

Bethel Street, Hoyland
Bramall Construction Ltd
Site Investigation Report

Solmek

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Bethel Street, Hoyland

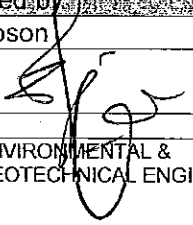
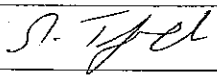
Site Investigation Report

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ENVIRONMENTAL &
GEOTECHNICAL ENGINEERS

SITE INVESTIGATION REPORT

Bethel Street, Hoyland

Site Investigation Report

1 INTRODUCTION

Authorisation

The site investigation described in this report was carried out by Solmek to the instructions of Bramall Construction Ltd on land located off Bethel Street, Hoyland near Barnsley.

Scope of Works

The proposed development comprises the construction of an Extra Care Residential Development. An access road and parking areas are also proposed along with soft landscaping and gardens. A drawing showing the position of the site is included in Appendix A (Figure 1).

The fieldwork and testing was generally carried out according to the recommendations of BS5930: 1999 "Code of Practice for Site Investigations" and all stratum descriptions are as recommended in that publication. The information provided in this report is based on the investigation fieldwork, and are subject to the comments and approval of the various regulatory authorities.

A geotechnical and environmental report, including a soil gas assessment was requested. A desk study was carried out by Solmek (S71203, December 2007) prior to this investigation and should be read in conjunction with this report. A brief summary is provided in Section 3.

There may be other conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report. Solmek reserve the right to alter conclusions and recommendations should further information be available or provided. Any schematic representation or opinion of the possible configuration of ground conditions between exploratory holes is conjectural and given for guidance only and confirmation of intermediate ground conditions should be considered if deemed necessary.



2 SITE DESCRIPTION AND FIELDWORK

The preliminary site inspection, as recommended in BS 5930 and BS 10175, was undertaken on 29th May 2008. The site is centred at the approximate Ordnance Survey Co-ordinates 437560E and 400600N and covers an area of approximately 0.47ha.

The site is an irregular shaped parcel of land and generally lies in a residential setting. There is a slight fall in topography across the site from south west to north east. Access can be gained off both Bethel Street to the south, and Victoria Street which is present to the east. At the time of the walkover, the site comprised a coverage of generally short grass with sporadic patches of more overgrown grass with weeds. Bethel Street is present in the western area, and is generally aligned from south to north off King Street.

The northern boundary of site is marked with a wooden fence that is between 1 and 2m tall in sections. Beyond the northern boundary is a public house and housing with gardens. Within the gardens a row of mature conifer trees are present. The western boundary comprises a 2m tall hedgerow. To the south western part of the boundary, a metal railing fence diverts southwards and encloses an offsite tarmac surfaced yard. This travels along Bethel Street until ending where buildings to the southwest form the remainder of the boundary. The eastern and southern boundaries are open.

Fieldwork

The fieldwork was carried out on 29th May 2008. The extent of the investigation was to provide geotechnical and contamination information based on the drilling of six small percussive boreholes (BH's 1 to 6), with associated sampling, insitu and laboratory testing. Boreholes BH1 and BH4 had to be re-drilled due to an obstruction within the borehole at shallow depth. These were moved and renamed BH1A and BH4A.

Logging of the boreholes was carried out by the drilling supervisor, with part time supervision by an engineer, and samples were taken for both geotechnical and contamination analysis. The samples were logged by an experienced engineering geologist in the soils laboratory. Insitu hand vane testing was undertaken within the underlying deposits along with Standard Penetration Tests (SPT). Soil gas monitoring pipes were installed into BH1A, BH4A and BH5. Gas monitoring was carried out during June 2008.



Descriptions of the strata encountered in the boreholes together with details of sampling and groundwater are presented in Appendix B of this report. A plan showing the location of the boreholes can be found in Appendix A (Figure 2).

3 DESK STUDY SUMMARY

History

The site was initially part of inferred farmland, and developed into a housing estate off Bethel Street in the western area, and Victoria Street; which was just positioned beyond the east of the area. A chapel/church also existed in the southern area of site. The housing was removed from 1980 onwards, and no further developments have taken place on the site.

Geology

Inspection of the published geological data (Sheet 87, Barnsley, Solid and Drift Edition) indicates very limited/negligible drift deposits over solid geology of Kent's Rock, Middle Coal Measures.

The Envirocheck Report states that the site is in an area where between 1 and 3% of homes are above the Action Level as sourced from the Health Protection Agency. No radon protective measures are necessary in the construction of new dwellings or extensions.

A mining report was requested from David Bellis Consulting. The mining report, dated 7th December 2007, stated that there are eight worked seams beneath the site. The shallowest seam is the Barnsley, and was recorded at a depth of 58mbgl having a section of 180cm. The report states that coal is in reserve, however no workings are currently planned. There are no faults or abnormal features related to the site, and there are no recorded shafts or adits within 20m. There are no tips or lagoons in the vicinity. The report states that there are possible ancient coal mining workings within the likely zone of influence on the surface in the vicinity of the property for which no accurate plans or records exist. The report concludes by stating that old workings are present, but all settlement is likely to have completed long ago. There is no evidence of coal mining related subsidence claims in relation to the site in the past 10 years.

Environmental Setting

The solid geology is designated a minor aquifer.

4 GROUND CONDITIONS

A summary of the ground conditions encountered is given below. The borehole logs are presented in Appendix B.

Made Ground

Made ground was encountered in all six boreholes (including BH1 and BH4), and ranged in depth from 0.2mbgl in BH2 to 1.2mbgl in BH4A. The made ground comprised a surface layer of brick rubble, soil and gravel generally over brick rubble and sandstone gravel within clay fill matrix.

Natural Deposits

The underlying natural ground was of mixed strata. Within BH1A natural deposits of very sandy, very clayey gravel overlay a 0.7m thick band of intact coal which was present to 1.8mbgl. Within BH's 3, 4A and 6 deposits of firm and stiff very sandy clay were proven to rockhead at depths of between 1.1m (BH6) and 2.4m (BH3). Within BH5, dense very gravelly, very clayey sand was proven to a depth of 0.9mbgl where rockhead was encountered. Natural ground was not encountered within BH2 as the made ground deposits directly overlies the solid geology. A 200mm thick band of intact coal was encountered at 1.8mbgl in BH4A.

Rockhead

Moderately weak brown sandstone was proven in the base of borehole's 2, 3, 5 and 6 at depths of between 0.2mbgl (BH2) and 2.4mbgl (BH3). Siltstone was encountered within BH1A at 1.8mbgl. Once in the solid geology, the boreholes were progressed a maximum of 1.1m (BH2) before SPT refusal was reached. Refusal was encountered straight away within BH's 4A at the base of the coal band. Rockhead was inferred at obstructions and refusal of the SPT tool within BH's 1 and 4.



Groundwater

Groundwater was not encountered during the fieldwork. During monitoring visits groundwater was recorded in BH1A only; at depths of between 1.51 and 1.60mbgl.

5 CONTAMINATION ANALYSIS & RESULTS

The proposed development is for residential development with associated hardstanding as parking areas. Garden areas and soft landscaping are proposed. Therefore, Soil Guideline Values (SGV) for residential land use with plant uptake have been used in Table 1 below. The SGV are used as part of the CLEA Model as published by DEFRA and the EA. For determinants where no SGV are currently available, EA derived thresholds and LQM CIEM Generic Assessment Criteria thresholds have been used. The LQM CIEM standards are derived from the current CLEA UK Model.

To provide information upon the possibility of ground contamination, six samples of made ground (four shallow and two deeper), were submitted for soil contamination testing. Polyaromatic Hydrocarbon (PAH) and Total Petroleum Hydrocarbon (TPH) testing were carried out on three of the samples. Three samples were subject to leachate testing. Additional pH and sulphate testing was carried out on the natural soils in the geotechnical laboratory. Three samples were also subjected to asbestos analysis. One sample (BH3 0.5-1.0m) was subject to Waste Acceptance Criteria (WAC) testing. The results are provided in full in Appendix C and summarised as Table 1 below.

The samples were tested for a range of potential contaminants, based on Contaminated Land Report 8 – *Potential Contaminants for the Assessment of Contaminated Land* produced by DEFRA and the Environment Agency. This report identifies the most significant risks posed by various potential contaminants, and the most likely contaminants arising from past and current industrial land uses.

Levels of arsenic, copper, zinc and TPH were above the SGV/EA/LQM thresholds within the sample of shallow made ground from BH1A. PAH results were above the relevant guidelines for samples taken from BH's 4A and 5.

Three samples were examined for asbestos presence. In each of the samples no man made fibres were detected.



The results of the leachate analysis were compared with the leachate quality thresholds given by the EA and Drinking Water Standards (Water Supply Regulations 1989). From the three made ground samples subject to leachate testing, it was revealed that generally no samples were raised, with the concentration values recorded below detection limits or threshold values apart from the concentration of cadmium in the sample from BH1A which was just above the threshold value.

Determinant	Units	Number of Samples above Level of Detection	Minimum Level	Maximum Level	Threshold Value	Number of Results Exceeding Threshold Value
Metals						
Cadmium	mg/kg	3	<0.2	1.8	2*	0
Chromium	mg/kg	5	13	55	130*	0
Copper	mg/kg	5	22	337	111 [#]	1
Lead	mg/kg	5	40	368	450*	0
Mercury	mg/kg	1	<0.5	1.6	8*	0
Nickel	mg/kg	5	15	64	50*	1
Zinc	mg/kg	5	56	413	330 [#]	1
Semi metals and non metals						
Arsenic	mg/kg	5	12	40	20*	1
Boron	mg/kg	4	<0.3	0.6	3**	0
Selenium	mg/kg	1	<0.3	0.9	35*	0
Inorganic chemicals						
Cyanide	mg/kg	0	<2	-	25**	0
W.S. Sulphate	mg/l	5	13	41	500***	0
Sulphide	mg/kg	4	<10	79	250**	0
Other						
pH	pH	5	7.3	8.2	<5.5**	0
PAH	mg/kg	3	49	88	50**	2
TPH	mg/kg	3	101	1127	500 ^{##}	1
Phenols	mg/kg	0	<0.5	-	78*	0
Asbestos - no fibres detected						
TABLE 1: SUMMARY OF CONTAMINATION TESTING RESULTS						

* denotes: SGV

** denotes: EA derived thresholds

*** denotes: BRE Special Digest One

denotes: LQM CIEH Generic Assessment Criteria (thresholds from CLEA UK)

denotes: Half special waste paper



Contamination Assessment

A qualitative approach using the statutory definition of Contaminated land, as defined within Section 78A (2) of Part 11A of the Environmental Protection Act (1990), has been adopted. This defines contaminated land as:

"Any land which appears to the local authority in whose area it is situated to be in such a condition by reason of substances in or on or under the land that "Significant harm is being caused or there is a significant possibility of such harm being caused; or pollution of controlled waters is being or is likely to be, caused".

The concept of "significant harm" is dealt with via Government guidance (DETR circular 02/2000 Contaminated Land). The statutory guidance uses the concept of pollutant linkages set out in Section 2.4 of the Circular. Before the local authority can make a judgment on whether "significant harm" and the significant possibility of harm is being caused they are required to identify a "significant pollution linkage". This means effectively that three elements (a source of contamination, a relevant receptor and a pathway) must be present. Without identification of all three elements together, land should not be regarded as "contaminated" in the statutory sense. See Appendix D for additional notes on contamination guidelines.

Conceptual Model and Pollution Linkages

The contamination conceptual model in Table 2 identifies the potential pollution linkages present on site based on source – pathway – receptor relationships.

SOURCES	PATHWAYS	RECEPTORS
Generally low levels of contamination present in shallow made ground apart from in the vicinity of BH1A. History of site indicates previous use as fields followed by housing and a chapel, now demolished.	Dermal absorption	Users of site, adults and child receptors.
	Inhalation of soil/volatised compounds	
	Ingestion of soil	
	Contact with contaminated groundwater	
	Ground gas migration	
	Dermal absorption	Construction Workers
	Inhalation of soil/volatised compounds	
	Ingestion of soil	
	Contact with contaminated groundwater	
	Dermal absorption	Users of surrounding sites
	Inhalation of soil/volatised compounds	
	Ingestion of soil	
	Taken up through roots and foliage	Vegetation, gardens/soft landscaping proposed.
	Direct contact	
	Slow seepage or leaching of contaminants	Groundwater not encountered. Minor aquifer.



	Slow seepage or leaching of contaminants	Surface Water, none in immediate vicinity.
	Accumulation of contaminated sediments	
	Direct contact	Construction Materials

TABLE 2: SUMMARY OF POLLUTION LINKAGES

In general terms, the users of the site, construction workers, users of the surrounding sites, groundwater and construction materials are considered to be **potentially** at risk from contamination in the soils on site as pollution linkages may be present for each receptor. Surface water is considered a lower risk due to the distance from a surface water body.

Users of the Site Once Development is Complete

The users of the site are likely to be exposed to contaminants present in the soils beneath the site, as gardens and soft landscaping are proposed in the final development. **Potential** exposure pathways include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatilised compounds, and inadvertent soil ingestion (or deliberate soil ingestion in the case of some children).

To establish if the levels of contaminants present on site may pose a risk to the health of the future users of the site the results of the contamination testing have been compared to a series of site specific threshold values (see Table 1) based on the CLEA Soil Guideline Values (SGV) for residential with plant uptake land use.

Levels of metals arsenic, copper, nickel, zinc and TPH within the sample of made ground from BH1A are above relevant guidelines. It is assumed that the site will be covered predominantly by the building development, and hardstanding in the form of an access road and driveways. Garden areas may also be incorporated as part of the development. This will cap the site and provide a barrier to any insitu made ground. We recommend that for the majority of the site including the building footprint, access road and parking areas no remediation of the existing ground is required, however it would be prudent to undertake some shallow screening of any deleterious material, such as brick rubble from the made ground in areas of proposed gardens and soft landscaping during the initial site strip.

Given the test results, it would be prudent to import materials for use as garden cover. The clean cover should comprise at least 200mm of topsoil over 300mm of clay subsoil.



The current legislation on waste involves the categorization of materials into inert waste, non reactive hazardous wastes and hazardous wastes. The determination of the category depends on DEFRA landfill directive waste acceptance criteria (WAC). The result of the WAC test undertaken on a sample of the shallow made ground from BH3 proved the made ground here can be classified as non-reactive hazardous waste in accordance with BS EN 12457-3 due to the concentration of Total Organic Carbon content.

If any zones of odorous, brightly coloured or suspected contaminated ground are encountered then work should cease in that area until the material has been tested. The results of the tests will determine whether or not remediation will be required.

Construction Workers and Users of Surrounding Sites

Short term human exposure to contaminants present in soils can occur via several pathways during the construction and ground works phase of the development. These include dermal absorption after contact with contaminated ground, inhalation of soil or dust (including windblown dust), inhalation of volatilised compounds, inadvertent soil ingestion and contact with contaminated groundwater.

Using guidance in the HSE publication *"Protection of Workers and the General Public during the Development of Contaminated Land"*, the made ground can generally be classed as uncontaminated however the levels of arsenic, copper, nickel and zinc in the vicinity of BH1A fall into the contaminated category. Concentrations of sulphide in the majority of the samples fall into the contaminated category. PPE should be employed in accordance with HSE guidance and safeguards should be taken to limit dust during ground works, and limit access to the public.

Vegetation

Plants can be affected by soil contamination in a number of ways resulting in growth inhibition, nutrient deficiencies and yellowing of leaves. Contaminants are taken up by plants through the roots and through foliage. Contaminants identified as being highly phytotoxic include boron, cadmium, copper, lead, nickel, and zinc.

To establish if the levels of contaminants present on site may pose a risk to vegetation the results of the contamination testing have been compared to a series of threshold values published in *'Code of Good Agricultural Practice for the Protection of Soil'*. Following comparison, the levels of the phytotoxic determinants zinc, copper and lead in the vicinity of BH1A are above the threshold



values elsewhere levels were all low and acceptable. Therefore it would be prudent to import clean materials onsite for use as suitable topsoil (200mm) and clay subsoil (300mm) within proposed garden areas.

Groundwater

The principal pathway by which soil contamination may reach the water environment is through a slow seepage or leaching to groundwater or surface water. The potential for contaminants to migrate along such pathways is dependent on the chemical and physical characteristics of the contaminants and the local hydrogeology. The site lies on a minor aquifer.

Given the lack of local surface water receptors along with the lack of groundwater (groundwater in BH1A, only, between 1.51 and 1.60mbgl from monitoring), presence of impermeable clay rich sub strata beneath the made ground and generally low leachate results there appears to be no potential pathway for contamination to migrate to ground and surface water receptors.

Construction Materials

Materials at risk from potential soil contamination include inorganic matrices such as cement and concrete and also organic material; e.g. plastics and rubbers. Acid ground conditions and elevated levels of sulphates can accelerate the corrosion of building materials. Plastics and rubbers are generally used for piping and service ducts and are potentially attacked by a range of chemicals, most of which are organic, particularly petroleum based substances. Drinking water supplies can be tainted by substances that can penetrate piping and water companies enforce stringent threshold values.

BRE Special Digest One: *"Concrete in Aggressive Ground"*. 2005 3rd Edition has been used to assess the risks posed to underground concrete and to establish the design measures required to mitigate the risks. The results of the pH and sulphate tests fall into Class DS-1, ACEC (Class AC-1) requirements for concrete protection. A sample of the natural clay at 1.6mbgl within BH3 proved to be acidic in nature where the ACEC classifies as AC-3z. These assume mobile groundwater conditions.

The levels of potential contaminants detected have been compared to thresholds supplied in the Water Regulations Advisory Scheme Guidance Note 9-04-03 *"The Selection of materials for Water Supply Pipes to be laid in Contaminated Land"*. The thresholds enforced by the various



water authorities vary however. The levels of contaminants in the ground are below the material selection threshold level, except for raised levels of arsenic, pH, PAH and TPH particularly in the vicinity of BH1A. Consultation with the utility providers is recommended. As a minimum services should be placed into clean service corridors.

6 SOIL GAS ASSESSMENT

Ground gases such as carbon dioxide and methane can be classed as a form of contamination where there is a potential risk to human health. As a result, gas monitoring was undertaken on three occasions during June 2008 to confirm the potential risks posed by ground gases. The gas was monitored by measuring emissions from three monitoring points installed in boreholes 1A, 4A and 5 during the site investigation. The results are tabulated in Appendix C. The monitoring was generally carried out in accordance with current guidance provided within CIRIA C665:2007.

The atmospheric pressure has an impact on the concentrations of gas released. Atmospheric pressure ranged between 990 and 1003 millibars during the surveys. This is considered to be average for the time of year, so gas results during the surveys are likely to be representative of normal weather/atmospheric conditions. Falling and rising atmospheric pressure regional trends were noted during the surveys.

Carbon dioxide concentrations were recorded between 0.0 and 3.0% volume, and oxygen levels did not fall below 18.2% volume. Methane was not detected. No significant flows were recorded.

The results obtained have been compared with relevant guidance that includes the following:

- BRE/Environment Agency BR414 (2001) - Protective Measures for housing on gas-contaminated land
- Wilson & Card (1999) - Reliability and Risk in Gas Protection Design
- CIRIA 149 (1995) - Protecting Development from Methane
- CIRIA C665 (2007) – Assessing risks posed by hazardous ground gases to buildings.

The Building Regulations set action levels for both methane and carbon dioxide from which an initial assessment can be made. The action threshold for methane is 1% while for carbon dioxide an initial consideration should be undertaken if gas concentrations exceed 1.5%. Action might be required if carbon dioxide concentrations exceed 5%. If these thresholds are exceeded, reference



should be made to specific documentation to determine the nature and extent of the gas control measures required.

The proposed development involves the construction of residential units, the NHBC Traffic light system, shown in Table 3 has therefore been used to assess the gas regime.

Traffic light classification	Methane		Carbon dioxide	
	Typical max concentration (% v/v)	Gas screening value (litres/hr)	Typical max concentration (% v/v)	Gas screening value (litres/hr)
Green	1	0.16	5	0.78
Amber 1	5	0.63	10	1.56
Amber 2	20	1.56	30	3.13
Red				

TABLE 3: NHBC Traffic Light System (From CIRIA C665)

Using Gas Screening Values (GSV) stated above, the site would be classified as **Amber 1**. Table 4 shows the necessary protective measures.

Traffic light classification	Protection measures required
Green	Gas protection measures not considered necessary.
Amber 1	Gas resistant membrane & ventilated sub-floor void to create permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as per BRE Report 414.
Amber 2	As Amber 1 but membrane should be installed by a specialist contractor; certification of correct installation is also required. Installation & certification 'package' is the ideal way to do this.
Red	Standard residential housing would be unacceptable without further risk assessment.

TABLE 4: NHBC PROTECTION MEASURES

7 CONCEPTUAL MODEL AND RISK ASSESSMENT

The conceptual model (Table 5) collates the salient aspects of the site to form a model. This model identifies the potential pollution linkages that may influence the proposed development and the relevant geological considerations.

SOURCES	PATHWAYS	RECEPTORS	MITIGATION	RISK RATING
History of site indicates previous use as fields followed by housing and chapel. Currently site is cleared of former structures. Mining area Generally low levels of contamination present in shallow made ground apart from in the vicinity of BH1A. Elevated arsenic, copper, nickel, zinc, PAH and TPH contaminants in sample of made ground from BH1A. PAH raised in BH's 4A and 5. Generally low leachate results.	Dermal absorption Inhalation of soil/volatilsed compounds Ingestion of soil Contact with contaminated groundwater	Proposed residential development, children and adults. Permanent and transient residents within the proposed structure.	The site to be capped by the development including residential development and hard cover parking areas. Screen made ground of brick rubble in proposed garden areas and place beneath hardcover otherwise remove from site to approved tip.	LOW
Coal mining area No methane recorded CO₂ 0.0%-3.0% O₂ above 18.2% No flow rates No radon protection measures required.	Ground gas migration. Made ground over low permeable clay onto siltstone and sandstone.	Proposed residential areas, children and adults. Permanent and transient residents within the proposed structure.	NHBC Traffic Light System = Amber 1. Basic protection measures necessary.	LOW /MOD
Generally low levels of contamination present in shallow made ground apart from in the vicinity of BH1A. Elevated arsenic, copper, nickel, zinc, PAH and TPH contaminants in sample of made ground from BH1A. Levels of sulphide generally classed as contaminated. Generally low leachate results.	Dermal absorption Inhalation of soil/volatilsed compounds (dust) Ingestion of soil Contact with contaminated groundwater	Construction workers.	Made ground on site classed as contaminated in vicinity of BH1A Appropriate PPE should be employed as a matter of course. Gloves to be worn in contact with ash material. Limit dust during ground works and demolition.	LOW
Generally low levels of contamination present in shallow made ground apart from in the vicinity of BH1A. Elevated arsenic, copper, nickel, zinc, PAH and TPH contaminants in sample of made ground from BH1A. Generally low leachate results.	Dermal absorption Inhalation of soil/volatilsed compounds (dust) Ingestion of soil	Surrounding areas comprise residential areas.	Damping down of site in dry/windy conditions and limit access by the public.	LOW
Generally low levels of contamination present in shallow made ground apart from in the vicinity of BH1A. Elevated arsenic, copper, nickel, zinc, PAH and TPH contaminants in sample of made ground from BH1A. PAH raised in BH's 4A and 5. Generally low leachate results.	Uptake via roots and leaf surfaces	Soft landscaping and garden areas.	Screen made ground of ash and brick rubble and place beneath hardcover. Import clean topsoil and subsoil for garden/soft landscaped areas.	LOW
Generally low levels of contamination present in shallow made ground apart from in the vicinity of BH1A.	Seepage or leaching of contaminants.	Surface Water. None within vicinity	The site to be capped by the development including residential units and hard	LOW



Generally low leachate results. Elevated arsenic, copper, nickel, zinc, PAH and TPH contaminants in sample of made ground from BH1A. PAH raised in BH's 4A and 5. Generally low leachate results.	Made ground over low permeable clay onto sandstone and siltstone. Accumulation of contaminated sediments in water body.	of the site.	cover parking areas. Significant clay head. Generally low leachate contamination results.	
Generally low levels of contamination present in shallow made ground apart from in the vicinity of BH1A. Elevated arsenic, copper, nickel, zinc, PAH and TPH contaminants in sample of made ground from BH1A. Generally low leachate results.	Seepage or leaching of contaminants Made ground over low permeable clay onto limestone.	Groundwater None encountered during fieldwork. Groundwater recorded between 1.51 and 1.6mbgl in BH1A during monitoring Minor aquifer.	Site to be capped by the proposed development. No surface water receptors in the vicinity. Generally low leachate contamination results. Localised groundwater potentially perched around BH1A.	LOW
Generally low levels of contamination present in shallow made ground apart from in the vicinity of BH1A. Elevated arsenic, pH, PAH and TPH contaminants in sample of made ground from BH1A. Generally low leachate results.	Contact with contaminated soil/deleterious material.	Construction Materials and service fabrics	Class DS-1, AC-1 locally AC-3z Services potentially at risk from raised arsenic, pH, PAH and TPH. Consultation with utility providers recommended.	LOW /MOD

TABLE 5: CONCEPTUAL MODEL AND RISK ASSESSMENT

8 GEOTECHNICAL TESTING

Samples taken from the boreholes underwent a series of geotechnical tests according to BS 1377:1990. The geotechnical results are presented in Appendix C.

Triaxial testing was undertaken on three samples of natural clay from depths of between 0.8 and 1.6mbgl, these were supplemented by insitu hand vanes in the boreholes. The cell pressures represent the soil conditions at the depth the sample was taken. The results of the triaxial testing indicate C_u values of between 54 and 97kN/m². This range of results is indicative of firm to stiff clay. The insitu hand vanes through the strata profile were higher, between 72 and 95kN/m², indicating stiff conditions.

Due to the sand and gravel content of the natural clays across the site, it was not possible to undertake any Atterberg Limit testing. Therefore particle size distribution testing was carried out on five samples of natural materials. The results varied and were presented as very sandy, very clayey gravel, slightly clayey sand, very sandy clay or sandy gravelly clay.



Five samples of soil were tested for their acidity and soluble sulphate content to assess whether the natural soils may be potentially aggressive to building fabric. The results of the testing for pH ranged from 4.9 (acidic) to 7.6 (slightly alkaline), soluble sulphates were between 45 and 128mg/l.

9 CONCLUSIONS

The proposed development comprises the construction of a three to four storey residential building. An access road serving the development and areas of hardstanding/parking are also proposed together with garden areas.

Foundations

The site comprises made ground of topsoil with brick rubble and gravel fill to depths of between 0.2 and 1.2mbgl. Where encountered under the made ground, relatively thin natural deposits comprised dense gravel or sand, coal and firm or stiff clay. This drift overlies moderately weak sandstone rockhead which was proven in the base of borehole's 2, 3, 5 and 6 at depths of between 0.2mbgl (BH2) and 2.4mbgl (BH3). Siltstone was encountered within BH1A at 1.8mbgl. Groundwater was not recorded during the fieldwork but was proven between 1.51 and 1.60mbgl in BH1A during the monitoring visits.

The proposed development is to be of three and four storey construction. Structural loads are assumed to be moderate.

Based on the evidence of the fieldwork and testing results, it appears likely that deeper made ground will be encountered at foundation depth within boreholes in the north eastern part of the site (BH's 3 and 4A) which is underlain with natural firm and stiff clays. It would be prudent to deepen the foundations in this area. Using an average shear strength of 74kN/m^2 for the clay here, for strip footing foundations of 0.6m width at a depth of 1.2mbgl, an allowable bearing pressure of 175kN/m^2 has been calculated.

Dense granular deposits of gravel or sand were present under the made ground in boreholes sunk in the north west and south eastern parts of the site. Settlements on the dense granular deposits in these areas will be less than 25mm for 0.6m wide strip footings.



Stiff clay was again present under the made ground in the western part of the site although it is understood that parking areas are proposed here.

In the south east rockhead underlies the made ground. It would therefore be prudent to extend foundations to competent underlying sandstone rockhead in this case. It would be practical to use traditional strip foundations and taking into account the SPT N values a bearing capacity of at least 250kN/m^2 can be given for 0.6m wide footing at a those depths.

Prior to placing any foundation concrete all exposed formations should be well compacted and any obvious soft/loose spots should be removed and replaced with hardcore. Furthermore, all excavations should be inspected to ensure that they fully penetrate any areas of disturbed ground.

Where the made ground is less than 600mm thick a ground floor slab can be used. Areas in excess of 600mm would require a suspended reinforced ground slab or precast concrete floor.

Excavation and Groundwater

Based on the borehole records, excavations down to foundation depth would encounter made ground comprising topsoil brick rubble and gravel fill over varying natural deposits of dense sandy gravel or firm or stiff clay onto sandstone rockhead.

Stability of excavations is considered to be poor in the made ground but good in the natural clay, shoring will be required in deep excavations particularly if they are required to be left open for long periods and during inclement weather conditions. Excavation sides should be designed, constructed and supported in accordance with the recommendations given in CIRIA Report No. 97.

Groundwater was not encountered during the fieldwork. During monitoring visits groundwater was recorded in BH1A only; at depths of between 1.51 and 1.60mbgl. Dewatering is unlikely to be required in shallow excavations. However, it should be noted that groundwater conditions can reflect seasonal climatic variations and can vary as a result of local dewatering schemes and abstractions.

Sulphate Results

No pyritic soils were noted during the fieldwork and pH values were acidic to slightly alkaline with no elevated soluble sulphates recorded. Based on these results, Design Sulphate Class DS-1 should be appropriate and assuming mobile groundwater conditions the Aggressive Chemical Environment for Concrete (ACEC) assessment for the site should be taken as AC-1, as prescribed in current BRE Special Digest 1. A sample of the natural clay at 1.6mbgl within BH3 proved to be acidic in nature where the ACEC classifies as AC-3z for mobile groundwater conditions.

Contamination Analysis

Levels of metals arsenic, copper, nickel, zinc and TPH within the sample of made ground from BH1A are above relevant guidelines. Elsewhere raised PAH was recorded in the areas of BH's 4A and 5. It is assumed that the site will be covered predominantly by the building development, and hardstanding in the form of an access road and driveways. Garden areas may also be incorporated as part of the development. This will cap the site and provide a barrier to any insitu made ground. We recommend that for the majority of the site including the building footprint, access road and parking areas no remediation of the existing ground is required, however it would be prudent to undertake some shallow screening of any deleterious material, such as brick rubble from the made ground in areas of proposed gardens and soft landscaping during the initial site strip.

Given the test results, it would be prudent to import materials for use as garden cover. The clean cover should comprise at least 200mm of topsoil over 300mm of clay subsoil.

The current legislation on waste involves the categorization of materials into inert waste, non reactive hazardous wastes and hazardous wastes. The determination of the category depends on DEFRA landfill directive waste acceptance criteria (WAC). The result of the WAC test undertaken on a sample of the shallow made ground from BH3 proved the made ground here can be classified as non-reactive hazardous waste in accordance with BS EN 12457-3.

If any zones of odorous, brightly coloured or suspected contaminated ground are encountered then work should cease in that area until the material has been tested. The results of the tests will determine whether or not remediation will be required.



The potential risks to groundwater, surface water, vegetation, construction workers and surrounding areas have been assessed as low. The potential risks to vegetation through garden and soft landscaped areas can be considered low provided that a clean cover as detailed earlier is implemented.

Road and Pavement Design

It is likely that the formation level for the access road and areas of hardstanding will either comprise made ground or granular deposits of weathered sandstone. An equilibrium CBR value of 2% should be assumed for the design of parking areas, roads and pavements where made ground is encountered. Where weathered granular deposits are encountered, compaction in accordance with the Specification for Highway Works is recommended.

Ground Gas

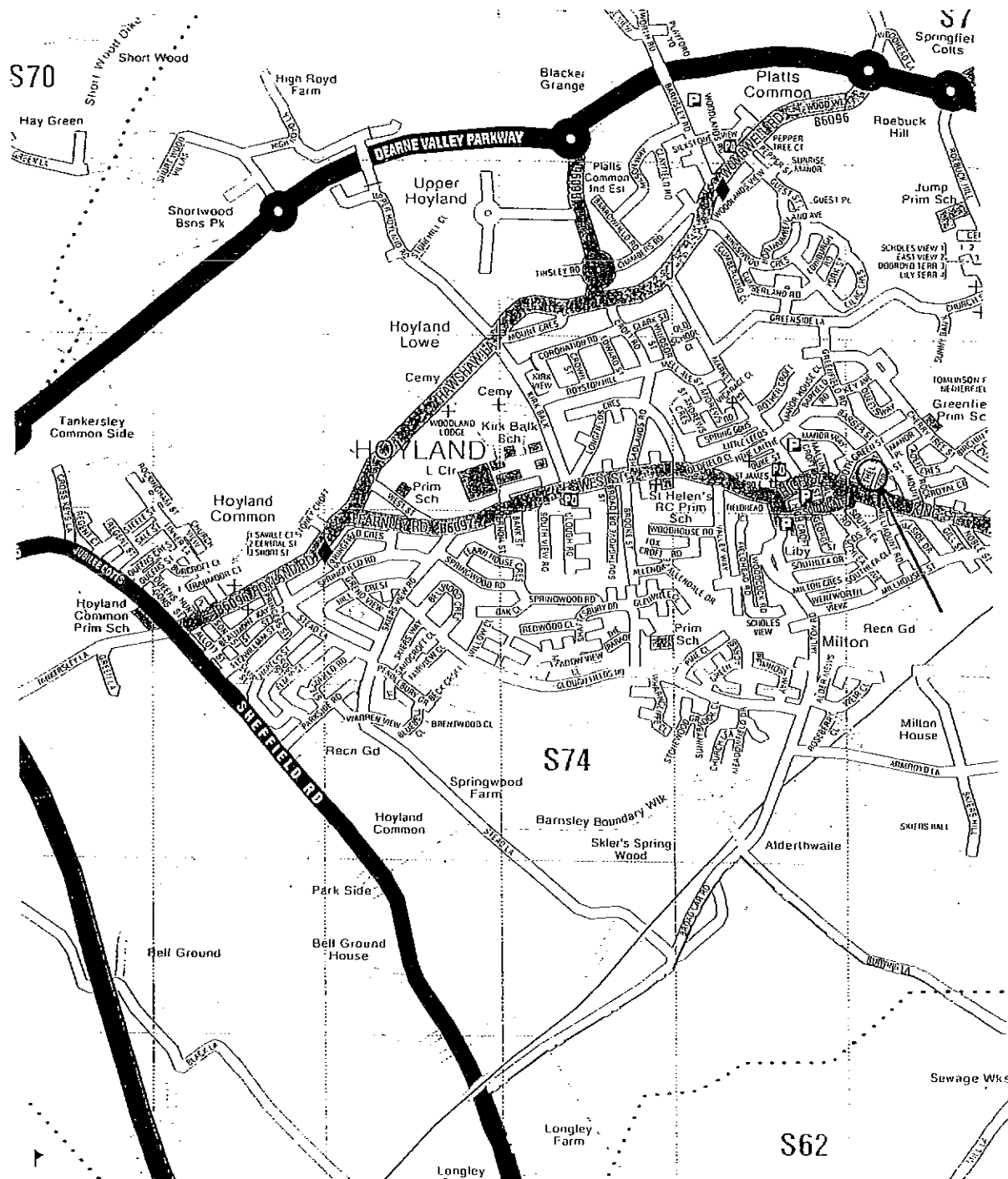
The gas levels accord with the NHBC Traffic Light Classification of Amber 1. Gas protection measures are necessary in accordance with CIRIA C665, 2007.

The Envirocheck Report states that no radon protective measures are required in the construction of new buildings.

SOLMEK



APPENDIX A



CLIENT: Bramall Construction

PROJECT: Bethal Street, Hoyland

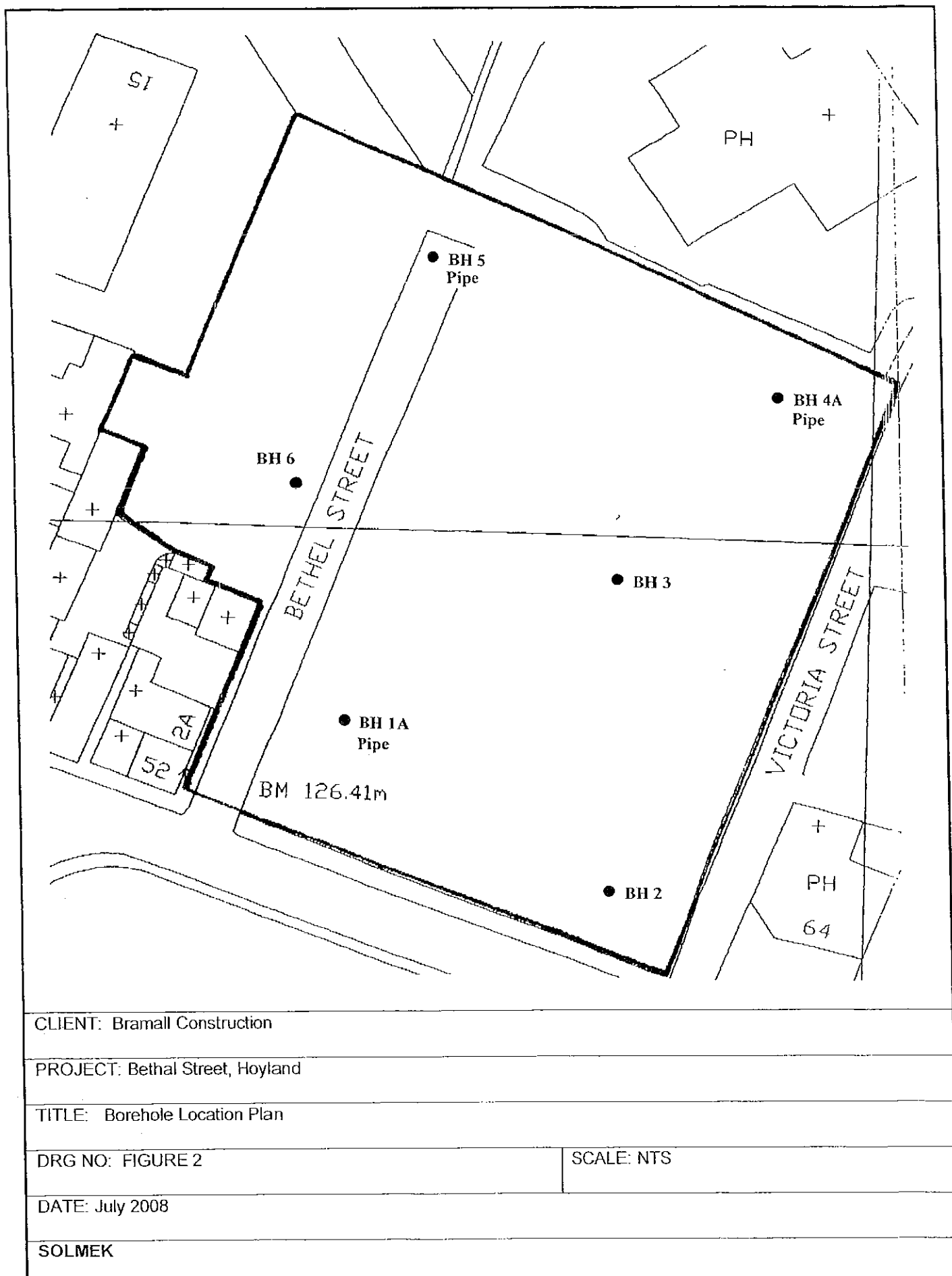
TITLE: Site Location Plan

DRG NO: FIGURE 1

SCALE: NTS

DATE: July 2008

SOLMEK



APPENDIX B

Tel 01642 607083
Fax 01642 612355

Project Bethel Street, Hoyland				BOREHOLE No BH1
Job No S80517	Date 29-05-08	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet 1 of 1

[illegible]

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered.

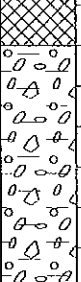
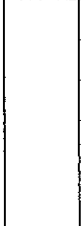
All dimensions in metres Scale 1:18.75	Client Bramall Construction	Method/ Plant Used	Logged By RJH
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GRD_BOREHOLE_LOG S80517.GPJ AGS3_ALL.GDT 09/07/08

BOREHOLE LOG

Tel 01642 607083
Fax 01642 612355

Project Bethel Street, Hoyland				BOREHOLE No BH1A	
Job No S80517	Date 29-05-08	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.20	D	95kpa				(0.20) 0.20	MADE GROUND. Soil, brick rubble and gravels.		
0.20-0.50	D					(0.30) 0.50	MADE GROUND. Brick rubble, gravels, sandstone fragments and clay.		
0.50-1.00	D					(0.60) 1.10	Dense brown and grey mottled very sandy very clayey GRAVEL with weathered sandstone fragments.		
1.00	HV	N=50 for 300mm				(0.70) 1.80	COAL		
1.10-1.80	D					(0.50) 2.30	Dense grey brown weathered SILTSTONE.		
1.80-1.90	D								
2.00	SPT								

GRD BOREHOLE LOG S80517.GPJ AGS3 ALL GDT 08/07/08

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered. Pipe at 2.00m.
All dimensions in metres Scale 1:18.75			Client Bramall Construction			Method/ Plant Used			Logged By RJH		

BOREHOLE LOG

Project Bethel Street, Hoyland				BOREHOLE No BH2	
Job No S80517	Date 29-05-08	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.00-0.20	D					(0.20) 0.20	MADE GROUND. Soil, brick rubble and gravels.		
0.20-0.50	D						Medium dense to dense highly weathered SANDSTONE.		
0.50-1.00	D					(1.10)			
1.00	SPT	N=50 blows for 300mm				1.30			

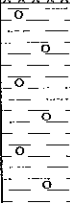
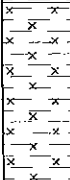
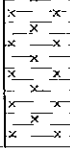
Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered.

All dimensions in metres Scale 1:18.75	Client Bramall Construction	Method/ Plant Used	Logged By RJH
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GRD_BOREHOLE_LOG_S80517.GPJ AGS3 ALL GDT 09/07/08

BOREHOLE LOG

Project Bethel Street, Hoyland				BOREHOLE No BH3	
Job No S80517	Date 29-05-08	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.00-0.30	D	72kpa				(0.30)	MADE GROUND. Soil, a little brick rubble and gravels.		
0.30-0.50	D					0.30 (0.20)	MADE GROUND. Brick rubble, gravels. sandstone fragments and clay.		
0.50-1.00	D					0.50 (0.60)	MADE GROUND. Dark brown sandy clay with gravels.		
1.00	HV	95kpa				1.10 (0.50)	Firm black very sandy CLAY with some fine angular gravel.		
1.10-1.60	D					1.60 (0.80)	Stiff brown and grey mottled sandy silty CLAY with weathered sandstone fragments.		
1.60-2.00	D					2.40			
2.00-2.20	D	N=50 blows for 200mm							
2.00	HV								
2.20	SPT								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered.
All dimensions in metres Scale 1:18.75			Client Bramall Construction			Method/ Plant Used			Logged By RJH		

GRD BOREHOLE LOG S80517.GPJ AGS3 ALL GDT 09/07/08

Tel 01642 607083
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Tel 01642 607083
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SRD_BOREHOLE_LOG S80517 GPJ AGS3_ALL.GDT 09/07/08

BOREHOLE LOG

Project Bethel Street, Hoyland				BOREHOLE No BH4A	
Job No S80517	Date 29-05-08	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.00-0.20	D	N=15				(0.20) 0.20	MADE GROUND. Soil, a little brick rubble, sandstone and gravels.		
0.20-0.50	D						MADE GROUND. Medium dense brick rubble, sandstone, clay and gravels.		
0.50-1.00	D					(1.00)			
1.00-1.20	D	N=50 blows for 100mm				1.20	Stiff brown and grey mottled sandy CLAY with weathered sandstone fragments.		
1.00	SPT					(0.60)			
1.20-1.80	D					1.80			
1.80-1.90	D	N=50 blows for 100mm				(0.20)	Dense COAL.		
1.90	SPT					2.00			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpl	From	To	Hours	From	To	
											No groundwater encountered. Pipe at 1.90m.
All dimensions in metres Scale 1:18.75			Client Bramall Construction			Method/ Plant Used			Logged By RJH		

GRD_BOREHOLE_LOG_S80517.GPJ AGS3 ALL GDT 09/07/08

BOREHOLE LOG

Project Bethel Street, Hoyland				BOREHOLE No BH5	
Job No S80517	Date 29-05-08	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.00-0.30	D						MADE GROUND. Soil, a little brick rubble, sandstone and gravels.		
0.30-0.70	D					(0.70)			
0.70-0.90	D					0.70			
0.90-1.00	D					(0.20)	Dense brown and grey mottled very gravelly very clayey SAND (weathered sandstone).		
1.00	SPT	N=50 blows for 200mm				0.90			
						(0.30)	Dense highly weathered SANDSTONE.		
						1.20			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered. Pipe at 1.00m.
All dimensions in metres Scale 1:18.75			Client Bramall Construction			Method/ Plant Used			Logged By RJH		

GRD BOREHOLE LOG S80517.GPJ AGS3 ALL GDT 09/07/08

BOREHOLE LOG

Project Bethel Street, Hoyland				BOREHOLE No BH6	
Job No S80517	Date 29-05-08	Ground Level (m)	Co-Ordinates Q		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geo.ogy	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.00-0.20	D						MADE GROUND. Soil with a little brick rubble, sandstone and gravels.		
0.20-0.50	D					(0.50)			
0.50-0.80	D					0.50			
						(0.30)	MADE GROUND. Dark brown grey sandy clay with gravels and coal.		
						0.80			
						(0.30)	Stiff brown and grey mottled sandy gravelly CLAY.		
1.00-1.20	D					1.10			
1.00	SPT	N=15							
1.20-1.80	D					(0.30)	Dense highly weathered SANDSTONE.		
						1.40			
1.80-1.90	D								
1.90	SPT	N=50 blows for 100mm							

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											No groundwater encountered.

All dimensions in metres Scale 1:18.75	Client Bramall Construction	Method/ Plant Used	Logged By RJH
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GRD BOREHOLE LOG S80517.GPJ AGS3 ALL GDT 09/07/08

APPENDIX C

(B.S. 1377 : PART 2 : 1990)

Sheet 1 of 1.

*: Liquid Limit and Plastic Limit Wet Sieved.

SYMBOLS: NP: Non Plastic

SOLMEK 

Compiled by	Date	Checked by	Date	Approved by	Date
<i>I. mid-Season</i>	27/06/2008	<i>I. mid-Season</i>	27/06/2008		
BETHEL STREET, HOYLAND, SOUTH YORKSHIRE				Contract No: S80517	
				Client Ref:	

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

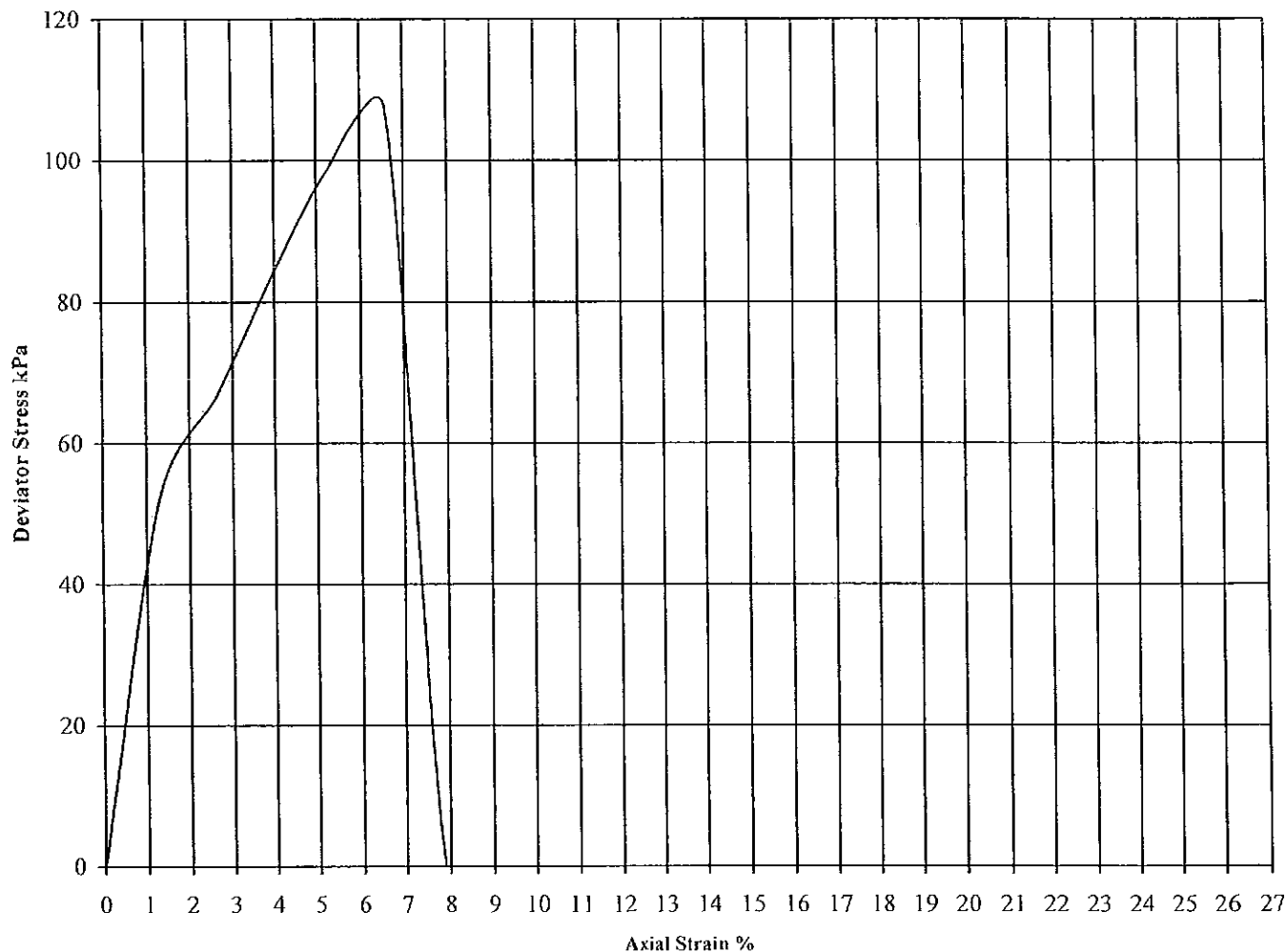
B.S. 1377 : Part 7 : Clause 9 : 1990

Hole Reference:

Borehole 3

Depth (m)

1.60 - 2.00



Diameter (mm):		38	Height (mm):		76	Test:	38 mm Multi Stage.			
Stage	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Deviator Stress (kPa)	Cohesion (kPa)	Failure Strain (%)	Mode of Failure	Shear Strength (kPa)	Remarks
1	25	1.93	1.54	40	108	54	6.6	Brittle	54	Firm yellow grey thinly laminated CLAY

Checked and Approved	Date
<i>I. A. Johnson</i>	27/6/08



Bethel Street, Hoyland,
South Yorkshire

Contract No
S80517

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

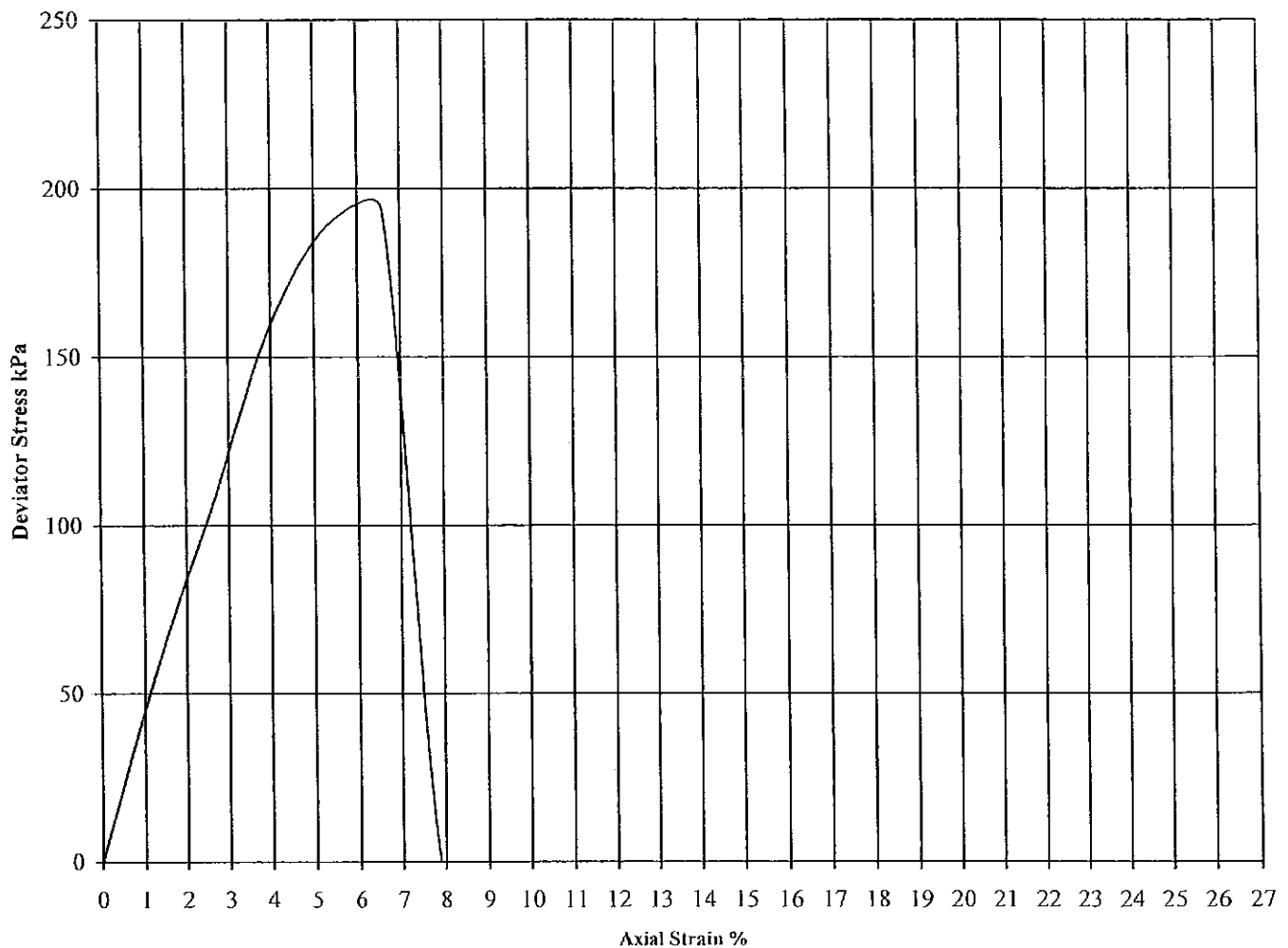
B.S. 1377 : Part 7 : Clause 9 : 1990

Hole Reference:

Borehole 4A

Depth (m)

1.20 - 1.80



Diameter (mm):		38		Height (mm):		76		Test:		38 mm Multi Stage.	
Stage	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Deviator Stress (kPa)	Cohesion (kPa)	Failure Strain (%)	Mode of Failure	Shear Strength (kPa)	Remarks	
1	16	2.18	1.87	30	194	97	6.6	Compound	97	Stiff slightly gravelly CLAY	

Checked and Approved	Date
<i>I. N. S. S. S.</i>	22/5/08



Bethel Street, Hoyland,
South Yorkshire

Contract No
S80517

Undrained Shear Strength in Triaxial Compression

without measurement of Pore Pressure

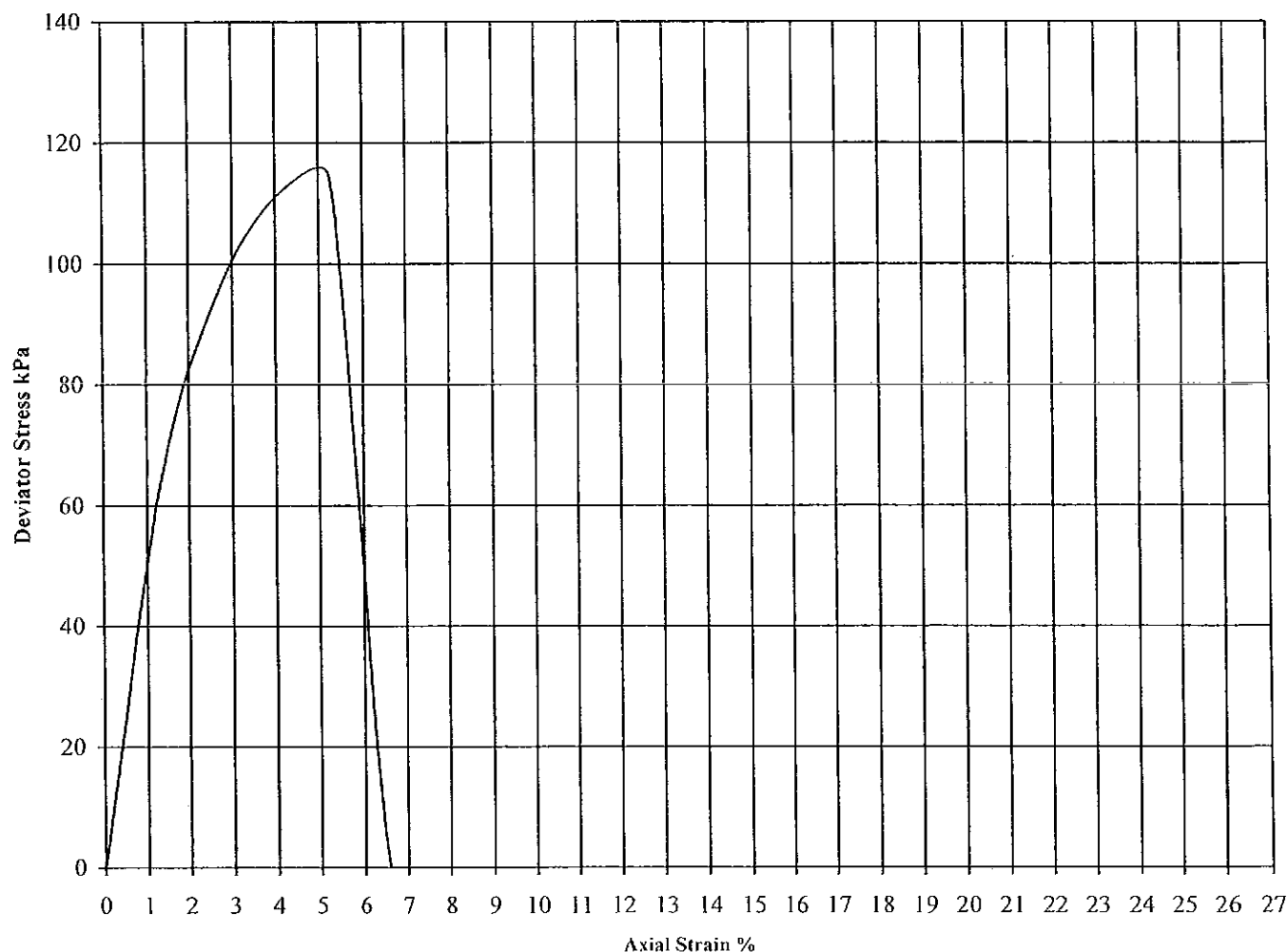
B.S. 1377 : Part 7 : Clause 9 : 1990

Hole Reference:

Borehole 6

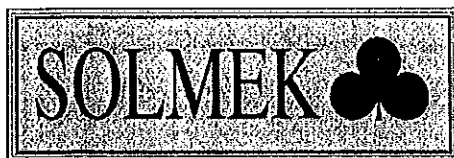
Depth (m)

0.80 - 1.00



Diameter (mm):		38	Height (mm):		76	Test:	38 mm Multi Stage.			
Stage	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Deviator Stress (kPa)	Cohesion (kPa)	Failure Strain (%)	Mode of Failure	Shear Strength (kPa)	Remarks
1	19	2.09	1.76	20	114	57	5.3	Compound	57	Firm yellow grey slightly gravelly CLAY

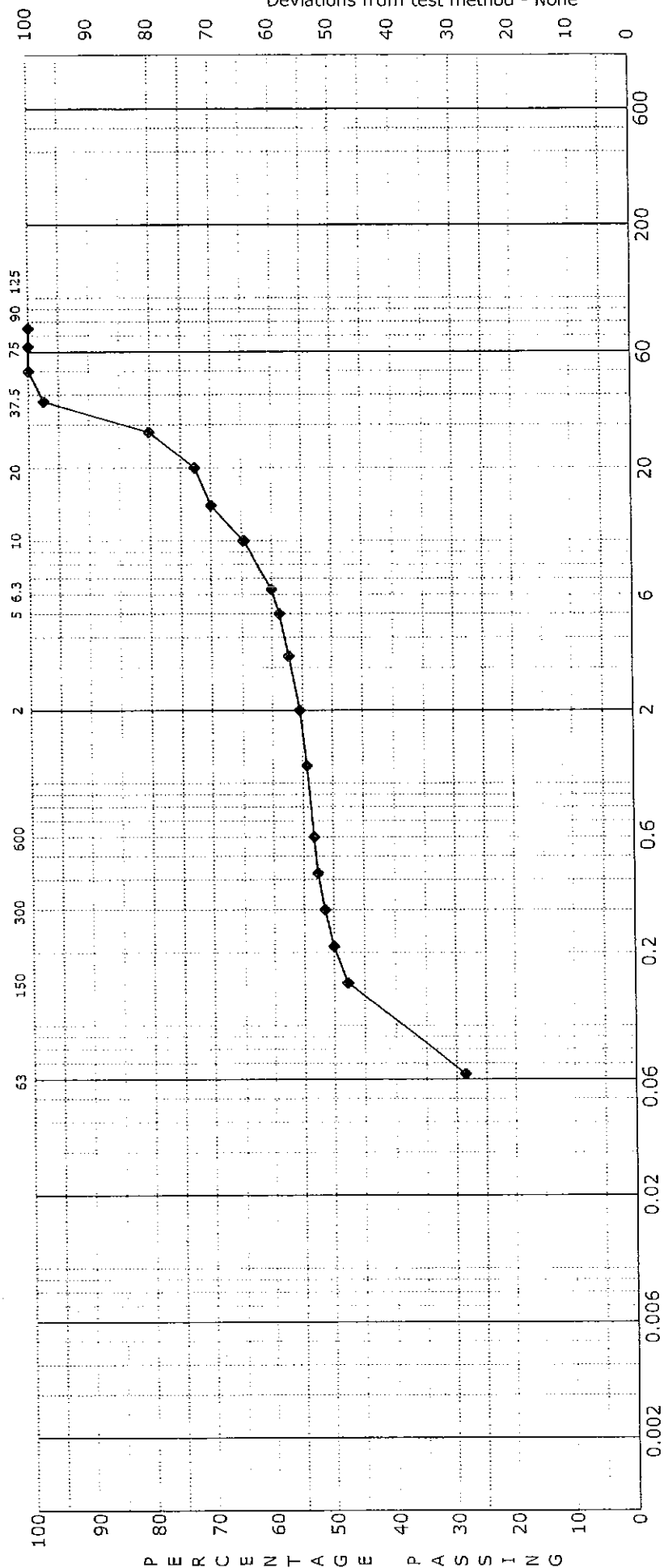
Checked and Approved	Date
<i>E. Wilson</i>	27/6/08



Bethel Street, Hoyland,
South Yorkshire

Contract No
S80517

BS Test Sieves In mm and microns



	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
CLAY											
		SILT			SAND						
								GRAVEL			

[illegible]

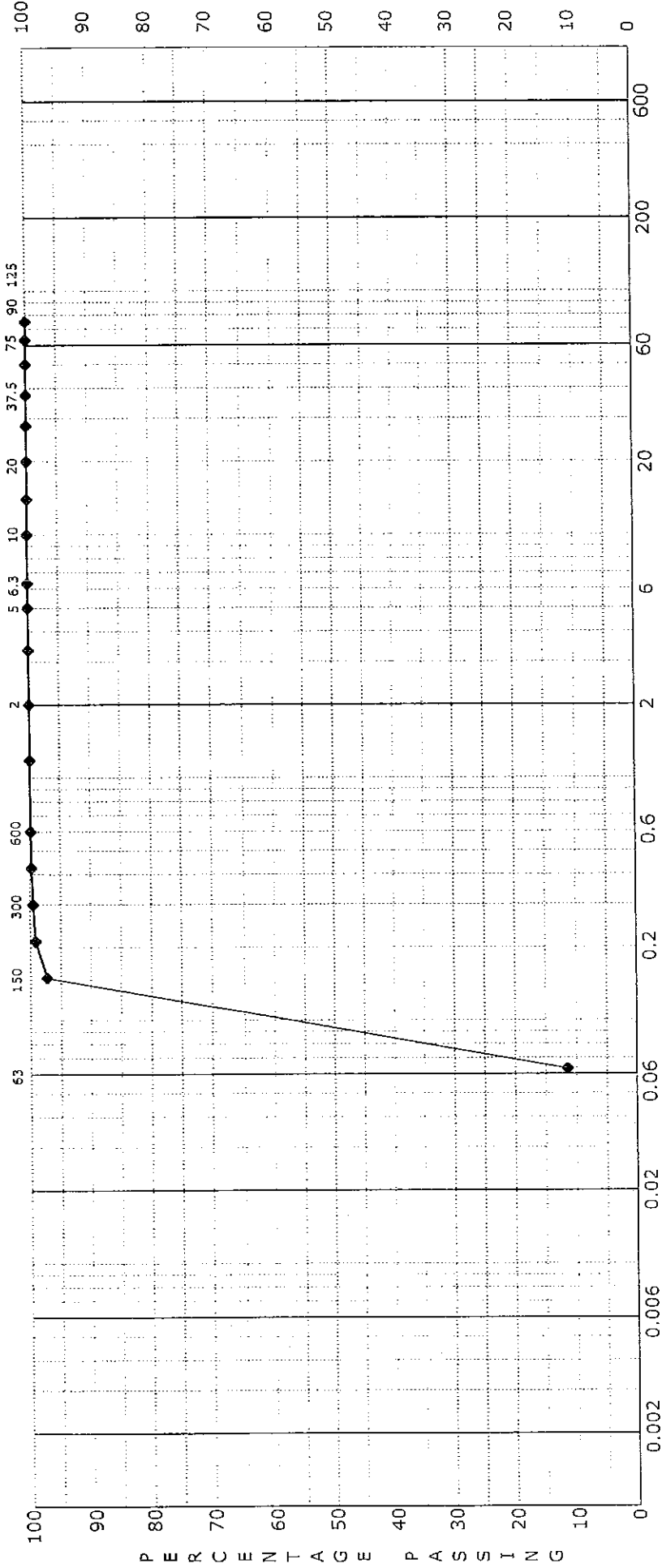
112 Yarm Road
Stockton-on-Tees
TS18 3NA
01642 607083



Scheme : Bethel Street, Hoyland, South Yorkshire

Client :

BS Test Sieves In mm and microns



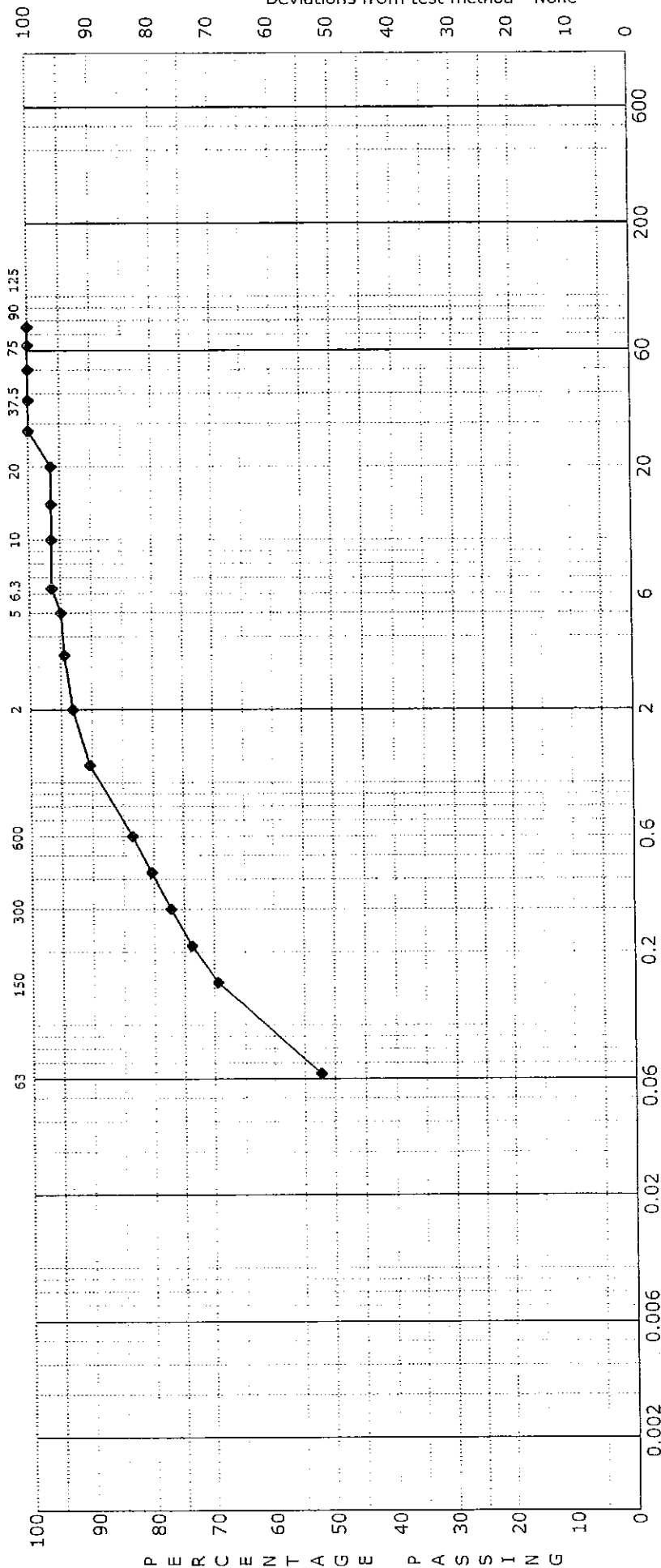
PARTICLE SIZE IN MILLIMETRES

CLAY	SILT			SAND			GRAVEL			BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

BH No.	Depth	MC	C _u	C _z	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%GRAVEL	%SAND	%SILT	%CLAY
◆	2	0.60 - 1.00	22.7		5.0000	0.1122	0.0818		0	88	12	0



BS Test Sieves In mm and microns



PARTICLE SIZE IN MILLIMETRES

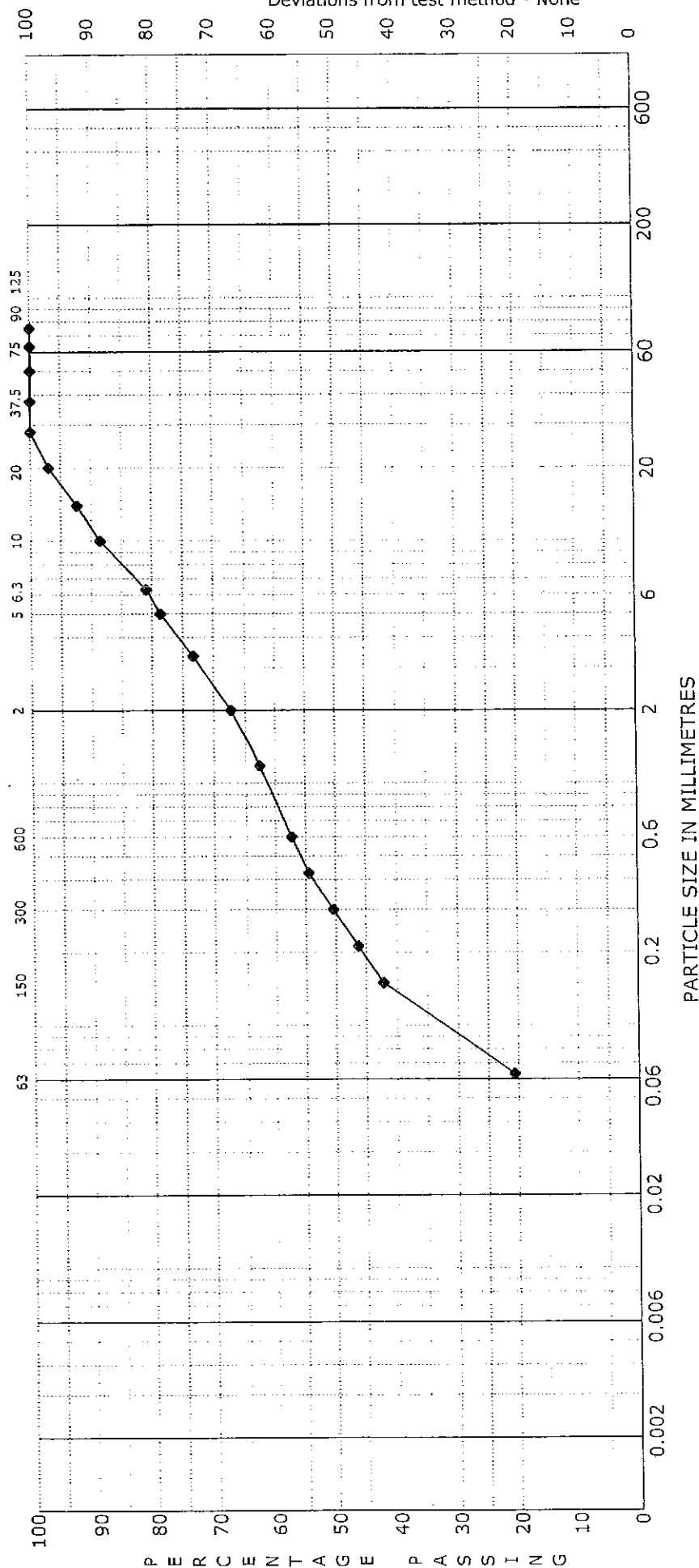
CLAY	SILT			SAND			GRAVEL			BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
BH No.										
Depth										
MC										
C _u										
C _z										
D ₁₀										
D ₃₀										
D ₆₀										
D ₁₀₀										
%SAND										
%GRAVEL										
%SILT										
%CLAY										

12 Yarm Road
Stockton-on-Tees
TS18 3NA
01642 607083

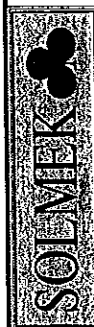


Scheme : Bethel Street, Hoyland, South Yorkshire
Client :

BS Test Sieves In mm and microns

[illegible][illegible]

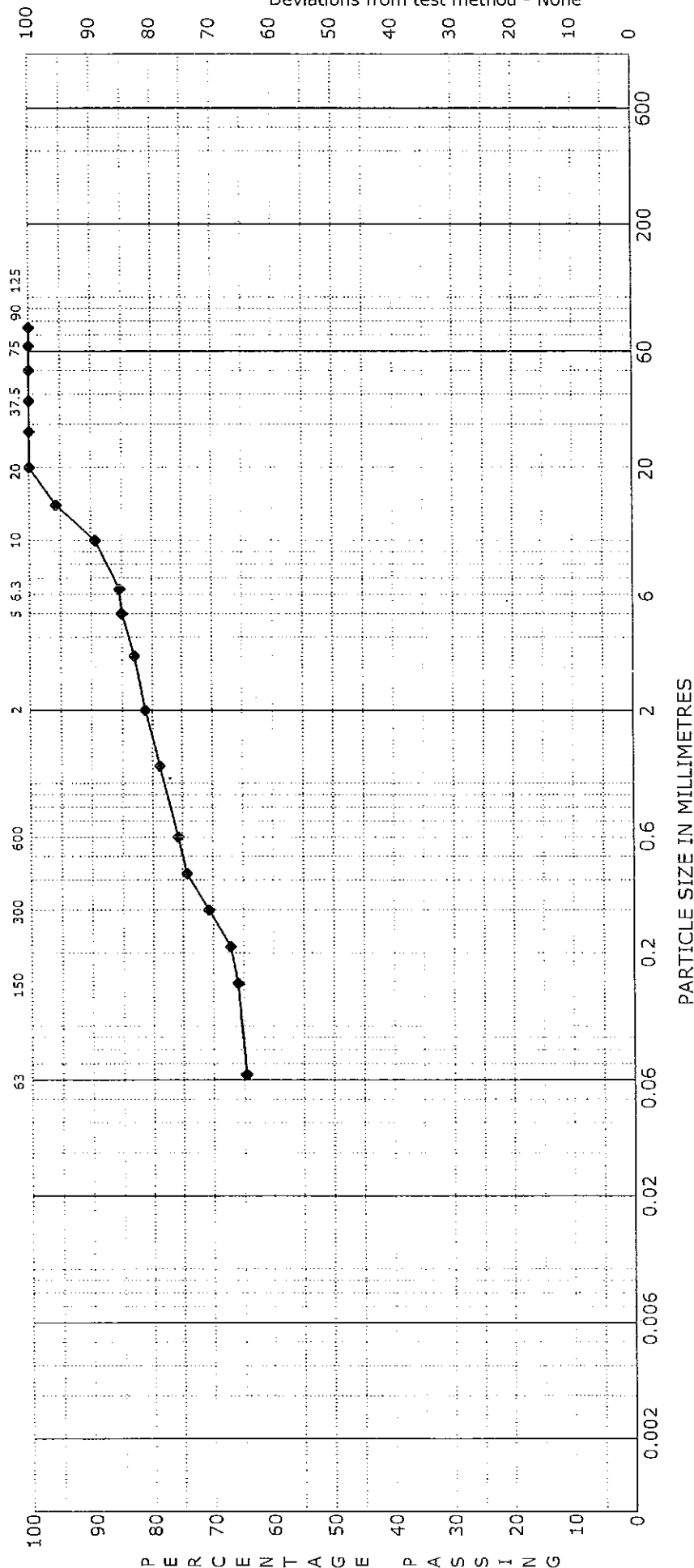
12 Yarm Road
Stockton-on-Tees
TS18 3NA
01642 607083



Scheme : Bethel Street, Hoyland, South Yorkshire

Client :

BS Test Sieves In mm and microns



PARTICLE SIZE IN MILLIMETRES

CLAY	SILT			SAND			GRAVEL			BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

BH No.	Depth	MC	C _u	C _z	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%GRAVEL	%SAND	%SILT	%CLAY
◆	6	0.80 - 0.90	17.4		20.0000				19	16	65	0

Scheme : Bethel Street, Hoyland, South Yorkshire

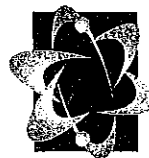
Client :

12 Yarm Road
 Stockton-on-Tees
 TS18 3NA
 01642 607083





2531



chemtech
environmental

ANALYTICAL TEST REPORT

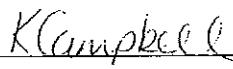
Contract no: SOLS/37246
Contract name: Bethel Street, Hoyland
Client reference: S80517
Clients name: Solmek
Clients address: 12 Yarm Road
Stockton-on-Tees
TS18 3NA

Date received: 04 June 2008
Date started: 04 June 2008
Date of issue: 10 June 2008

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd were not responsible for sampling.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
All results are reported on a dry basis.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 8 weeks from initial receipt unless otherwise instructed.

Key: U UKAS accredited test
M MCERTS & UKAS accredited test
\$ Test carried out by an approved subcontractor
NAF Non asbestos fibres

Approved by:


Karan Campbell John Campbell
Director Director

Chemtech Environmental Limited

SAMPLE DESCRIPTIONS

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation.

They are not intended as full geological descriptions.

MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample.

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

Lab number	Sample id	Depth (m)	Description	Moisture (%)
37246-1	BH 1 a	0.00-0.20	Sandy Loam	20.0
37246-2	BH 2	0.00-0.20	Sandy Loam	11.0
37246-3	BH 3	0.30-0.50	Gravelly Sand	14.1
37246-4	BH 4 a	0.20-0.50	Gravelly Loam	10.3
37246-5	BH 5	0.00-0.30	Gravelly Loam	15.7
37246-6	BH 6	0.00-0.20	Sandy Loam	9.5

Chemtech Environmental Limited

SOILS

Lab number			37246-1	37246-2	37246-3	37246-4	37246-5	37246-6
Sample id			BH 1 a	BH 2	BH 3	BH 4 a	BH 5	BH 6
Depth (m)			0.0-0.20	0.00-0.20	0.30-0.50	0.20-0.50	0.00-0.30	0.00-0.20
Test	Method	Units						
Arsenic (total)	CE054 ^H	mg/kg	40	13	20	15	12	-
Boron (water soluble)	CE063 ^H	mg/kg	0.6	0.3	0.3	<0.3	0.3	-
Cadmium (total)	CE054 ^H	mg/kg	1.8	0.2	<0.2	<0.2	0.4	-
Chromium (total)	CE054 ^H	mg/kg	55	15	44	13	24	-
Copper (total)	CE054 ^H	mg/kg	337	22	28	31	30	-
Lead (total)	CE054 ^H	mg/kg	368	42	40	45	58	-
Mercury (total)	CE054 ^H	mg/kg	1.6	<0.5	<0.5	<0.5	<0.5	-
Nickel (total)	CE054 ^H	mg/kg	64	15	17	16	18	-
Selenium (total)	CE054 ^H	mg/kg	0.9	<0.3	<0.3	<0.3	<0.3	-
Zinc (total)	CE054 ^H	mg/kg	413	59	56	56	86	-
pH	CE004 ^H	units	7.4	7.3	7.9	8.2	7.8	-
Sulphate (2:1 water soluble)	CE049 ^U	mg/l	41	40	15	13	15	-
Sulphide	CE016 ^H	mg/kg	28	<10	16	24	79	-
Cyanide (total)	CE013 ^U	mg/kg	<2	<2	<2	<2	<2	-
Phenols (total)	CE015 ^H	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	-
PAH								
PAH (total)	CE032	mg/kg	-	49	-	88	74	-
TPH								
TPH (C10-C40)	CE033 ^U	mg/kg	1127	-	101	-	-	178
Subcontracted analysis								
Asbestos	\$	-	NAF	-	NAF	-	NAF	-

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LEACHATES

Lab number			37246-1L	37246-3L	37246-5L
Sample id			BH 1 a	BH 3	BH 5
Depth (m)			0.0-0.20	0.30-0.50	0.00-0.30
Test	Method	Units			
Arsenic	CE055 ^U	mg/l	0.002	0.006	0.002
Boron	CE063 ^U	mg/l	0.14	0.04	<0.03
Cadmium	CE055 ^U	mg/l	0.006	<0.001	<0.001
Chromium	CE055 ^U	mg/l	0.004	<0.003	<0.003
Copper	CE055 ^U	mg/l	0.010	0.006	0.004
Lead	CE055 ^U	mg/l	<0.009	<0.009	<0.009
Mercury	CE055 ^U	mg/l	<0.001	<0.001	<0.001
Nickel	CE055 ^U	mg/l	0.006	<0.003	<0.003
Selenium	CE055 ^U	mg/l	0.002	<0.001	<0.001
Zinc	CE055 ^U	mg/l	<0.020	<0.020	<0.020
Hardness (by calculation)	CE056 ^U	mg/l	378	77	45
pH	CE004 ^U	units	7.5	7.6	7.4
PAHs					
PAH (total)	CE051	mg/l	<0.0001	<0.0001	<0.0001
TPH					
TPH (C10-C40)	CE052	mg/l	<0.01	<0.01	<0.01

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	STATUS	LOD	UNITS
CE054	Arsenic (total)	Aqua regia digest, ICP-OES	M	1	mg/kg
CE063	Boron (water soluble)	Hot water extract, ICP-OES	M	0.3	mg/kg
CE054	Cadmium (total)	Aqua regia digest, ICP-OES	M	0.2	mg/kg
CE054	Chromium (total)	Aqua regia digest, ICP-OES	M	1	mg/kg
CE054	Copper (total)	Aqua regia digest, ICP-OES	M	1	mg/kg
CE054	Lead (total)	Aqua regia digest, ICP-OES	M	1	mg/kg
CE054	Mercury (total)	Aqua regia digest, ICP-OES	M	0.5	mg/kg
CE054	Nickel (total)	Aqua regia digest, ICP-OES	M	1	mg/kg
CE054	Selenium (total)	Aqua regia digest, ICP-OES	M	0.3	mg/kg
CE054	Zinc (total)	Aqua regia digest, ICP-OES	M	3	mg/kg
CE004	pH	BS 1377, pH Meter	M	0.1	units
CE049	Sulphate (2:1 water soluble)	Aqueous extraction, IC-COND	U	10	mg/l
CE016	Sulphide	Acid distillation, Titrimetry	M	10	mg/kg
CE013	Cyanide (total)	Acid distillation, Colorimetry	U	2	mg/kg
CE015	Phenols (total)	Distillation, Colorimetry	M	0.5	mg/kg
CE032	PAH (total)	Solvent extraction, GC-FID		5	mg/kg
CE033	TPH (C10-C40)	Solvent extraction, GC-FID	U	10	mg/kg
\$	Asbestos (qualitative)	MDHS 77, Microscopy	U	-	-

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METHOD DETAILS

METHOD	WATERS/LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE055	Arsenic	ICP-OES	U	0.001	mg/l
CE063	Boron	ICP-OES	U	0.03	mg/l
CE055	Cadmium	ICP-OES	U	0.001	mg/l
CE055	Chromium	ICP-OES	U	0.003	mg/l
CE055	Copper	ICP-OES	U	0.004	mg/l
CE055	Lead	ICP-OES	U	0.009	mg/l
CE055	Mercury	ICP-OES	U	0.001	mg/l
CE055	Nickel	ICP-OES	U	0.003	mg/l
CE055	Selenium	ICP-OES	U	0.001	mg/l
CE055	Zinc	ICP-OES	U	0.02	mg/l
CE056	Hardness (by calculation)	ICP-OES	U	1	mg/l
CE004	pH	BS 1377, pH Meter	U	0.1	units
CE051	PAH (total)	Solvent extraction, GC-FID		0.0001	mg/l
CE052	TPH (C10-C40)	Solvent extraction, GC-FID		0.01	mg/l

Waste Acceptance Criteria Testing

BS EN 12457-Part 3, 2 Stage Process



chemtech
environmental

Sample Details

Contract Name Bethel Street, Hoyland
Lab Number SOLS/37247-1
Sample ID BH 3 0.50-1.00m
Date Sampled -
Date Received 4 June 2008
Particle Size (<4mm)
Method of size reduction N/A
Non-crushable matter N/A

Test Values

Mass of Raw Test Portion (MW) kg 0.212
Mass of Dried Test Portion (MD) kg 0.175
Moisture Content Ratio (MC) % 21.14
Dry Matter Content Ratio (DR) % 82.55
Leachant Volume (1) (L2) Litre 0.319
Leachant Volume (2) (L8) Litre 1.400
Eluate Volume (1) (VE1) Litre 0.238
Eluate Volume (2) (VE2) Litre 1.332

Eluate Analysis	Conc in Eluate	
Liquid : Waste Ratio	2:1	8:1
pH (units)	7.4	8.1
Temperature (°C)	20	20
Conductivity (µS/cm)	115	42
	mg/l	mg/l
Arsenic as As	0.006	<0.001
Barium as Ba	0.214	0.119
Cadmium as Cd	<0.001	<0.001
Chromium as Cr	0.003	<0.003
Copper as Cu	0.006	<0.004
Mercury as Hg	<0.001	<0.001
Molybdenum as Mo	0.097	0.037
Nickel as Ni	<0.003	<0.003
Lead as Pb	<0.009	<0.009
Antimony as Sb	0.018	0.003
Selenium as Se	0.001	0.001
Zinc as Zn	<0.020	<0.020
Chloride as Cl	27	4.0
Fluoride as F	1.0	0.5
Sulphate as SO ₄	44	<10
Total Dissolved Solids (TDS)	95	38
Phenol Index	<0.01	<0.01
Dissolved Organic Carbon (DOC)	103.7	6.5

Amount Leached		BS EN 12457-3 Limit Values mg/kg at L:S 10:1		
2:1	10:1	Inert Waste	Non-reactive Hazardous Waste	Hazardous Waste
mg/kg	mg/kg			
0.01	<0.02	0.5	2	25
0.44	1.32	20	100	300
<0.002	<0.01	0.04	1	5
0.006	<0.03	0.5	10	70
0.01	<0.05	2	50	100
<0.002	<0.01	0.01	0.2	2
0.20	0.45	0.5	10	30
<0.006	<0.03	0.4	10	40
<0.018	<0.09	0.5	10	50
0.04	0.05	0.06	0.7	5
0.002	<0.01	0.1	0.5	7
<0.04	<0.20	4	50	200
55	71	800	15000	25000
2.0	5.7	10	150	500
90	<147	1000	20000	50000
193	459	4000	60000	100000
<0.02	<0.1	1		
211	197	500	800	1000

Waste Analysis

Total Organic Carbon
Loss on Ignition
BTEX
PCBs (7 congeners)
Mineral Oil (C10 - C40)
PAH (total)
pH
Acid Neutralisation Capacity (pH4)
Acid Neutralisation Capacity (pH7)

Units	Result			
% w/w	3.5	3%	5%	6%
% w/w	11.5			10%
mg/kg	<0.01	6		
mg/kg	<0.1	1		
mg/kg	22	500		
mg/kg	<5	100		
pH units	7.4		>6	
mol/kg	0.03		To be evaluated	
mol/kg	0.01		To be evaluated	

Disclaimer : The Landfill Waste Acceptance Criteria limits in this report are provided for guidance only.
Chemtech Environmental Ltd does not take responsibility for any errors or omissions. Data is correct as of 01/09/2005
Waste Acceptance Criteria testing is outside the scope of the laboratory's UKAS accreditation.

Comments

Authorised by:

J. Campbell

Name:

John Campbell

Report date:

16 June 2008

Position:

Director

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GAS MONITORING SHEET

[illegible]



12 Yarm Road
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Cleveland
TS18 3NE
Tel 01642 607 083 fax. 01642 612 355
Email: south@solmek.com
www.solmek.com

TEST : GAS SURVEY
CONDITIONS : WEATHER: CLOUDY/SHOWERY. GROUND DAMP
ATMOSPHERIC PRESSURE : 990mb
REGIONAL TREND : FALLING
CLIENT : BRAMALL CONSTRUCTION
LOCATION : HOYLAND
DATE : 18/06/08
VISIT : 2 OF 3
OPERATOR : AC
EQUIPMENT : GEOTECH GA2000

RESULTS

Position	CH ₄		CO ₂		O ₂ (%v/v)	VOC ppm	Flow Litres/hr	Groundwater level (mbgl)
	(%v/v)	GSV (l/hr)	(%v/v)	GSV (l/hr)				
BH1A	ND	0.0	3.0	0.0030	18.7	*	+0.1	1.56
BH4	ND	0.0	2.3	0.0023	19.4	*	ND	DRY
BH5	ND	0.0	ND	0.0	20.1	*	ND	DRY

KEY

CH₄ = Methane, CO₂ = Carbon Dioxide, O₂ = Oxygen, GSV = Gas Screening Value

ND = Not Detected, * = not measured, N/A = Not applicable, % = By volume, mbgl = m below ground level, VOC = Volatile Organic Compounds (measured using a PID metre)



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Cleveland
TS18 3NE
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TEST : GAS SURVEY
CONDITIONS : WEATHER: CLUDY BUT WARM, GROUND: DRY
ATMOSPHERIC PRESSURE : 1003mb
REGIONAL TREND : FALLING
CLIENT :
LOCATION : HOYLAND
DATE : 24/06/08
VISIT : 3 OF 3
OPERATOR : SF
EQUIPMENT : GEOTECH GA2000

RESULTS

Position	CH ₄		CO ₂		O ₂ (%v/v)	VOC ppm	Flow Litres/hr	Groundwater level (mbgl)
	(%v/v)	GSV (l/hr)	(%v/v)	GSV (l/hr)				
BH1A	ND	0.0	2.0	0.0020	19.5	*	ND	1.60
BH4	ND	0.0	ND	0.0	20.0	*	ND	DRY
BH5	ND	0.0	0.9	0.0009	19.4	*	+0.1	DRY

KEY

CH₄ = Methane, CO₂ = Carbon Dioxide, O₂ = Oxygen, GSV = Gas Screening Value

ND = Not Detected, * = not measured, N/A = Not applicable, % = By volume, mbgl = m below ground level, VOC = Volatile Organic Compounds (measured using a PID metre)

APPENDIX D

Gas Protection Measures - Residential Development

Characteristic Situation	Membrane	Floor Slab	Sub-floor ventilation	External ventilation	Additional measures to reduce gas concentrations in the ground
1	No special precautions				
2 (equivalent to basic radon)	Waterproof DPM (see note below)	well constructed suspended floor or raft foundation well constructed suspended floor or raft foundation	Beam & block floors: open void min. 150mm depth Suspended in-situ concrete floors: proprietary void former: - expanded polystyrene shuttering with equivalent clear void depth of 22mm or - geocomposite drainage blanket or 20mm single size gravel blanket (min. 300mm thick) Rafts: granular blanket min. 300mm thick (not suitable on sites with high water table)	Area of side ventilation >2,000 mm ² /m run of wall Vents on at least 2 opposite sides of ventilation layer (usually via air bricks) Area of side ventilation >2,000 mm ² /m run of wall Vents on at least 2 opposite sides of ventilation layer (usually via air bricks)	None required
3 (equivalent to full radon)	Gas resistant membrane (basic)				None required
4	Gas resistant membrane (with aluminium foil)	well constructed suspended floor (raft foundation unsuitable) well constructed suspended floor (raft foundation unsuitable)	Beam & block floors: open void min. 150mm depth Suspended in-situ concrete floors: proprietary void former: - expanded polystyrene shuttering with equivalent clear void depth of 22mm (structures <7.5m wide only) or - expanded polystyrene shuttering with equivalent clear void depth of 100mm (structures >7.5m wide) or - geocomposite drainage blanket (structures <7.5m wide only)	Area of side ventilation >4500 mm ² /m run of wall Vents on at least 2 opposite sides of ventilation layer (usually via air bricks) Design of ventilation layer should be checked by calculation. Area of side ventilation >4500 mm ² /m run of wall Vents on at least 2 opposite sides of ventilation layer (usually via air bricks)	In-ground barrier / in ground venting layer / trenches / wells (see CIRIA 149)
5		Beam & block floors with open void min. 150mm depth			In-ground barrier / in ground venting layer / trenches / wells (see CIRIA 149). Probabilistic QRA required.

Note: DPM should be 2000 g where beam & block floors are used; 1200 g is suitable for cast *in situ* floor slabs

A qualitative approach using the statutory definition of Contaminated land as defined within Section 78A (2) of Part 11A of the Environmental Protection Act has been adopted. This defines contaminated land as:

"Any land which appears to the local authority in whose area it is situated to be in such a condition by reason of substances in or on or under the land that "Significant harm is being caused or there is a significant possibility of such harm being caused; or pollution of controlled waters is being or is likely to be, caused". "

The concept of "significant harm" is dealt with via the Government guidance DETR Circular 02/2000 Contaminated Land: "Implementation of Part IIA of the Environmental Protection Act 1990". The statutory guidance uses the concept of pollutant linkages set out in Section 2.4 of the Circular. Before the local authority can make a judgment on whether "significant harm" and the significant possibility of harm is being caused they are required identify a "significant pollution linkage". This means effectively that three elements (a source of contamination, a relevant receptor and a pathway) must be present. Without identification of all three elements together, land should not be regarded as "contaminated" in the statutory sense. See Appendix 6 for additional notes on contamination guidelines.

The contamination testing results have been compared to a range of site specific threshold values devised in relation to the nature of the site and the proposed development. These thresholds are based on the CLEA Soil Guideline Values (SGV). Current soil guideline values are given in the DEFRA and Environment Agency's R&D Publications SGV 1, 3, 4, 5, 7, 9, and 10.

Contaminated Land Report 10 *"The Contaminated Land Exposure Assessment Model (CLEA): Technical basis and algorithms"* and the various SGV Reports describe residential land use as land on which a people live in a wide range of dwellings including for example detached, semi detached, terraced, converted and purpose built flats. The land use takes into account several different house designs including houses based on suspended floors and ground bearing slabs. It assumes that residents have access to private gardens and/or community open space close to the home. Two SGV are provided, calculated with and without a contribution from eating home grown vegetables. This represents the key difference in potential exposure to contamination between those living in a house with or without a private garden.

Pathways and Receptors

The receptors listed below are considered in CLR8 to be potentially at risk from contamination related to industrial land due to the pathways also described.

Humans

Human exposure to contaminants present in soils can occur via several pathways. Direct exposure pathways include dermal absorption after contact with contaminated ground, inhalation of soil or dust, inhalation of volatilised compounds, and inadvertent soil ingestion (or deliberate soil ingestion in the case of some children). Other indirect pathways include human ingestion of plants grown in contaminated soil or contaminated ground or surface water. Contaminants associated with wind blown dust can affect humans on surrounding sites.

Water

The principal pathway by which the contaminants in the made ground may reach the water environment is through a slow seepage or leaching to either groundwater or surface water. The potential for contaminants to migrate along such pathways is dependent on the chemical and physical characteristics of the contaminants and the local hydrogeology. Surface watercourses may also accumulate contamination as contaminated sediments are deposited within the water body.

Vegetation and the Ecosystem

Plants can be affected by soil contamination in a number of ways resulting in growth inhibition, nutrient deficiencies and yellowing of leaves. Contaminants are taken up by plants through the roots and through foliage. Contaminants may accumulate within the plant or be excreted naturally. Plants form a secondary pathway for contaminants if consumed by humans or animals.

Construction Materials

Materials at risk from possible soil contaminants include inorganic matrices such as cement and concrete and also organic material such as plastics and rubbers. Acid ground conditions and high levels of sulphates can accelerate the corrosion of building materials. Plastics and rubbers are generally used for piping and service ducts and are potentially attacked by a range of chemicals, most of which are organic, particularly petroleum based substances. Drinking water supplies can be tainted by substances that can penetrate piping and water companies enforce stringent threshold values.

There are various guidelines which relate to contamination of water, soils and gas in the UK.

The CLEA values provide the most recent and appropriate guidance on soil contamination that applies to the UK. These give soil guideline values (SGV) at which a risk to human health may exist and are primarily intended as a guide to site redevelopment. Values are given for different land uses; these include residential gardens and commercial areas where the risks are less.

CLEA SOIL GUIDELINE VALUES (mg/kg)							
DETERMINANT	SOURCE	RESIDENTIAL WITH PLANT UPTAKE		RESIDENTIAL WITHOUT PLANT UPTAKE	ALLOTMENTS		COMMERCIAL/ INDUSTRIAL
ARSENIC	SGV1	20		20	20		500
CADMIUM	SGV3	pH6	1	30	pH6	1	1400
		pH7	2		pH7	2	
		pH8	8		pH8	8	
CHROMIUM	SGV4	130		200	130		5000
LEAD	SGV10	450		450	450		750
MERCURY	SGV5	8		15	8		480
NICKEL	SGV7	50		75	50		5000
SELENIUM	SGV9	35		260	35		8000

These figures need to be compared with the modified average given in the Environment Agency document CLR7 "Assessment of risks to human health from land contamination. An overview of the development of soil guideline values and related research".

There are various guidelines employed for assessing water quality. There are some UK guidelines which are derived from EC Regulations. In addition, Dutch ground water quality thresholds are commonly referred to due to their ease of use and the stringent nature of the need for ground water quality control in a country which is low lying. Other information and guidelines used are taken from waste management and are termed leachate quality thresholds. However, some professional judgement and modelling may be required where the contamination is in close proximity to a sensitive receptor such as a lake, river or aquifer.

Requirements of Parties within the Development Process

Interested parties involved in the development process may use the data in different ways and there may be varying views and interpretation of the factual data. Local Authority staff may have a view on contamination and human health and the wider environment. The Environment Agency are concerned principally with the protection of surface and groundwater. Building Insurers, funders and purchasers may be primarily concerned with issues of potential commercial blight. Purchasers are also not always fully informed, and perceptions on issues associated with risk can affect the decision to purchase. Developers and construction organisations will focus on financial aspects of dealing with the contamination in the context of the development and construction programme.

Risks & Liabilities from Contamination

In simple terms, risks associated with contamination may be considered in terms of 1) statutory risks and 2) development related risks. If contamination is severe or forms a potential hazard based on its potential to affect groundwater, surface water or human health, a statutory risk may be present, and as such, if the risk is not reduced, criminal proceedings may be instigated by a government body or local authority.

If the contamination is less severe or not considered to be mobile, it may be considered a commercial liability which could, in theory remain untreated, but which may at a later date affect the value of the property, or, with changing legislation, become a statutory risk. Commercial liabilities could give rise to civil proceedings by third parties if there are grounds for action.

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Site investigation is a process of sampling. The scope and size of an investigation may be considered proportional to levels of confidence regarding the ground and groundwater conditions. The exploratory holes undertaken investigate only a small volume of the ground in relation to the overall size of the site, and can only provide a general indication of site conditions. The opinions provided and recommendations given in this report are based on the ground conditions as encountered within each of the exploratory holes. There may be different ground conditions elsewhere on the site which have not been identified by this investigation and which therefore have not been taken into account in this report. Reports are generally subject to the comments of the local authority and Environment Agency. The comments made on groundwater conditions are based on observations made at the time that site work was carried out. It should be noted that mobile contamination, ground gas levels and groundwater levels may vary owing to seasonal, tidal and/or weather related effects. Solmek cannot be held liable for any unrecorded or unforeseen obstructions between exploratory boreholes and trial pits. This includes instances where previous structures on the site (buried man made structures) or the presence of boulder clay (cobbles and/or boulder obstructions) have been anticipated. All types of piling operations should make allowance for obstructions within the construction budget to accommodate this. Unrecorded ancient mining may occur anywhere where seams that have been worked and influence the rock and soil above. Dissolution cavities can occur where gypsum or chalk is present. Rotary drilling is the recommended technique to prove the integrity of the rock.

Where the scope of the investigation is limited via access to information, time constraints, equipment limitations, testing, interpretation or by the client or his agents budgetary constraints, elements not set out in the proposal and excluded from the report are deemed to be omitted from the scope of the investigation.

Desk studies are generally prepared in accordance with RICS guidelines. Environmental site investigations are generally undertaken as 'exploratory investigations' in accordance with the definitions provided in paragraph 5.4 of BS 10175:2001 in order to confirm the conceptual assumptions. You are advised to familiarize yourself with the typical scope of such an investigation. No pumping of water will be undertaken unless a licence or facilities/equipment have been arranged by others.

Where the type, number or/and depth of exploratory hole is specified by others, Solmek cannot and will not be responsible for any subsequent shortfall or inadequacy in data, and any consequent shortfall in interpretation of environmental and geotechnical aspects which may be required at a later date in order to facilitate the design of permanent or temporary works.

All information acquired by Solmek in the course of investigation is the property of Solmek, and, only also becomes the joint property of the Client only on the complete settlement of all invoices relating to the project. Solmek reserve the right to use the information in commercial tendering and marketing, unless the Client expressly wishes otherwise in writing. The quoted rates do not include VAT, and payment terms are 30 days from dispatch of invoice from our offices. Quotes are subject to a site visit.

We have allowed for 1 mobilisation and normal working hours unless otherwise stated. The scope of the investigation may be reviewed following the desk study and/or fieldwork. The presence or otherwise of Japanese Knotweed or other invasive plants can be difficult to identify especially during winter months. If Japanese Knotweed or other invasive species are suspect, it should be confirmed by an ecologist. We have not allowed for acquiring services information, and cannot be responsible for damage to underground services or pipes not shown to us or not clearly shown on plans. Costs incurred will be passed on to you, and in commissioning Solmek you understand and accept that you/your agent have a contractual relationship with Solmek & you accept this. Our rates assume unobstructed, reasonably level and firm access to the exploratory positions and adequate clear working areas and headroom. We have priced on the basis that you or your client have the necessary permissions, wayleaves and approvals to access land. All boreholes and pits are backfilled with arisings except where gas monitoring pipes are installed with stopcock covers. Solmek are not responsible for any uneven surfaces as a result of siteworks and rutting and backfilled excavations may require re-levelling and/or making good by others after fieldwork is complete, and Solmek has not allowed for this. No price has been provided or requested for a return visit to remove pipework and covers. Hourly rates apply to consultancy only and do not include expenses unless otherwise shown. If warranties are required, legal costs incurred will be passed on to you assuming Solmek agree to complete such warranties, modified or otherwise and you understand and agree to pay all costs.

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