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Intrusive Site Investigation Report

LOCATION	Slack's Millom Ltd., Borwick Rails, Millom, Cumbria, LA18 4JU
ISSUE DATE	30th April 2020
FOR	Slack's Millom Ltd.
CLIENT REF.	STEPH01042020
OUR REF.	G20108

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1. Introduction

In accordance with your instruction, Geoinvestigate Ltd. has carried out a site investigation on a plot of land within the grounds of Slack's Millom Ltd.

The proposed development is to comprise removal of a small part of the existing factory (circular conveyor housing) and construction of a new portal frame style commercial structure akin to the two structures within the site adjacent to the investigation area.

The site is located relatively close to the tidal shore line and within the grounds of a former steelworks site. The Millom Ironworks Local Nature Reserve is also located within the former ironworks site and is situated to the east of the study area.

The purpose of this investigation was to establish the nature of the ground conditions at the site to assess the level of risk that is posed to the site and the proposed development with regard to geotechnical hazards and the potential for hazardous gas and contamination to occur.

2. Scope of Investigation

2.1 Scope of Works

The following investigation works were undertaken based on the findings of an initial desk-based appraisal and the specific requirements of the client:

- The sinking of seven (7) boreholes (BH1, BH2, BH3a, BH3b, BH4, BH5a and BH5b) to depths of between 0.80m and 4.00m across the site, with associated soil sampling and supervision of the works by a suitably qualified geo-environmental engineer. The boreholes were sunk by windowless sampling using a Dando Terrier 2002 drilling rig.

- The installation of three (3) gas monitoring wells in boreholes BH1, BH2 and BH3b with up to six (6) gas monitoring visits over a period of up to three (3) months (if appropriate), including readings below 1000mb and where possible following a sharp drop in atmospheric pressure.

- Geotechnical Testing comprising eleven (11) moisture determinations and two (2) Atterberg Limit plasticity tests to provide information with regard to soil conditions and shrinkage potential at the site.

- Contamination analyses of six (6) samples of soils recovered from depths of between 0.20m and 2.00m, at the site to determine whether metals/metalloids, asbestos, polycyclic aromatic hydrocarbons (PAHs), and petroleum hydrocarbons (including BTEX*) are absent or within acceptable limits. Leachate from two (2) samples was also tested to check the mobility of the contaminants.

  *Benzene, toluene, ethyl benzene and xylenes.

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

The 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 and plasticity test results are provided along with moisture and shear strength profiles in Appendix 2. The results of the contamination testing are included in Appendix 3.

2.2 Sampling Rationale

The boreholes were sunk and safe and accessible locations within or close to the proposed building footprint at positions which would be able to offer as full an understanding of the ground conditions at the study site while avoiding damage to buried services and being accessible with the tracked borehole drilling rig.

3. Investigation Findings

3.1 Encountered Ground Conditions

BGS mapping shows the site to be directly underlain by limestone bedrock at unknown depth with no overlying drift deposits mapped. Blown sands (sand), raised marine deposits (sand and gravel), tidal flats deposits (clay and silt), and storm beach deposits (gravel) are all mapped close by, however. Borehole records in the vicinity generally record sands or silts with boulder clay commencing from ca. 6m below ground level (BGL), with some records showing approximately 2m of slag, undoubtedly sourced from the nearby former ironworks site.

BH1

Borehole BH1 found made ground to extend to 1.60m BGL generally comprising compact or medium dense sandy gravel or clayey sandy gravel. Loose gravelly sand with clay inclusions was present to 0.70m BGL, however. Various gravel constituents were present including sandstone, concrete, slag, brick, pot ash and igneous rock.

Medium dense, natural, sandy gravel was then encountered from 1.60m to 3.00m, at which depth repeated collapse caused the borehole to be terminated. This became loose and wet below 2.70m.

Standard Penetration Tests (SPTs) were undertaken at 1m intervals and a continual penetration test continued form the base of the borehole to attempt to probe underlying soils which could not be successfully sampled. The SPTs returned N values of N=22, N=17 and N=6 at 1m, 2m and 3m respectively, and the continual probing returned N values of N=27 and N=17 at 3.5m and 4.0m. The results of continual probing such as this are not always entirely accurate due to the building skin friction on the drill rods as the probing progresses but these results are nonetheless favourable, particularly for the coarse gravel such as that found at the base of the borehole (in which less skin friction might be anticipated).

BH2

Borehole BH2 met refusal at just 1.30m BGL without finding the base of the made ground . Refusal may have been met on a buried obstruction or boulder. The made ground encountered to 1.30m was comparable to that at BH1 with a stiff pale brown sandy gravelly clay stratum also encountered between 0.40m and 0.70m.

What progress was possible with the SPT in the made ground at the base of the borehole would suggest an N value in the range 30<N<40.

BH3a and BH3b

BH3a met refusal at just 0.80m BGL on a concrete obstruction though it is not clear whether this might simply comprise a boulder or is actually a relic foundation or similar.

BH3b also failed to penetrate the made ground strata, meeting refusal at 2.00m BGL. Compact / dense sandy gravel or gravelly sand was encountered below 0.35m which for the most part appeared to comprise concrete but could have been slag or contained a significant slag constituent.

An SPT N value of N=59 was returned in the made ground at 1.00m BGL, and refusal was met by the SPT test cone at 2m with just 30mm penetration achieved.

BH4

BH4 found made ground to extend to 1.80m BGL comprising loose to medium dense slightly clayey sandy gravel with gravel constituents including concrete, brick, coal, sandstone, slate, igneous rocks and ash.

Medium dense, natural, sandy gravel was then encountered from 4.00m, being slightly clayey to 3.00m and very wet between 3.00m and 3.50m, and also becoming very sandy or borderline gravelly sand below 3.50m.

SPTs were undertaken at 1m intervals and returned N values of N=7, N=23, N=16 and N=13 at 1m, 2m, 3m and 4m respectively.

BH5a and BH5b

BH5a met refusal at just 0.80m BGL. Recently placed (presumably site-sourced) sandy gravelly clay fill was encountered to 0.60m underlain by grey and brown slightly clayey sandy gravel fill.

BH5b found similar material to 0.50m where loose dark brown gravelly sand fill was found to 1.65m containing gravel of sandstone, brick, concrete, slag and ash with occasional black glass (possibly associated with the slag and former ironworks), coal and slate. A inclusion of compact red and grey sandy gravel and cobbles of brick, concrete and slag (possibly comprising demolition rubble) was found from 1.00m to 1.50m.

Natural soils akin to those at BH4 were then encountered to 3.00m where repeated collapse caused the borehole to be terminated. These soils became wet below 2.60m.

SPTs were undertaken at 1m intervals and returned N values of N=31, N=13 and N=10 at 1m, 2m and 3m respectively.

Summary / Applying to all boreholes

- BH2, BH3a, BH3b and BH5a failed to penetrate the made ground finding at least 1.30m, 0.80m, 2.00m and 0.80m of fill respectively. The made ground generally comprised well compacted sandy gravel. These boreholes all remained open and dry on completion.
- BH1, BH4 and BH5b found the base of the made ground to be located at 1.60m, 1.80m and 1.65m with generally medium dense sandy gravel soils below those depths. These boreholes all collapsed below depths of 2.30m (BH5b) or 3.00m (BH1 and BH4), approximately coinciding with the commencement of wet soils and the presumed water table.

3.2 Soil Plasticity and Vegetation Influence.

Attempts at plasticity testing of the soils recovered from the site confirmed the soils are non-plastic and not shrinkable (see Table 4, Appendix 2).

As such no consideration to vegetation influence will be required when designing foundations for the proposed development.

4. Contamination Testing

Clearly, the primary potential sources of contamination at this site comprise the former ironworks and the associated slag/ash content of the made ground, and the site's current use for manufacturing processes. However, given that the activities at the site are mostly restricted to plastics moulding, only a limited risk would be expected from the current on-site activities.

It was considered that if former land uses within and near to the site had caused contamination the contaminants could occur in the near surface or deeper made ground (and potentially topsoil) horizons.

Therefore six (6) samples, representative of various types of near-surface and deeper made ground encountered throughout the site, were recovered from depths of between 0.20m and 2.00m from across the site and were tested for a range of substances. These included common contaminants such as Metals/metalloids and PAHs, together with analysis for petroleum hydrocarbons, BTEX and asbestos content where deemed appropriate. Leachate from two (2) of the samples was analysed also to check for contaminant mobility.

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. These include DEFRA category 4 screening levels (C4SLs), Environment Agency Environmental Quality Standards (EQSs), Site Specific Assessment Criteria (SSAC) generated using CLEA software version 1.06 site specific risk assessment modelling, and Land Quality Management / Chartered Institute of Environmental Health (LQM/CIEH) Safe for Use Limits (S4ULs).

As the site is a commercial site and the proposed development does not alter this, it falls within the commercial end-use category. As it is highly unlikely that the cultivation of vegetables / fruit for consumption will be undertaken (or indeed possible), no consideration to this end is deemed necessary in the following risk assessment.

No site-specific assessment criteria (SSAC) have been created for the site as no unusual circumstances (i.e. occupation periods etc.) are considered to be present/likely at the site that would render the generic commercial 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 might 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

Between 1.6m and 2.0m of made ground is generally expected to be present throughout the site. Many of the made ground strata contained slag and/or ash constituents which can sometimes be representative of an elevated possibility of contamination, particularly relating to combustion products such as trace metals and PAHs.

No other obvious chemical substances (liquids, staining or odours) or signs of physical contamination such as glass or metal shards were noted in any of the material encountered in the boreholes, nor was any visible evidence of possible asbestos containing materials (ACMs).

Overall, save for the possibility of the slag/ash to contain or have caused contamination, it was not anticipated that chemical or physical contamination would pose a significant hazard for the new development, but clearly soil analyses would be required to confirm this.

Samples submitted for analysis were generally chosen to give a representation of the majority of strata encountered throughout the site, with deliberate consideration of both near-surface and deeper soils to determine both the risks to human receptors and the nearby marine waters.

As discussed earlier in the report, levels of determinands have been compared to the assessment criteria for commercial end-use, as published by the LQM/CIEH and DEFRA. The results of the analyses of six (6) samples of soil recovered from the site from depths of between 0.20m and 2.00m returned concentrations of a range of substances falling below respective assessment criteria adopted from the sources without exception.

Table 1 on the following page compares the laboratory analysis results for each part of the proposed development with the appropriate commercial assessment criteria.

A mean Total Organic Carbon Content (TOC) of 4.03% and mean Soil Organic Matter Content (SOM) of 6.95% (estimated from the TOC) were returned from the soil analyses. Therefore, the LQM/CIEH S4ULs for PAHs and Hydrocarbons were chosen using the highest Soil Organic Matter (SOM) option of 6.0% which comprises a conservative choice.

Table 1: Chemical Determinands in Soil

	Range of Returned concentrations (mg/kg)	S4UL* (LQM/CIEH) (mg/kg)	C4SL* (DEFRA) (mg/kg)
Asbestos	None detected (all 4 samples)	Any presence unacceptable	
Arsenic	13-43	640	640
Boron	0.7-2.3	240,000	
Cadmium	<0.2-0.9	190	410
Chromium VI	<1 (all 6)	33	49
Chromium III	9.3-95	8,600	
Copper	9.7-155	68,000	
Lead	3.2-197		2,330
Mercury (elemental)	<0.5-3.6	58 (25.8**)	
Nickel	3.1-58	980	
Selenium	1.9-8.8	12,000	
Zinc	6.9-237	730,000	
pH	7.9-11.3		
Water Soluble SO_4	72-1187		
Phenol	<0.5 (all 6)	3,200 (37,000**)	
Total PAH	<0.34 – 5.71		
PAH Naphthalene	<0.02-0.16	1,100 (432**)	
PAH Acenapthylene	<0.02-0.03	100,000	
PAH Acenapthene	<0.02-0.03	100,000	
PAH Fluorene	<0.02-0.03	71,000	
PAH Phenanthrene	<0.02-0.39	23,000	
PAH Anthracene	<0.02-0.13	640,000	
PAH Fluoranthene	<0.02-0.89	23,000	
PAH Pyrene	<0.02-0.78	54,000	
PAH Benzo[a]anthracene	<0.02-0.48	180	
PAH Chrysene	<0.03-0.55	350	
PAH Benzo(b)fluoranthene	<0.02-0.70	45	
PAH Benzo(k)fluoranthene	<0.03-0.24	1,200	
PAH Benzo(a)pyrene	<0.02-0.49	36	76
PAH Dibenzo(a,h)anthracene	<0.02-0.06	3.6	
PAH Indeno(123-cd)pyrene	<0.02-0.44	510	
PAH Benzo(ghi)perylene	<0.02-0.39	4,000	
Benzene	<0.01 (all 3)	90	98
Toluene	<0.01 (all 3)	180,000 (4,360**)	
Ethyl Benzene	<0.01 (all 3)	27,000 (2,840**)	
m- & p- Xylene	<0.02 (all 3)	31,000 (3,460**) (m) 30,000 (3,170**) (p)	
O-Xylene	<0.01 (all 3)	30,000 (3,170**)	
TPH Aromatic C5-C7	<0.01 (all 3)	86,000 (4,710**)	98 (benzene)
TPH Aromatic C7-C8	<0.01 (all 3)	180,000 (4,360**)	
TPH Aromatic C8-C10	<0.01 (all 3)	17,000 (3,580**)	
TPH Aromatic C10-C12	<1 (all 3)	34,000 (2,150**)	
TPH Aromatic C12-C16	<1 (all 3)	38,000	
TPH Aromatic C16-C21	1-3	28,000	
TPH Aromatic C21-C35	2-4	28,000	
TPH Aromatic C35-C44	<1-2	28,000	
TPH Aliphatic C5-C6	<0.1 (all 3)	12,000 (1,150**)	
TPH Aliphatic C6-C8	<0.1 (all 3)	40,000 (736**)	
TPH Aliphatic C8-C10	<0.1 (all 3)	11,000 (451**)	
TPH Aliphatic C10-C12	<4 (all 3)	47,000 (283**)	
TPH Aliphatic C12-C16	<4 (all 3)	90,000 (142**)	
TPH Aliphatic C16-C35	68-150	180,000	
TPH Aliphatic C35-C44	14-48	180,000	

*For commercial use with no allowance for cultivation of fruit/veg and at 6% organic matter where relevant.

**Figures in parentheses represent estimated soil saturation limits above which there *may* be some potential for free phase contamination to exist.

As can be seen from the results in Table 1 and the detailed results presented in Chemtech Environmental Ltd. report 85713 (Appendix 3), all of the returned results are less than the adopted target values.

5.2.2 Contamination Risk to Controlled Waters

Given the possible sources of historical contamination and nearby marine waters, leachate was analysed from two (2) samples obtained from BH3b at 2.00m and BH5b at 1.00m. 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. 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	0.12-8.79	50-100 (DW, range: 50-100) (No Aq standard)
Boron	<6-6	1000 (DW & Aq)
Cadmium	<0.07 (both)	5 (DW & Aq)
Chromium	<0.2-0.4	50-250 (DW) / 5-250 (Aq, range: 5-250)
Copper	<0.4-3.6	50-112 (DW) / 5-112 (Aq, range: 5-112)
Lead	<0.2-0.6	50-250 (DW) / 4-250 (Aq, range: 4-250
Mercury (elemental Hg)	<0.008-0.027	1 (DW & Aq)
Nickel	<0.5 (both)	20** (DW) / 50-200 (Aq, range: 50-200)
Selenium	0.68-0.85	10 (DW) (No Aq standard)
Zinc	<1-3	3000 (DW, range: 3000-5000) / 30-2000 (Aq, range: 30-2000)
pH	9.2-11.6	Range 5.5 to 10 (UK drinking water standards)
Organic Chemicals		
Cyanide Free cyanide	<20-71 <20 (both)	50 (DW) / 5 (Aq)
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 concentrations		

*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 3 and the detailed results presented in Chemtech Environmental Ltd report 85713 (Appendix 3), soils at the site have been shown to generally not be leaching any potential contaminants at elevated levels and as such would not be considered to pose a potential risk to the local ground or surface water features through leaching.

A non-zero level of cyanide was noted in one of the leachates but the free cyanide content of the same leachate was below detectable limits. This, together with the undetectably low soil cyanide concentrations, would suggest no noteworthy risk to waters can be inferred from this result.

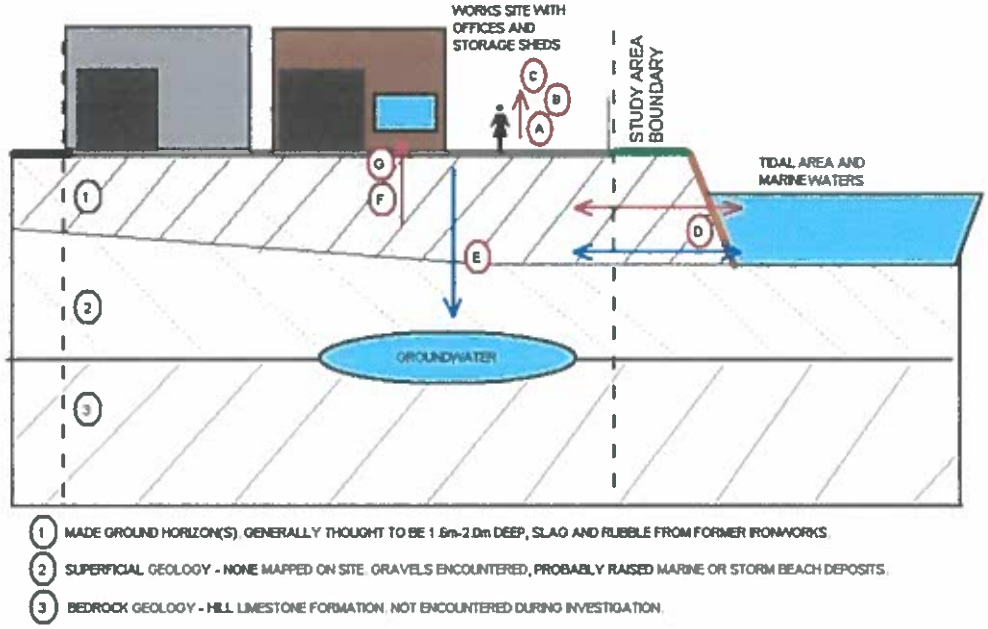
In summary, the leachate testing returned negligible concentrations of potential contaminants which would generally pass the adopted water quality standards and would not be considered to be representative of any noteworthy risk to surface or ground waters.

5.3 Review of Results

The data presented in Tables 1 and 2 and the associated discussion show that returned concentrations of potential contaminants in the soils and leachates analysed generally fall below the adopted assessment criteria and as such surface and sub-soils at the site are considered to be uncontaminated and fit for purpose in the context of the proposed commercial land use. Nor would the soils be expected to pose any risk to surface or underground waters.

The conceptual ground hazard model (CGHM) presented below shows the potential hazards and pollutant linkages which have been considered at the site; all of these are considered to have been disproven. The ground gas monitoring exercise is ongoing however and will need to be completed before a final decision can be made in that regard (a radon risk has been identified regardless).

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



IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES

-Contamination arising due to historical development and industrial use of site and surrounding area including former ironworks, railwaws, any made ground, current buildings/infrastructure/activities and other local current or past land uses.
-Potential hazardous gas sourced from made ground on and near to the site.
-Geotechnical concerns regarding made ground (compressible deposits etc.).

IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

A - End Users through Direct Contact / Inhalation / Ingestion. Buildings and hard-standing encompass most 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. (Considered highly unlikely given the commercial use and layout of the site.)
D - Neighbouring Sites through lateral migration (in soil and water, including surface water run-off) including risk to River Calder.
E - Ground water through leaching of sub-soil.
Low risk with regard to Linkages A-C. No problematic levels of potential contaminants discovered in soils or leachates.
F - Buildings and services through direct contact.
Concrete in contact with made ground does not require special design.
G -End users and buildings through ground gas migration. (Low risk anticipated).
Monitoring exercise ongoing. No risk identified to date with regard to CH_4/CO_2 etc.
However, an elevated radon risk has been identified.
H - Buildings and services from various geotechnical risks.
Made ground appears to be consistent and relatively competent, as does underlying natural gravel.

6. Hazardous Gas

6.1 Gas Regime

A ground gas monitoring exercise is being undertaken at the site. Gas monitoring wells were installed in boreholes BH1, BH2 and BH3a.

The results of the first gas monitoring visit at the site are presented in Table 3 below. A further set of up to five additional measurements may be required to complete the gas risk assessment at the site.

Table 3 Summary of Gas Monitoring Data

Borehole	Number of Visits	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)	Flow Rate (l/hr)	Atmospheric Pressure (mb)
BH1	1	0.1	0.8	19.8	1	<1	<0.1	992
BH2		<0.1	0.6	19.9	1	<1	<0.1	
BH3a		<0.1	<0.1	20.7	3	<1	<0.1	

The single gas monitoring visit carried out to date at an atmospheric pressure of 992mb returned:

- Normal levels of O_2 of between 19.8% and 20.7%.
- Very low levels of CH_4 between <0.1% and 0.1%.
- Very low levels of CO_2 between <0.1% and 0.8%.
- Low CO levels between 1ppm and 3ppm.
- Negligible H_2S below detectable limits (<1ppm) in all three wells.
- Consistently negligible flow rates below detectable limits (<0.1 l/hr) on all monitoring occasions.

6.2 Radon Gas

The interactive map viewer at UKradon.org states that, "Some parts of this 1km grid square are in bands of elevated radon potential. Maximum radon potential is 10-30 %.". As such, it is recommended that radon protection be included in all new structures to ensure the safety of site users.

7. Conclusions

7.1 Contamination

Analysis of the ground conditions at the site and an assessment of the potential pathways have confirmed that soils at the site are uncontaminated in the context of the current and proposed land use and surrounding area, and therefore pose no elevated significant risk to identified receptors. 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.

7.2 Hazardous Gas

Gas monitoring is ongoing at the site with one of a potential six monitoring visits having been undertaken to date. The monitoring undertaken to date has found normal, non-hazardous gas concentrations.

On this basis, the site would fall into Characteristic situation 1 (CS1) of the Modified Wilson and Card classification (CIRIA C665). Therefore, if continued monitoring returns comparable results, no gas protection measures will be required in the new building(s) with regard to CO_2, CH_4 etc.

However, radon protection measures are recommended regardless for the new structure(s).

A Gas Monitoring Addendum Report containing final recommendations will subsequently be issued on completion of the gas monitoring exercise.

7.3 Foundations and Floors

The presence of a fairly consistent thickness of compacted fill materials (between 1.60m and ≥2.00m), and the presence of generally medium dense gravel natural soils below suggests that the ground conditions at the site are quite consistent, and would be expected to offer fairly favourable bearing capacities throughout.

The findings of the boreholes sunk at the site suggest that the new structure could be seated on 1m deep reinforced strip or pad foundations.

At this depth, the made ground should offer bearing capacities of at least 70kPa for 1m wide foundations.

No consideration to vegetation influence is considered necessary.

A suspended floor should be used throughout the development. This will probably be required for radon gas protection measures so that a passively ventilated sub-floor void can be incorporated into the floor design together with a radon protection membrane. An alternative might be to utilise a low-fines gravel subbase with gas drains* below a ground-bearing floor slab, again incorporating a radon protection membrane. This recommendation should be re-evaluated on completion of the gas monitoring exercise.

*Normally a network of perforated piping below a building floor vented to above ground locations to allow passive ground gas ventilation to occur without the need for a sub-floor void.

7.4 Concrete Design

The results of chemical analyses of the fill returned Water Soluble Sulphate levels of between 72mg/l and 1187mg/l (SO_4) and pH levels of between 7.9 and 11.3. On this basis concrete in contact with the ground (brownfield site, no mobile water) may be designed to ACEC Class DS-1 AC-1s of BRE Special Digest 1 – Concrete in aggressive ground. If piles foundations were to be adopted extending below the water table, a classification of DS-1 AC-1 would be appropriate.

END OF REPORT

The findings and contents of this (intrusive) Site Investigation Report pertain solely to the study area(s) outlined herein and are based solely on the findings of the excavations undertaken as part of the current exercise unless otherwise stated. The findings and/or recommendations of this report do not take into account any ground conditions that may be present but have hitherto not been encountered and as such further investigation and/or a reconsideration of the findings of this report should be undertaken if such conditions are subsequently encountered or an alternative development plan or land use is subsequently proposed.

This report considers various environmental and/or geological risks posed to the site and/or proposed development and offers advice accordingly as guidance only. The findings of this report will remain valid provided no change of ground or groundwater conditions, either natural or anthropogenic, take place and no warrantee is offered or implied.

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APPENDIX 1

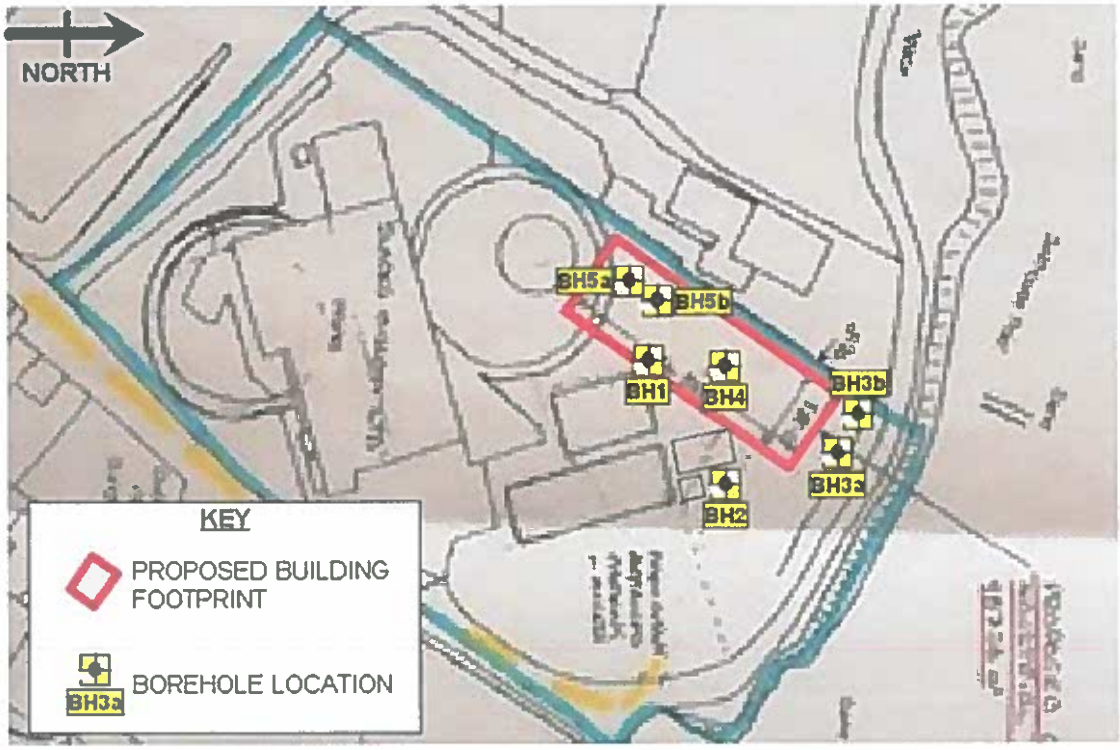
Site Plan

and

Borehole Logs

GEOINVESTIGATE Ltd.

OUR REF: G20108	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE: 01//04/2020	LOCATION: Slack's Millom Ltd , Borwick Rails, Millom, Cumbria, LA18 4JU	



GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G20108 **BH No.1** **Sheet No. 1 of 1**

Location: Slacks of Millom, Millom, Cumbria LA18 4JU **DATE:** 01/04/20

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	TURF / MADE GROUND. Loose brown gravelly sand. Gravel is fine to coarse of sandstone, concrete, slate, brick and pot. Sand is fine to medium. Stiff clay inclusion 0.30m to 0.40m. Firm to stiff clay inclusion 0.60m to 0.65m. Fine sand inclusion with occasional gravel from 0.40m to 0.60m.	700			O	Cv kN/m^2			0.25
					O				0.50
0.70									0.75
	MADE GROUND. Very compact brown sandy fine to coarse gravel of sandstone, concrete and occasional slate.	300			O S		1.00m -1.45m 20,28,8,4,4,6, N=22		1.00
1.00									
	MADE GROUND. Medium dense red and brown sandy gravel. Gravel is fine to coarse of sandstone, concrete, ash and brick.	250			O				1.25
1.25									
	MADE GROUND. Firm / medium dense brown very gravelly sandy clay / clayey sandy gravel. Gravel is fine to coarse of sandstone, ash, brick and igneous lithologies.	350			O				1.50
1.60									1.75
	Medium dense brown and grey sandy GRAVEL. Gravel is fine to coarse and mostly rounded of sandstone and slate with igneous lithologies also noted.	###			O S		2.00m - 2.45m 4,4,4,5,4,4 N=17		2.00
									2.25
					O				2.50
	Becoming loose, wet and very sandy with a higher coarse gravel content below 2.70m.						3.00m - 3.45m 3,2,1,2,2,1 N=6		2.75
3.00					O S				3.00
	Borehole Terminated at 3.00m due to repeated collapse.						Continuous*: 3.50m - 3.95m 6,6,7,6,7,7 N=27		3.25
					S				3.50
	*Continuous SPT testing extended beyond base of borehole due to collapsing ground. Results may be higher than true strength of ground due to skin friction experienced by drilling rods during continuous probing.						4.00m - 4.45m 6,6,5,4,4,4 N=17		3.75
					S				4.00

Remarks: Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.00m
Borehole Closed below 2.50m
Borehole remained dry to closure depth on completion.
Gas well installed to 2.40m 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 using solid cone

BH1

GEOINVESTIGATE Ltd.

Your Ref.
Our Ref. G20108
Location: Slacks of Millom, Millom, Cumbria LA18 4JU

BH No.2 Sheet No. 1 of 1
DATE: 01/04/20

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	MADE GROUND. Loose pale grey sandy gravel of shale chippings.	100				Cv kN/m²			
0.40	MADE GROUND. Compact brown and reddish brown slightly clayey gravelly sand. Gravel is fine to coarse of sandstone, igneous lithologies, concrete, shale, coal and occasional ash.	300			O				0.25
0.70	MADE GROUND. Stiff pale brown sandy gravelly clay. Gravel is fine to coarse of igneous lithologies and sandstone.	300			O				0.50
1.00	No recovery from 0.70m to 1.00m.	300					1.00m - 1.30m 6,10,8,10,ref. (refusal at 1.30m)		0.75
1.30	MADE GROUND. Medium dense red and brown sandy gravel. Gravel is fine to coarse of sandstone, concrete, ash and brick.	300			O S				1.00
	Borehole terminated at 1.30m due to refusal								1.25

Remarks: Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 1.30m
Borehole Closed below 2.50m
Borehole remained dry to closure depth on completion.
Gas well installed to 1.30m 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 using solid cone

BH2

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G20108 **BH No.3a** **Sheet No. 1 of 1**
Location: Slacks of Millom, Millom, Cumbria LA18 4JU **DATE:** 01/04/20

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	MADE GROUND. Compact dark brown slightly clayey gravelly sand. Gravel is fine to coarse of sandstone, igneous lithologies, concrete, shale, coal and occasional ash. Sand is fine to medium. Becoming very clayey below 0.60m. Concrete at base.	800			O O	Cv kN/m²			0.25 0.50 0.75
0.80	Borehole Terminated at 0.80m. due to refusal								

Remarks:
No casing.
Dynamic windowless sampling by Terrier Rig to 0.80m
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 using solid cone

BH3a

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G20108 **BH No.3b** **Sheet No. 1 of 1**
Location: Slacks of Millom, Millom, Cumbria LA18 4JU **DATE:** 01/04/20

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	MADE GROUND. Compact dark brown slightly clayey gravelly sand. Gravel is fine	350			O	Cv kN/m²			0.25
0.35	to coarse of sandstone, igneous lithologies, concrete, shale, coal and occasional ash. Sand is fine to medium. Becoming soft to firm very sandy gravelly clay below 0.20m.				O				0.50
	MADE GROUND. Compact grey sandy gravel and Cobbles of Concrete.	600					1.00m - 1.45m 13,18,15,18,16,10		0.75
0.90	Becoming possibly partially degraded concrete below 0.60m. Recovered as gravelly sand. Potentially compacted slag from old steelworks site.				O S		N=59		1.00
									1.25
	MADE GROUND. Dense grey sandy gravel of Concrete and possible Slag.	900			O				1.50
1.80	Compact/dense grey and pale brown fine to coarse sand inclusion from 1.20m to								1.75
2.00	MADE GROUND. Dense / compact white, pale gray and pale brown fine to coarse sand. Occasional fine to medium gravel of possible slag.	200			O S		2.00m - 2.03m REFUSAL		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 open and dry on completion.
Gas well installed to 2.00m 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 using solid cone

BH3b

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G20108 **BH No.4 Sheet No. 1 of 1**
Location: Slacks of Millom, Millom, Cumbria LA18 4JU **DATE:** 01/04/20

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	MADE GROUND. "Loose medium dense" dark slightly reddish brown slightly clayey sandy gravel. Gravel is fine to coarse and occasional cobbles of concrete, brick, coal, sandstone, slate, igneous litholgies and ash.				O	Cv kN/m²			0.25
					O				0.50
							1.00m - 1.45m 4,3,2,1,3,1 N=7		0.75
		###			O S				1.00
									1.25
					O				1.50
1.80									1.75
	Medium dense brown slightly clayey sandy GRAVEL. Gravel is fine to coarse and mostly rounded of sandstone, slate and igneous lithologies.						2.00m - 2.45m 3,6,6,6,6,5 N=23		
					O S				2.00
									2.25
		###			O				2.50
									2.75
3.00							3.00m - 3.45m 2,4,4,4,4,4 N=16		
					O S				3.00
	Medium dense brown sandy GRAVEL. Gravel is fine to coarse and mostly rounded of sandstone and igneous lithologies. Very wet.	500							3.25
3.50					O				3.50
	Medium dense greyish brown very sandy GRAVEL / gravelly SAND. Gravel is fine to coarse and mostly rounded of sandstone and igneous lithologies.	500							3.75
							4.00m - 4.45m 3,4,5,3,3,2 N = 13		
4.00					O S				4.00
	Borehole Terminated at 4.00m sue to closure								

Remarks: Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 4.00m
Borehole Closed below 3.00m
Borehole remained dry to closure depth on completion.

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test using solid cone

BH4

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G20108 **BH No.5a** **Sheet No. 1 of 1**
Location: Slacks of Millom, Millom, Cumbria LA18 4JU **DATE:** 01/04/20

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	MADE GROUND. Firm brown sandy gravelly clay. Gravel is fine to coarse of sandstone, brick, concrete, coal and occasional ash. Recently placed fill.	600				Cv kN/m^2			0.25
0.60	Damp-proof membrane at base of straum, probably former ground level.				O				0.50
0.80	MADE GROUND. Loose grey and brown sticky sandy gravel. Gravel is fine to coarse of limestone.	200			O				0.80
	Borehole Terminated at 0.80m due to refusal								

Remarks:
No casing
Dynamic windowless sampling by Terrier Rig to 0.80m
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 using solid cone

BH5a

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G20108 **BH No.5b** **Sheet No. 1 of 1**

Location: Slacks of Millom, Millom, Cumbria LA18 4JU **DATE:** 01/04/20

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
						Cv kN/m²			
	MADE GROUND. Loose dark brown clayey gravelly sand. Gravel is fine to coarse and cobbles of sandstone, brick, concrete, coal and occasional ash. Recently placed fill.	300			O				0.25
0.30									
		200			O				0.50
0.50	MADE GROUND. Firm brown very sandy gravelly clay. Gravel is fine to coarse and Cobbles of sandstone, brick, concrete, and occasional ash.	500					1.00m - 1.45m 7,11,15,8,5,3 N=31		0.75
	MADE GROUND. Loose dark brown gravelly sand. Gravel is fine to coarse of sandstone, concrete, brick, slag, ash, and occasional black glass, coal and slate.				O S				1.00
1.00									1.25
	MADE GROUND. Compact red and grey sandy gravel and cobbles. Gravel is fine to coarse and cobbles of brick, concrete and slag with occasional ash.	500			O				1.50
1.50									
1.65		150							
	MADE GROUND. Loose dark brown gravelly sand. (As 0.50m to 1.00m).								1.75
	Medium dense brown sandy GRAVEL. Gravel is fine to coarse and mostly rounded of sandstone and igneous lithologies.	950			O S		2.00m - 2.45m 2,3,3,4,3,3 N=13		2.00
									2.25
2.60					O				2.50
	Loose to medium dense greyish brown very sandy GRAVEL / gravelly SAND. Gravel is fine to coarse and mostly rounded of sandstone and igneous lithologies. Wet.	400							2.75
3.00					O S		3.00m - 3.45m 2,2,2,2,3,3 N=10		3.00
	Borehole Terminated at 3.00m due to closure.								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 3.00m

Borehole closed below 2.30m

Borehole remained dry to closure depth on completion.

Key:

- Slotted Pipe
- Plain Pipe
- Bentonite
- Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test using solid cone

BH5b

APPENDIX 2

Moisture Content and Atterberg Limits Test Results (Table 4), and Moisture Content Profiles

GEOINVESTIGATE Ltd.

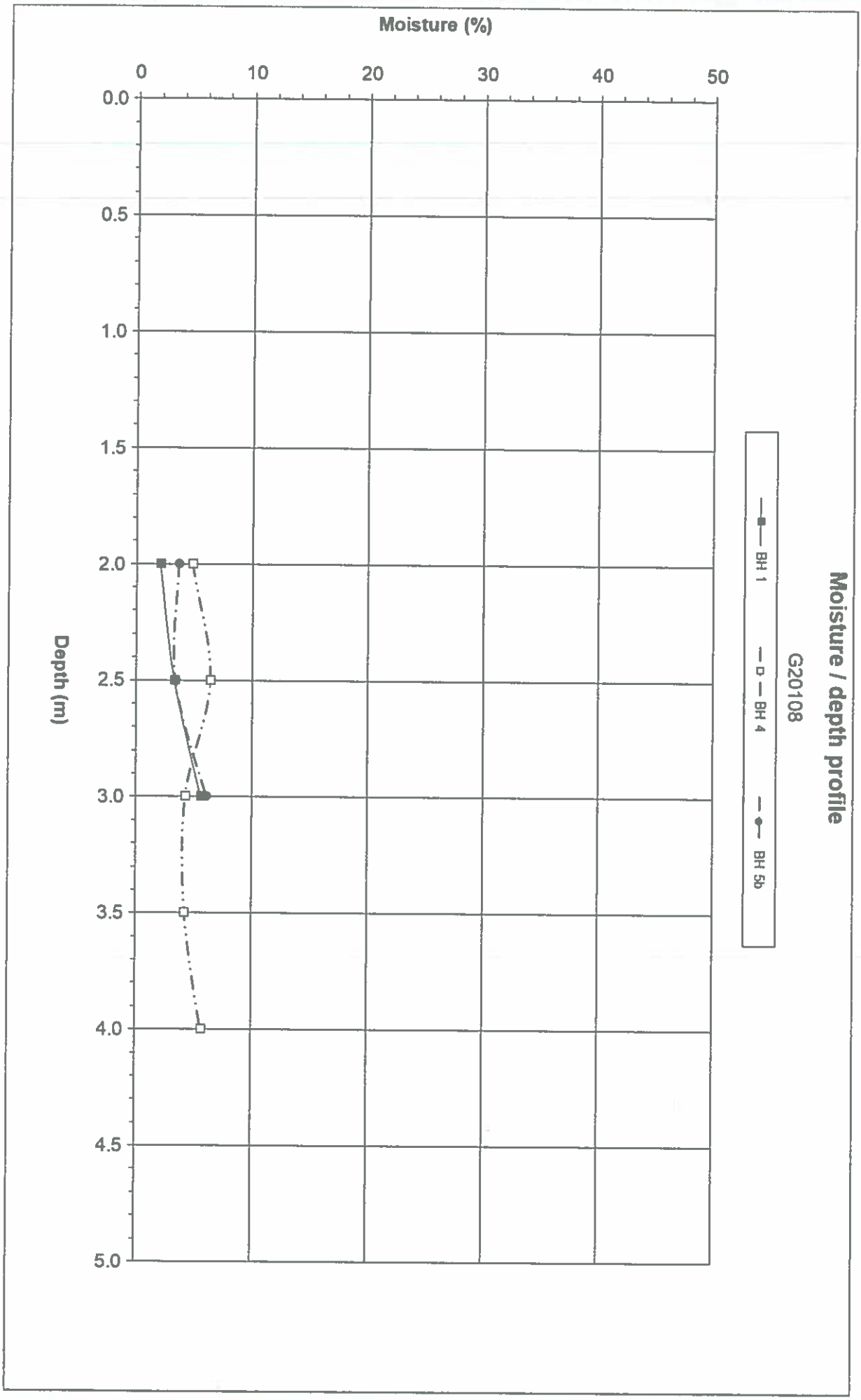
Atterberg Limit Test Results

Our ref. G20108
Your ref.

Table 4
Location: Slacks of Millom, Millom, Cumbria LA18 4JU

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	2.00	2.0	9.1	21.9	*	*	*	*
	2.50	3.3						
	3.00	5.6						
4	2.00	4.8						
	2.50	6.4						
	3.00	4.2	11.5	36.4	*	*	*	*
	3.50	4.2						
	4.00	5.6						
5b	2.00	3.6						
	2.50	3.4						
	3.00	6.1						

* Essentially non-plastic material


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)
BH 1
BH 4
BH 5b
G20108
Moisture / depth profile

APPENDIX 3

Chemtech Analytical Test Report

2531

ANALYTICAL TEST REPORT

Contract no:	85713
Contract name:	Proposed Development, Slacks Millom Ltd, Borwick Rails, Millom, Cumbria, LA18 4JU
Client reference:	G20108
Clients name:	Geo Investigate
Clients address:	Units 3a & 4 Terry Dicken Industrial Estate Ellerbeck Way, Stokesley North Yorkshire TS9 7AE
Samples received:	09 April 2020
Analysis started:	09 April 2020
Analysis completed:	20 April 2020
Report issued:	20 April 2020

Notes:

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
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.
BTEX compounds are identified by retention time only and may include interference from co-eluting compounds.

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:

J. Campbell

John Campbell
Director

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
85713-1	BH1	1.20	Clayey Sand with Gravel	-	-	14.1
85713-2	BH3a	0.50	Sandy Clay with Gravel	-	-	18.3
85713-3	BH3b	2.00	Clayey Sand with Gravel	-	-	25.9
85713-4	BH4	0.20	Clayey Sand with Gravel	-	-	13.5
85713-5	BH5a	0.50	Sandy Clay with Gravel	-	-	11.8
85713-6	BH5b	1.00	Clayey Sand with Gravel	-	-	13.1

Chemtech Environmental Limited

SOILS

Lab number			85713-1	85713-2	85713-3	85713-4	85713-5	85713-6
Sample id			BH1	BH3a	BH3b	BH4	BH5a	BH5b
Depth (m)			1.20	0.50	2.00	0.20	0.50	1.00
Date sampled			02/04/2020	02/04/2020	02/04/2020	02/04/2020	02/04/2020	02/04/2020
Test	**Method**	**Units**						
Arsenic (total)	CE127 M	mg/kg As	33	25	13	40	29	43
Boron (water soluble)	CE063 M	mg/kg B	2.3	1.3	1.0	1.3	0.7	1.0
Cadmium (total)	CE127 M	mg/kg Cd	0.4	0.4	<0.2	0.7	<0.2	0.9
Chromium (total)	CE127 M	mg/kg Cr	71	95	9.3	77	92	78
Chromium (III)	CE208	mg/kg CrIII	71	95	9.3	77	92	78
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	41	82	9.7	125	45	155
Lead (total)	CE127 M	mg/kg Pb	64	106	3.2	146	29	197
Mercury (total)	CE127 M	mg/kg Hg	0.6	<0.5	<0.5	1.4	<0.5	3.6
Nickel (total)	CE127 M	mg/kg Ni	17	43	3.1	35	58	40
Selenium (total)	CE127 M	mg/kg Se	3.4	1.9	8.8	2.7	2.9	2.6
Zinc (total)	CE127 M	mg/kg Zn	79	141	6.9	204	77	237
pH	CE004 M	units	9.0	7.9	11.3	8.5	8.5	8.6
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	412	95	1187	357	72	157
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	2.2	<1	13.7	2.4	<1	3.2
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	3.7	6.8	0.3	6.2	0.6	6.6
Estimate of OMC (calculated from TOC)	CE072 M	% w/w	6.4	11.7	0.5	10.7	1.0	11.4
PAH								
Acenaphthene	CE087 M	mg/kg	0.03	<0.02	<0.02	<0.02	<0.02	0.02
Acenaphthylene	CE087 M	mg/kg	<0.02	0.03	<0.02	0.03	<0.02	0.02
Anthracene	CE087 U	mg/kg	0.11	0.07	<0.02	0.10	0.03	0.13
Benzo(a)anthracene	CE087 U	mg/kg	0.13	0.36	<0.02	0.23	0.12	0.48
Benzo(a)pyrene	CE087 U	mg/kg	0.15	0.35	<0.02	0.26	0.14	0.49
Benzo(b)fluoranthene	CE087 M	mg/kg	0.21	0.49	<0.02	0.39	0.18	0.70
Benzo(ghi)perylene	CE087 M	mg/kg	0.15	0.26	<0.02	0.25	0.11	0.39
Benzo(k)fluoranthene	CE087 M	mg/kg	0.06	0.16	<0.03	0.16	0.08	0.24
Chrysene	CE087 M	mg/kg	0.19	0.42	<0.03	0.34	0.15	0.55
Dibenz(ah)anthracene	CE087 M	mg/kg	0.02	0.06	<0.02	0.04	<0.02	0.06
Fluoranthene	CE087 M	mg/kg	0.26	0.71	<0.02	0.56	0.20	0.89
Fluorene	CE087 U	mg/kg	0.03	0.02	<0.02	0.02	<0.02	0.03
Indeno(123cd)pyrene	CE087 M	mg/kg	0.13	0.29	<0.02	0.26	0.11	0.44
Naphthalene	CE087 M	mg/kg	0.16	0.03	<0.02	0.09	<0.02	0.10
Phenanthrene	CE087 M	mg/kg	0.34	0.31	<0.02	0.39	0.07	0.38
Pyrene	CE087 M	mg/kg	0.26	0.59	<0.02	0.50	0.18	0.78
PAH (total of USEPA 16)	CE087	mg/kg	2.22	4.15	<0.34	3.62	1.37	5.71

Chemtech Environmental Limited

SOILS

Lab number			85713-1	85713-2	85713-3	85713-4	85713-5	85713-6
Sample Id			BH1	BH3a	BH3b	BH4	BH5a	BH5b
Depth (m)			1.20	0.50	2.00	0.20	0.50	1.00
Date sampled			02/04/2020	02/04/2020	02/04/2020	02/04/2020	02/04/2020	02/04/2020
Test	**Method**	**Units**						
BTEX & TPH								
Benzene	CE192 U	mg/kg	<0.01	<0.01	-	<0.01	-	-
Toluene	CE192 U	mg/kg	<0.01	<0.01	-	<0.01	-	-
Ethylbenzene	CE192 U	mg/kg	<0.01	<0.01	-	<0.01	-	-
m & p-Xylene	CE192 U	mg/kg	<0.02	<0.02	-	<0.02	-	-
o-Xylene	CE192 U	mg/kg	<0.01	<0.01	-	<0.01	-	-
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01	<0.01	-	<0.01	-	-
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01	<0.01	-	<0.01	-	-
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	<0.01	<0.01	-	<0.01	-	-
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	<1	<1	-	<1	-	-
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	<1	<1	-	<1	-	-
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	1	3	-	2	-	-
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	2	4	-	3	-	-
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	<1	2	-	1	-	-
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1	<0.1	-	<0.1	-	-
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1	<0.1	-	<0.1	-	-
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1	<0.1	-	<0.1	-	-
EPH Aliphatic (>C10-C12)	CE068	mg/kg	<4	<4	-	<4	-	-
EPH Aliphatic (>C12-C16)	CE068	mg/kg	<4	<4	-	<4	-	-
EPH Aliphatic (>C16-C35)	CE068	mg/kg	68	150	-	89	-	-
EPH Aliphatic (>C35-C44)	CE068	mg/kg	14	48	-	46	-	-
Subcontracted analysis								
Asbestos (qualitative)	$	-	NAD	NAD	-	NAD	NAD	-

Chemtech Environmental Limited

PREPARED LEACHATES

Lab number			85713-3L	85713-6L
Sample id			BH3b	BH5b
Depth (m)			2.00	1.00
Test	**Method**	**Units**		
Arsenic (dissolved)	CE128 U	µg/l As	0.12	8.79
Boron (dissolved)	CE128 U	µg/l B	<6	6
Cadmium (dissolved)	CE128 U	µg/l Cd	<0.07	<0.07
Chromium (dissolved)	CE128 U	µg/l Cr	<0.2	0.4
Copper (dissolved)	CE128 U	µg/l Cu	<0.4	3.6
Lead (dissolved)	CE128 U	µg/l Pb	<0.2	0.6
Mercury (dissolved)	CE128 U	µg/l Hg	<0.008	0.027
Nickel (dissolved)	CE128 U	µg/l Ni	<0.5	<0.5
Selenium (dissolved)	CE128 U	µg/l Se	0.68	0.85
Zinc (dissolved)	CE128 U	µg/l Zn	3	<1
pH	CE213 U	units	11.6	9.2
Sulphate	CE049 U	mg/l SO_4	26	9.6
Sulphur (dissolved)	CE128 U	mg/l S	26.1	5.1
Sulphide	CE079	µg/l S^{2-}	<100	<100
Cyanide (free)	CE147	µg/l CN	<20	<20
Cyanide (total)	CE147	µg/l CN	<20	71
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
CE208	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	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO_4
CE079	Sulphide	Extraction, Continuous Flow Colorimetry	As received		10	mg/kg S^{2-}
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE145	Thiocyanate	Weak acid extraction, Colorimetry	Dry	M	1	mg/kg SCN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	As received		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	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
CE192	Benzene	Headspace GC-FID	As received	U	0.01	mg/kg
CE192	Toluene	Headspace GC-FID	As received	U	0.01	mg/kg
CE192	Ethylbenzene	Headspace GC-FID	As received	U	0.01	mg/kg
CE192	m & p-Xylene	Headspace GC-FID	As received	U	0.02	mg/kg
CE192	o-Xylene	Headspace GC-FID	As received	U	0.01	mg/kg
CE067	VPH Aromatic (>EC5-EC7)	Headspace GC-FID	As received		0.01	mg/kg

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE067	VPH Aromatic (>EC7-EC8)	Headspace GC-FID	As received		0.01	mg/kg
CE067	VPH Aromatic (>EC8-EC10)	Headspace GC-FID	As received		0.01	mg/kg
CE068	EPH Aromatic (>EC10-EC12)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC12-EC16)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC16-EC21)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC21-EC35)	Solvent extraction, GC-FID	As received		1	mg/kg
CE068	EPH Aromatic (>EC35-EC44)	Solvent extraction, GC-FID	As received		1	mg/kg
CE067	VPH Aliphatic (>C5-C6)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C6-C8)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C8-C10)	Headspace GC-FID	As received		0.1	mg/kg
CE068	EPH Aliphatic (>C10-C12)	Solvent extraction, GC-FID	As received		4	mg/kg
CE068	EPH Aliphatic (>C12-C16)	Solvent extraction, GC-FID	As received		4	mg/kg
CE068	EPH Aliphatic (>C16-C35)	Solvent extraction, GC-FID	As received		4	mg/kg
CE068	EPH Aliphatic (>C35-C44)	Solvent extraction, GC-FID	As received		10	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

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METHOD DETAILS

METHOD	PREPARED LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE002	Leachate preparation (EA)	L:S 10:1		-	-
CE128	Arsenic (dissolved)	ICP-MS	U	0.06	µg/l As
CE128	Boron (dissolved)	ICP-MS	U	8	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
CE213	pH	Based on BS 1377, pH Meter	U	-	units
CE049	Sulphate	Ion Chromatography	U	1.7	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)	Continuous Flow 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	Acenaphthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Acenaphthylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(b)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(ghi)perylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(k)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Chrysene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Dibenz(ah)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluorene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Indeno(123cd)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Naphthalene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Phenanthrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Pyrene	Solvent extraction, GC-MS		0.1	µg/l
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)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
85713-1	BH1	1.20	N	
85713-2	BH3a	0.50	N	
85713-3	BH3b	2.00	N	
85713-4	BH4	0.20	N	
85713-5	BH5a	0.50	N	
85713-6	BH5b	1.00	N	