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DATA ACQUISITION
CONSULTANCY

Phase 2 Intrusive Site Investigation Report

LOCATION	Land at Hemlington North, Middlesbrough TS8 9DE
ISSUE DATE	15th August 2018
FOR	Middlesbrough Council
CLIENT REF.	PO 8094369
OUR REF.	G18222b

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1. Introduction

In accordance with your instruction, Geoinvestigate Ltd. has carried out a Phase 2 investigation at the site known as Hemlington North, Middlesbrough TS8 9DE. The site currently comprises a parcel of largely level grassland to the northeast of the Gables Inn.

The site slopes gently down towards Stainton Way which forms the northern boundary. Fairly mature to mature trees and bushes are present on the south and east boundaries of the site and a residential property with sporadic younger vegetation is present beyond a drainage ditch/stream at the western boundary.

The Phase 1 report produced previously by Geoinvestigate (repot ref. G18222a, issued 12th July 2018) found relatively few potential sources of contamination within or close to the site with the most likely sources comprising the construction and removal of a series of small buildings (probably outbuildings or animal sheds) formerly within the site, and nearby historical residential and road developments. The findings of the Phase 1 Desk Study have formed the basis for the design of the current investigation.

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 the possible geotechnical hazards and the potential for contamination and hazardous gas to occur at the site.

The boundary of the current study area is shown on the site plan presented in Appendix 1 of this report.

The proposed development at the site currently comprises a residential housing development; no outline development plan is currently available but this report has assumed that the proposed development will mostly comprise normal 2-3 storey housing.

1.1 Design of Investigation

The study area has had only limited use/development in the past with only minor/small buildings having been present previously. As such it was considered unlikely that any relic foundations or building footprints would be found or targetable by the investigation works.

Superficial and bedrock geology is mapped respectively as Devensian Till (Diamicton) with the Mercia Mudstone Group commencing at depth. No nearby BGS borehole records were available but more distant logs suggest that 10m of sandy gravelly clay (boulder clay) might be expected, with some of the more distant records to the west and northwest reporting silty clay and occasionally clay with organic inclusions at shallow depths.

Given the findings of the desk study, and the anticipated ground conditions and potential sources of contamination and/or made ground, this investigation was designed to establish the nature of the ground conditions across the site as a whole with no obvious areas that should be specifically targeted where made ground or contamination might be more likely to be present.

As there is currently no definite development plan for the site the borehole locations were chosen to give maximum coverage of the site as a whole for both geo-environmental and geotechnical considerations combined, rather than to target either proposed building locations (for geotechnical reasons) or areas

intended to comprise soft landscaping (to address potential contamination issues) separately. No California bearing ratio (CBR) testing was undertaken at the site at this stage because the routes/locations of roads and parking areas in the new development are yet to be established. Provision was made for the installation of monitoring wells and subsequent ground gas monitoring at the discretion of the attending engineer who deemed this to be essential to establishing the potential ground gas risk at the site (see section 6 later).

2. Scope of Phase 2 Investigation

2.1 Scope of Works

Given the above the following investigation was carried out to assess the potential risks at the site:

- The sinking of eight (8) windowless sampling boreholes (ref. BH1 to BH8) to depths of between 3.40m and 4.00m with associated soil sampling and supervision of the works by a suitably qualified geo-environmental engineer. The boreholes were sunk using a Dando Terrier 2002 mini drilling rig.

- The hand excavation of four (4) trial pits (ref. TPA to TPD) to a depth of 1.00m to further inspect near-surface soils and recover additional samples for contamination testing.

- The sinking of a single (1) cable percussion borehole (CP1) to a depth of 15.00m with associated soil sampling and supervision of the works by a suitably qualified geo-environmental engineer

- Geotechnical Testing comprising ten (10) Atterberg Limits tests and sixty-seven (76) moisture determinations to provide information with regard to soil plasticity on the site.

- Contamination analyses of six (6) samples of topsoil and made ground recovered at depths up to 2.00m to confirm that metals, asbestos, polycyclic aromatic hydrocarbons (PAHs), and petroleum hydrocarbons are absent or within acceptable limits. (Chemical analyses based on findings of the Phase 1 Desk Study Report, additional initial site assessment by Geoinvestigate, and on the attending engineer's assessment of encountered soils). Leachate from two (2) samples was also tested to check the mobility of contaminants.

- Provision of a factual and interpretative report including; site plan, borehole and trial pit logs, geotechnical and contamination soil analysis results, and gas monitoring data, together with advice on suitable foundation types and, if required, remediation and validation.

The borehole and trial pit 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 and trial pit logs also provided in Appendix 1.

Moisture and Atterberg Limit test results (Table 4) and moisture and shear strength profiles are provided in Appendix 2.

The results of the contamination testing are included in Appendix 3.

2.2 Sampling Rationale

As discussed in section 1.1, as there were no obvious areas that should be specifically targeted where made ground or contamination might be more likely to be present and no proposed development plan, borehole locations were chosen to give maximum coverage of the site as a whole for both geo-environmental and geotechnical considerations combined.

Samples chosen for contamination were partly targeted samples of material deemed the most likely to contain contamination (made ground) or to come into contact with future site users (topsoil). Samples chosen are considered to be adequately representative of all soil types present at the site.

3. Phase 2 Investigation Findings

3.1 Encountered Ground Conditions

⟹ 3.1.1 Windowless Sampling Boreholes (BH1 to BH8)

All of the excavations at the site encountered turf underlain by topsoil at the site surface to depths of between 0.10m and 0.35m. The topsoil contained gravel constituents of just sandstone, brick and occasional coal.

This was underlain in all of the windowless sampling boreholes by made ground to between 0.40m and 2.20m below ground level (BGL). This generally comprised sandy gravelly clay fill, often noted to probably comprise reworked natural clay soils. The clay fill was noted to variably contain gravel constituents of sandstone, brick and coal with occasional plastic and pot also noted in places.

Near surface made ground at BH1 and BH2 comprised gravel fill, variably containing limestone, brick, concrete, coal and plastic. A horizon of softer, slightly organic fill was found at the base of the made ground at BH2 (0.70m to 1.10m BGL) and BH3 (1.70m to 2.20m BGL), and a probable buried former topsoil horizon was found at the base of the made ground at BH5 (0.80m to 1.20m BGL).

Below the made ground, natural soils comprised firm to stiff, stiff or very stiff sandy gravelly clay (boulder clay) which extended to the full depth of all of the boreholes save for at BH2 where medium dense gravelly sand was encountered from 3.10m to termination at 4.00m BGL.

Natural underlying clay soils returned shear vane test results ranging from 76kN/m^2 to >130kN/m^2, with lower values (lowest 30kN/m^2) returned in places in the overlying made ground.

SPT N values of N=19 and N>>50 were returned respectively for the gravelly sand stratum at the base of BH2 and at the 3.40m refusal depth of BH5 (probably a large cobble or boulder).

The boreholes all remained open and dry on completion though standing water levels were recorded in boreholes BH18 (3.40m), BH19 (3.80m), BH27 (3.90m) and BH28 (3.60m). Boreholes BH13 and BH18 closed below depths of 3.60m and 3.40m respectively on completion of drilling.

Roots were encountered at shallow depth in a number of boreholes and to 1.50m and 1.60m in BH7 and BH8 respectively.

3.1.2 Cable Percussion Borehole (CP1)

Borehole CP1 was sunk to determine the deeper ground conditions below the site. CP1 was sunk close to borehole BH3 in the west of the site where the deepest made ground had been encountered.

CP1 encountered turf/topsoil over clay fill to a depth of 1.90m underlain by firm to stiff sandy gravelly (boulder) clay to 5.80m BGL. A 0.30m thick loose to medium dense wet sand horizon was then encountered followed by stiff boulder clay to completion at 15.00m BGL.

The borehole struck water at 5.90m on entering the sand horizon, which subsequently rose to 4.70m BGL.

3.1.2 Hand Excavated Trial Pits (TPA to TPD)

The hand excavated pits encountered comparable ground conditions to those found in the shallower boreholes with turf/topsoil underlain by made ground comprising clay fill to depths of between 0.60m and 0.80m, and ≥1.00m at TPA which did not find the base of the made ground stratum.

Similar underlying natural soils were encountered, comprising stiff boulder clay to 1.00m in the remaining three trial pits.

3.1.4 Review of ground conditions encountered.

<u>Made ground</u>

- Made ground has been encountered throughout the site, largely comprising clay fill and generally extending to depths of between 0.40m and 1.30m.
- An area of deeper made ground has been encountered at BH3 and CP1 which has been found to extend to 2.20m and 1.90m in those two boreholes respectively.
- Slightly organic softer horizons were noted at the base of the made ground at BH2, BH3 and BH5, identified as a possible buried topsoil horizon at BH5. Consequently, ground gas monitoring well were installed at the site and a gas monitoring exercise instigated.

<u>Natural Underlying Strata</u>

- Firm to stiff, stiff or very stiff sandy gravelly clay (boulder clay) has been encountered at all borehole locations to their full depth with the exception of BH2 which encountered medium dense sandy gravel below 3.10m.
- The deeper cable percussion borehole CP1 encountered a loose to medium dense wet sand horizon from 5.80m to 6.10m. Standing water in the borehole subsequently rose from this depth to 4.70m BGL.
- All other boreholes remained open and dry.

3.2 Soil Plasticity and Vegetation Influence

Noteworthy roots were encountered in boreholes in the south of the site (BH7 and BH8) to depths of 1.50m and 1.60m. Similar would generally be expected in ground close to the mature trees at the southern and eastern site boundaries. Less mature trees are also present close to BH1 at the northwest of the site.

Possible moisture depletion might be inferred from the moisture profiles of BH5, BH7 and BH8 extending to between 2.00m and 2.50m BGL.

Cohesive soils at the site generally classify as Clay of Intermediate (CI) Plasticity according to BS5930 with one test (at BH2) returning a classification of Clay of Low (CL) Plasticity, and one test (at BH7) returning a

classification of Clay of borderline Intermediate/High (CI/CH) Plasticity. With plasticity indices of between 13.1% and 28.3% (though generally between 19.1% and 25.5%) returned by the testing, these soils equate to NHBC Medium (and occasionally low) Shrinkage Potential Soils.

It is unclear at this stage whether any of the mature vegetation at the southern and eastern boundaries of the site is inside of the study area; trees outwith the site boundary may therefore be allowed to grow unchecked in the future, and any within the site may be removed prior to development.

Therefore, consideration will be required for proposed new structures at the site regarding potential vegetation influence and also potential heave on tree removal where appropriate. See Section 7.3 for recommendations.

4. Contamination Testing

The Phase 1 desk study and pre-investigation research had identified that most credible sources of made ground and/or possible contamination within the site would be; the former presence of a series of small, possibly light or temporary, structures within the site and the development of nearby land as roads and residential plots. No significant depths of made ground were originally anticipated and so the findings of BH3 and CP1 were somewhat unexpected.

It was considered that if former land uses within and near to the site had caused contamination the contaminants would most probably occur in the near surface or shallow made ground or topsoil horizons and perhaps in deeper made ground where present.

Therefore six (6) samples of near-surface (≤0.50m) made ground or topsoil recovered from across the site were tested for a range of substances together with a sample of deeper fill from BH3 (2.00m). 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 PAHs and Asbestos. In addition, testing was also carried out for petroleum hydrocarbons where deemed appropriate. Leachate from two (2) of the samples was analysed also to check for potential contaminant mobility.

The results of the contamination testing are included in the Chemtech Environmental Ltd. Report presented 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 environment agency, DEFRA and by the Chartered Institute of Environmental Health; Environment Agency Environmental Quality Standards (EQSs) Soil Guideline Values (SGVs), Site Specific Assessment Criteria (SSAC) generated using CLEA software version 1.06 site specific risk assessment modelling, DEFRA Category 4 Screening Levels (C4SLs), and Land Quality Management / Chartered Institute of Environmental Health (LQM/CIEH) Safe for use Levels (S4ULs) in order to assess the presence of potentially harmful chemicals within soils and water.

As the whole of the site is to be developed as a residential development, it falls within the residential end-use category. As it is possible that persons living on the site will cultivate vegetables / fruit for consumption, consideration to this end is considered necessary.

In this instance it has not been considered appropriate to generate site specific assessment criteria (SSAC) as no unusual circumstances are considered to exist that might render the generic assessment criteria unsuitable.

The results of the contamination testing that has been carried out 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.

Had any results been found to be above the intervention values, an assessment of the available pathways and receptors would have been carried out to determine whether further investigation or remediation may have been 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 underlain by made ground was found to extend generally to depths of between 0.40m and 1.30m while made ground was found to extend to greater depth in one part of the site, extending to 2.20m at BH3 and to 1.90m CP1. The majority of made ground at the site was found to comprise clay fill with gravel constituents comprising various combinations of the following; sandstone, brick, concrete and coal with occasional limestone, pot and plastic fragments also recorded. No horizons exhibiting any visual or olfactory evidence of contamination were encountered at the site (such as hydrocarbon odours etc.), nor was there any visible evidence of Asbestos contamination such as roofing board.

In light of this it was anticipated that if chemical contamination was likely to pose a significant hazard for the new development and its users this would most likely be associated with made ground though the likelihood of any significant risk was expected to be low. This would clearly need to be confirmed by soil analyses however.

As discussed earlier in the report, levels of determinands have been compared to the adopted assessment criteria for residential end-use as published by the Environment Agency, DEFRA and LQM/CIEH.

The results of the analyses of six (6) samples of soil recovered from the site from depths up to 2.00m returned concentrations of a range of substances falling below respective assessment criteria adopted from the sources named above without exception.

A summary of the returned soil concentrations together with their respective adopted assessment criteria are presented in Table 1 on the following page.

Analyses of leachates are discussed in the following section.

A mean Total Organic Carbon Content (TOC) of 1.44% and mean Soil Organic Matter Content (SOM) of 2.49% (estimated from the TOC) were returned from the soil analyses; therefore the LQM/CIEH GAC for PAHs and Hydrocarbons were chosen using the Soil Organic Matter (SOM) option of 2.5%.

Table 1: Chemical Determinands in soils.

	Range of Returned concentrations (mg/kg)	Residential EA SGV or DEFRA C4SL (mg/kg)	LQM/CIEH S4UL* (mg/kg)
Asbestos	None detected (all 6)	Any presence unacceptable	
Arsenic	2.555-3.4	32/37***	37
Boron	0.7-2.1		290
Cadmium	<0.2-0.2	10/26***	11
Chromium VI	<1 (all 6)	21***	6
Chromium III	18-38		910
Copper	10-122		2,400
Lead	17-82	200***	
Mercury (elemental)	<0.5 (all 6)	1	1.2
Nickel	10-41		180
Selenium	0.4-0.9	350	250
Zinc	42-621		3,700
pH	8.2-8.8	See Report Section 7.4 “Concrete Design”	
Water Soluble SO_4	24-334		
Phenol	<0.5 (all 6)	420	550
Total PAH	<0.27-19.5		
PAH Naphthalene	<0.01-0.11		5.6
PAH Acenapthylene	<0.01-0.07		420
PAH Acenapthene	<0.01-0.12		510
PAH Fluorene	<0.01-0.14		400
PAH Phenanthrene	<0.02-2.65		220
PAH Anthracene	<0.02-0.65		5400
PAH Fluoranthene	0.03-3.66		560
PAH Pyrene	<0.02-2.78		1200
PAH Benzo[a]anthracene	<0.02-1.62		11
PAH Chrysene	<0.02-1.44		22
PAH Benzo(b)fluoranthene	<0.02-2.02		3.3
PAH Benzo(k)fluoranthene	<0.02-0.87		93
PAH Benzo(a)pyrene	<0.02-1.43	5***	2.7
PAH Indeno(123-cd)pyrene	<0.02-0.81		36
PAH Dibenzo(a,h)anthracene	<0.02-0.24		0.28
PAH Benzo(ghi)perylene	<0.02-0.87		340
TPH Aromatic C5-C7	<0.01 (both)		140
TPH Aromatic C7-C8	<0.01 (both)		290
TPH Aromatic C8-C10	<0.01 (both)		83
TPH Aromatic C10-C12	<1 (both)		180
TPH Aromatic C12-C16	<1 (both)		330
TPH Aromatic C16-C21	2-10		540
TPH Aromatic C21-C35	2.8		1500
TPH Aromatic C35-C44	<1 (both)		1500
TPH Aliphatic C5-C6	<0.1 (both)		78
TPH Aliphatic C6-C8	<0.1 (both)		230
TPH Aliphatic C8-C10	<0.1 (both)		65
TPH Aliphatic C10-C12	<4 (both)		330 (118)**
TPH Aliphatic C12-C16	<4 (both)		2,400 (59)**
TPH Aliphatic C16-C35	33-54		92,000 (21)**
TPH Aliphatic C35-C44	10-11		92,000 (21)**

*For residential use with allowance for plant uptake / consumption of homegrown produce and SOM of 2.5% where relevant.

**Value in parentheses denotes estimated soil saturation limit above which a possibility of free-phase contamination might exist in soil.

***DEFRA C4SL for residential use with allowance for plant uptake / consumption of homegrown produce.

As can be seen from the results in Table 1a and the detailed results presented in Chemtech Environmental Ltd report 72959 (Appendix 3) the results of contamination analyses of soils recovered from the proposed residential development area of the site have returned levels of potential contaminants below the adopted soil assessment criteria without exception.

Asbestos was found to be absent from all six (6) samples negligible levels of petroleum hydrocarbons were returned wherever soils were analysed.

Levels of aliphatic hydrocarbons for carbon number fraction C16-C35 have been returned very slightly in excess of the estimated soil saturation limits for these soils but well below their respective safe for use levels. On occasion exceedances of estimated soil saturation limits might be inferred to represent some risk of free phase contamination being present in the soils (i.e. not adsorbed onto the soil structure). However, this is not considered to be the case for these results given the extremely low returned soil concentrations and the lack of any visual or olfactory evidence of possible hydrocarbon contamination in any soils uncovered by the investigation works throughout the site.

5.2.2 Contamination Risk to Controlled Waters

5.2.2.1 Leachate analysis

Given the possible sources of historical contamination and the presence of a possible surface water receptor adjacent to the site (drainage ditch/stream on the western boundary), leachate was analysed from two (2) of the samples of made ground (those obtained from BH3 and BH5). This screening 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 (EQSs). The results of the testing and the assessment criteria are shown Table 2 below.

Table 2: Chemical Determinands in Leachate

	Returned Concentrations (µg/l)	UK Standard for Surface Waters intended for Drinking Water Abstraction* (DW) and/or protection of Aquatic Life in surface waters* (Aq) (µg/l)
Inorganic Chemicals		
Arsenic	0.28-1.99	**50** (DW, range: 50-100) (No Aq standard)
Boron	9-11	**1000** (DW & Aq)
Cadmium	<0.07 (both)	**5** (DW & Aq)
Chromium	<0.2 (both)	**50** (DW) / **5** (Aq, range: 5-250)
Copper	1.9-3.0	**50** (DW) / **5** (Aq, range: 5-112)
Lead	<0.2-0.5	**50** (DW) / **4** (Aq, range: 4-250
Mercury (elemental Hg)	<0.008 (both)	**1** (DW & Aq)
Nickel	0.7-1.6	**20**** (DW) / **50** (Aq, range: 50-200)
Selenium	0.11-0.56	**10** (DW) (No Aq standard)
Zinc	3-4	**3000** (DW, range: 3000-5000) / **30** (Aq, range: 30-2000)
pH	8.3-8.4	**Range 5.5 to 10** (UK drinking water standards)
Organic Chemicals		
Phenols	<10 (both)	**50****(DW) / **300** (Aq)
PAHs (total)	<1.6*** (both)	**0.2** (DW, range: 0.2-1.0) (No Aq standard)
No individual PAH species were present at detectable levels:		

*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

As can be seen from Table 2 and the detailed results presented in Chemtech Environmental Ltd report 72959 soils from the site have been shown to be capable of leaching only negligible levels of potential contaminants and as such are not considered to pose a potential risk to the local surface and ground waters.

Concentrations of PAHs and Phenol are negligible and consistently below detectable limits for both of the analysed leachates and would not be considered to pose a risk to controlled waters. The returned pH levels of between 8.3 and 8.4 lie within the acceptable range (pH 5.5 to pH10) for pH as per UK drinking water standards.

In summary, the leachate testing returned negligible concentrations of determinands which would pass local drinking water and ground water quality standards and soils would therefore not be considered to pose any noteworthy threat to surface or underground waters.

5.3 Review of Results

The data presented in Tables 1 and 2 and the associated discussion show that soils and leachates analysed from the site have returned negligible concentrations of potential contaminants and as such surface and sub-soils at the site are considered to be uncontaminated and fit for purpose in the context of a residential end use.

Therefore, no remedial works will be required at the site prior to its redevelopment for residential use.

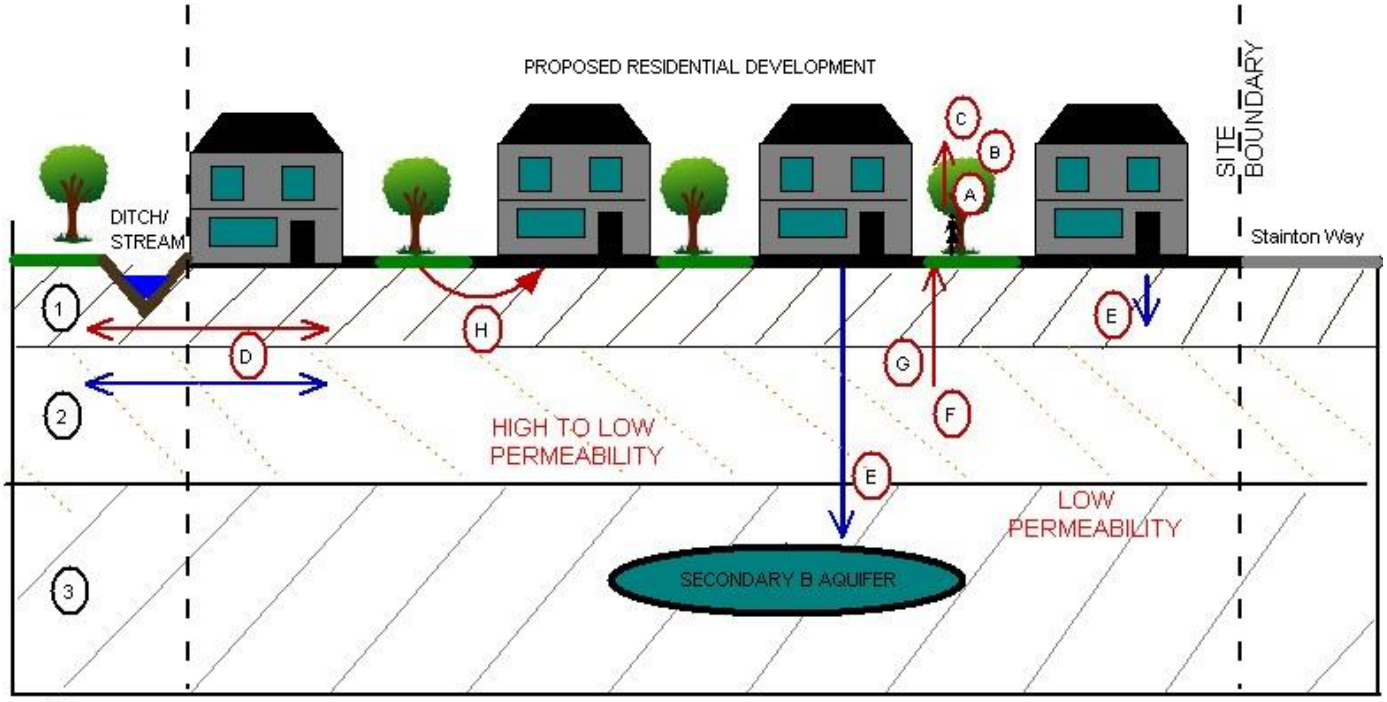
5.3.1 CGHM

The conceptual ground hazard model (CGHM) presented on the following page shows the potential hazards and pollutant linkages which have been considered at the site. All risks regarding potential contamination have been shown to be absent.

The CGHM also considers potential geotechnical risks at the site and as such the identified risk regarding shrink-swell clays and vegetation influence is included.

The potential ground gas risk associated with the presence of deeper made ground at the site is also included on the CGHM. The gas monitoring exercise is ongoing for the site but data gathered to date has identified no significant risk in this regard.

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



1 TOPSOIL / MADE GROUND HORIZON. MADE GORUND FOUND TO EXTEND TO UP TO 2.20m.

2 SUPERFICIAL GEOLOGY - DEVENSIAN TILL (DIAMICTON). SANDY GRAVELLY (BOULDER) CLAY CONFIRMED AT SITE.

3 BEDROCK GEOLOGY - MERCIA MUDSTONE GROUP.

IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES

-On site buildings and removal.
-Development of roadways and residential areas nearby.
-Hazardous gas sources from possible made ground within or near to site.
-Ground instability via shrink-swell clays.

IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

A - End Users through Direct Contact / Inhalation / Ingestion. Buildings and hard-standing may encompass some of the site, removing any pathway to end users through direct contact in these areas.
B - Plants and Trees through uptake.
C - End Users through cultivation and consumption of vegetables / fruit. Possible given the intended layout and end use of the site.
D - Neighbouring Sites through lateral migration (in soil and water, including surface water run-off).
E - Ground water through leaching of sub-soil.
F - Buildings and services through direct contact.
Linkages A-F considered to have been disproved. (See report sections 5 and 7.1).
G -End users and buildings through ground gas migration.
Monitoring exercise ongoing though no noteworthy risk identified to date. (See report sections 6 and 7.2).
H - Ground instability via shrink-swell deposits and/or areas of deeper made ground.
Potential risk identified but easily mitigated with correct foundation design. (See report sections 3 and 7.3).

6. Hazardous Gas

6.1 Gas Regime

The earlier Phase 1 Desk Study Report (Ref. Report G18222a) concluded that a necessity for ground gas monitoring would be unlikely. However, the presence of deeper made ground at BH3 and CP1 and to depths in excess of 1.00m at three other locations within the site caused the attending engineer to conclude that the installation of ground gas monitoring wells and an associated monitoring exercise would be necessary to properly quantify this risk, especially given that some of the fill materials were thought to be slightly organic in composition.

Gas monitoring wells were therefore installed in boreholes BH3, BH5 and BH8. The results of four (4) initial gas monitoring visits at the site are presented in Table 3 below.

A further set of two additional measurements will be required to complete the gas risk assessment at the site but no elevated results have been returned to date (see below).

Table 3 Summary of Gas Monitoring Data

Borehole	Number of Visits	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow Rate (l/hr)	Atmospheric Pressure (mb)
BH3	4	<0.1 (all)	1.1-2.3	17.3-19.0	<0.1	1004-1026
BH5		<0.1 (all)	1.2-2.5	19.0-19.7	<0.1	
BH8		<0.1 (all)	1.3-2.4	19.0-19.9	<0.1	

The four gas monitoring visits carried out to date at atmospheric pressures of between 1004mb and 1026mb returned:

- Near normal levels of O_2 of between 17.3% and 19.9%.
- Levels of CH_4 consistently below detectable limits (<0.1%) on all monitoring occasions.
- Low levels of CO_2 of between 1.1% and 2.5%.
- Negligible H_2S and CO below detectable limits (<1ppm) on all monitoring occasions.
- Consistently negligible flow rates below detectable limits (<0.1 l/hr) on all monitoring occasions.

As no monitoring visits have been able to be carried out on days of low atmospheric pressure (<1000mb), the final two gas monitoring visits are deemed to be required before final conclusions regarding the ground gas situation at the site can be made. At least one of these visits should be carried out during a period when atmospheric pressure is below 1000mb.

6.2 Radon Gas

The desk study findings confirmed that Radon protection is not necessary 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 site is uncontaminated and fit for purpose in the context of the proposed residential development.

Therefore, no remedial works will be necessary prior to the commencement of the new development.

Additionally, no risk has been identified to ground and surface waters, including the drainage ditch/stream directly adjacent to the site.

7.2 Hazardous Gas

Gas monitoring is ongoing at the site with four of a planned six monitoring visits having been undertaken to date. However, the monitoring undertaken to date has returned no cause for concern in this regard.

If the continued monitoring returns comparable data the site is expected fall into Characteristic situation 1 (CS1) 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).

No radon protection measures are required for the new development.

It is intended to carry out at least one of the remaining monitoring visits while atmospheric pressure is below 1000mb. An addendum to this report will be issued on completion of the monitoring exercise.

7.3 Foundations & Floors

Summary of ground conditions:

- Generally, competent boulder clay has been encountered throughout most of the site commencing from relatively shallow depth.
- Competent sands and gravels have been encountered at BH2 and CP1
- An area of deeper made ground has been identified at BH3 and CP1 in the west of the site.
- Possible root influence on potentially shrinkable clays has been identified close to vegetation at the southern and eastern boundaries, and perhaps to a lesser extent in the northwest corner of the site.
- No relic foundations of former buildings have been encountered in the excavations carried out at the site to date.

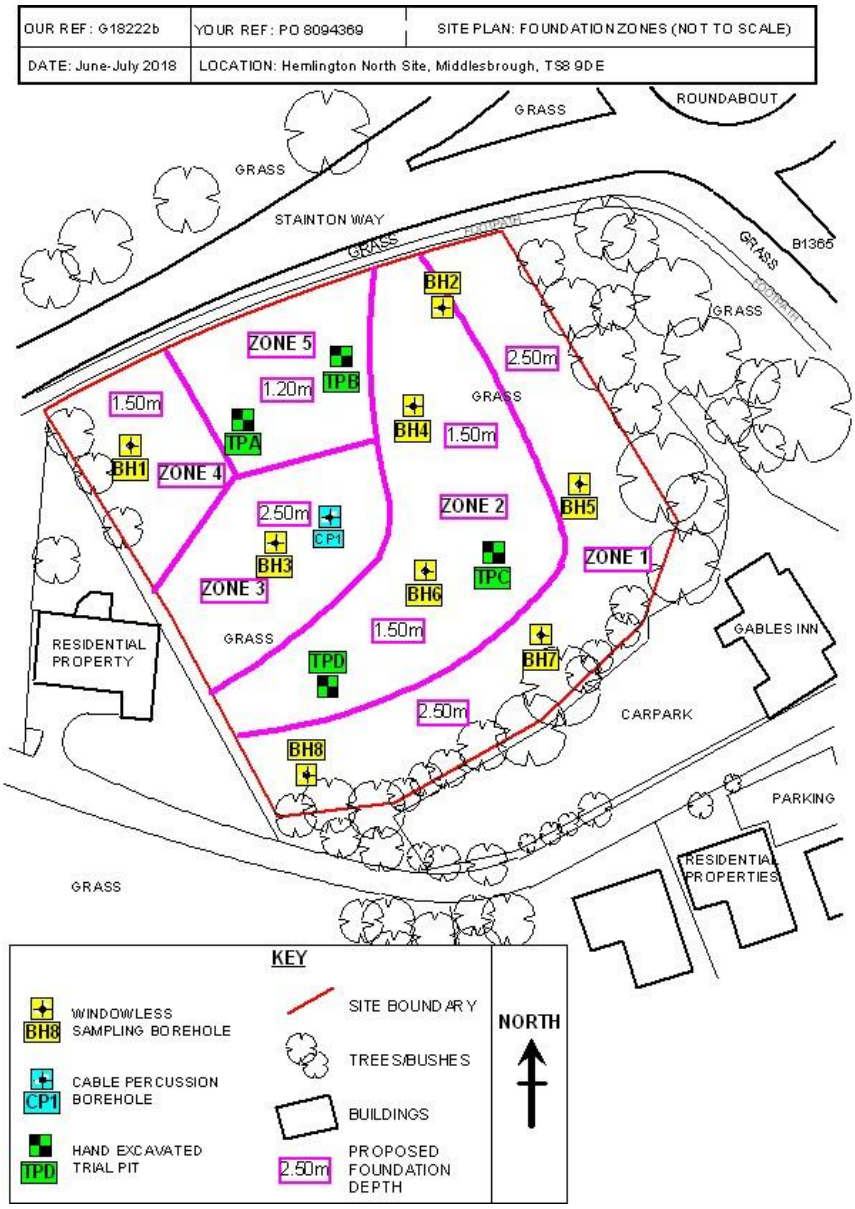
Reinforced strip foundations are anticipated to be acceptable for the whole of the site but these should extend to greater depths where deeper made ground or potential root influence has been identified.

Relevant points to note regarding their design or appropriateness include the following:

- In the south and east of the site, these should extend to 2.50m below the current ground level to compensate for the potential vegetation influence and should include anti-heave protection measures if any vegetation removal is proposed and/or likely.
- Deeper strip or trench fill foundations will be appropriate where deeper made has been encountered in the west of the site at BH3 and CP1 and all foundations at the site should extend beyond the made ground and be seated in the underlying natural competent boulder clay.

Appropriate foundation depths are roughly divided into approximate zones of foundation depth on figure 2 below.

Figure 2: Recommended Foundation Depths by Zone



Summary of Figure 2:

Zone 1: Area of possible tree root influence including possible heave if removal of existing trees occurs. Deeper reinforced strip footings seated at 2.50m with anti-heave protection.

Zone 2: Area of some (but lesser) possible tree root influence and sporadically slightly deeper made ground. Reinforced strip footings seated at 1.50m

Zone 3: Area of deeper made ground. Deeper reinforced strip footings seated at 2.50m.

Zone 4: Area of possible tree root influence. Reinforced strip footings seated at 1.50m.

Zone 5: No unusual circumstances, competent ground at relatively shallow depth. Reinforced strip footings seated at 1.20m.

Note once more that all foundations at the site should extend beyond the made ground and be seated in the underlying natural competent boulder clay. In Zone 3 the area of deeper made ground may have been overestimated and is based on the available information only. Adjustment of depths/Zones may be possible provided foundations are seated in natural underlying soils.

At these depths bearing capacities of at least 150kPa will be available.

A suspended block and beam floor is recommended for all new structures at the site to allow for any potential settlement of near surface ground and/or potential vegetation influence (and/or heave) where relevant.

7.4 Concrete Design

The results of chemical analyses of the fill returned Water Soluble Sulphate levels of between 24mgl^{-1} and 334mgl^{-1} (though generally below 100mgl^{-1}) and pH levels of between 8.2 and 8.7. On this basis concrete in contact with the ground may be designed to ACEC Class DS-1 AC-1s of "BRE Special Digest 1 – Concrete in aggressive ground".

7.5 Soakaways

Clay (boulder clay/Devensian Till) soils have been encountered throughout the site which would be expected to exhibit very low infiltration rates.

Therefore, though no water infiltration testing has been carried out at the site, soakaways are highly unlikely to comprise a suitable means of surface water disposal in the new development.

END OF REPORT

GEO INVESTIGATE™

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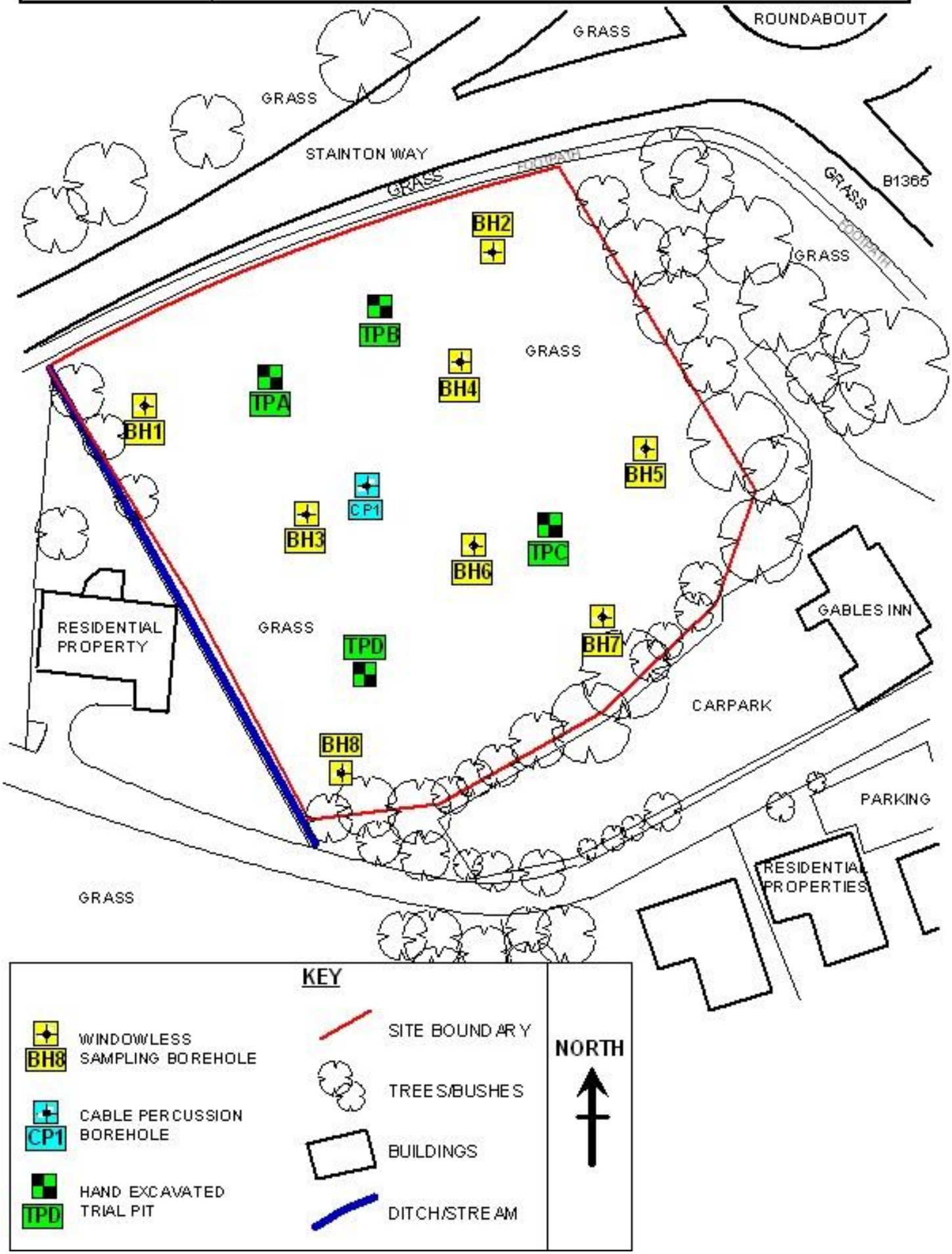
APPENDIX 1

Site Plan

and

Borehole & Trial Pit Logs

OUR REF: G18222b	YOUR REF: PO 8094369	SITE PLAN (NOT TO SCALE)
DATE: June-July 2018	LOCATION: Hemlington North Site, Middlesbrough, TS8 9DE	



GEOINVESTIGATE Ltd.

Your Ref. PO 8094369 **Our Ref.** G18222 **BH No.1** **Sheet No. 1 of 1**
Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE:** 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100				Cv kN/m^2			
		300			O				0.20
0.40	MADE GROUND. Compact brown clayey gravel. Gravel is fine to coarse of brick, concrete and occasional plastic				O	90			0.50
	Stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.								0.75
					O	102			1.00
									1.25
					O	>130			1.50
									1.75
					O	>130			2.00
	Becoming dark brown below 2.20m	3600							2.25
					O	>130			2.50
									2.75
					O	110			3.00
									3.25
					O	90			3.50
	Becoming firm to stiff below 3.70m								3.75
4.00					O	76			4.00
	Borehole terminated at 4.00m								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 4.00m
Borehole remained open 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

BH1

GEOINVESTIGATE Ltd.

Your Ref. PO 8094369 **Our Ref.** G18222 **BH No.2** **Sheet No. 1 of 1**
Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE:** 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100				Cv kN/m^2			
0.30	MADE GROUND. Compact yellow gravel. Gravel is fine to coarse of dolomitic limestone fill	200			O				0.20
0.70	MADE GROUND. Firm brown clayey sandy gravel. Gravel is fine to coarse of sandstone, brick and occasional concrete	400			O	72			0.50
1.10	MADE GROUND. Soft dark brown silty sandy gravelly clay. Gravel is fine to coarse of brick. Slightly organic.	400							0.75
	Stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.				O	30			1.00
					O	100			1.25
					O	114			1.50
					O	>130			1.75
	Becoming firm to stiff and very gravelly below 2.80m				O	76			2.00
3.10	Medium dense brown gravelly SAND. Slightly clayey in places. Gravel is fine to coarse of sandstone. Moist	900			O				2.25
					O				2.50
					O				2.75
					O				3.00
					O				3.25
					O				3.50
							4.00m - 4.45m 3/3/4/5/5/5 N=19		3.75
4.00					O S				4.00
	Borehole terminated at 4.00m								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 4.00m
Borehole remained open 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

BH2

GEOINVESTIGATE Ltd.

Your Ref. PO 8094369 **Our Ref.** G18222 **BH No.3** **Sheet No. 1 of 1**
Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE**: 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100				Cv kN/m^2			
					O				0.20
	MADE GROUND. Stiff brown sandy gravelly clay. Gravel is fine to coarse of sandstone, coal, brick and occasional concrete. Possible reworked natural clay soils.				O	>130			0.50
									0.75
		1600			O	60			1.00
									1.25
					O	60			1.50
1.70									1.75
	MADE GROUND. Soft to firm blackish brown clayey gravelly sand / clayey sandy gravel. Gravel is fine to coarse of sandstone coal and occasional brick. Slightly organic in nature.	500			O	38			2.00
2.20									2.25
	Firm to stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.				O	82			2.50
									2.75
					O	84			3.00
									3.25
					O	80			3.50
									3.75
4.00					O	76			4.00
	Borehole terminated at 4.00m								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 4.00m
Borehole remained open and dry on completion
Gas well installed to 4.00m 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

BH3

GEOINVESTIGATE Ltd.

Your Ref. PO 8094369 **Our Ref.** G18222 **BH No.4** **Sheet No. 1 of 1**
Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE:** 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100				Cv kN/m^2			
					O				0.20
	MADE GROUND. Stiff brown sandy gravelly clay. Gravel is fine to coarse of sandstone coal and brick. Possible reworked natural soils. Becoming firm below 0.80m				O	>130			0.50
		1200							0.75
					O	46			1.00
1.30									1.25
	Stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.				O	116			1.50
									1.75
					O	110			2.00
									2.25
					O	126			2.50
		2700							2.75
					O	>130			3.00
									3.25
					O	112			3.50
									3.75
4.00					O	106			4.00
	Borehole terminated at 4.00m								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 4.00m
Borehole remained open 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

BH4

GEOINVESTIGATE Ltd.

Your Ref. PO 8094369 **Our Ref.** G18222 **BH No.5** **Sheet No. 1 of 1**
Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE:** 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100			O	Cv kN/m^2			0.20
0.80	MADE GROUND. Stiff brown sandy gravelly clay. Gravel is fine to coarse of sandstone, brick, concrete and occasional plastic.	700			O	130			0.50 0.75
1.20	MADE GROUND. Firm brown very sandy very gravelly clay. Gravel is fine to coarse of sandstone and brick. Possibly a buried topsoil horizon.	400			O	52			1.00 1.25
	Very stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.				O	>130			1.50 1.75
					O	>130			2.00 2.25
					O	>130			2.50 2.75
					O	>130			3.00 3.25
3.40					O S	>130	3.40m - 3.42m N=50/20mm		3.40
	Borehole terminated at 3.40m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.40m
Borehole remained open and dry on completion
Gas well installed to 3.40m 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

BH5

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G18222 **BH No.6** **Sheet No. 1 of 1**

Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE**: 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100				Cv kN/m^2			
					O				0.20
	MADE GROUND. Stiff brown sandy gravelly clay. Gravel is fine to coarse of sandstone, coal, brick and occasional pot.	800			O	>130			0.50
									0.75
0.90									
	Firm to stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.				O	100			1.00
									1.25
					O	88			1.50
									1.75
					O	80			2.00
	Becoming stiff below 2.20m								2.25
		3100			O	>130			2.50
									2.75
					O	126			3.00
									3.25
					O	104			3.50
									3.75
4.00					O	100			4.00
	Borehole terminated at 4.00m								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 4.00m

Borehole remained open 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

BH6

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G18222 **BH No.7** **Sheet No. 1 of 1**

Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE**: 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100				Cv kN/m^2			
		300			O				0.20
0.40	MADE GROUND. Stiff brown sandy gravelly clay. Gravel is fine to coarse of sandstone, coal and occasional brick. Possible reworked natural soils.				O	>130			0.50
	Stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.								0.75
					O	102			1.00
	Roots to 1.50m. Large root at 0.80m.								1.25
					O	116			1.50
									1.75
	Very stiff from 1.90m to 3.30m				O	>130			2.00
		3600							2.25
					O	>130			2.50
									2.75
					O	>130			3.00
									3.25
					O	122			3.50
									3.75
4.00					O	114			4.00
	Borehole terminated at 4.00m								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 4.00m

Borehole remained open 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

BH7

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G18222 **BH No.8** **Sheet No. 1 of 1**

Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE**: 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	TURF/TOPSOIL. Firm brown very sandy	200				Cv kN/m^2			
0.20	gravelly clay. Gravel is fine to coarse of sandstone and brick				O				0.20
0.40	MADE GROUND. Stiff brown sandy	200							
	gravelly CLAY. Gravel is fine to coarse of sandstone, coal and occasional brick. Possible reworked natural soils.				O	130			0.50
									0.75
	Stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.				O	86			1.00
									1.25
	Becoming very stiff below 1.30m				O	>130			1.50
	Roots to 1.60m								
									1.75
					O	>130			2.00
		3600							2.25
					O	>130			2.50
									2.75
					O	>130			3.00
									3.25
					O	>130			3.50
									3.75
	Becoming sitff below 3.70m								
4.00					O	112			4.00
	Borehole terminated at 4.00m								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 4.00m

Borehole remained open and dry on completion

Gas well installed to 4.00m 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

BH8

GEOINVESTIGATE Ltd

Your Ref. PO 8094369 **Our Ref.** G18222b **BH No. CP1** **Sheet No. 1 of 2**
Location: Hemlington North Site, Middlesbrough, TS8 9DE **DATE**: 13/07/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Samples / Tests No	Type	Depth (m)	Results	Depth to Water	Depth (m)
0.35	Turf and Topsoil. Brown very sandy clay. Occasional sandstone, brick and coal gravel.	350								
1.90	MADE GROUND. Soft to firm reddish brown mottled grey very sandy gravelly clay. Gravel is fine to coarse of sandstone, brick and coal.	1550				D	0.50			
						D	1.00			1.00
						S	1.20-1.65	2/2/2/2/2/3 N = 9		
5.80	Firm to stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.	3900				D	2.00			2.00
						D	3.00			3.00
						S	3.00-3.45	2/3/3/3/3/4 N = 13		
						D	4.00			4.00
						D	5.00			5.00
6.10	Loose to medium dense brown SAND. Wet.	300				S	6.00-6.45	2/2/2/3/3/3 N = 11		6.00
10.00	Stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.	3900				D	7.00			7.00
						D	8.00			8.00
						S	9.00-9.45	3/3/4/5/6/7 N = 22		9.00
	Borehole log continued on following sheet					D	10.00			10.00

Remarks: Light cable percussion drilling to 15.00m
150mm casing from ground level to 6.00m
Water level at 5.90m rose to 4.70m in 20mins

KEY:
B Bulk disturbed sample **Cv** Shear vane
S Standard Penetration Test **W** Water sample
C SPT with solid cone
D Small disturbed sample
U Undisturbed sample

CP 1

GEOINVESTIGATE Ltd

Your Ref. PO 8094369 **Our Ref.** G18222b **BH No. CP1** **Sheet No. 2 of 2**
Location: Hemlington North Site, Middlesbrough, TS8 9DE **DATE**: 13/07/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Samples / Tests No	Type	Depth (m)	Results	Depth to Water	Depth (m)
	Stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.					D	11.00			11.00
						S	12.00-12.45	3/4/5/6/8/8 N = 27		12.00
		5000				D	13.00			13.00
						D	14.00			14.00
15.00						D	15.00			15.00
	Borehole Terminated at 15.00m					S	15.00-15.45	5/7/8/9/9/9 N = 35		

Remarks: Light cable percussion drilling to 15.00m
150mm casing from ground level to 6.00m
Water level at 5.90m rose to 4.70m in 20mins

KEY:
B Bulk disturbed sample **Cv** Shear vane
S Standard Penetration Test **W** Water sample
C SPT with solid cone
D Small disturbed sample
U Undisturbed sample

CP 1

GEOINVESTIGATE Ltd.

Your Ref. PO 8094369 **Our Ref.** G18222 **TPA** **Sheet No. 1 of 1**
Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE:** 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100			O	Cv kN/m^2			0.20
	MADE GROUND. Firm brown sandy gravelly clay. Gravel is fine to coarse of sandstone, coal, brick and occasional concrete. Possible reworked natural soils.	900			O				0.50
									0.75
1.00					O				1.00
	Trial pit terminated at 1.00m								

Remarks:
Hand excavated to 1.00m
Trial Pit remained stable and dry on completion

Key:
O Disturbed sample
Cv Shear vane
W Water sample

TPA

GEOINVESTIGATE Ltd.

Your Ref. PO 8094369 **Our Ref.** G18222 **TPB** **Sheet No. 1 of 1**
Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE:** 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100			O	Cv kN/m^2			0.20
0.60	MADE GROUND. Firm brown sandy gravelly clay. Gravel is fine to coarse of sandstone, coal, brick and occasional concrete. Possible reworked natural soils.	500			O				0.50
1.00	Stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.	400			O				0.75 1.00
	Trial Pit terminated at 1.00m								

Remarks:
Hand excavated to 1.00m
Trial Pit remained stable and dry on completion

Key:
O Disturbed sample
Cv Shear vane
W Water sample

TPB

GEOINVESTIGATE Ltd.

Your Ref. PO 8094369 **Our Ref.** G18222 **TPC** **Sheet No. 1 of 1**
Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE:** 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100			O	Cv kN/m^2			0.20
0.80	MADE GROUND. Stiff brown sandy gravelly clay. Gravel is fine to coarse of sandstone, coal, brick and occasional concrete and pot.	700			O				0.50 0.75
1.00	Stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.	200			O				1.00
	Borehole terminated at 1.00m								

Remarks:
Hand excavated to 1.00m
Trial Pit remained stable and dry on completion

Key:
O Disturbed sample
Cv Shear vane
W Water sample

TPC

GEOINVESTIGATE Ltd.

Your Ref. PO 8094369 **Our Ref.** G18222 **TPD** **Sheet No. 1 of 1**
Location: Hemlington North Site, Middlesbrough TS8 9DE **DATE:** 27/06/18

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF/TOPSOIL. Firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and brick	100			O	Cv kN/m^2			0.20
0.60	MADE GROUND. Stiff brown sandy gravelly clay. Gravel is fine to coarse of sandstone, brick	500			O				0.50
1.00	Firm brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.	400			O				0.75 1.00
	Trial Pit terminated at 1.00m								

Remarks:
Hand excavated to 1.00m
Trial Pit remained stable and dry on completion

Key:
O Disturbed sample
Cv Shear vane
W Water sample

TPD

APPENDIX 2

Moisture Content and Atterberg Limit Test Results (Table 4)

And

Moisture Content / Shear Strength Profiles

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G18222
Your ref.

Table 4
Location: Hemlington, Middlesbrough TS8 9DE

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 BS5930 [1999]
1	0.50	21.0						
	1.00	17.9						
	1.50	18.0	83.5	21.5	18.6	37.7	19.1	CI
	2.00	14.7						
	2.50	15.6						
	3.00	15.8						
	3.50	14.7						
	4.00	15.0						
2	0.50	18.9						
	1.00	41.9						
	1.50	21.8	>95	21.8	17.5	30.6	13.1	CL
	2.00	18.5						
	2.50	17.8						
	3.00	14.7						
	3.50	13.3						
	4.00	13.7						

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G18222
Your ref.

Table 4
Location: Hemlington, Middlesbrough TS8 9DE

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 BS5930 [1999]
3	0.50	16.5						
	1.50	26.5	>95	26.5	22.8	44.4	21.6	CI
	2.00	22.6						
	2.50	24.8	89.7	27.6	23.9	44.4	20.5	CI
	3.00	23.9						
	3.50	25.4						
	4.00	21.6						
4	0.50	18.8						
	1.00	22.8						
	1.50	18.7						
	2.00	16.9	>95	16.9	20.8	40.9	20.1	CI
	2.50	15.6						
	3.00	12.9						
	3.50	14.8						
	4.00	14.1						

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G18222
Your ref.

Table 4
Location: Hemlington, Middlesbrough TS8 9DE

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 BS5930 [1999]
5	1.00	15.2						
	1.50	21.0						
	2.00	12.4	>95	12.4	23.5	48.2	24.7	CI
	2.50	15.9						
	3.00	13.6						
	3.40	14.0						

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G18222
Your ref.

Table 4
Location: Hemlington, Middlesbrough TS8 9DE

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 BS5930 [1999]
6	0.50	17.5						
	1.00	20.2						
	1.50	21.5	>95	21.5	22.7	48.2	25.5	CI
	2.00	18.8						
	2.50	16.5						
	3.00	15.8						
	3.50	15.7						
	4.00	16.5						
7	1.00	14.7	86.4	17.0	22.3	50.6	28.3	CI/CH
	1.50	16.2						
	2.00	12.9	90.7	14.2	18.4	42.4	24.0	CI
	2.50	13.2						
	3.00	11.2						
	3.50	13.0						
	4.00	16.4						

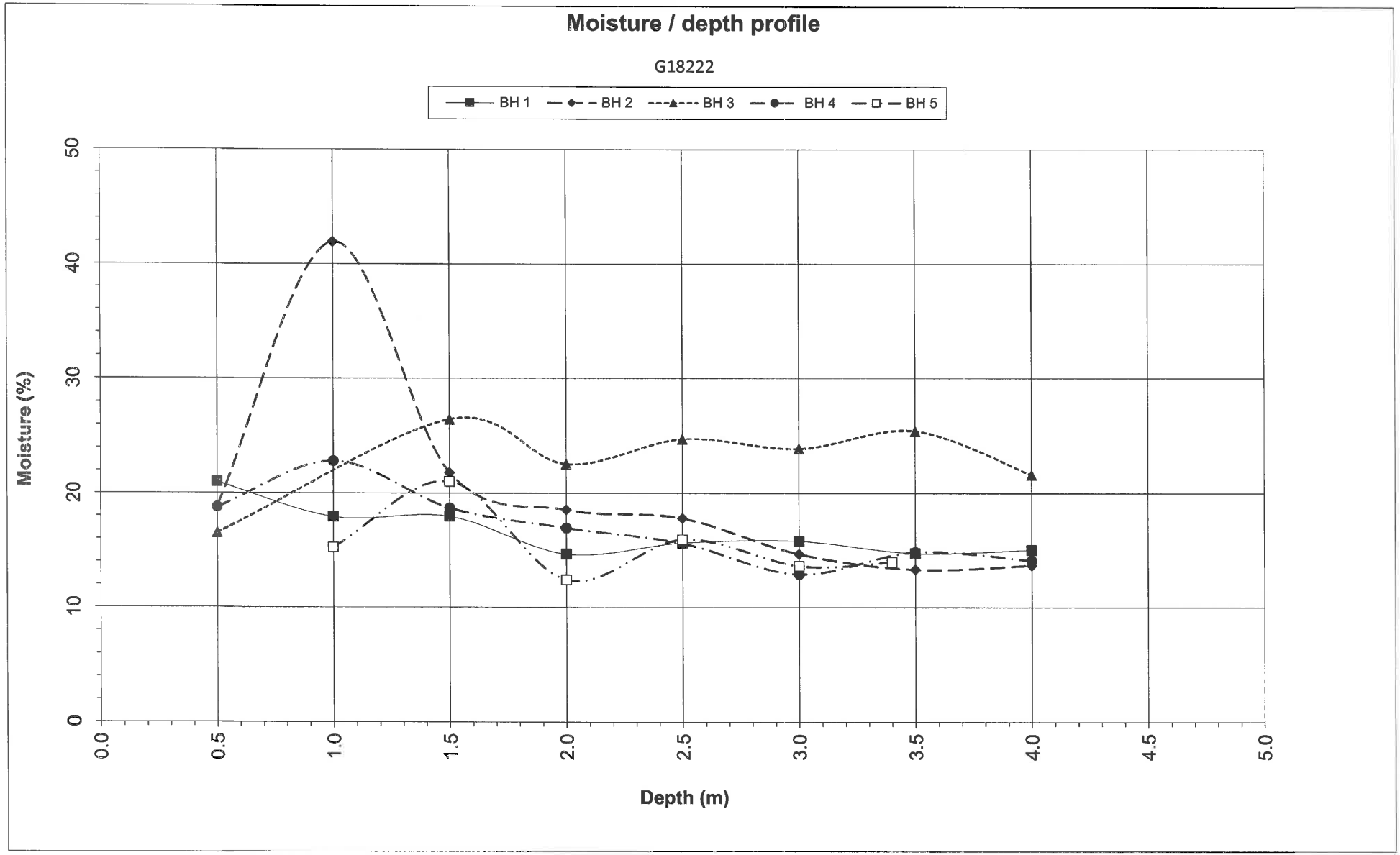
GEOINVESTIGATE Ltd.

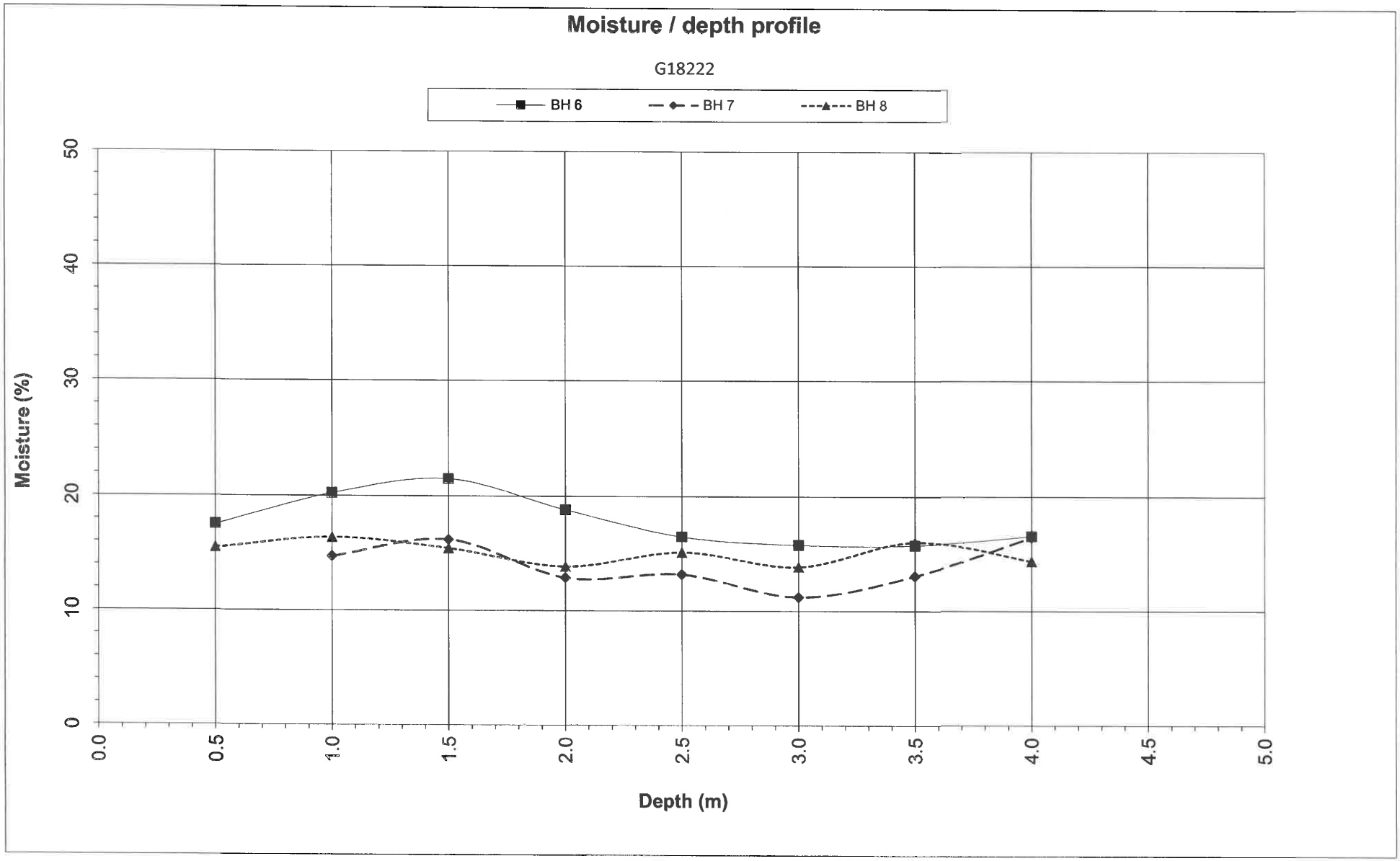
Atterberg Limit Test Results

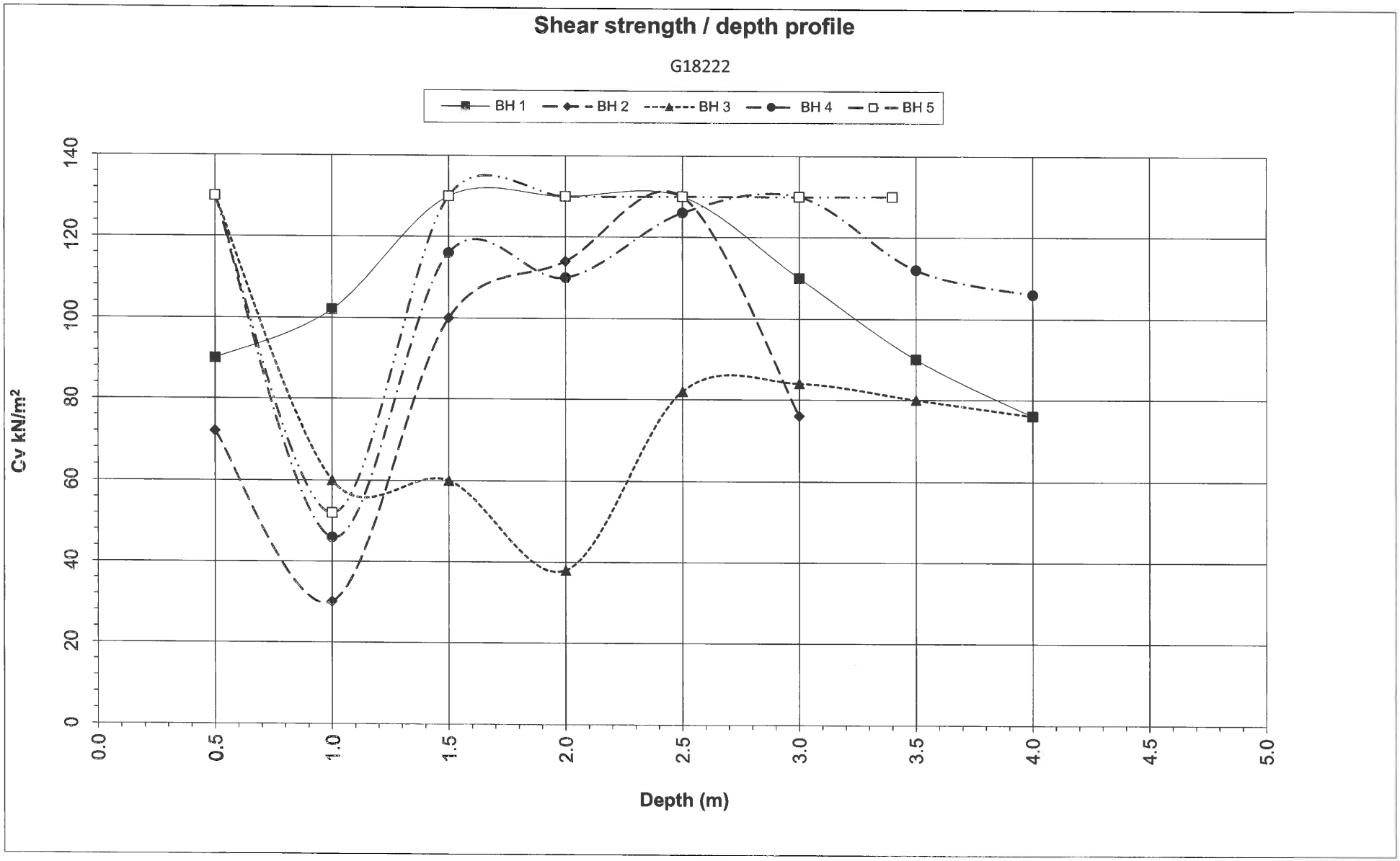
Our ref. G18222
Your ref.

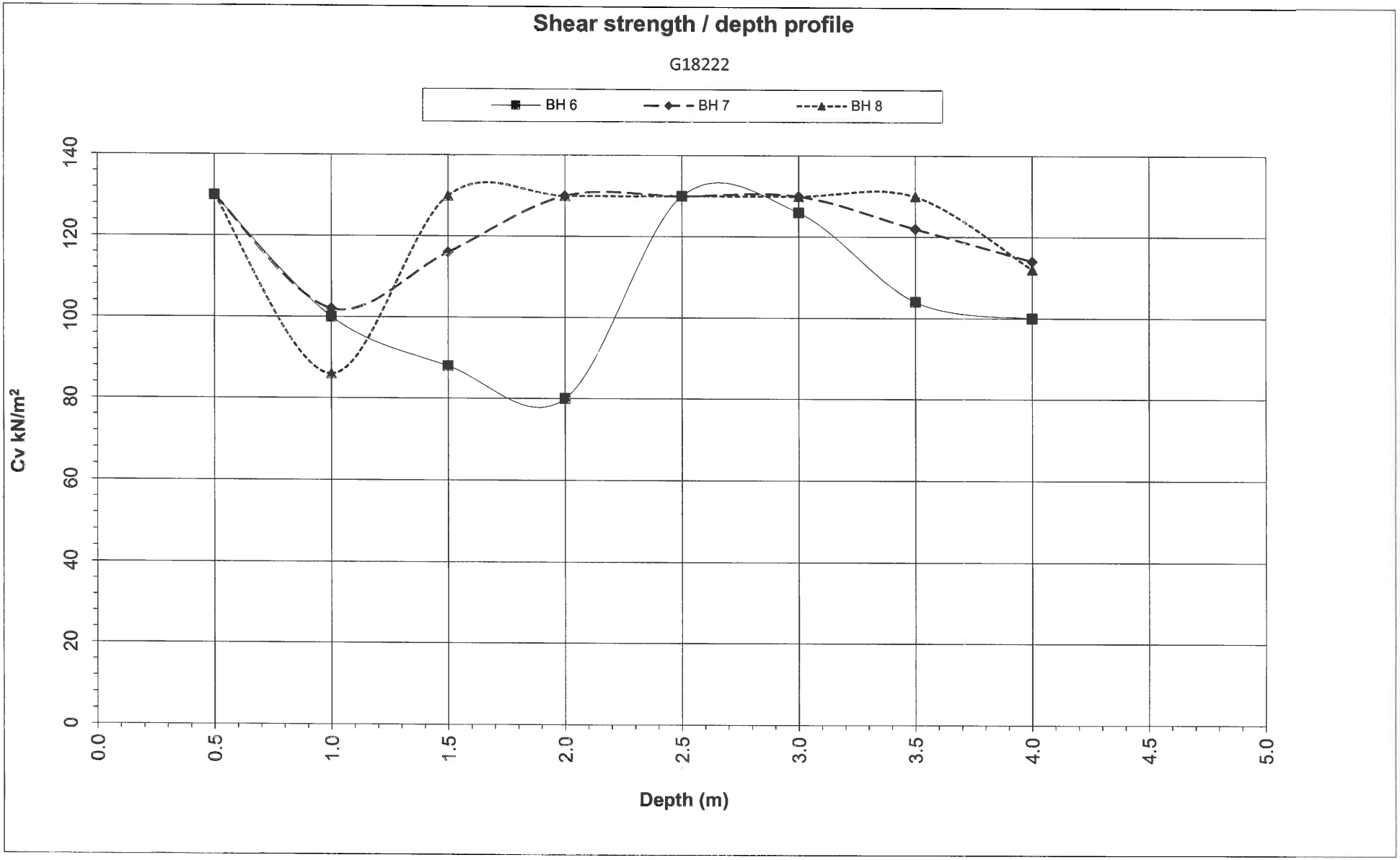
Table 4
Location: Hemlington, Middlesbrough TS8 9DE

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 BS5930 [1999]
8	0.50	15.5						
	1.00	16.4						
	1.50	15.4	91.2	16.9	21.0	40.2	19.2	CI
	2.00	13.8						
	2.50	15.1						
	3.00	13.8						
	3.50	16.0						
	4.00	14.3						


Moisture / depth profile
G18222
BH 1
BH 2
BH 3
BH 4
BH 5
Moisture (%)
0
10
20
30
40
50
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Depth (m)


Moisture / depth profile
G18222
BH 6
BH 7
BH 8
Moisture (%)
0
10
20
30
40
50
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Depth (m)


Shear strength / depth profile
G18222
BH 1
BH 2
BH 3
BH 4
BH 5
Cv kN/m²
0
20
40
60
80
100
120
140
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Depth (m)


Shear strength / depth profile
G18222
BH 6
BH 7
BH 8
Cv kN/m²
0
20
40
60
80
100
120
140
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Depth (m)

APPENDIX 3

Chemtech Analytical Test Report

2531

ANALYTICAL TEST REPORT

Contract no:	72959
Contract name:	Land at Hemlington Grange, Middlesbrough, TS8 9DE
Client reference:	G18222b
Clients name:	Geo Investigate
Clients address:	Units 3a & 4, Terry Dicken Industrial Estate Ellerbeck Way, Stokesley North Yorkshire TS9 7AE
Samples received:	10 July 2018
Analysis started:	10 July 2018
Analysis completed	17 July 2018
Report issued:	17 July 2018

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:

James Spittle
Customer Services Team Leader

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
72959-1	BH1	0.20	Sandy Clay with Gravel	-	-	10.5
72959-2	BH3	2.00	Clay with Gravel	-	-	16.2
72959-3	BH5	0.50	Sand Clay with Gravel	-	-	10.0
72959-4	BH6	0.20	Sand Clay with Gravel	-	-	10.2
72959-5	BH8	0.20	Sandy Clay with Gravel & Roots	-	-	12.5
72959-6	TPB	0.50	Sandy Clay with Gravel & Roots	-	-	11.0

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SOILS

Lab number			72959-1	72959-2	72959-3	72959-4	72959-5	72959-6
Sample id			BH1	BH3	BH5	BH6	BH8	TPB
Depth (m)			0.20	2.00	0.50	0.20	0.20	0.50
Date sampled			27/06/2018	27/06/2018	27/06/2018	27/06/2018	27/06/2018	27/06/2018
Test	Method	Units						
Arsenic (total)	CE127 M	mg/kg As	2.5	2.8	3.4	3.3	2.6	3.1
Boron (water soluble)	CE063 M	mg/kg B	0.8	1.1	0.9	0.9	2.1	0.7
Cadmium (total)	CE127 M	mg/kg Cd	<0.2	<0.2	0.2	<0.2	<0.2	<0.2
Chromium (total)	CE127 M	mg/kg Cr	18	31	26	38	21	28
Chromium (III)	-	mg/kg CrIII	18	31	26	38	21	28
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	10	14	15	15	122	10
Lead (total)	CE127 M	mg/kg Pb	69	18	48	38	82	17
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	10	47	18	27	41	13
Selenium (total)	CE127 M	mg/kg Se	0.5	0.9	0.5	0.7	0.8	0.4
Zinc (total)	CE127 M	mg/kg Zn	55	57	155	89	621	42
pH	CE004 M	units	8.8	8.7	8.3	8.2	8.3	8.3
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	334	65	33	24	28	44
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	mg/kg CN	<1	<1	<1	<1	<1	<1
Thiocyanate	CE145 M	mg/kg SCN	<1	<1	<1	<1	<1	<1
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	3.27	0.39	2.25	0.84	1.27	0.64
Estimate of OMC (calculated from TOC)	CE072 M	% w/w	5.64	0.67	3.88	1.45	2.19	1.10
PAH								
Acenaphthene	CE087 M	mg/kg	0.04	<0.01	0.12	<0.01	0.02	<0.01
Acenaphthylene	CE087 M	mg/kg	<0.01	<0.01	0.07	<0.01	<0.01	<0.01
Anthracene	CE087 U	mg/kg	0.17	<0.02	0.65	<0.02	0.13	<0.02
Benzo(a)anthracene	CE087 U	mg/kg	0.55	<0.02	1.62	0.07	0.46	0.09
Benzo(a)pyrene	CE087 U	mg/kg	0.44	<0.02	1.43	0.05	0.41	0.09
Benzo(b)fluoranthene	CE087 M	mg/kg	0.63	<0.02	2.02	0.10	0.56	0.11
Benzo(ghi)perylene	CE087 M	mg/kg	0.25	<0.02	0.87	<0.02	0.24	0.03
Benzo(k)fluoranthene	CE087 M	mg/kg	0.23	<0.02	0.87	0.05	0.24	0.09
Chrysene	CE087 M	mg/kg	0.43	<0.01	1.44	0.06	0.45	0.07
Dibenz(ah)anthracene	CE087 M	mg/kg	0.06	<0.02	0.24	<0.02	0.05	<0.02
Fluoranthene	CE087 M	mg/kg	0.90	<0.02	3.66	0.10	0.91	0.17
Fluorene	CE087 U	mg/kg	0.03	<0.01	0.14	<0.01	0.02	<0.01
Indeno(123cd)pyrene	CE087 M	mg/kg	0.23	<0.02	0.81	<0.02	0.21	0.03
Naphthalene	CE087 M	mg/kg	0.02	<0.01	0.11	<0.01	<0.01	<0.01
Phenanthrene	CE087 M	mg/kg	0.58	<0.02	2.65	0.06	0.43	0.07
Pyrene	CE087 M	mg/kg	0.77	<0.02	2.78	0.09	0.74	0.15
PAH (total of USEPA 16)	CE087	mg/kg	5.33	<0.27	19.5	0.58	4.88	0.91
TPH								
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	-	-	<0.01	-	<0.01	-

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SOILS

Lab number			72959-1	72959-2	72959-3	72959-4	72959-5	72959-6
Sample id			BH1	BH3	BH5	BH6	BH8	TPB
Depth (m)			0.20	2.00	0.50	0.20	0.20	0.50
Date sampled			27/06/2018	27/06/2018	27/06/2018	27/06/2018	27/06/2018	27/06/2018
Test	Method	Units						
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	-	-	<0.01	-	<0.01	-
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	-	-	<0.01	-	<0.01	-
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	-	-	<1	-	<1	-
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	-	-	<1	-	<1	-
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	-	-	10	-	2	-
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	-	-	8	-	2	-
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	-	-	<1	-	<1	-
VPH Aliphatic (>C5-C6)	CE067	mg/kg	-	-	<0.1	-	<0.1	-
VPH Aliphatic (>C6-C8)	CE067	mg/kg	-	-	<0.1	-	<0.1	-
VPH Aliphatic (>C8-C10)	CE067	mg/kg	-	-	<0.1	-	<0.1	-
EPH Aliphatic (>C10-C12)	CE068	mg/kg	-	-	<4	-	<4	-
EPH Aliphatic (>C12-C16)	CE068	mg/kg	-	-	<4	-	<4	-
EPH Aliphatic (>C16-C35)	CE068	mg/kg	-	-	54	-	33	-
EPH Aliphatic (>C35-C44)	CE068	mg/kg	-	-	10	-	11	-
Subcontracted analysis								
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD	NAD	NAD

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PREPARED LEACHATES

Lab number			72959-2L	72959-3L
Sample id			BH3	BH5
Depth (m)			2.00	0.50
Test	Method	Units		
Arsenic (dissolved)	CE128 U	µg/l As	0.28	1.99
Boron (dissolved)	CE128 U	µg/l B	11	9
Cadmium (dissolved)	CE128 U	µg/l Cd	<0.07	<0.07
Chromium (dissolved)	CE128 U	µg/l Cr	<0.2	<0.2
Copper (dissolved)	CE128 U	µg/l Cu	1.9	3.0
Lead (dissolved)	CE128 U	µg/l Pb	<0.2	0.5
Mercury (dissolved)	CE128 U	µg/l Hg	<0.008	<0.008
Nickel (dissolved)	CE128 U	µg/l Ni	1.6	0.7
Selenium (dissolved)	CE128 U	µg/l Se	0.11	0.56
Zinc (dissolved)	CE128 U	µg/l Zn	4	3
pH	CE004 U	units	8.4	8.3
Sulphate	CE049 U	mg/l SO_4	<10	<10
Sulphur (dissolved)	CE128 U	mg/l S	1.6	0.5
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				
Acenaphthene	CE051	µg/l	<0.1	<0.1
Acenaphthylene	CE051	µg/l	<0.1	<0.1
Anthracene	CE051	µg/l	<0.1	<0.1
Benzo(a)anthracene	CE051	µg/l	<0.1	<0.1
Benzo(a)pyrene	CE051	µg/l	<0.1	<0.1
Benzo(b)fluoranthene	CE051	µg/l	<0.1	<0.1
Benzo(ghi)perylene	CE051	µg/l	<0.1	<0.1
Benzo(k)fluoranthene	CE051	µg/l	<0.1	<0.1
Chrysene	CE051	µg/l	<0.1	<0.1
Dibenz(ah)anthracene	CE051	µg/l	<0.1	<0.1
Fluoranthene	CE051	µg/l	<0.1	<0.1
Fluorene	CE051	µg/l	<0.1	<0.1
Indeno(123cd)pyrene	CE051	µg/l	<0.1	<0.1
Naphthalene	CE051	µg/l	<0.1	<0.1
Phenanthrene	CE051	µg/l	<0.1	<0.1
Pyrene	CE051	µg/l	<0.1	<0.1
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
CE049	Sulphate (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	10	mg/l SO_4
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		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	Acenaphthene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Benzo(b)fluoranthene	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	Benzo(k)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	Wet	U	0.01	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Naphthalene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Pyrene	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
CE068	EPH Aromatic (>EC12-EC16)	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 (>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	-	-

Chemtech Environmental Limited

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 S2-
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 (speciated)	Solvent extraction, GC-MS		0.1	µg/l
CE051	PAH (total of USEPA 16)	Solvent extraction, GC-MS		1.6	µg/l

Chemtech Environmental Limited

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)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
72959-1	BH1	0.20	N	
72959-2	BH3	2.00	N	
72959-3	BH5	0.50	N	
72959-4	BH6	0.20	N	
72959-5	BH8	0.20	N	
72959-6	TPB	0.50	N	