



Phase 2 Intrusive Site Investigation Report

LOCATION	Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF
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FOR	Holloway Jennings Consulting Engineers
CLIENT REF.	
OUR REF.	G16304

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1. Introduction

Following submission of a Limited Desk Study Report (by Peter Brett Associates ref 33403/3501/Ntn/BG/DBi issued February 2015) and Our Phase 1 Desk Study Report and in accordance with your instruction, Geoinvestigate Ltd subsequently carried out a Phase 2 investigation at land off Huthwaite Lane, Thurgoland S35 7AF.

The purpose of the Phase 2 investigation was to establish the nature of the ground conditions at the site for foundation design and to assess any risks with regard to possible geotechnical hazards and the potential for hazardous gas and contamination to occur at the site.

The site comprises a roughly rectangular parcel of land to the south of Huthwaite Lane, which forms the northern boundary. Domestic dwellings occupy land beyond the eastern and western boundaries, whilst a disused quarry lies to the south. The site comprises overgrown grass and small shrubs, with a mature hedge / wooded area beyond the southern boundary. The site slopes to the north, away from a ridge along the southern boundary, where the land slopes into the former quarried area. The aforementioned Desk Study concluded that the former workings encroach no closer than 8m from the site. The site lies in an essentially rural setting with some residential land use to the east and west.

2. Scope of Phase 2 Investigation

2.1 Scope of Works

The previous Phase 1 report concluded that and in line with the clients specification the following investigation would be appropriate to assess the potential risks highlighted in that study:

- The sinking of eight (8) boreholes (ref Nos. BH1 – BH8) to depths of between 1.50 and 2.00m within the proposed building footprints and external areas of the development with associated soil sampling and supervision of the works by a suitably qualified geo-environmental engineer. The boreholes were sunk by windowless sampling drilling techniques using a Dando Terrier drill rig.
- The installation of three (3) gas monitoring wells in boreholes BH1, BH5 and BH6.
- The excavation of four (4) hand dug trial pits (TPA, TPB, TPC, TPD and TPE) in proposed garden areas to obtain pertinent samples for contamination testing.
- Infiltration testing in line with BRE 365 or BS 5930 in TPD and BH8 respectively to give infiltration values for proposed soakaway design.
- Geotechnical Testing comprising twenty eight (28) moisture determinations and three (3) Atterberg Limit Tests to provide information on the general condition and plasticity of the soils.

- Six (6) gas monitoring visits (where possible) over a period of three (3) months, including readings below 1000mb and where possible following a sharp drop in atmospheric pressure.
- Contamination analyses on six (6) samples recovered at depths of 0.15m to 0.40m to confirm that metals, Asbestos and speciated polycyclic aromatic hydrocarbons (PAHs) are absent or within acceptable limits. Leachate testing was carried out on three samples of fill from a depth of 0.20m and 0.15m in BH1 and TPB.
- Provision of a factual and interpretative report including; site plan, borehole logs, contamination results, and gas measurements, together with advice on appropriate foundation types, the contamination situation and, if required, remediation and validation.

The trial pit and borehole positions are shown on the plan provided in Appendix 1.

The excavations were sampled and logged at site by a geo-environmental engineer and the ground conditions encountered are described on the borehole logs also provided in Appendix 1.

Moisture results together with moisture profiles are provided in Table 4 - Appendix 2.

The results of the contamination testing and CLEA v1.06 software are included in Appendices 3 and 4.

2.2 Sampling Rationale

BHs 1 to 7 were positioned mainly to establish the ground conditions beneath the proposed buildings and external areas, with TPA, TPB, TPC, TPD and TPE positioned with a focus on the proposed garden areas. Their purpose was to recover soil samples for geotechnical and contamination testing.

The infiltration testing (carried out within TPD and BH8) were positioned within an area earmarked for the installation of soakaways.

3. Phase 2 Findings

3.1 Encountered Ground Conditions

It was anticipated from the Desk Study findings (where the Grenoside Sandstone outcrops within the former quarried area to the south of the site) that sandstone would be encountered at shallow depth at the site with little or no overburden anticipated. A thin coal seam was shown (on BGS Mapping) to overly sandstone, however this is shown a reasonable distance from the site.

3.1.1 Windowless Sampling Boreholes – BH1 to BH8

In general BH1 to BH8 encountered similar ground conditions comprising turf underlain by topsoil to depths of between 0.20m and 0.30m underlain generally by medium dense natural slightly clayey gravelly sand to depths of between 0.45m and 1.10m.

Below the gravelly sand stratum, BH1, BH2, BH5, BH7 and BH8 encountered a horizon of moderately strong weathered silty sandstone bordering on sandy siltstone rock to depths of between 1.20m and 1.70m. Below this moderately strong coarse grained sandstone was encountered.

In BH3, BH4 and BH6 the weathered silty sandstone / sandy siltstone was absent, and the soil was directly underlain by the coarse grained sandstone.

In Situ SPT values (carried out with a solid cone sampler) in the sandstone rock at a depth of 1.00m (and occasionally 2.00m) returned N Values of between N=30 to N=63 and refusal values of N=50/150mm to 84/150mm. A single value of N=16 was recorded in the sandy gravel at a depth of 1.00m in BH7.

Generally, the boreholes remained open and dry on completion.

No roots were recovered from the boreholes.

3.1.2 Trial Pits – TPA, TPB, TPC, TPD and TPE.

Generally the trial pits encountered similar conditions to the boreholes, with thin turf and topsoil encountered to depths of between 0.10m and 0.25m.

Below the turf and topsoil TPA moderately strong silty sandstone / sandy siltstone commenced below 0.40m, whilst in TPB the aforementioned rock was found directly below the turf and topsoil. In TPC made ground comprising sandy gravel and cobbles of sandstone was found between depths of 0.20m and 0.50m with coarse grained sandstone commencing below this. In TPD a thin horizon of weak to moderately strong weathered sandy siltstone commenced below 0.35m underlain by moderately strong silty sandstone to 0.80m. TPE was similar to TPB where moderately strong silty sandstone / sandy siltstone rock was encountered below the turf and topsoil.

3.1.3 Infiltration Testing

Infiltration testing was carried out within TPD and BH7 in the position of the proposed soakaways.

In TPD, the base of the pit was located within weathered silty sandstone, whereas the nearby in BH7 the underlying coarse grained sandstone was chosen as the zone to be tested.

The results of the testing found that in TPD (Infiltration Test 1) infiltration was insufficient to provide a value and the test was deemed to have failed, whilst in BH7 (Infiltration Test 2 with a deeper infiltration zone than the trial pit) a permeability k value of $2.04\text{E}-0.6\text{ms}^{-1}$ was returned.

3.1.4 Summary of Ground Conditions Encountered

The windowless sampling boreholes sunk at the site encountered similar ground conditions with boreholes encountering shallow granular soils then competent weathered silty sandstone / sandy siltstone and / or coarse grained sandstone. Similar conditions were encountered in the trial pits, with TPC being the only excavation at the site to encounter any made ground. Nonetheless, this fill comprised sandy gravel and cobbles of sandstone and was only 300mm thick and underlain by sandstone rock. Given the proximity of TPC to the adjacent quarry to the south, it is construed that this may have originated from the quarrying activities.

It is considered that the basal coarse grained sandstone encountered in the excavations is the Grenoside Sandstone, regarded in the previous Desk Study report as that exposed in the quarry to the south of the site. No excavations encountered the Grenoside Sandstone Coal which reportedly directly above the sandstone in the stratigraphic column.

3.2. Moisture content and Vegetation Influence.

Given the general absence of cohesive strata at the site, together with the presence of sandstone (and occasionally silty siltstone) rock at a shallow depth below the site it was considered that although vegetation was present to the south of the site that the risk to the site from seasonal shrinkage and swelling would be very low.

Notwithstanding, two Atterberg Limit tests were attempted and returned material classifying as essentially non plastic in nature.

Given the above, although mature vegetation is present to the south of the site, it is considered that no special precautions are required with regard to foundation depths and vegetation influence at the site.

4. Contamination Testing

The desk study has highlighted in the Desk Study that the disused Huthwaite Quarry immediately to the south of the site provides the most credible potential source of contamination to the site in the form of the probable presence of made/ in-filled ground. In addition the development of the area (the adjacent housing etc), might also provide a source of contamination to the site.

It was considered that if former land uses within the site had caused contamination the contaminants would most probably occur in the near surface topsoil, or any deeper made ground beneath the site

Therefore six (6) samples were recovered from topsoil or made ground and natural strata (up to 0.50m in depth) from across the site and were tested for a range of substances.

These included common contaminants such as Arsenic, Lead and Cadmium which are normally included in a general human health contamination suite together with analysis for Speciated polycyclic aromatic hydrocarbons (PAHs) and Asbestos. Additionally, leachate testing was also carried out on two samples to establish the mobility of potential contaminants.

The results of the contamination testing are included in Appendix 3 of this report and have been used in the contamination risk assessment set out in the following sections.

5. Risk Assessment

5.1 Method

Geoinvestigate Ltd. uses a combination of assessment criterion provided by the DEFRA, the Environment Agency and by the Chartered Institute of Environmental Health in order to assess the presence of potentially harmful chemicals within soils and water; DEFRA category 4 screening levels (C4SLs) published Soil Guideline Values (SGVs) and Land Quality Management / Chartered Institute of Environmental Health (LQM/CIEH) Safe for Use Limits (S4ULs). As the site is to be developed as housing it would be prudent to treat it as falling within the residential end-use category. In addition, given that gardens are present within the development an allowance for plant-uptake should be made also.

However, in this instance, no site specific assessment criteria (SSAC) have been created for the site as no unusual circumstances are anticipated to exist which would render generic assessment criteria inadequate.

The results of the contamination testing that has been undertaken have been compared to the soil quality values from the above sources. Where they fall below these limit values they have been deemed safe for a residential end use.

Where results are above the intervention values, an assessment of the available pathways and receptors has been carried out to determine whether further investigation or remediation is necessary.

An appraisal of the chemical results and relevant limits is set out in the Contamination Risk Assessment that follows.

5.2 Contamination Risk to Identified Receptors

5.2.1 Contamination Risk to Human Health

Topsoil at the site generally extends to depths of between 0.10m to 0.35m. The topsoil was generally sandy gravel in composition. A single isolated horizon of made ground was encountered in TPC between depths of 0.20m and 0.50m and mostly comprises sand and gravel of sandstone.

No hydrocarbon staining, odours, obvious chemical substances or signs of physical contamination such as glass or metal shards were noted in any of the fill or natural material recovered in the boreholes. Neither was there any visible evidence of Asbestos contamination such as roofing board. In light of this it was not anticipated that chemical or physical contamination would pose a significant hazard for the new development and its users.

As discussed earlier in the report, levels of determinands have been compared to the SGVs for residential end-use as published by the Environment Agency in their individual SGV and toxicology reports and accompanying documents, LQM/CIEH values, and DEFRA C4SLs.

The results of the analyses of six (6) samples of topsoil, natural material and occasional made ground recovered from the site from depths up to 0.40m returned concentrations of a range of substances generally falling below their respective assessment criteria adopted from the sources named above. Exceptions to this are discussed in Section 5.3.1 later in this report. The results of the analyses are shown in Table 1 (below) along with the published SGVs, LQM/CIEH (S4UL) values and DEFRA C4SLs.

Average total Organic Carbon Contents of 2.64%, and Soil Organic Matter Contents of 4.55% estimated from this, were returned from the soil analyses; therefore the LQM/CIEH S4ULs for PAHs and Hydrocarbons were chosen using the Soil Organic Matter (SOM) option of 2.5% as a conservative choice.

Table 1: Chemical Determinands in Soils

	Range of Returned concentrations (mg/kg)	Residential Soil Guideline Value – EA (mg/kg)	Safe for Use Limit* – LQM/CIEH (mg/kg)	Category 4 Screening Level* – DEFRA (mg/kg)
Asbestos	None Detected (all)	Any presence unacceptable		
Arsenic	5.7-20	32		37
Boron	<0.5		290	
Cadmium	<0.2-0.4	10	11	26
Chromium VI	<1 (all)		6	21
Chromium III	79-107		910	
Copper	14-43		2400	
Lead	43-110			200
Mercury (elemental)	<0.5	1		
Nickel	22-29	130		
Selenium	0.7-1.3	350		
Zinc	59-173		3700	
Phenol	<0.5	420	550	

Table 1 Continued on following page

Table 1 (Ctd): Chemical Determinands in Soils

	Range of Returned concentrations (mg/kg)	Residential Soil Guideline Value – EA (mg/kg)	Safe for Use Limit* – LQM/CIEH (mg/kg)	Category 4 Screening Level* – DEFRA (mg/kg)
PAH Naphthalene	<0.01-0.08		5.6	
PAH Acenaphthylene	<0.01		420	
PAH Acenaphthene	<0.01-0.02		510	
PAH Fluorene	<0.01-0.02		400	
PAH Phenanthrene	<0.02-0.34		220	
PAH Anthracene	<0.02-0.06		5400	
PAH Fluoranthene	<0.02-0.38		560	
PAH Pyrene	<0.02-0.35		1200	
PAH Benzo[a]anthracene	<0.02-0.16		11	
PAH Chrysene	<0.01-0.17		22	
PAH Benzo(b)fluoranthene	<0.02-0.24		3.3	
PAH Benzo(k)fluoranthene	<0.02-0.09		93	
PAH Benzo(a)pyrene	<0.02-0.17		2.7	5
PAH-Dibenz(a,h)anthracene	<0.02-0.03		0.28	
PAH-Indeno(123-cd)pyrene	<0.02-0.13		36	
PAH Benzo(ghi)perylene	<0.02-0.13		340	
Total PAH	<0.27-2.36			

* for residential land use with home grown produce.

No asbestos fibres were detected in the three samples tested.

Values for Speciated TPH on the single sample tested returned negligible concentrations for each representative determinand.

Analysis of soils from the site without exception returned values falling within adopted assessment criteria in near surface (0.40m) soils.

5.2.2 Contamination Risk to Controlled Waters

Concentrations of most potential contaminants fell below the chosen assessment criteria in the topsoil and made ground horizons encountered during the investigation (save for the exception noted above). Therefore there is considered to be a low risk to underlying groundwater from leaching.

Notwithstanding, leachate was analysed from two (2) samples obtained from 0.20m in BH1, and 0.15m in TPB. The screening of these returned generally negligible concentrations and concentrations below detectable limits and/or safe levels for domestic water supply or the protection of aquatic life levels as published by the Environment Agency which were used as the assessment criteria. The results of the testing and the assessment criteria are shown Table 2 on the following page.

Table 2: Chemical Determinands in Leachate

	Range of Returned Concentrations (µg/l)	UK Standard for Surface Waters intended for Drinking Water Abstraction* (DW) and/or * (Aq) (µg/l)
<u>Inorganic Chemicals</u>		
Arsenic	0.13-0.21	50 (DW, range: 50-100) (No Aq standard)
Boron	8-9	1000 (DW & Aq)
Cadmium	<0.07-0.09	5 (DW & Aq)
Chromium	<0.2	50 (DW) / 5 (Aq, range: 5-250)
Copper	2.7-2.8	50 (DW) / 5 (Aq, range: 5-112)
Lead	<0.2	50 (DW) / 4 (Aq, range: 4-250)
Mercury (elemental Hg)	<0.008	1 (DW & Aq)
Nickel	<0.5-1.2	20** (DW) / 50 (Aq, range: 50-200)
Selenium	<0.07	10 (DW) (No Aq standard)
Zinc	1-2	3000 (DW, range: 3000-5000) / 30 (Aq, range: 30-2000)
Cyanide (free)	<20	50 (DW)
Cyanide (total)	<20	50 (DW)
Thiocyanate	<200	
<u>Organic Chemicals</u>		
Phenols	<10	50**(DW) / 300 (Aq)
PAHs (total)	<1.6***	0.2 (DW, range: 0.2-1.0) (No Aq standard)
pH	5.7	Drinking water standards pH5.5 -10

*sourced from Environment Agency database at <http://evidence.environment-agency.gov.uk/ChemicalStandards/home.aspx>.

If more than one option is available (dependant on other water properties or environmental setting) the lowest value has been adopted.

**Standard for water supply as no standard available for surface water abstraction for drinking water.

*** Sum of USEPA 16, each at Lower Limit of Detection of <0.1

Concentrations of Phenol and PAH are below detectable limits and would not be considered to pose a risk to controlled waters.

5.3 Review of Results

The data presented in Table 1 and Table 2 show that, in the soil samples analysed, returned concentrations of potential contaminants in soil fall below the adopted assessment criteria and as such, excluding the exceptions noted below, surface and sub-soils at the site are considered to be generally uncontaminated and fit for purpose in the context of a residential end use.

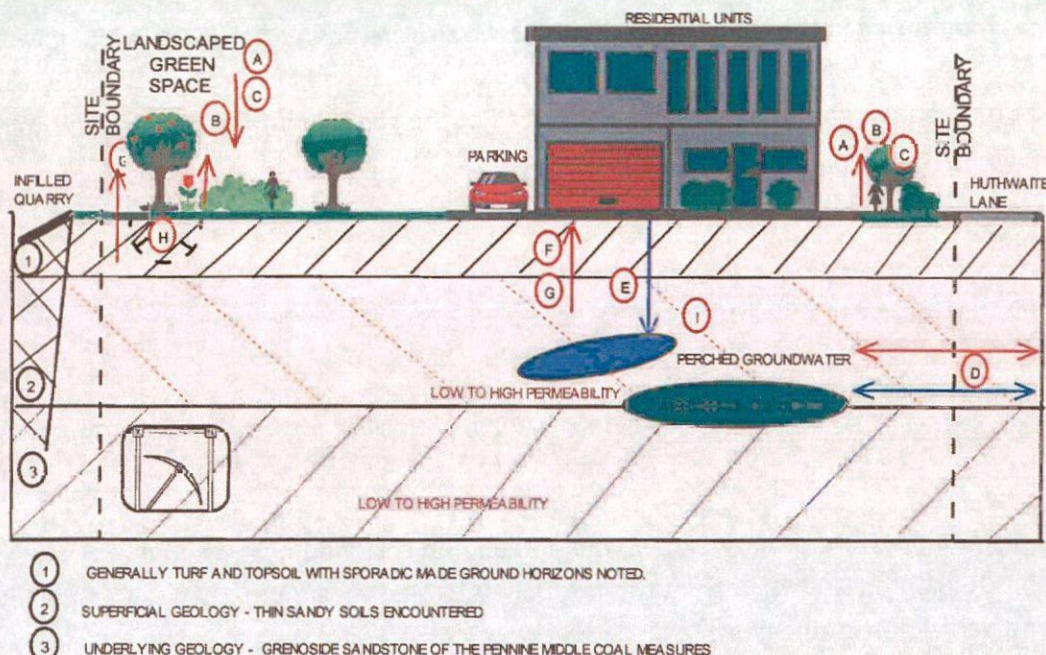
5.3.1 Summary and Conceptual Ground Hazard Model

Given the findings in section 5.3 above a remediation and validation exercise will not be required as no pollutant linkages identified in the CGHM presented below. Therefore, the site is suitable for the intended land use.

The CGHM presented on the following page shows that pollutant linkages remain at the site between the made ground horizon and human receptor groups.

With regard to pollutant linkage G, monitoring for possible hazardous ground gas is ongoing (see Sections 6 and 7.2 below) with a final assessment to be made in a subsequent addendum to this report. To date no significant hazard has been identified.

Figure 1 – Conceptual cross section of site including a Source, Pathway and Receptor Model



IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES

- Possible infilled/made ground associated with site and residential development. - *No significant source of contamination identified at the site.*
- Potential hazardous gas sourced from made/in-filled ground and potential coal seams. - *Low gassing regime identified at site to date - no anticipated mitigation measures required.*
- Presence in a coal mining area. - *Desk Study and Coal Authority Report determined low risk to site from shallow mineworkings.*

IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

- A - Residents, Workers & End Users through Direct Contact / Inhalation / Ingestion.
- B - Plants and Trees through uptake.
- C - End Users through cultivation and consumption of vegetables / fruit.
- D - Neighbouring Sites through lateral migration (in soil and water, including surface water run-off).
- E - Ground water through leaching of sub-soil.
- F - Building and services through direct contact.
- G - End users and buildings through ground gas migration. *Initial testing results have returned favourable results indicating the site has a low gassing regime*
- H - Zone of root influence.
- I - Influence from mine workings.

6. Hazardous Gas

6.1 Gas Regime

The earlier Phase 1 Desk Study Report suggested that made ground on the adjacent site associated with its previous use as a quarry could have the potential to generate gas.

The initial results of gas monitoring in the shallow boreholes at the site are presented in Table 2 below.

However, a further set of 4 measurements are required from all of the gas monitoring points to properly establish the initial and longer term gassing regime at the site.

Table 2 Summary of Initial Gas Monitoring Data

Borehole	Number of Visits	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow Rate (l/hr)	Atmospheric Pressure (mb)
BH1	2	0.0-0.2	0.2-1.7	18.6-20.4	<0.1	989-997
BH5		0.0	0.1	19.9-20.3	<0.1	
BH6		0.0-0.3	0.2-1.2	18.8-19.7	<0.1	

The gas monitoring visits at a pressure of between 989mb and 997mb returned near normal or depleted levels of O₂ between at 16.6% and 20.4%, with maximum 0.3% CH₄ and maximum 1.7% CO₂. Gas flow rates were <0.1 l/hr and below detectable limits.

6.2 Radon Gas

The desk study findings confirmed that **No Radon** protection measures are required for new buildings at the site.

7. Conclusions

7.1 Contamination

Analysis of the ground conditions at the site and an assessment of the potential pathways have confirmed that the ground is generally uncontaminated and therefore unlikely to pose a significant risk to human health in the context of the proposed residential end-use of this site. Neither would the strata pose a significant risk to surface and underground waters, due to the presence of negligible levels of contaminants leaching from the material.

No remediation is required at the site.

7.2 Hazardous Gas

On the basis of the initial gas results the gas conditions at the site would be expected to fall within "Characteristic Situation 1" of the Modified Wilson and Card classification or "Green" of the NHBC Traffic Light System for low rise housing with a ventilated under-floor void (min 150mm) (CIRIA C665). Consequently on the basis of these results no gas measures are anticipated to be required in the construction of the new buildings at the site.

However, a further four (4) sets of gas monitoring results need to be obtained before a final decision can be made on the level of gas protection required at the site. These have been scheduled to be carried out over the coming months and the final results will be provided in an addendum to this report which will be available in late November 2016.

7.3 Foundations & Floors

The information in the Coal Authority Coal Mining Report within the Phase 1 Desk Study, together with the site being outside of a Development High Risk Area with regard to shallow coal mining confirmed that the likelihood of shallow coal mine-workings being present below the site was Low, therefore no remedial actions need be taken with regard to drilling and grouting at the site for example.

As discussed in section 3.14 earlier, initial weathered silty sandstone rock, underlain by more competent sandstone (considered to be the Grenoside Sandstone) is present at the site at a relatively shallow depth of between 0.45m and 1.10m. Although a review of the stability of the adjacent Huthwaite Quarry to the south of the site is provided in the Report by P Brett and Associates, it is considered that the dwellings and associated gardens are at such a distance from the original quarry face to as not be significantly affected by this (geotechnically). In addition, the working quarry wall has been covered by a significant thickness of fill for a number of years, thereby minimising the risk of collapse.

The high SPT N values indicate that the sandstone at 1.00m (BH1 to BH6) and 1.10m (BH7) would provide suitable founding strata for traditional trench fill / strip foundations at the site. At the above depths, trench fill or pad foundations underlain sandstone or siltstone may be designed to net bearing pressures of 150kN/m² or 175 kN/m² respectively. Care should be taken to ensure that the foundation bases are underlain by competent un-weathered undisturbed sandstone rock, if any weak horizons are encountered then some provision should be made for incorporating some light reinforcement into the concrete.

Following removal of any topsoil or made ground the medium dense gravelly sand or sandstone rock would provide a competent base for construction of a lightly loaded ground bearing floor slab. Care should be taken to ensure compaction or removal of any soft spots at the site.

7.4 Concrete Design

The results of chemical analyses of the fill returned Water Soluble Sulphate levels of between 13mg/l and 39mg/l (SO_4) and pH levels of between 4.9 and 6.3. On this basis concrete in contact with the ground may be designed to ACEC Class DS-1 AC-2z of BRE Special Digest 1 – Concrete in aggressive ground.

END OF REPORT



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APPENDIX 1
SITE PLAN, TRIAL PIT AND BOREHOLE LOGS

GEOINVESTIGATE Ltd.

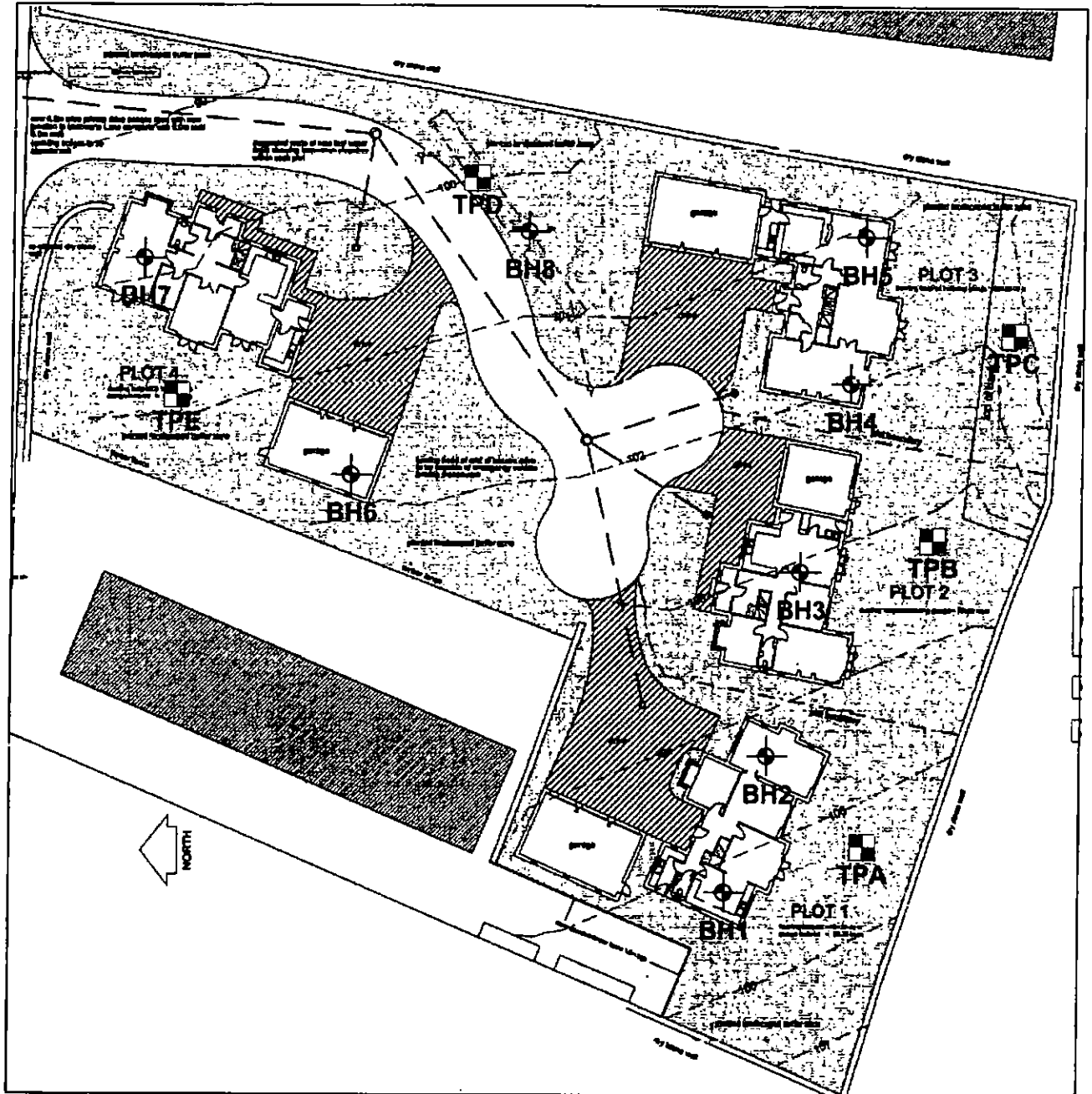
OUR REF:G16304

YOUR REF:

SITE PLAN (NOT TO SCALE)

DATE:08/09/16

LOCATION: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF



GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

G16304

TP A

Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF / TOPSOIL Dark brown clayey sand	100				Cv kN/m ²			
0.40	Loose dark orangish brown and brown sandy gravel/ gravelly sand. Gravel is fine to coarse of sandstone. Cobbles noted	300			O				0.20
0.60	Moderately strong orange and greyish brown weathered silty SANDSTONE / sandy SILTSTONE	200							0.50 0.60
	Trial Pit Terminated at 0.60m								

Remarks:

Hand excavated to 0.60m

Trial Pit remained stable and dry on completion

Key:

 Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

O Disturbed sample
 Cv Shear vane
 W Water sample
 S Standard Penetration Test
 C Cone Penetration Test

TPA

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TP B

Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	TURF / TOPSOIL Medium dense dark brown gravelly sand	200			O	Cv kN/m ²			0.20
0.40	Moderately strong orange and greyish brown weathered silty SANDSTONE / sandy SILTSTONE	200							0.40
	Trial Pit Terminated at 0.40m								

Remarks:

Hand excavated to 0.40m

Trial Pit remained stable and dry on completion

Key:

- Slotted Pipe
- Plain Pipe
- Bentonite
- Gravel Filter

- O** Disturbed sample
- Cv** Shear vane
- W** Water sample
- S** Standard Penetration Test
- C** Cone Penetration Test

TPB

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G16304

TP C

Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	TURF / TOPSOIL Medium dense dark brown gravelly sand	200				Cv kN/m ²			0.20
0.50	MADE GROUND Orangish brown sandy gravel and cobbles. Gravel and cobbles are fine to coarse of sandstone	300			O				0.40 0.50
0.55	Moderately strong orangish brown coarse grained SANDSTONE	50							0.55
	Trial Pit Terminated at 0.55m								

Remarks:

Hand excavated to 0.55m

Trial Pit remained stable and dry on completion

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

TPC

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G16304

TP D

Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.25	TURF / TOPSOIL Medium dense dark brown gravelly sand	250				Cv kN/m ²			0.20
0.35	Firm to stiff / weak to moderately strong orangish and greyish brown weathered sandy SILTSTONE	100							
	Moderately strong orangish brown and grey silty SANDSTONE. Weathered in places	450							0.50
0.80	Trial Pit Terminated at 0.80m								0.80
	Infiltration Test carried out within trial pit initial water level at 0.30m								

Remarks:

Hand excavated to 0.80m
Trial Pit remained stable and dry on completion
Infiltration test carried out with pit base at 0.80m

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

Disturbed sample
 Cv Shear vane
 W Water sample
 S Standard Penetration Test
 C Cone Penetration Test

TPD

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

G16304

TP E

Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.25	TURF / TOPSOIL Medium dense dark brown gravelly sand	250			O	Cv kN/m ²			0.20
0.50	Moderately strong orange and greyish brown weathered silty SANDSTONE / sandy SILTSTONE	250							0.50
	Trial Pit Terminated at 0.50m								

Remarks:

Hand excavated to 0.50m

Trial Pit remained stable and dry on completion

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

TPE

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G16304

BH No.1 Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	TURF / TOPSOIL Medium dense dark brown gravelly sand	300			O	Cv kN/m ²	6,15,39 N=60/225mm 1.00-1.225m		0.20
0.45	Medium dense dark orangish brown slightly clayey gravelly SAND. Gravel is fine to coarse of sandstone	150			O				0.50
	Moderately strong orange and greyish brown weathered silty SANDSTONE / sandy SILTSTONE	750			O C				0.75
1.20									1.00
									1.25
1.50	Moderately strong orangish brown coarse grained SANDSTONE	300			O				1.50
	Borehole Terminated at 1.50m due to refusal								

Remarks:

Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 1.50m
Borehole remained dry on completion
Gas well installed to 1.50m with bung and cover

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

BH1

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

G16304

BH No.2

Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	TURF / TOPSOIL Medium dense dark brown gravelly sand	200				Cv kN/m ²			
0.90	Medium dense dark orangish brown slightly clayey gravelly SAND. Gravel is fine to coarse of sandstone	700			O				0.30
					O				0.50
									0.75
1.40	Moderately strong orange and greyish brown highly weathered silty SANDSTONE / sandy SILTSTONE	500			O C		4,6,7,7,7,9 N=30 1.00-1.45m		1.00
									1.25
					O				1.50
2.00	Moderately strong orangish brown coarse grained SANDSTONE	600							1.75
					O C		16,28,35 N=79/225mm 2.00-2.225m		2.00
	Borehole Terminated at 2.00m due to refusal								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 2.00m

Borehole remained dry on completion

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

O Disturbed sample
 Cv Shear vane
 W Water sample
 S Standard Penetration Test
 C Cone Penetration Test

BH2

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G16304

BH No.3 Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	TURF / TOPSOIL Medium dense dark brown gravelly sand	200				Cv kN/m ²			
0.80	Medium dense dark orangish brown slightly clayey gravelly SAND. Gravel is fine to coarse of sandstone	600				O O			0.30
									0.50
									0.75
1.10	Moderately strong orangish brown coarse grained SANDSTONE	300				O C	24.60 N=84/150mm 1.00-1.15m		1.00 1.10
	Borehole Terminated at 1.10m due to refusal								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 1.10m

Borehole remained dry on completion

Key:



Slotted Pipe

Plain Pipe

Bentonite

Gravel Filter

0 Disturbed sample

Cv Shear vane

W Water sample

S Standard Penetration Test

C Cone Penetration Test

BH3

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

G16304

BH No.4

Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	TURF / TOPSOIL Medium dense dark brown gravelly sand	300				Cv kN/m ²			0.25
0.70	Medium dense dark orangish brown slightly clayey gravelly SAND. Gravel is fine to coarse of sandstone	400			O				0.50 0.75
1.30	Moderately strong orangish brown coarse grained SANDSTONE	500			O C		4,6,9,13,17,19 N=58 1.00-1.45m		1.00 1.30
	Borehole Terminated at 1.30m due to refusal								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 1.30m

Borehole remained dry on completion

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

O Disturbed sample
 Cv Shear vane
 W Water sample
 S Standard Penetration Test
 C Cone Penetration Test

BH4

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

G16304

BH No.5

Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	TURF / TOPSOIL Medium dense dark brown gravelly sand	200				Cv kN/m ²			0.25
0.40	Medium dense dark orangish brown slightly clayey gravelly SAND. Gravel is fine to coarse of sandstone	200			O				0.50
	Moderately strong orange and greyish brown highly weathered silty SANDSTONE / sandy SILTSTONE	900			O C		6,8,8,9,13,32 N=63 1.00-1.45m		0.75
1.30									1.00
1.40	Moderately strong orangish brown coarse grained SANDSTONE	100			O				1.25
	Borehole Terminated at 1.40m due to refusal								1.40

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 1.40m

Borehole remained dry on completion

Gas well installed to 1.40m with gas bung and cover

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

BH5

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G16304

BH No.6 Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	TURF / TOPSOIL Medium dense dark brown gravelly sand	300			O	Cv kN/m ²			0.20
0.80	Medium dense dark orangish brown slightly clayey gravelly SAND. Gravel is fine to coarse of sandstone	500			O				0.50 0.75
1.50	Moderately strong orangish brown coarse grained SANDSTONE	700			O C		3,4,7,9,12,30 N=48 1.00-1.45m		1.00 1.25
	Borehole Terminated at 1.50m due to refusal				O		N=50/150mm 1.50-1.65m		1.50

Remarks:

Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 1.50m
Borehole closed below 1.40m on completion
Gas well installed to 1.40m with bung and cover

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter
 Disturbed sample
 Shear vane
 Water sample
 Standard Penetration Test
 Cone Penetration Test

BH6

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

G16304

BH No.7

Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	TURF / TOPSOIL Medium dense dark brown gravelly sand	200			O	Cv kN/m ²			0.20
1.10	Medium dense dark orangish brown slightly clayey gravelly SAND. Gravel is fine to coarse of sandstone	900			O				0.50
					O C		4,2,3,4,4,5 N=16 1.00-1.45m		0.75
1.70	Moderately strong orange and greyish brown weathered silty SANDSTONE / sandy SILTSTONE	600			O				1.00
									1.25
									1.50
									1.75
2.00	Moderately strong orangish brown coarse grained SANDSTONE	300			O C		N=50/150mm 2.00-2.15m		2.00
	Borehole Terminated at 2.00m due to refusal								

Remarks:

Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.00m
Borehole remained dry on completion
Gas well installed to 4.00m with bung and cover

Key:

Slotted Pipe
 Plain Pipe
 Bentonite
 Gravel Filter

Disturbed sample
 Cv Shear vane
 W Water sample
 S Standard Penetration Test
 C Cone Penetration Test

BH7

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G16304

BH No.8 Sheet No. 1 of 1

Location: Proposed Development, Land off Huthwaite Lane, Thurgoland S35 7AF

DATE: 08-09-16

Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	TURF / TOPSOIL Medium dense dark brown gravelly sand	300				Cv kN/m ²			0.20
0.70	Moderately strong orange and greyish brown weathered silty SANDSTONE / sandy SILTSTONE	400							0.50
1.60	Moderately strong orangish brown coarse grained SANDSTONE	900							0.75
									1.00
									1.25
									1.50
									1.60
	Borehole Terminated at 1.60m due to refusal								
	Infiltration test carried out with borehole base at 1.60m and casing at 1.00m								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 1.60m

Borehole remained open and dry on completion

Infiltration testing carried out within borehole

Key:

Slotted Pipe

Plain Pipe

Bentonite

Gravel Filter

Disturbed sample

Shear vane

Water sample

Standard Penetration Test

Cone Penetration Test

BH8

APPENDIX 2
MOISTURE CONTENT,
ATTERBERG LIMIT TEST RESULTS (TABLE 4)
AND INFILTRATION TEST RESULTS

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G16304
Your ref.

Table 1
Location: Proposed Development, Land off Huthwaite Lane, Thurgolanc

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification
1	0.50	17.0	54.8		23.2	39.2	16.0	CI
	1.00	19.0						
	1.50	4.9						
2	0.30	17.8	32.7		*	*	*	*
	0.50	18.3						
	1.00	14.1						
	1.50	13.9						
	2.00	2.8						
3	0.20	11.6						
	0.50	19.8						
	1.00	7.3						

* Note - essentially non plastic material

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G16304
Your ref.

Table 1
Location: Proposed Development, Land off Huthwaite Lane, Thurgolanc

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification
4	0.30	27.4						
	0.50	20.3						
	1.00	7.5						
	1.30	8.3						
5	0.20	45.2						
	0.50	7.7						
	1.00	6.8	21.0		*	*	*	*
	1.40	10.2						

* Note - essentially non plastic material

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

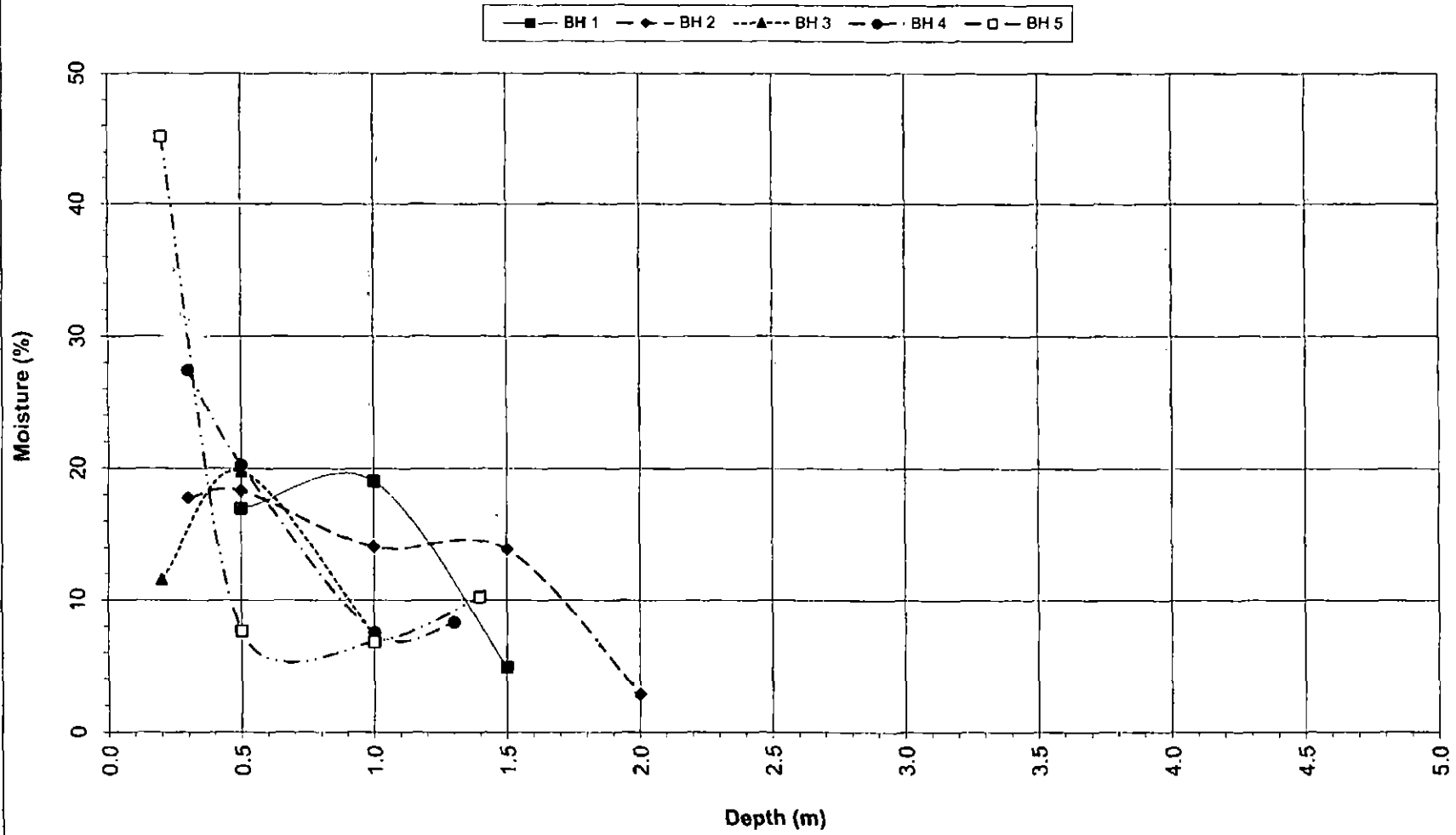
Our ref. G16304
Your ref.

Table 1
Location: Proposed Development, Land off Huthwaite Lane, Thurgolanc

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification
6	0.30	30.5						
	0.50	16.0						
	1.00	13.3						
	1.50	11.7						
7	0.50	14.2						
	1.00	12.3						
	1.50	10.8						
	2.00	7.1						

Moisture / depth profile

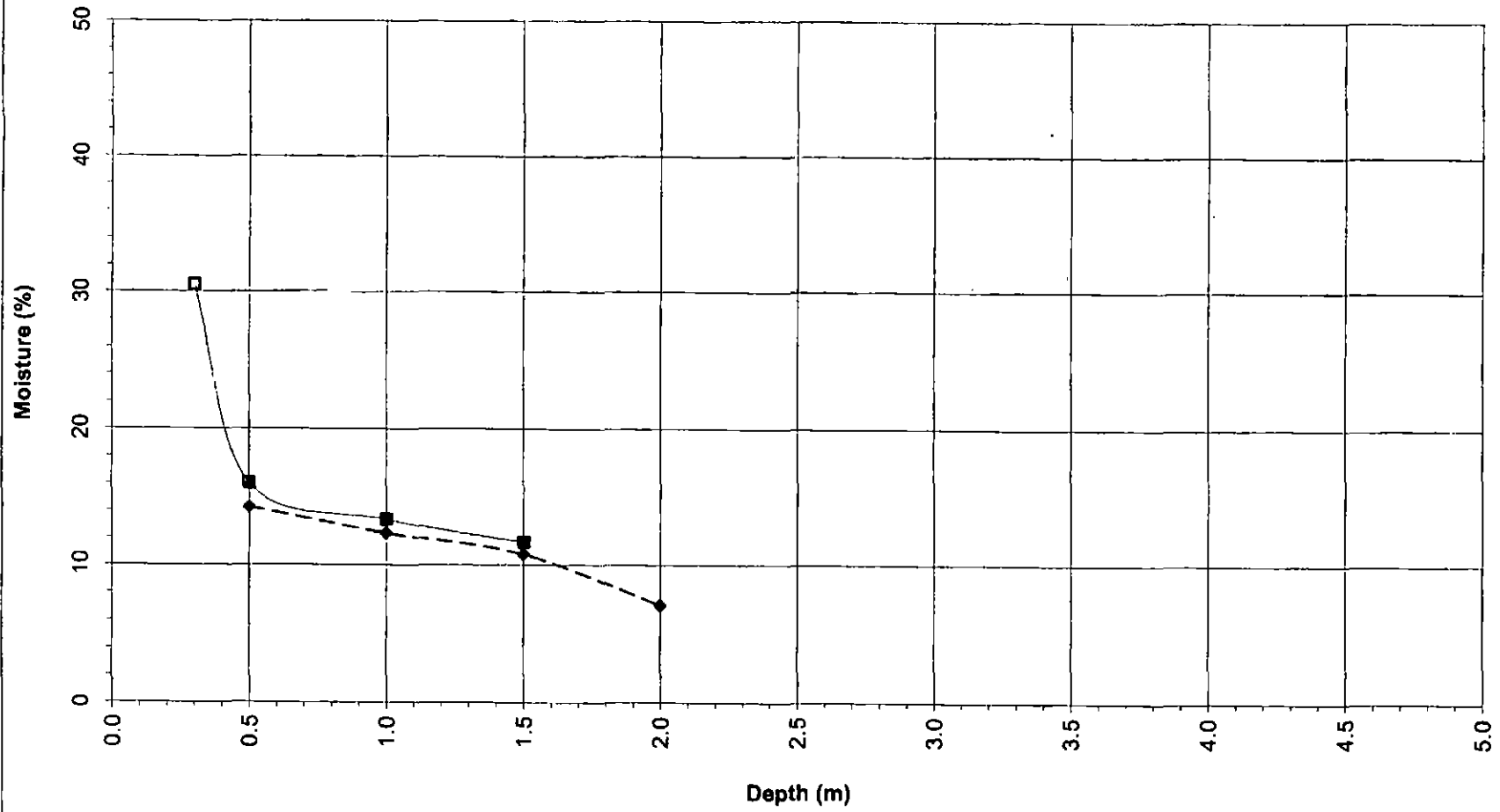
G16304



Moisture / depth profile

G16304

—■— BH 6 -◆- BH 7



Infiltration Test Result
G16304
Land off Huthwaite Lane,
Thurgoland, S35 7AF
08/09/16

Infiltration test 1
(In TPD)

Time/s	Depth to water/mm
0	300
60	305
120	309
180	311
240	313
300	315
600	321
900	326
1200	330
1500	333
1800	337
2400	342
3000	347
3600	352

Pit dimensions:

L 350mm

W 350mm

D 800mm (filled to 0.30m below ground level)

Internal surface area of pit to 50% depth* (m²): 0.4725 (a_{p50})

Storage volume of pit 75% to 25% filled* (m³): 0.03063 (V_{p75-25})

Time to reach 75% filled* (s): Not reached

Time to reach 25% filled* (s): Not reached

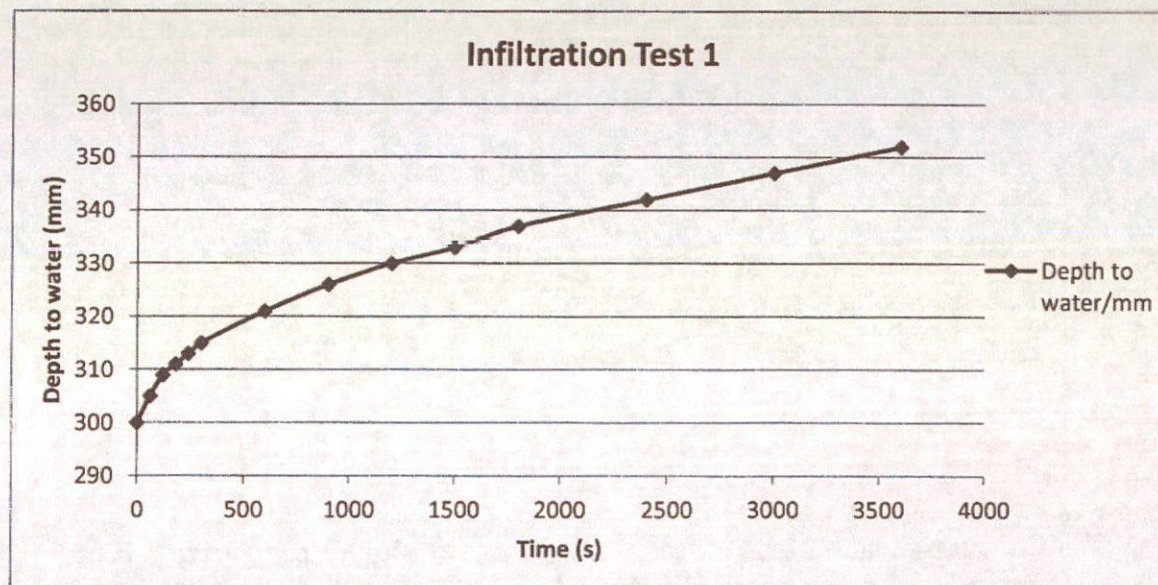
Time from 75% depth to 25% depth* (s): - (t_{p75-25})

* of 500mm filled depth

$$\text{Soil infiltration rate, } f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Source: BRE Digest 365 (BRE, 2007)

Failed test



Infiltration Test Result

G16304

Land off Huthwaite Lane, Thurgoland, S35 7AF

19/09/16

Infiltration test 2

(BH8)

Time/s	Depth to water/m	Head/m (if GWL present)
0	0	1.600
30	0.07	1.530
60	0.09	1.510
90	0.1	1.500
120	0.13	1.470
150	0.13	1.470
180	0.15	1.450
210	0.18	1.420
240	0.19	1.410
270	0.2	1.400
300	0.22	1.380
420	0.26	1.340
480	0.28	1.320
540	0.33	1.270
600	0.35	1.250
900	0.42	1.180
1200	0.53	1.070
1500	0.61	0.990
1800	0.66	0.940

Borehole dimensions:

Depth of Casing, D = 1.00 m

Diameter of Casing, D = 0.125 m

Cross-sectional area, A = 0.012277 m²

Depth below Casing, L = 0.60 m

Ground Water Level = N/A m

Intake factor, F, using:

$$F = \frac{2 \pi L}{\log_e [(L/D) + \sqrt{1 + (L/D)^2}]}$$

Source: BS 5930

Intake factor, F = 1.660 m

Choose start time t_1 to be: $t_1 = 30$ s

Choose end time t_2 to be: $t_2 = 1800$ s

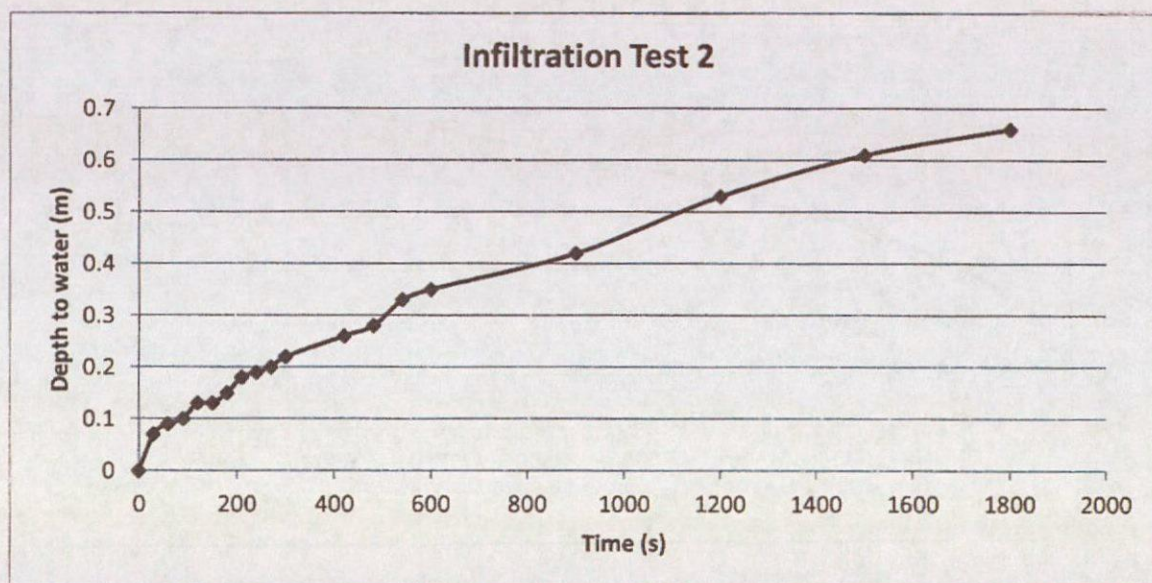
Head at time t_1 , $H_1 = 1.53$ m

Head at time t_2 , $H_2 = 0.94$ m

Permeability, k, using: $k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$ (general approach)

Source: BS 5930

Permeability, k = 2.04E-06 ms⁻¹



APPENDIX 3
CHEMTECH ANALYTICAL
TEST REPORT



ANALYTICAL TEST REPORT

Contract no: 61257
Contract name: Land off Huthwaite Lane, Thurgoland, Sheffield, S35 7AF
Client reference: G16304b
Clients name: Geo Investigate
Clients address: Units 4 & 5, Terry Dicken Industrial Estate
Ellerbeck Way, Stokesley
North Yorkshire
TS9 7AE

Samples received: 13 September 2016

Analysis started: 14 September 2016

Analysis completed 20 September 2016

Report issued: 20 September 2016

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was 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.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key: U UKAS accredited test
M MCERTS & UKAS accredited test
\$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing
NAD No Asbestos Detected

Approved by:

Dave Bowerbank
Customer Services Co-ordinator

Chemtech Environmental Limited

SAMPLE INFORMATION

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.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones.

Lab ref	Sample Id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
61257-1	BH1	0.20	Loamy Clay	-	-	13.1
61257-2	TPA	0.20	Loamy Clay	-	-	19.7
61257-3	TPB	0.15	Loamy Clay	-	-	16.7
61257-4	TPC	0.40	Loamy Sand with Gravel	-	-	6.3
61257-5	TPD	0.20	Loam	-	-	20.5
61257-6	TFE	0.20	Loamy Clay	-	-	19.8

Chemtech Environmental Limited

SOILS

Lab number				61257-1	61257-2	61257-3	61257-4	61257-5	61257-6
Sample Id				BH1	TPA	TPB	TPC	TPD	TPE
Depth (m)				0.20	0.20	0.15	0.40	0.20	0.20
Date sampled				08/09/2016	08/09/2016	08/09/2016	08/09/2016	08/09/2016	08/09/2016
Test	Method	Units							
Arsenic (total)	CE127 ^M	mg/kg As		7.3	12	11	5.7	20	21
Boron (water soluble)	CE063 ^M	mg/kg B		<0.5	<0.5	<0.5	<0.5	0.5	6.0
Cadmium (total)	CE127 ^M	mg/kg Cd		<0.2	<0.2	<0.2	<0.2	0.4	0.4
Chromium (total)	CE127 ^M	mg/kg Cr		102	107	84	79	82	103
Chromium (III)	-	mg/kg CrIII		102	107	84	79	82	103
Chromium (VI)	CE146	mg/kg CrVI		<1	<1	<1	<1	<1	<1
Copper (total)	CE127 ^M	mg/kg Cu		21	20	20	14	43	38
Lead (total)	CE127 ^M	mg/kg Pb		43	59	49	22	110	101
Mercury (total)	CE127 ^M	mg/kg Hg		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni		29	22	24	25	29	28
Selenium (total)	CE127 ^M	mg/kg Se		0.9	0.9	0.8	0.7	1.3	1.2
Zinc (total)	CE127 ^M	mg/kg Zn		95	76	74	59	173	165
pH	CE004 ^M	units		5.0	4.9	4.9	5.0	5.9	6.3
Sulphate (2:1 water soluble)	CE061 ^M	mg/l SO ₄		39	24	24	14	15	13
Sulphur (total)	CE127	mg/kg S		165	247	340	189	420	366
Sulphide	CE079	mg/kg S ²⁻		<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN		<1	<1	<1	<1	<1	<1
Cyanide (total)	CE077 ^M	mg/kg CN		<1	<1	<1	<1	<1	<1
Thiocyanate	CE145 ^M	mg/kg SCN		<1	1.3	1.4	<1	2.0	1.3
Phenols (total)	CE078	mg/kg PhOH		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Organic Carbon (TOC)	CE072 ^M	% w/w C		1.19	-	-	-	4.09	-
Estimate of OMC (calculated from TOC)	CE072 ^M	% w/w		2.05	-	-	-	7.05	-
PAH									
Naphthalene	CE087 ^M	mg/kg		0.04	<0.01	0.02	0.01	0.08	0.03
Acenaphthylene	CE087 ^M	mg/kg		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	CE087 ^M	mg/kg		0.02	<0.01	<0.01	<0.01	0.02	<0.01
Fluorene	CE087 ^U	mg/kg		0.02	<0.01	<0.01	<0.01	0.02	<0.01
Phenanthrene	CE087 ^M	mg/kg		0.14	<0.02	0.03	0.03	0.34	0.12
Anthracene	CE087 ^U	mg/kg		0.03	<0.02	<0.02	<0.02	0.06	0.02
Fluoranthene	CE087 ^M	mg/kg		0.12	<0.02	0.04	<0.02	0.38	0.23
Pyrene	CE087 ^M	mg/kg		0.12	0.02	0.03	<0.02	0.35	0.20
Benzo(a)anthracene	CE087 ^U	mg/kg		0.06	<0.02	<0.02	<0.02	0.16	0.11
Chrysene	CE087 ^M	mg/kg		0.06	<0.01	0.01	0.01	0.17	0.11
Benzo(b)fluoranthene	CE087 ^M	mg/kg		0.06	<0.02	0.02	<0.02	0.24	0.18
Benzo(k)fluoranthene	CE087 ^M	mg/kg		0.03	<0.02	<0.02	<0.02	0.09	0.07
Benzo(a)pyrene	CE087 ^U	mg/kg		0.05	<0.02	<0.02	<0.02	0.17	0.11
Indeno(123cd)pyrene	CE087 ^M	mg/kg		0.03	<0.02	<0.02	<0.02	0.13	0.09
Dibenz(ah)anthracene	CE087 ^M	mg/kg		<0.02	<0.02	<0.02	<0.02	0.03	0.02
Benzo(ghi)perylene	CE087 ^M	mg/kg		0.03	<0.02	0.03	<0.02	0.12	0.08
PAH (total of USEPA 16)	CE087	mg/kg		0.82	<0.27	<0.27	<0.27	2.36	1.40

61257

Land off Huthwaite Lane, Thurgoland, Sheffield, S35 7AF
G16304b

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SOILS

Lab number			61257-1	61257-2	61257-3	61257-4	61257-5	61257-6
Sample id			BH1	TPA	TPB	TPC	TPD	TPE
Depth (m)			0.20	0.20	0.15	0.40	0.20	0.20
Date sampled			08/09/2016	08/09/2016	08/09/2016	08/09/2016	08/09/2016	08/09/2016
Test	Method	Units						
TPH								
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	-	-	<0.01	-	-	-
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	-	-	<0.01	-	-	-
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	-	-	<0.01	-	-	-
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	-	-	<1	-	-	-
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	-	-	<1	-	-	-
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	-	-	<1	-	-	-
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	-	-	2	-	-	-
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	-	-	<1	-	-	-
VPH Aliphatic (>C5-C6)	CE067	mg/kg	-	-	<0.1	-	-	-
VPH Aliphatic (>C6-C8)	CE067	mg/kg	-	-	<0.1	-	-	-
VPH Aliphatic (>C8-C10)	CE067	mg/kg	-	-	<0.1	-	-	-
EPH Aliphatic (>C10-C12)	CE068	mg/kg	-	-	<4	-	-	-
EPH Aliphatic (>C12-C16)	CE068	mg/kg	-	-	4	-	-	-
EPH Aliphatic (>C16-C35)	CE068	mg/kg	-	-	117	-	-	-
EPH Aliphatic (>C35-C44)	CE068	mg/kg	-	-	36	-	-	-
Subcontracted analysis								
Asbestos (qualitative)	\$	-	-	NAD	-	NAD	-	NAD

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PREPARED LEACHATES

Lab number			61257-1L	61257-3L
Sample Id			BH1	TPB
Depth (m)			0.20	0.15
Test	Method	Units		
Arsenic (dissolved)	CE128 ^U	µg/l As	0.21	0.13
Boron (dissolved)	CE128 ^U	µg/l B	9	8
Cadmium (dissolved)	CE128 ^U	µg/l Cd	0.09	<0.07
Chromium (dissolved)	CE128 ^U	µg/l Cr	<0.2	<0.2
Copper (dissolved)	CE128 ^U	µg/l Cu	2.8	2.7
Lead (dissolved)	CE128 ^U	µg/l Pb	<0.2	<0.2
Mercury (dissolved)	CE128 ^U	µg/l Hg	<0.008	<0.008
Nickel (dissolved)	CE128 ^U	µg/l Ni	1.2	<0.5
Selenium (dissolved)	CE128 ^U	µg/l Se	<0.07	<0.07
Zinc (dissolved)	CE128 ^U	µg/l Zn	2	1
pH	CE004 ^U	units	5.7	5.7
Sulphate	CE049 ^U	mg/l SO ₄	<10	<10
Sulphur (dissolved)	CE128 ^U	mg/l S	0.8	1.0
Sulphide	CE079	µg/l S ²⁻	<100	<100
Cyanide (free)	CE147	µg/l CN	<20	<20
Cyanide (total)	CE147	µg/l CN	<20	<20
Thiocyanate	CE014	µg/l SCN	<200	<200
Phenols (total)	CE148	µg/l PhOH	<10	<10
PAH				
PAH (total of USEPA 16)	CE051	µg/l	<1.6	<1.6

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	M	0.5	mg/kg B
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
-	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO ₄
CE127	Sulphur (total)	Arid extraction, ICP-MS	Dry		100	mg/kg S
CE079	Sulphide	Extraction, Continuous Flow Colorimetry	Wet		10	mg/kg S ²⁻
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet		1	mg/kg CN
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	Wet	M	1	mg/kg CN
CE145	Thiocyanate	Weak acid extraction, Colorimetry	Dry	M	1	mg/kg SCN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	Wet		0.5	mg/kg PhOH
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	M	0.1	% w/w C
CE072	Estimate of OMC (calculated from TOC)	Calculation from Total Organic Carbon	Dry	M	0.1	% w/w
CE087	Naphthalene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	Wet	U	0.01	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	Wet		0.27	mg/kg
CE067	VPH Aromatic (>EC5-EC7)	Headspace GC-FID	Wet		0.01	mg/kg
CE067	VPH Aromatic (>EC7-EC8)	Headspace GC-FID	Wet		0.01	mg/kg
CE067	VPH Aromatic (>EC8-EC10)	Headspace GC-FID	Wet		0.01	mg/kg
CE068	EPH Aromatic (>EC10-EC12)	Solvent extraction, GC-FID	Wet		1	mg/kg

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE068	EPH Aromatic (>EC12-EC16)	Solvent extraction, GC-FID	Wet		1	mg/kg
CE068	EPH Aromatic (>EC16-EC21)	Solvent extraction, GC-FID	Wet		1	mg/kg
CE068	EPH Aromatic (>EC21-EC35)	Solvent extraction, GC-FID	Wet		1	mg/kg
CE068	EPH Aromatic (>EC35-EC44)	Solvent extraction, GC-FID	Wet		1	mg/kg
CE067	VPH Aliphatic (>C5-C6)	Headspace GC-FID	Wet		0.1	mg/kg
CE067	VPH Aliphatic (>C6-C8)	Headspace GC-FID	Wet		0.1	mg/kg
CE067	VPH Aliphatic (>C8-C10)	Headspace GC-FID	Wet		0.1	mg/kg
CE068	EPH Aliphatic (>C10-C12)	Solvent extraction, GC-FID	Wet		4	mg/kg
CE068	EPH Aliphatic (>C12-C16)	Solvent extraction, GC-FID	Wet		4	mg/kg
CE068	EPH Aliphatic (>C16-C35)	Solvent extraction, GC-FID	Wet		4	mg/kg
CE068	EPH Aliphatic (>C35-C44)	Solvent extraction, GC-FID	Wet		10	mg/kg
\$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

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METHOD DETAILS

METHOD	PREPARED LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE001	Leachate preparation (EA)	L:S 10:1		-	-
CE128	Arsenic (dissolved)	ICP-MS	U	0.06	µg/l As
CE128	Boron (dissolved)	ICP-MS	U	6	µg/l B
CE128	Cadmium (dissolved)	ICP-MS	U	0.07	µg/l Cd
CE128	Chromium (dissolved)	ICP-MS	U	0.2	µg/l Cr
CE128	Copper (dissolved)	ICP-MS	U	0.4	µg/l Cu
CE128	Lead (dissolved)	ICP-MS	U	0.2	µg/l Pb
CE128	Mercury (dissolved)	ICP-MS	U	0.008	µg/l Hg
CE128	Nickel (dissolved)	ICP-MS	U	0.5	µg/l Ni
CE128	Selenium (dissolved)	ICP-MS	U	0.07	µg/l Se
CE128	Zinc (dissolved)	ICP-MS	U	1	µg/l Zn
CE004	pH	Based on BS 1377, pH Meter	U	-	units
CE049	Sulphate	Ion Chromatography	U	10	mg/l SO ₄
CE128	Sulphur (dissolved)	ICP-MS	U	0.2	mg/l S
CE079	Sulphide	Continuous Flow Colorimetry		100	µg/l S ²⁻
CE147	Cyanide (free)	Distillation, Colorimetry		20	µg/l CN
CE147	Cyanide (total)	Continuous Flow Colorimetry		20	µg/l CN
CE014	Thiocyanate	Colorimetry		200	µg/l SCN
CE148	Phenols (total)	Continuous Flow Colorimetry		10	µg/l PhOH
CE051	PAH (total of USEPA 16)	Solvent extraction, GC-MS		1.6	µg/l

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DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
IT	Sample not cooled
OR	Other (specify)

Lab ref	Sample Id	Depth (m)	Deviating	Tests (Reason for deviation)
61257-1	BH1	0.20	N	
61257-2	TPA	0.20	N	
61257-3	TPB	0.15	N	
61257-4	TPC	0.40	N	
61257-5	TPD	0.20	N	
61257-6	TPE	0.20	N	