further consultation.

APPENDIX II

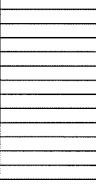
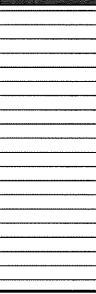
Borehole Logs

BOREHOLE LOG				Client: SALVATION ARMY Job No: SH10209 Logged by: G PILKINGTON Date logged: 07.08.08		Contractor: GSS (UK) LTD Rig: SM 14 Method: Date drilled: 07.08.08		Ground level: Co-ordinates:		Borehole No. BH1 Sheet No. 1 OF 1	
FROM (m)	TO (m)	SAMPLE No.	SAMPLE TYPE:	STRENGTH TEST RECORDS (N Value/Blow Count)	SCALE	DEPTH (m)	SYMBOLIC LOG	GEOLOGICAL SUMMARY			
					0	0.00		MADE GROUND.			
					1	1.40		Brown CLAY.			
					2	2.00		Soft MUDSTONE.			
					3	3.40		COAL.			
					4	4.60		Grey MUDSTONE.			
					5						
					6						
					7						
					8	8.00		Black MUDSTONE.			
					8.40						
					9			Brown silty MUDSTONE.			
					10	10.10		Grey silty MUDSTONE.			
					11	11.40		Grey MUDSTONE.			
					12						
					13						
					14						
					15	15.00					
					16						
					17						
					18						
					19						
					20						

Comments



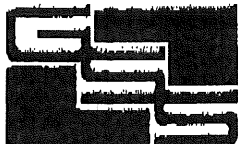
Wardell Armstrong
Engineering & Environmental Solutions

BOREHOLE LOG				Client: SALVATION ARMY Job No: SH10209 Logged by: G PILKINGTON Date logged: 08.08.08		Contractor: GSS (UK) LTD Rig: SM 14 Method: Date drilled: 08.08.08		Ground level: Co-ordinates:		Borehole No. BH2 Sheet No. 1 OF 1	
FROM (m)	TO (m)	SAMPLE No.	SAMPLE TYPE.	STRENGTH TEST RECORDS (N Value/Blow Count)	SCALE	DEPTH (m)	SYMBOLIC LOG	GEOLOGICAL SUMMARY			
						0	0.00		MADE GROUND.		
						0.40			Brown CLAY.		
						1	1.80		Grey MUDSTONE.		
						2					
						3					
						3.40			Black MUDSTONE.		
						3.80			COAL.		
						4.60			Grey MUDSTONE.		
						5					
						6					
						7					
						8					
						8.40			Black MUDSTONE.		
						8.80			Brown silty MUDSTONE.		
						10					
						10.40			Grey silty MUDSTONE.		
						11					
						11.60			Grey MUDSTONE.		
						12					
						13					
						14					
						15	15.00				
						16					
						17					
						18					
						19					
						20					

Comments



Wardell Armstrong
Engineering & Environmental Solutions



GROUND SUPPORT SERVICES (UK) LTD
GEOTECHNICAL AND GROUND SUPPORT FOUNDATION SPECIALISTS

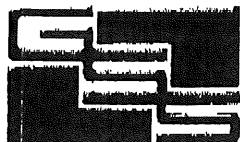
Ivy mount, High Road, Carlton in lindrick, Worksop, Notts, England, S819EB
Phone: 0800 458 6004 Email: drillrig@hotmail.com Fax: 01909 540756

Site Investigation Drillers log			Site: <u>Queens road</u>			Sheet: <u>1 of 1</u>				
Rig: <u>Sm 14</u>			Crew: <u>G. Pilkington M Spalander</u>			Date: <u>7-8-08</u>				
Hours on site:			Travelling Time:							
Equipment used: <u>2 water pumps 1 skip</u>										
BH	Depth	Strata Description	BH	Depth	Strata Description					
move rig and water flush equipment to										
<u>Queens road</u>										
move to BH 1 set up for water flush										
1	000 - 1.40	made ground								
	1.40 - 2.00	Clay brown								
	2.00 - 3.40	mudstone soft								
	3.40 - 4.60	Coal								
	4.60 - 8.00	mudstone grey								
	8.00 - 8.40	mudstone black								
	8.40 - 10.10	mudstone brown								
		silty								
	10.10 - 11.40	mudstone grey								
		silty								
	11.40 - 15.00	mudstone grey								
Backfill BH 1 with bentonite 3 bags										
concrete surface.										
move pumps and skip off site										
Casing / Water level details										
BH	Casing Die	Depth	Strike	Water Rise	Sealed	Totals	BH's	Drill	Case	Core
1	PW	3.00				Today	1	15.00	3.00	
						Previous	-	-	-	
						To date	1	15.00	3.00	

SH10209.

Signed

Driller



GROUND SUPPORT SERVICES (UK) LTD

GEOTECHNICAL AND GROUND SUPPORT FOUNDATION SPECIALISTS

Ivy mount, High Road, Carlton in lindrick, Worksop, Notts, England, S819EB
Phone: 0800 458 6004 Email: drillrig@hotmail.com Fax: 01909 540756

Site Investigation Drillers log			Site: <u>Queens road</u>			Sheet: <u>1 of 1</u>				
Rig: <u>Sm 14</u>			Crew: <u>G. Pilkington M Spolander</u>			Date: <u>8-8-08</u>				
Hours on site:				Travelling Time:						
Equipment used: <u>2 water pumps 1 skip</u>										
BH	Depth	Strata Description	BH	Depth	Strata Description					
<u>move water pumps and skip to site</u>										
<u>move to BH 2</u>										
<u>2</u>	<u>0.00 - 0.40</u>	<u>made ground</u>								
	<u>0.40 - 1.80</u>	<u>Clay brown</u>								
	<u>1.80 - 3.40</u>	<u>mudstone grey</u>								
	<u>3.40 - 3.80</u>	<u>mudstone black</u>								
	<u>3.80 - 4.60</u>	<u>Coal</u>								
	<u>4.60 - 8.40</u>	<u>mudstone grey</u>								
	<u>8.40 - 8.80</u>	<u>mudstone black</u>								
	<u>8.80 - 10.40</u>	<u>mudstone brown</u>								
		<u>silty</u>								
	<u>10.40 - 11.60</u>	<u>mudstone grey</u>								
		<u>silty</u>								
	<u>11.60 - 15.00</u>	<u>mudstone grey</u>								
<u>Backfill Bh 2 with bentonite</u>			<u>3 bags</u>							
<u>Concrete in surface</u>			<u>1 bag cement for</u>	<u>2 holes</u>						
<u>move rig and water flush equipment</u>										
<u>from Queens road.</u>										
Casing / Water level details										
BH	Casing Dic	Depth	Strike	Water Rise	Scaled	Totals	BH's	Drill	Case	Core
<u>2</u>	<u>Pw</u>	<u>2.00</u>				Today	<u>1</u>	<u>15.00</u>	<u>2.00</u>	
						Previous	<u>1</u>	<u>15.00</u>	<u>3.00</u>	
						To date	<u>2</u>	<u>30.00</u>	<u>5.00</u>	

Signed GPP Driller

APPENDIX III

Window Sample Borehole Logs

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS101
Job No: SH10209	
Date: 23/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.05	0.05	TARMAC
0.05-0.25	0.20	CONCRETE
0.25-0.90	0.65	Soft-Firm orange-mottled grey CLAY.
0.90-1.90	1.00	Firm-Stiff thinly laminated grey CLAY.
1.90-2.80	0.90	Very weak black COAL.
2.80-4.00	1.20	Weak orange-grey MUDSTONE.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
---------	-----------	--------

SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS101	0.40	Soil MIDI-PAH, Sol. Sulphate (2:1)

Drilled By: Leger Site Investigations
Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS102
Job No: SH10209	
Date: 23/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.30	0.30	CONCRETE
0.30-1.00	0.70	Soft-Firm orange-mottled grey CLAY.
1.00-1.70	0.70	Stiff thinly laminated grey CLAY.
1.70-2.80	1.10	Very weak black COAL.
2.80-3.00	0.20	Weak grey MUDSTONE.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
---------	-----------	--------

SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS102	0.50	Soil MAXI

Drilled By: Leger Site Investigations
Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS103
Job No: SH10209	
Date: 23/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.10	0.10	TARMAC
0.10-0.35	0.25	MADE GROUND Loose light brown sandy gravel of fine-medium grained sandstone.
0.35-0.95	0.60	Soft-Firm orange-mottled grey CLAY.
0.95-3.40	1.45	Stiff dark grey slightly gravelly CLAY. Gravel of mudstone.
3.40-3.50	0.10	Very weak black COAL.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
---------	-----------	--------

SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS103	0.60	Soil MIDI-PAH

Drilled By: Leger Site Investigations
Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS104
Job No: SH10209	
Date: 23/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.10	0.10	TARMAC
0.10-0.40	0.30	MADE GROUND Loose grey sandy gravel of fine-medium grained sandstone.
0.40-0.60	0.20	MADE GROUND Soft black sandy gravelly clay. Gravel of ash, brick and fine-medium grained sandstone.
0.60-1.10	0.50	Slight hydrocarbon odour. Soft-Firm orange-mottled grey slightly gravelly CLAY. Gravel of coal.
1.10-3.40	2.30	Stiff thinly laminated dark grey slightly gravelly CLAY. Gravel of coal and mudstone.
3.40-3.50	0.10	Very weak black COAL.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
---------	-----------	--------

SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS104	0.50	Soil MIDI-PAH, TPHCWG, TOC, Asbestos
WS104	0.80	TOC

Drilled By: Leger Site Investigations
Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS105
Job No: SH10209	
Date: 23/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.10	0.10	TARMAC
0.10-0.40	0.30	MADE GROUND Loose red grey black sandy gravel of brick, concrete, cement, tarmac and fine-medium grained sandstone.
0.40-1.70	1.30	Firm orange-mottled grey CLAY.
1.70-1.90	0.20	Stiff thinly laminated dark grey CLAY.
1.90-3.40	1.50	Very weak black COAL.
3.40-4.00	0.60	Weak orange grey MUDSTONE.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
---------	-----------	--------

SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS105	0.30	Soil MAXI, TPHCWG, Asbestos
WS105	0.70	Sol. Sulphate (2:1)

Drilled By: Leger Site Investigations
Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS106
Job No: SH10209	
Date: 23/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.15	0.15	CONCRETE
0.15-0.30	0.15	MADE GROUND Loose black sandy gravel of brick, ash, concrete and fine-medium grained sandstone.
0.30-0.80	0.50	Firm orange-mottled grey slightly gravelly CLAY. Gravel of coal.
0.80-1.40	0.60	Stiff thinly laminated dark grey CLAY.
1.40-2.50	1.10	Very weak black COAL.
2.50-3.70	1.20	Weak thinly laminated orange-grey MUDSTONE.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
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SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS106	0.20	Soil MIDI-PAH, Sol. Sulphate (2:1)
WS106	0.60	TOC

Drilled By: Leger Site Investigations
Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS107
Job No: SH10209	
Date: 24/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.10	0.10	TARMAC
0.10-0.50	0.40	MADE GROUND Loose light brown grey sandy gravel of fine-medium grained sandstone.
0.50-0.70	0.20	MADE GROUND Loose black sandy gravel of brick, ash, clinker, coal and fine-medium grained sandstone.
0.70-1.50	0.80	Firm orange-mottled grey CLAY.
1.50-1.80	0.30	Very Firm thinly laminated brown grey CLAY.
1.80-2.80	1.00	Very weak black COAL.
2.80-4.00	1.20	Very weak orange grey MUDSTONE.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
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SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS107	0.60	Soil MAXI, TPHCWG, TOC, Asbestos
WS107	0.90	Sol. Sulphate (2:1)

Drilled By: Leger Site Investigations

Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS108
Job No: SH10209	
Date: 24/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.10	0.10	TARMAC
0.10-0.50	0.40	MADE GROUND Loose light brown sandy gravel of fine-medium grained sandstone.
0.50-0.55	0.05	MADE GROUND Loose black slightly clayey sandy gravel of ash, tarmac, brick and fine-medium grained sandstone.
0.55-1.70	1.15	Firm orange-mottled grey slightly gravelly CLAY with many roots. Gravel of coal and mudstone.
1.70-2.70	1.00	Stiff thinly laminated dark brown CLAY.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
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SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS108	0.80	Soil MIDI-PAH

Drilled By: Leger Site Investigations
Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS109
Job No: SH10209	
Date: 24/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.05	0.05	TARMAC
0.05-0.20	0.15	CONCRETE
0.20-1.00	0.80	Soft-Firm orange-mottled grey slightly gravelly CLAY. Gravel of coal and mudstone.
1.00-2.00	1.00	Very Firm thinly laminated dark brown CLAY.
2.00-3.40	1.40	Weak thinly laminated dark brown/grey MUDSTONE.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
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SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS109	0.50	Soil MAXI, TPHCWG, VOC, SVOC

Drilled By: Leger Site Investigations
Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS110
Job No: SH10209	
Date: 24/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.10	0.10	TARMAC
0.10-0.60	0.50	MADE GROUND Loose grey/light brown sandy gravel of fine-medium grained sandstone and brick.
0.60-1.20	0.60	Soft-Firm orange-mottled grey CLAY.
1.20-1.70	0.50	Stiff thinly laminated dark brown CLAY.
1.70-3.10	1.40	Very weak dark brown/grey MUDSTONE.
3.10-3.70	0.60	Very weak black COAL.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
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SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS110	0.70	Soil MAXI

Drilled By: Leger Site Investigations
Logged By: M Kelly

WARDELL ARMSTRONG LLP

WINDOW SAMPLING

Client: Fowler Sandford	HOLE No:
Site: Land at the rear of 32 Queen's Road, Barnsley	WS111
Job No: SH10209	
Date: 24/07/2008	

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0.00-0.10	0.10	TARMAC
0.10-0.60	0.50	MADE GROUND Loose grey/light brown sandy gravel of fine-medium grained sandstone.
0.60-1.10	0.50	Soft-Firm orange-mottled grey CLAY.
1.10-2.80	1.70	Very Firm-Stiff thinly laminated dark brown CLAY.
2.80-3.90	1.10	Very weak black COAL.
3.90-4.00	0.10	Weak thinly laminated grey MUDSTONE.

IN-SITU SPT TESTS

Test ID	Depth (m)	Values
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SAMPLE DETAILS

Sample ID	Depth (m)	Analysis
WS111	0.80	Soil MIDI-PAH, Asbestos

Drilled By: Leger Site Investigations
Logged By: M Kelly

APPENDIX IV

Geochemical Laboratory Results

ALcontrol Laboratories Analytical Services Sample Descriptions

Job Number: 08/12759/02/01

Client: Wardell Armstrong LLP

Client Ref : SH10209

Grain sizes

<0.063mm Very Fine

0.1mm - 0.063mm Fine

0.1mm - 2mm Medium

2mm - 10mm Coarse

>10mm Very Coarse

[illegible]

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

¹ Sample Description supplied by client

Validated ☒
Preliminary ☐

ALcontrol Laboratories Analytical Services

Table Of Results

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 08/12759/02/01
Client: Wardell Armstrong LLP
Client Ref. No.: SH10209

Matrix: SOLID
Location: QUEENS ROAD
Client Contact: Mike Kelly

Sample Identity	WS101	WS102	WS103	WS104	WS104	WS105	WS105	WS106	WS106	Method Code	LoD/Units
Depth (m)	0.40	0.50	0.60	0.50	0.80	0.30	0.70	0.20	0.60		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sampled Date	23.07.08	23.07.08	23.07.08	23.07.08	23.07.08	23.07.08	23.07.08	23.07.08	23.07.08		
Sample Received Date	25.07.08	25.07.08	25.07.08	25.07.08	25.07.08	25.07.08	25.07.08	25.07.08	25.07.08		
Batch	1	1	1	1	1	1	1	1	1		
Sample Number(s)	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	Method Code	LoD/Units
GRO (C4-C12)	-	-	-	<10	-	<10	-	-	-		
MTBE	-	-	-	<10	-	<10	-	-	-		
Benzene	-	-	-	<10	-	<10	-	-	-		
Toluene	-	-	-	<10	-	<10	-	-	-		
Ethyl benzene	-	-	-	<10	-	<10	-	-	-		
m & p Xylene	-	-	-	<10	-	<10	-	-	-		
o Xylene	-	-	-	<10	-	<10	-	-	-		
Aliphatics C5-C6	-	-	-	<10	-	<10	-	-	-		
Aliphatics >C6-C8	-	-	-	<10	-	<10	-	-	-		
Aliphatics >C8-C10	-	-	-	<10	-	<10	-	-	-		
Aliphatics >C10-C12	-	-	-	<10	-	<10	-	-	-		
Aliphatics >C12-C16	-	-	-	10000	-	10000	-	-	-		
Aliphatics >C16-C21	-	-	-	120000	-	37000	-	-	-		
Aliphatics >C21-C35	-	-	-	580000	-	80000	-	-	-		
Total Aliphatics C5-C35	-	-	-	700000	-	130000	-	-	-		
Aromatics C6-C7	-	-	-	<10	-	<10	-	-	-		
Aromatics >C7-C8	-	-	-	<10	-	<10	-	-	-		
Aromatics >EC8-EC10	-	-	-	<10	-	<10	-	-	-		
Aromatics >EC10-EC12	-	-	-	<10	-	<10	-	-	-		
Aromatics >EC12-EC16	-	-	-	13000	-	18000	-	-	-		
Aromatics >EC16-EC21	-	-	-	63000	-	76000	-	-	-		
Aromatics >EC21-EC35	-	-	-	310000	-	420000	-	-	-		
Total Aromatics C6-C35	-	-	-	390000	-	510000	-	-	-		
TPH (Aliphatics and Aromatics C5-C35)	-	-	-	1100000	-	640000	-	-	-		

All results expressed on a dry weight basis.

Date 13.08.2008

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ISO 17025 accredited

^M MCERTS accredited

* Subcontracted test

» Shown on prev. report

Matrix: SOLID

Location: QUEENS ROAD

Client Contact:Mike Kelly

[illegible]

All results expressed on a dry weight basis.

Date 13.08.2008

☒

- # ISO 17025 accredited
- M MCERTS accredited
- * Subcontracted test
- » Shown on prev. report

Matrix: SOLID
Location: QUEENS ROAD
Client Contact: Mike Kelly

All results expressed on a dry weight basis.

Date 13.08.2008

☒

11

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Matrix: SOLID
Location: QUEENS ROAD
Client Contact: Mike Kelly

[illegible]

Date 13.08.2008



ALcontrol Laboratories Analytical Services Table Of Results

[#] ISO 17025 accredited

^M MCERTS accredited

* Subcontracted test

» Shown on prev. report

Job Number: 08/12759/02/01

Matrix: SOLID

Client: Wardell Armstrong LLP

Location: QUEENS ROAD

Client Ref. No.: SH10209

Client Contact:Mike Kelly

[illegible]

All results expressed on a dry weight basis.

Date 13.08.2008

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ISO 17025 accredited

^M MCERTS accredited

* Subcontracted test

» Shown on prev. report

Matrix: SOLID

Location: QUEENS ROAD

Client Contact: Mike Kelly

All results expressed on a dry weight basis.

Date 13.08.2008

☒

7

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Matrix: SOLID
Location: QUEENS ROAD
Client Contact: Mike Kelly

All results expressed on a dry weight basis.

Date 13.08.2008

☒

1

- # ISO 17025 accredited
- M MCERTS accredited
- * Subcontracted test
- » Shown on prev. report

Matrix: SOLID
Location: QUEENS ROAD
Client Contact: Mike Kelly

All results expressed on a dry weight basis.

Date 13.08.2008

Validated ☒
Preliminary ☐

ALcontrol Laboratories Analytical Services

Table Of Results

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 08/12759/02/01
Client: Wardell Armstrong LLP
Client Ref. No.: SH10209

Matrix: SOLID
Location: QUEENS ROAD
Client Contact: Mike Kelly

Sample Identity	WS107	WS107	WS108	WS109	WS110	WS111						
Depth (m)	0.60	0.90	0.80	0.50	0.70	0.80						
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID						
Sampled Date	23.07.08	23.07.08	23.07.08	23.07.08	23.07.08	23.07.08						
Sample Received Date	25.07.08	25.07.08	25.07.08	25.07.08	25.07.08	25.07.08						
Batch	1	1	1	1	1	1						
Sample Number(s)	19-20	21-22	23-24	25-26	27-28	29-30						
PAHs												
2-Chloronaphthalene	-	-	-	<100	-	-					TM157	<100 ug/kg
2-Methylnaphthalene	-	-	-	<100	-	-					TM157	<100 ug/kg
Phthalates												
Bis(2-ethylhexyl) phthalate	-	-	-	<100	-	-					TM157	<100 ug/kg
Butylbenzyl phthalate	-	-	-	<100	-	-					TM157	<100 ug/kg
Di-n-butyl phthalate	-	-	-	<100	-	-					TM157	<100 ug/kg
Di-n-Octyl phthalate	-	-	-	<100	-	-					TM157	<100 ug/kg
Diethyl phthalate	-	-	-	<100	-	-					TM157	<100 ug/kg
Dimethyl phthalate	-	-	-	<100	-	-					TM157	<100 ug/kg
Other Semi-volatiles												
1,2-Dichlorobenzene	-	-	-	<100	-	-					TM157	<100 ug/kg
1,2,4-Trichlorobenzene	-	-	-	<100	-	-					TM157	<100 ug/kg
1,3-Dichlorobenzene	-	-	-	<100	-	-					TM157	<100 ug/kg
1,4-Dichlorobenzene	-	-	-	<100	-	-					TM157	<100 ug/kg
2-Nitroaniline	-	-	-	<100	-	-					TM157	<100 ug/kg
2,4-Dinitrotoluene	-	-	-	<100	-	-					TM157	<100 ug/kg
2,6-Dinitrotoluene	-	-	-	<100	-	-					TM157	<100 ug/kg
3-Nitroaniline	-	-	-	<100	-	-					TM157	<100 ug/kg
4-Bromophenylphenylether	-	-	-	<100	-	-					TM157	<100 ug/kg
4-Chloroaniline	-	-	-	<100	-	-					TM157	<100 ug/kg
4-Chlorophenylphenylether	-	-	-	<100	-	-					TM157	<100 ug/kg
4-Nitroaniline	-	-	-	<100	-	-					TM157	<100 ug/kg
Azobenzene	-	-	-	<100	-	-					TM157	<100 ug/kg
Bis(2-chloroethoxy)methane	-	-	-	<100	-	-					TM157	<100 ug/kg
Bis(2-chloroethyl)ether	-	-	-	<100	-	-					TM157	<100 ug/kg
Carbazole	-	-	-	<100	-	-					TM157	<100 ug/kg
Dibenzofuran	-	-	-	<100	-	-					TM157	<100 ug/kg
Hexachlorobenzene	-	-	-	<100	-	-					TM157	<100 ug/kg

All results expressed on a dry weight basis.

Date 13.08.2008

☒

1

ISO 17025 accredited

^M MCERTS accredited

* Subcontracted test

» Shown on prev. report

Matrix: SOLID

Location: QUEENS ROAD

Client Contact: Mike Kelly

All results expressed on a dry weight basis.

Date 13.08.2008

☒

1

ISO 17025 accredited

^M MCERTS accredited

* Subcontracted test

» Shown on prev. report

Matrix: SOLID

Location: QUEENS ROAD

Client Contact:Mike Kelly

All results expressed on a dry weight basis.

Date 13.08.2008

☒

11

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Matrix: SOLID
Location: QUEENS ROAD
Client Contact: Mike Kelly

All results expressed on a dry weight basis.

Date 13.08.2008

☒

11

- # ISO 17025 accredited
- M MCERTS accredited
- * Subcontracted test
- » Shown on prev. report

Matrix: SOLID
Location: QUEENS ROAD
Client Contact: Mike Kelly

All results expressed on a dry weight basis.

Date 13.08.2008

ALcontrol Laboratories Analytical Services

Table Of Results - Appendix

Job Number: 08/12759/02/01
Client: Wardell Armstrong LLP
Client Ref. No.: SH10209

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03x10⁻⁷

NDP	No Determination Possible	*	Subcontracted test
NFD	No Fibres Detected	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
PFD	Possible Fibres Detected	EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample ¹	Surrogate Corrected
TM001	In - house Method	Screening of Soils for Fibres			WET	
TM062	MEWAM BOOK 124 1988.HMSO/ Method 17.7, Second Site property, March 2003	Determination of Phenolic compounds by HPLC with electro-chemical detection	✓	✓	WET	
TM068	ASTM D-1552	Total sulphur determination by combustion method	✓		DRY	
TM074	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS. MCERTS Accreditation on Soils for Naphthalene except when Kerosene present.	✓		DRY	
TM074	Modified: US EPA Method 8100	Determination of Polynuclear Aromatic Hydrocarbons (PAH) by GC-MS. MCERTS Accreditation on Soils for Naphthalene except when Kerosene present.	✓	✓	DRY	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)			WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓	✓	WET	
TM098	Method 4500E, AWWA/APHA, 20th Ed., 1999	Determination of Sulphate using the Kone Analyser	✓	✓	DRY	
TM116	Modified: US EPA Method 8260, 8120, 8020, 624, 610 & 602	Determination of Volatile Organic Compounds by Headspace / GC-MS			WET	
TM116	Modified: US EPA Method 8260, 8120, 8020, 624, 610 & 602	Determination of Volatile Organic Compounds by Headspace / GC-MS	✓		WET	
TM116	Modified: US EPA Method 8260, 8120, 8020, 624, 610 & 602	Determination of Volatile Organic Compounds by Headspace / GC-MS	✓	✓	WET	
TM129	Method 3120B, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 3050B	Determination of Metal Cations by IRIS Emission Spectrometer			DRY	
TM129	Method 3120B, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 3050B	Determination of Metal Cations by IRIS Emission Spectrometer	✓	✓	DRY	

¹ Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

ALcontrol Laboratories Analytical Services

Table Of Results - Appendix

Job Number: 08/12759/02/01
Client: Wardell Armstrong LLP
Client Ref. No.: SH10209

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03x10⁻⁷

NDP	No Determination Possible	*	Subcontracted test
NFD	No Fibres Detected	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
PFD	Possible Fibres Detected	EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample ¹	Surrogate Corrected
TM132	In - house Method	ELTRA CS800 Operators Guide	✓	✓	DRY	
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter	✓	✓	WET	
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser	✓		WET	
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the "Skalar SANS+ System" Segmented Flow Analyser			WET	
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the "Skalar SANS+ System" Segmented Flow Analyser	✓	✓	WET	
TM157		Determination of SVOC in Soils by GC-MS extracted by sonication in DCM/Acetone			WET	
TM173		Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID	✓		DRY	
TM180	Sulphide in waters and waste waters 1991 ISBN 01 175 7186 SCA rec. 2007 (unpublished) ¹	The Determination Of Easily Liberated Sulphide In Soil Samples by Ion Selective Electrode Technique	✓		WET	
TM213	In-house Method	Rapid Determination of PAHs by GC-FID			WET	
TM61/89		see TM061 and TM089 for details			WET	

¹ Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.

ALcontrol Laboratories Analytical Services Table Of Results - Appendix

Job Number: 08/12759/02/01
Client: Wardell Armstrong LLP
Client Ref. No.: SH10209

Summary of Coolbox temperatures

[illegible]

APPENDIX V

CLR 7 Statistical Analysis of Geochemical Results

APPENDIX VI

Gas Monitoring Results

WARDELL ARMSTRONG LLP

RECORD OF MEASUREMENTS FOR GAS MONITORING BOREHOLES

Client Name: Fowler Sandford

Date of Sampling: 06/08/2008

Site Name: Land at the rear of 32 Queen's Road

Job Number: SH10209

Borehole Ref.	CH ₄ % by Volume	CO ₂ % by Volume	O ₂ % by Volume	Flow Rate l/hr	Sample Type	Barometric Pressure (mb)	Relative Pressure (mb)	Depth of Water (m bgl)
WS104	0.0	13.1	8.3	0	Acc.	992	+0.05	3.24
WS107	0.0	1.6	19.2	-0.2	Acc.	991	+7.25	1.93

Atmospheric Pressure: As indicated

Instrument Used: Infrared GA 2000

Pressure Trend:

Sample Type: As indicated

Weather: Breezy with broken cloud.

Operator: JW

Notes:	
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WARDELL ARMSTRONG LLP

RECORD OF MEASUREMENTS FOR GAS MONITORING BOREHOLES

Client Name: Fowler Sandford

Date of Sampling: 19/08/2008

Site Name: Land at the rear of 32 Queen's Road

Job Number: SH10209

Borehole Ref.	CH ₄ % by Volume	CO ₂ % by Volume	O ₂ % by Volume	Flow Rate l/hr	Sample Type	Barometric Pressure (mb)	Relative Pressure (mb)	Depth of Water (m bgl)
WS104*	0	16.9	5.1	3.4	Acc.	983	0	3.02
WS107	0	1.5	19.4	0	Acc.	983	11.10	1.85

Atmospheric Pressure: As indicated

Instrument Used: Infrared GA 2000

Pressure Trend: Rising

Sample Type: As indicated

Weather: Cloudy, windy with scattered showers

Operator: KW

Notes:	*WS104 – peak reading in the table, while continuing measuring two other equilibrium noted: - after 1.30 min CH₄=0, CO₂=5.2% and O₂=14.9% - after 3min CH₄=0, CO₂=2% and O₂=18% Final flow reading = 0.1 l/hr.
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WARDELL ARMSTRONG LLP

RECORD OF MEASUREMENTS FOR GAS MONITORING BOREHOLES

Client Name: Fowler Sandford

Date of Sampling: 13/08/2008

Site Name: Land at the rear of 32 Queen's Road

Job Number: SH10209

Borehole Ref.	CH ₄ % by Volume	CO ₂ % by Volume	O ₂ % by Volume	Flow Rate l/hr	Sample Type	Barometric Pressure (mb)	Relative Pressure (mb)	Depth of Water (m bgl)
WS104	0.0	15.9	6.2	-0.1	Acc.	998	-1.28	3.15
WS107	0.0	1.6	18.8	0.1	Acc.	998	+8.0	1.97

Atmospheric Pressure: As indicated

Instrument Used: Infrared GA 2000

Pressure Trend:

Sample Type: As indicated

Weather: Sunny but windy

Operator: JAS

Notes:	
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WARDELL ARMSTRONG LLP

RECORD OF MEASUREMENTS FOR GAS MONITORING BOREHOLES

Client Name: Fowler Sandford

Date of Sampling: 29/07/2008

Site Name: Land at the rear of 32 Queen's Road

Job Number: SH10209

Borehole Ref.	CH ₄ % by Volume	CO ₂ % by Volume	O ₂ % by Volume	Flow Rate l/hr	Sample Type	Barometric Pressure (mb)	Relative Pressure (mb)	Depth of Water (m bgl)
WS104	0.0	12.1	8.1	0.2	Acc.	998	-0.6	3.31
WS107	0.0	2.1	18.9	0.1	Acc.	997	+2.24	1.96

Atmospheric Pressure: As indicated

Instrument Used: Infrared GA 2000

Pressure Trend:

Sample Type: As indicated

Weather: Breezy with broken cloud.

Operator: JW

Notes:	
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