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Phase 2 Intrusive Site Investigation Report

LOCATION	Proposed New Dwellings, 301 Altrincham Road, Manchester M22 4NY
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FOR	WCHG c/o BYA
CLIENT REF.	
OUR REF.	G16271

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1. Introduction

Following your instruction, Geoinvestigate Ltd carried out a Phase 2 investigation at land off Altrincham Road, Manchester.

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 risks highlighted in the Phase 1 conceptual ground hazard model (CGHM in Phase 1 Desk Study Report G16195) with regard to possible geotechnical hazards and the potential for hazardous gas and contamination to occur at the site.

The site currently comprises a roughly rectangular 0.13ha plot of land. Access to the site can be gained from Altrincham Road to the south east. The site currently comprises an plot of land with a large area of made ground corresponding with the footprint of the recently demolished detached building recently present on the site. Some significant vegetation including large trees is present on the site also, and this limited access for investigation to the site.

It is proposed to construct a new dwelling, together with a garage at the site.

2. Scope of Phase 2 Investigation

2.1 Scope of Works

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

- The sinking of five (5) boreholes (ref Nos. BH1 – BH5) to depths of between 3.00m and 4.00m within the footprint of each proposed dwelling, with associated soil sampling and supervision of the works by a suitably qualified geo-environmental engineer. The boreholes were sunk by windowless sampling drilling techniques using a Dando Terrier drill rig.

- Hand excavation four (4) hand dug trial pits (TPA to TPD) to depths of 0.60m to 0.80m within the proposed garden areas at the site, to obtain further samples for testing.

- The installation of three (3) gas monitoring wells in boreholes BH1, BH3 and BH5.

- Geotechnical Testing comprising forty (40) moisture determinations and three (3) Atterberg Limits to provide information on the general condition, plasticity and potential for vegetation influence on the soils.

- Six (6) gas monitoring visits (where possible) over a period of three (3) months, including readings below 1000mb and where possible following a sharp drop in atmospheric pressure.

- Contamination analyses on six (6) samples recovered at a depth of 0.20m to 0.50m to confirm that a generic suite of potential contaminants including metals, Asbestos and speciated polycyclic aromatic hydrocarbons (PAHs) are absent or within acceptable limits. Leachate testing was carried out on three (3) samples also, to check for sample mobility.

- Provision of a factual and interpretative report including; site plan, trial pit and borehole logs, contamination results and gas measurements, together with advice on appropriate foundation types, the contamination situation 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 logs also provided in Appendix 1.

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

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

2.2 Sampling Rationale

BHs 1, to 5 were positioned mainly to establish the ground conditions beneath the proposed dwellings. Their purpose was to give information and recover soil samples for geotechnical purposes. TPA to TPD were excavated in the garden areas to retrieve samples for contamination testing in these areas.

3. Phase 2 Findings

3.1 Encountered Ground Conditions

It was anticipated, from the findings of the Phase 1 Desk Study carried out by Geoinvestigate Ltd for the site (G16195 - 2016), that the site the site may be underlain by Glacial Till comprising mixed deposits (sand and clay with siltstone at depths of between 2.90m and 3.10m.

3.1.1 Windowless Sampling Boreholes – BH1 to BH5

Generally BH1 to BH5 encountered similar ground conditions. Below a depth of 0.90m the borehole ostensibly found medium dense to dense natural sand, silty sand and gravelly sand. Horizons of firm, firm to stiff and stiff sandy and sandy gravelly clay were encountered in BH3, BH4 and BH5 generally between depths of 0.60.m and 1.60m (BH1) 0.20m and 2.10m BH4 and 0.90m and 2.10m BH5.

At shallower depth BH1 and BH2 found topsoil extending to a depth of 0.40m, whilst compact granular fill (with brick, sandstone and concrete constituents) extended to depths of 0.60m, 0.20m and 0.90m in BH3, BH4 and BH5 respectively.

Vane shear strength values of between 56kN/m^2 to 130kN/m^2 were recorded in the clay strata below a depth of 1.00m.

In Situ SPT testing (carried out with a solid cone sampler) returned N values of between N=12 to N=14 at a depth of 1.00m in BH1 and BH2 rising to between N=21 to N=70 between 2.00m and 4.00m

No roots were recovered from the boreholes.

Standing water level was recorded in BH1, BH2 and BH4 at depths of between 2.70m and 3.50m. Save for BH1, which collapsed below 3.00m all of the boreholes remained open on completion of drilling.

3.1.2 Hand Excavated Trial Pits– TPA to TPD

Four (4) hand excavated trial pit was undertaken to give further information on the make-up of the ground and to collect samples for contamination testing in the proposed garden areas.

TPA encountered made ground similar to that found in BH3 to BH5 to a depth of 0.50m, underlain by stiff natural sandy gravelly clay. TPB, TPC and TPD encountered turf and topsoil to depths of 0.35m 0.40m and 0.30m respectively underlain by natural clayey sandy gravelly clay.

The granular made ground and topsoil included concrete, sandstone, brick, pot, glass and coal constituents.

The trial pits remained stable and dry on completion.

3.1.3 Summary of Ground Conditions Encountered

Below the initial topsoil or made ground the windowless sampling boreholes sunk at the site encountered generally competent ground conditions comprising mostly medium dense and dense (silty and gravelly) sand, with horizons of firm, firm to stiff and stiff clay noted to depths of between 1.60m to 2.40m in BH3, BH4 and BH5, below which medium dense and dense sand was found.

Although significant vegetation was present at the site no roots were encountered in the boreholes.

3.2. Moisture content and Vegetation Influence.

Plasticity testing of the cohesive soils at the site generally returned PIs (Plasticity Indices) of 15.2% to 35.3% classifying the soil as Clay of Low (CL) and Clay of High (CH) Plasticity according to BS5930.

Although no roots were encountered in the boreholes, significant vegetation was present at the site. BH3, close to the vegetation shows possible vegetation induced moisture depletion to a depth of at least 1.60m, in addition the clay stratum encountered was in a stiff condition, also indicative of vegetation influence. Therefore, given the above factors it is considered that precautions need to be taken with regard to foundation depths/ design and vegetation influence at the site.

4. Contamination Testing

The desk study concluded that the possible presence of made/in-filled ground and contamination may be present from former land uses within and adjacent to the site, however the risk of contamination was inferred to be low.

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

Therefore six (6) samples were recovered from topsoil or made ground (from depths of between 0.20m to 0.50m) from across the site and were tested for a range of substances.

These included common contaminants such as Arsenic, Lead and Cadmium which are normally included in a general human health contamination suite together with analysis for speciated Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPHs) and Asbestos.

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

5. Risk Assessment

5.1 Method

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

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

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

Where results are above the intervention values, an assessment of the available pathways and receptors has been carried out to determine whether further investigation or remediation is necessary. An appraisal of the chemical results and relevant limits is set out in the Contamination Risk Assessment that follows.

5.2 Contamination Risk to Identified Receptors

5.2.1 Contamination Risk to Human Health

Topsoil was generally encountered to 0.30m or 0.40m in most of the excavations undertaken at the site (BH1-BH2 and TPB-TPD) containing gravel of sandstone and brick at BH1-BH2 and also containing some gravel of pot, glass and coal at TPB-TPD suggesting that the topsoil has been subject to come degree of disturbance in the past. Made ground was present from the surface at BH3-BH5 and TPA to depths of between 0.20m and 0.90m. The made ground mostly comprised compact brown slightly clayey gravelly sand / sandy gravel fill with gravel constituents including sandstone, concrete, brick, coal, pot and tile. Exclusively at BH5 a distinct fill type was encountered comprising compact red and brown sandy gravel and cobbles of brick and concrete with wood and coal also noted. It is possible that much of the made ground comprised old/disturbed topsoil.

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

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

The results of the analyses of six (6) samples of made ground and topsoil recovered from the site from depths of between 0.20m and 0.50m returned concentrations of a range of substances generally falling below their respective assessment criteria adopted from the sources named above. The results of the analyses are shown in Table 1 (on the following page) together with the published Environment Agency SGVs, LQM/CIEH S4ULs, and DEFRA C4SLs.

An average (mean) total Organic Carbon Content of 2.98%, and Soil Organic Matter Content of 5.14% estimated from this, were returned from the soil analyses; therefore the LQM/CIEH S4ULs for PAHs and Hydrocarbons were chosen using the Soil Organic Matter (SOM) option of 2.5%.

Table 1: Chemical Determinands in Soils

	Range of Returned concentrations (mg/kg)	Residential Soil Guideline Value – EA (mg/kg)	Suitable 4 Use Levels* – LQM/CIEH (mg/kg)	Category 4 Screening Level* – DEFRA (mg/kg)
Asbestos	None Detected (all)	Any presence unacceptable		
Arsenic	6.9 - 16	32	37	37
Boron	<0.5 – 1.5		290	
Cadmium	<0.2 – 0.6	10	11	22
Chromium VI	<1		6	21
Chromium III	61 - 100		910	
Copper	15 - 42		2400	
Lead	46 - **290**			200
Mercury (elemental)	<0.5 – **1.6**	1	1.2	
Nickel	14 – 19		180	
Selenium	0.4 – 0.9	350	250	
Zinc	58 – 167		3700	
Phenol	<0.5	420	550	
PAH Naphthalene	<0.01 – 1.53		5.6	
PAH Acenapthylene	<0.01 – 0.05		420	
PAH Acenapthene	<0.01 – 1.40		510	
PAH Fluorene	<0.01 – 0.81		400	
PAH Phenanthrene	0.08 – 10.13		220	
PAH Anthracene	<0.05 – 2.98		5400	
PAH Fluoranthene	0.17 – 15.25		560	
PAH Pyrene	0.35 – 11.68		1200	
PAH Benzo[a]anthracene	0.09 – 7.29		11	
PAH Chrysene	0.09 – 6.30		22	
PAH Benzo(b)fluoranthene	0.08 – **6.87**		3.3	
PAH Benzo(k)fluoranthene	0.04 – 2.98		93	
PAH Benzo(a)pyrene	0.06 – **5.67**		2.7	5
PAH-Dibenz(a,h)anthracene	<0.02 – **0.98**		0.28	
PAH-Indeno(123-cd)pyrene	0.04 – 3.01		36	
PAH Benzo(ghi)perylene	<0.04 – 2.98		340	
Total PAH	0.90 – 79.7			
VPH EC 5 - 7	<0.01		140	
VPH EC 7 – 8	<0.01		290	
VPH EC 8 -10	<0.01		83	
EPH EC 10 – 12	<1		180	
EPH EC 12 – 16	<1		330	
EPH EC 16 – 21	<1 - 4		540	
EPH EC 21 -35	1 - 6		1500	
EPH EC 35 -44	<1 - 2		1500	
VPH C5 – 6	<0.1		78	
VPH C6 -8	<0.1 – 0.1		230	
VPH C8 – 10	<0.1 – 0.4		65	
EPH C10 – 12	<4		330	
EPH C12 – 16	<4 - 12		2400	
EPH C16 – 35	15 - 184		92000	
EPH C35 -44	<10 - 70		92000	

** for residential land use with home grown produce.*

No asbestos fibres were detected in any of the four samples tested.

Small exceedances of the adopted soil assessment criteria were returned from samples recovered from 0.50m in BH5 (Lead only), 0.30m in TPB (Lead and Mercury), and 0.30m in TPA (three species of PAH).

However, save for the exceptions noted above, analysis of soils from the site returned values consistently falling within adopted assessment criteria samples tested for all determinands

5.2.2 Contamination Risk to Controlled Waters

Concentrations of potential contaminants returned in six(6) soil samples mostly fell below the chosen assessment criteria. Therefore there is considered to be a low risk to underlying groundwater from leaching. Notwithstanding, three (3) leachate samples were obtained from 0.20m in TPD and 0.30m in TPA and 0.50m in 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. 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	0.97 – 2.79	**50** (DW, range: 50-100) (No Aq standard)
Boron	<6 – 18	**1000** (DW & Aq)
Cadmium	<0.07	**5** (DW & Aq)
Chromium	0.3 – 0.9	**50** (DW) / **5** (Aq, range: 5-250)
Copper	1.8 – **6.3**	**50** (DW) / **5** (Aq, range: 5-112)
Lead	0.3 – 2.8	**50** (DW) / **4** (Aq, range: 4-250
Mercury (elemental Hg)	<0.008 – 0.033	**1** (DW & Aq)
Nickel	<0.5 – 2.9	**20**** (DW) / **50** (Aq, range: 50-200)
Selenium	0.11 – 0.93	**10** (DW) (No Aq standard)
Zinc	<1	**3000** (DW, range: 3000-5000) / **30** (Aq, range: 30-2000)
Organic Chemicals		
Phenols	<10	**50****(DW) / **300** (Aq)
PAHs (total)	<1.6	**0.2** (DW, range: 0.2-1.0) (No Aq standard)

*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

An exceedance of the lowest assessment criteria option(s) for copper has been noted, this option relates to freshwater with very low calcium carbonate content (<50mgl^{-1}) which is unlikely in water of pH 7.7 to 8.5 as measured for these leachates (low $CaCO_3$ content might be expected to be more likely in more acidic to waters). Though no data has been collected regarding the calcium carbonate content of local waters and underlying groundwater the relatively low concentrations and consequently minor nature of the exceedances are considered to represent a negligible risk to underground waters.

Concentrations of Phenol and PAH are below detectable limits, and would not be considered to pose a risk to controlled waters. In addition the absence of surface water features and expected very low permeability of the underlying mudstone would render the risk to any underlying groundwater as minimal..

5.3 Review of Results

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

However, sporadic exceedances of assessment criteria were returned for certain contaminants as per the table below:

Sample	Description of material	Contaminant(s) at elevated levels	Concentration in soil (mg/kg)	Associated Assessment criterion (mg/kg)	Site Average (mean, mg/kg)
TPA (0.30m)	Compact brown slightly clayey sandy gravel / gravelly sand made ground.	Benzo(b)fluoranthene	6.87	3.3 (S4UL)	1.54
		Benzo(a)pyrene	2.67	2.7 (S4UL) or 5.0 (C4SL)	1.28
		Dibenz(a,h)anthracene	0.98	0.28 (S4UL)	0.22
TPB (0.30m)	Topsoil including additional gravel of pot, glass and coal.	Mercury	1.6	1.2 (S4UL)	0.8
		Lead	267	200 (C4SL)	166.5
BH5 (0.50m)	Compact red and brown sandy gravel made ground.	Lead	290		

As can be seen from this table the elevated levels of contaminants are only in excess of the associated assessment criteria by a small amount in each instance and as such would not be considered to pose a significant risk to identified potentially vulnerable receptors. Additionally:

- In each case the site average soil concentrations (of the six samples analysed) are comfortably below their respective assessment criteria.
- Each exceedance has only been returned for one of the six samples (save for lead which was returned at levels above the C4SL twice) with all other samples otherwise returning low levels for that particular potential contaminant.

Therefore, no single area of the site or particular soil type can be identified as uniquely containing elevated levels of contaminants with different potential contaminants appearing at slightly elevated levels in different areas of the site and different soil types.

As such, given the minor nature of the exceedances noted and the sporadic and generally singular occurrences of each in various locations/soil types, it would be very difficult to justify a remediation exercise to replace or improve soils at the site. The mixed nature of the potential contaminants (metallic and organic), the large amount of otherwise clean soils which would (most likely) have to be removed to landfill for relatively minor reasons, the relatively low risk to end users of the proposed redevelopment, and the large cost and potential stress associated with such works would suggest that such an exercise would be extremely wasteful and unnecessary.

However, only one sample of the compact brown slightly clayey sandy gravel / gravelly sand made ground encountered at TPA and BH3-BH4 has been analysed, all of which were located generally in the eastern corner of the site. This sample from TPA was the sample which returned elevated levels of three species of PAH. Therefore, to confirm the above conclusions are correct, it would be prudent to carry out some

limited additional sampling and analysis of these soils. The results of which might suggest that either; no remediation will be required at the site if results are favourable; or that areas in the east of the site intended to comprise soft landscaping in the proposed development might require some remedial works if results are not favourable.

Analysis of leachate from soils recovered from the site (including at TPA where slightly elevated PAHs were identified and at BH5 where slightly elevated lead was identified) has confirmed that no potential contaminants are mobile and as such do not represent any significant risk to local ground or surface waters.

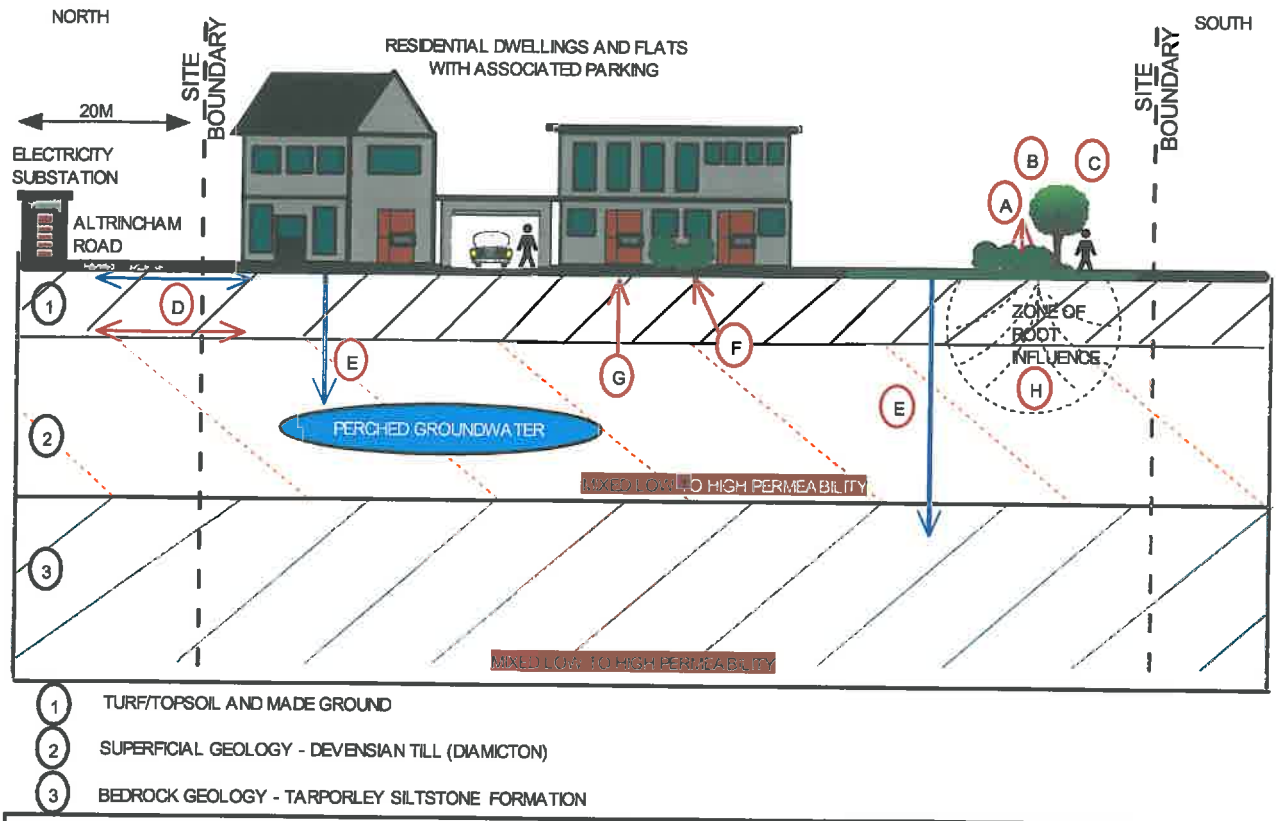
5.3.1 Summary and Conceptual Ground Hazard Model

Given the findings in section 5.3.1 above a remediation and validation exercise is not anticipated to be necessary at the site for the redevelopment.

Potential pollutant linkages identified are presented in the CGHM presented on the following page. None of these are currently considered to be present at the site to such an extent that an unacceptable risk will be posed to the identified receptors, provided this can be confirmed by subsequent testing.

With regard to pollutant linkage G, monitoring for possible hazardous ground gas is ongoing (see Sections 6 and 7.2 below) with a final assessment to be made in a subsequent addendum to this report. Although some depleted Oxygen levels and slightly elevated Carbon Dioxide concentration have been returned no significant hazard has been identified, that might not be mitigated with construction measures.

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



IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES

-Possible presence of made ground, and associated potential contaminants and hazardous ground gas arising from development on and adjacent to site. *Possible pollutant linkage identified in shallow made ground, likely to be confirmed absent by additional testing.*

-Potential shrink-swell clays. *Hazard identified - foundations altered accordingly*

POLLUTANT LINKAGES: IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

A - Residents, Construction Workers & End Users through Direct Contact / Inhalation / Ingestion.

B - Plants and Trees through uptake.

C - End Users through cultivation and consumption of vegetables / fruit. Currently considered possible given intended residential site use.

D - Neighbouring Sites and their users through lateral migration (in soil and water, including surface water run-off and runoff). Subsurfce migration possibly unlikely due to likely presence of low permeability clay.

E - Ground water through leaching of sub-soil. Highly unlikely to be of concern due to low permeability clay subsoils and absence of productive aquifers & surface water features. *Possible pollutant linkages identified in A - E likely to be confirmed absent by further testing*

F - Building and services through direct contact.

G - End users and buildings through ground gas migration. *Low level gassing regime identified to be confirmed on conclusion of monitoring exercise.*

H - Buildings through tree root influence and seasonal shrink/swell of clays or potential heave on removal of vegetation. Foundation depths altered accordinly to take into account hazard identified.

6. Hazardous Gas

6.1 Gas Regime

The earlier Phase 1 Desk Study Report suggested that possible made ground on the site associated with remodeling of the dwelling and the presence of coal bearing strata could have the potential to generate gas.

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

However, a further set of 4 measurements are required from all of the gas monitoring points to properly establish the initial and longer term gassing regime at the site, although these are unlikely to vary greatly from those results already returned.

Borehole	Number of Visits	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow Rate (l/hr)	Atmospheric Pressure (mb)
BH1	2	0.0-0.1	2.0-2.1	18.6-19.2	<0.1	978-1015
BH3		0.0	3.1-3.2	14.0-16.1	<0.1	
BH5		0.0-0.1	4.6-4.8	12.0-14.2	<0.1	

The gas monitoring visits at a pressure of between 978mb and 1015mb returned near normal or depleted levels of O_2 between at 12.0% and 18.6%, with maximum 0.1% CH_4 and maximum 4.8% CO_2. Gas flow rates were <0.1 l/hr and below detectable limits.

6.2 Radon Gas

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

7. Conclusions

7.1 Contamination

Analysis of the ground conditions at the site and an assessment of the potential pathways have confirmed that the site, as proposed by the current redevelopment plans, would generally be unlikely to pose a significant risk to human health and other identified receptors in the context of the proposed residential end-use.

Therefore, it is unlikely that any remediation exercise will be necessary at the site.

However, it is recommended that an additional sampling and analysis exercise is carried out in the east of the site where slightly elevated levels of three PAH species have been returned for the sample recovered from TPA. Similar made ground was encountered at BH3 and BH4 also in the east of the site.

If additional analysis suggests there is no significant risk with regard to possible PAH contamination in this area of the site then no remediation will be considered necessary at the site prior to its redevelopment for residential use. If the additional works suggest there is some noteworthy cause for concern in this area then a remediation exercise will likely be required though any such works will be limited to areas where soft landscaping is proposed for the new development as no pathway by which potentially vulnerable receptors might come into contact with potential contamination will be present in any other areas (due to hardstanding etc.).

In the latter eventuality a remediation and validation strategy will be required to be produced and submitted to the local authority for approval prior to commencement of the remedial works with a validation report also required later to confirm the works were carried out prudently and successfully.

7.2 Hazardous Gas

On the basis of the initial gas results the gas conditions at the site would be expected to fall within "Characteristic Situation 1" of the Modified Wilson and Card classification or "Green" of the NHBC Traffic Light System for low rise housing with a ventilated under-floor void (min 150mm) (CIRIA C665). Consequently on the basis of these results gas mitigation measures in accordance with the above are anticipated to be required in the construction of the new buildings at the site.

However, a further four (4) sets of gas monitoring results need to be obtained before a final decision can be made on the level of gas protection required at the site. These have been scheduled to be carried out over the coming months and the final results will be provided in an addendum to this report which will be available in late May 2017.

7.3 Foundations & Floors

As discussed in section 3.14 earlier, although the ground conditions present at the site were generally competent in nature, some variability was evidenced, with BH1 and BH2 encountering generally sand and BHs 3, 4 and 5 finding firm to stiff and stiff clay underlain by sand. The presence of some significant vegetation in the locality and clay of high plasticity within BH4 at 1.50m (section 3.2) would necessitate that precautions are made with regard to likely vegetation influence at the site. Foundations should also incorporate some anti heave measures in the upper section and with the suspended floors incorporating a minimum 150mm void.

The above factors, would necessitate that foundations of the dwellings planned at BH3, BH4 and BH5 extend into the sand below the clay to guard against possible damage attributable to vegetation induced soil shrinkage and swelling. At a depth of 2.20m trench fill or pad foundations for the new buildings at BH3, BH4 and BH5 may be designed net bearing pressures of 100kN/m^2 or 125kN/m^2 respectively.

Elsewhere (BH1 and BH2) due to the presence of sand (of non-plastic nature) over the entire depth of the boreholes, foundations may be placed at a shallow depth of 1.00m. At this depth trench fill or pad foundations may be designed net bearing pressures of 100kN/m^2 or 125kN/m^2 respectively.

With regard to floors, as previously mentioned above the buildings at BH3, BH4 and BH5 should be suspended with a minimum 150mm void, however at BH1 and BH2 buildings may incorporate a lightly loaded ground bearing floor slab

7.4 Concrete Design

The results of chemical analyses of the fill returned Water Soluble Sulphate levels of between 21mg/l and 1185mg/l (SO_4) and pH levels of between 5.0 and 8.1. On this basis concrete in contact with the ground may be designed to ACEC Class DS-2 AC-2s of BRE Special Digest 1 – Concrete in aggressive ground.

END OF REPORT

GEO INVESTIGATE ™

Units 4 and 5 Terry Dicken Industrial Estate
Ellerbeck Way
Stokesley
North Yorkshire
TS9 7AE

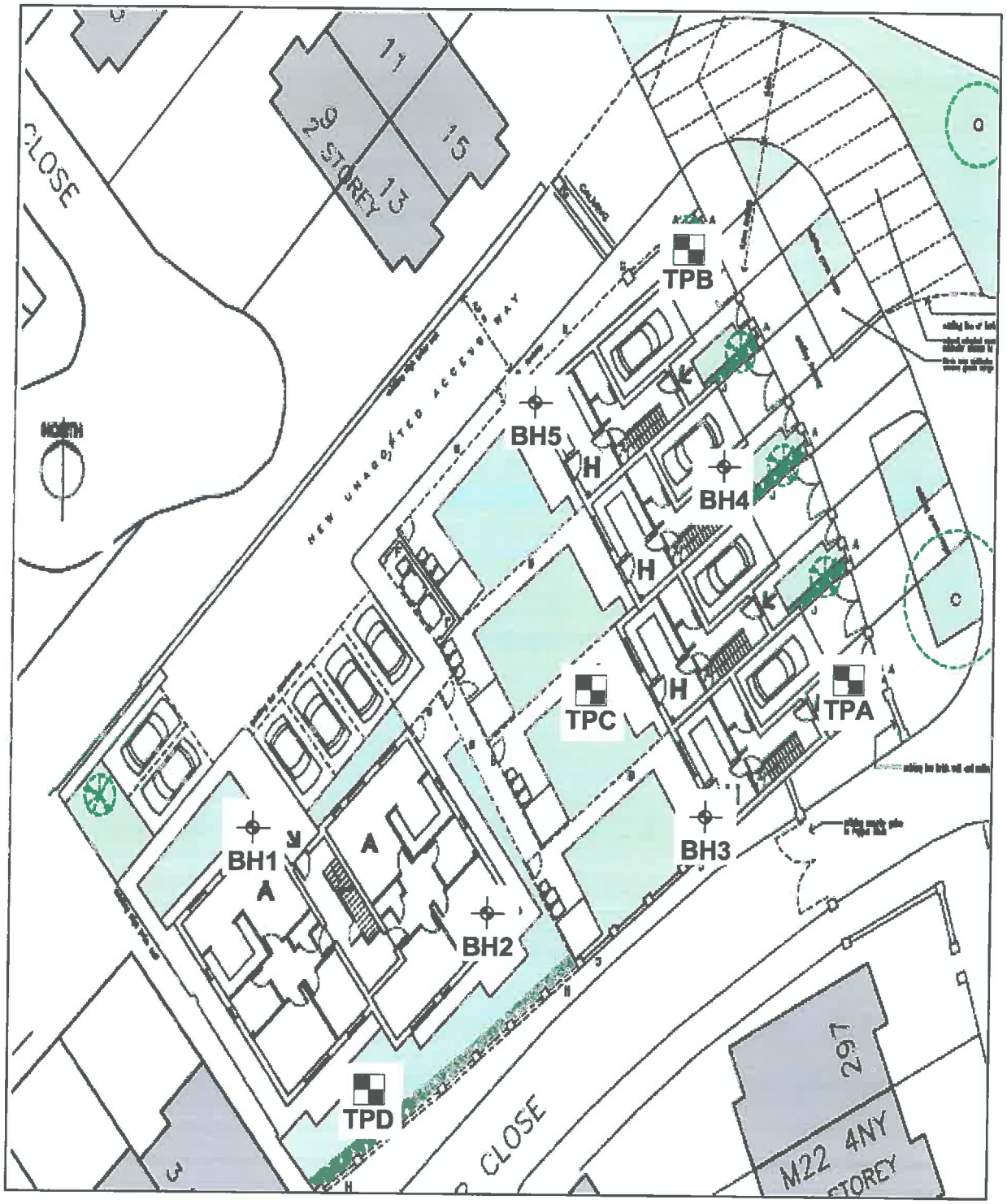
Tel. 01642 713779
Fax 01642713923
Email enquiries@geoinvestigate.co.uk

APPENDIX 1

SITE PLAN, TRIAL PIT AND BOREHOLE LOGS

GEOINVESTIGATE Ltd.

OUR REF:G16271	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE:20/10/16	LOCATION:301 Altrincham Road, Manchester M22 4NY	



GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G16271 **BH No.1** **Sheet No. 1 of 1**
Location: 301 Altrincham Road, Manchester M22 4NY **DATE:** 20/10/16

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.40	TOPSOIL Stiff brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and occasional brick.	400			O	Cv kN/m^2			0.20
0.90	Stiff / compact orangish brown very sandy CLAY / clayey SAND.	500			O				0.50 0.75
1.40	Medium dense light reddish brown fine to coarse SAND.	500			O C		1.00-1.45 2/3/3/4/3/4 N=14		1.00 1.25
2.80	Medium dense brown slightly silty fine to coarse SAND. Wet.	1400			O O C O		2.00-2.45 5/5/6/7/6/8 N=27	2.70m	1.50 1.75 2.00 2.25 2.50 2.75
3.80	Medium dense orangish brown coarse SAND. Moist.	1000			O C O		3.00-3.45 8/8/10/9/9/10 N=38		3.00 3.25 3.50 3.75
4.00	Dense brown very gravelly SAND / sandy GRAVEL. Gravel is fine to coarse of sandstone. Wet.	200			O				4.00
	Borehole Terminated at 4.00m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 4.00m
Borehole closed below 3.00m on completion
Standing water level at 2.70m on completion

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH1

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G16271 **BH No.2** **Sheet No. 1 of 1**
Location: 301 Altrincham Road, Manchester M22 4NY **DATE:** 20-10-16

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.40	TOPSOIL Loose dark brown and black slightly clayey gravelly sand. Gravel is fine to coarse of sandstone and brick.	400			O	Cv kN/m^2			0.20
	Loose to medium dense light brown fine to coarse SAND.				O				0.50
		700							0.75
1.10					O C		1.00-1.45 2/2/3/3/3/3 N=12		1.00
	Medium dense orangish brown silty SAND. Wet.								1.25
					O				1.50
		1200							1.75
2.30					O C		2.00-2.45 4/5/5/5/6/5 N=21		2.00
	Medium dense orangish brown coarse SAND. Moist.								2.25
					O				2.50
									2.75
		1500			O C		3.00-3.45 5/5/6/6/5/5 N=22	3.10m	3.00
									3.25
3.80					O				3.50
									3.75
3.85	Dense brown gravelly SAND. Wet.	50							
3.90	Hard reddish brown SANDSTONE. Possible cobble.	50			O C		3.90-3.93 N=50/30mm		3.90
	Borehole Terminated at 3.90m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.90m
Borehole remained open on completion
Standing water level at 3.10m on completion

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter
O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

BH2

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G16271 **BH No.3** **Sheet No. 1 of 1**
Location: 301 Altrincham Road, Manchester M22 4NY **DATE:** 20-10-16

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/m^2			
	MADE GROUND Compact brown and dark brown slightly clayey in places sandy gravel / gravelly sand. Gravel is fine to coarse of concrete, brick, sandstone, coal, pot and tile.	600			O				0.20
0.60					O				0.50
	Stiff orangish brown mottled grey very sandy CLAY with occasional fine to coarse gravel of sandstone.	1000							0.75
					O	130			1.00
									1.25
1.60					O				1.50
	Dense light grey and brown fine gravelly SAND. Gravel is fine to coarse of sandstone.	500							1.75
2.10					O C		2.00-2.45 6/8/10/10/12/14 N=46		2.00
	Dense orangish brown coarse SAND.	700							2.25
					O				2.50
2.80									2.75
3.00	Hard / stiff reddish brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone.	200			O	130			3.00
	Borehole Terminated at 3.00m due to refusal								

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

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH3

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G16271 **BH No.4** **Sheet No. 1 of 1**
Location: 301 Altrincham Road, Manchester M22 4NY **DATE:** 20-10-16

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/m^2			
0.20	MADE GROUND Compact brown and dark brown slightly clayey in places sandy gravel / gravelly sand. Gravel is fine to coarse of concrete, brick, sandstone, coal, pot and tile.	200							0.25
					O	86			0.50
	Firm orangish brown and dark brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal. Possible reworked natural.	900							0.75
1.10					O	80			1.00
	Firm orangish brown mottled grey sandy CLAY with occasional fine to coarse gravel of sandstone.	500							1.25
1.60					O	72			1.50
	Firm dark brown very sandy very gravelly CLAY / clayey sandy GRAVEL. Gravel is fine to coarse of sandstone. Moist.	500							1.75
2.10					O	64			2.00
	Medium dense brown slightly silty SAND. Moist.	800							2.25
					O				2.50
2.90									2.75
	Medium dense to dense grey and orangish brown slightly gravelly SAND. Gravel is fine to coarse of sandstone.	1100			O C		3.00-3.45 4/4/5/7/9/9 N=30		3.00
									3.25
					O			3.50m	3.50
	Becoming wet from 3.60m						4.00-4.45 12/12/14/13/ 15/18 N=60		3.75
4.00					O C				4.00
	Borehole Terminated at 4.00m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 4.00m
Standing water level at 3.50m on completion

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH4

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G16271 **BH No.5** **Sheet No. 1 of 1**
Location: 301 Altrincham Road, Manchester M22 4NY **DATE:** 20-10-16

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 brown and red sandy gravel. Gravel is fine to coarse of brick, concrete, wood and coal. Many cobbles noted.	900			O O	Cv kN/m^2			0.20 0.50 0.75
0.90									
	Firm orangish brown and grey sandy CLAY with occasional fine to coarse gravel of sandstone.	1200			O O	68 62			1.00 1.25 1.50 1.75
2.10					O	56			2.00
	Dense orangish brown coarse SAND.	900			O		3.00-3.45 12/16/15/17/ 17/21 N=72		2.25 2.50 2.75
3.00					O				3.00
	Borehole Terminated at 3.00m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.00m
Borehole remained dry on completion
Gas well installed to 3.00m 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
C Cone Penetration Test

BH5

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G16271 **TP A** **Sheet No. 1 of 1**

Location: 301 Altrincham Road, Manchester M22 4NY **DATE:** 20-10-16

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 brown and dark brown slightly clayey in places sandy gravel / gravelly sand. Gravel is fine to coarse of concrete, brick, sandstone, coal,	500			O	Cv kN/m^2			0.30
0.50	pot and tile.								0.50
	Stiff grey and orangish brown very sandy CLAY with occasional fine to coarse	300							
0.80	gravel of sandstone.								0.80
	Trial pit terminated at 0.80m								

Remarks:

Hand excavated to 0.80m

Trial pit remained stable and dry on completion

Key:

Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

TP A

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G16271 **TP B** **Sheet No. 1 of 1**

Location: 301 Altrincham Road, Manchester M22 4NY **DATE:** 20-10-16

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	TOPSOIL Loose / soft dark brown and black clayey sandy gravel / gravelly sand.	350				Cv kN/m^2			
0.35	Gravel is fine to coarse sandstone, brick, pot, glass and coal.				O				0.30
	Stiff brown sandy gravelly CLAY. Gravel is	250							0.50
0.60	fine to coarse of sandstone.								0.60
	Trial pit terminated at 0.60m								

Remarks:

Hand excavated to 0.60m

Trial pit remained stable and dry on completion

Key:

- Slotted Pipe
- Plain Pipe
- Bentonite
- Gravel Filter

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

TP B

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G16271 **TP C** **Sheet No. 1 of 1**

Location: 301 Altrincham Road, Manchester M22 4NY **DATE:** 20-10-16

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	TOPSOIL Loose / soft dark brown and black clayey sandy gravel / gravelly sand. Gravel is fine to coarse sandstone, brick, pot, glass and coal.	400			O	Cv kN/m^2			0.30
0.40	Loose light brown fine to coarse SAND	400							0.50
0.80	Trial pit terminated at 0.80m								0.80

Remarks:

Hand excavated to 0.80m

Trial pit remained stable and dry on completion

Key:

- Slotted Pipe
- Plain Pipe
- Bentonite
- Gravel Filter

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

TP C

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G16271 **TP D** **Sheet No. 1 of 1**

Location: 301 Altrincham Road, Manchester M22 4NY **DATE:** 20-10-16

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	TOPSOIL Loose / soft dark brown and black clayey sandy gravel / gravelly sand. Gravel is fine to coarse sandstone, brick, pot, glass and coal.	300				Cv kN/m^2 O			0.20
0.80	Loose light brown fine to coarse SAND	500							0.50
	Trial pit terminated at 0.80m								0.80

Remarks:

Hand excavated to 0.80m

Trial pit remained stable and dry on completion

Key:

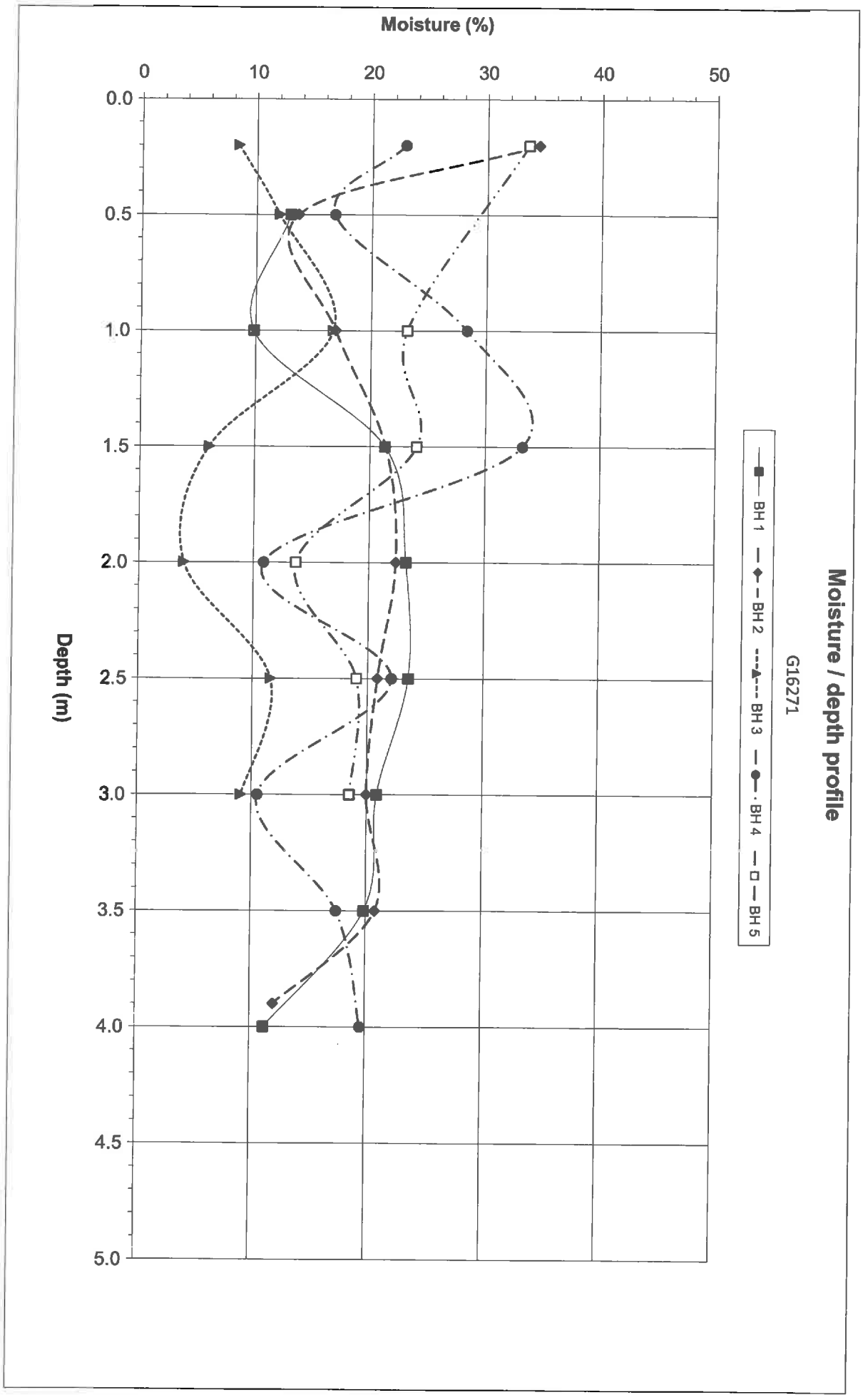
- Slotted Pipe
- Plain Pipe
- Bentonite
- Gravel Filter

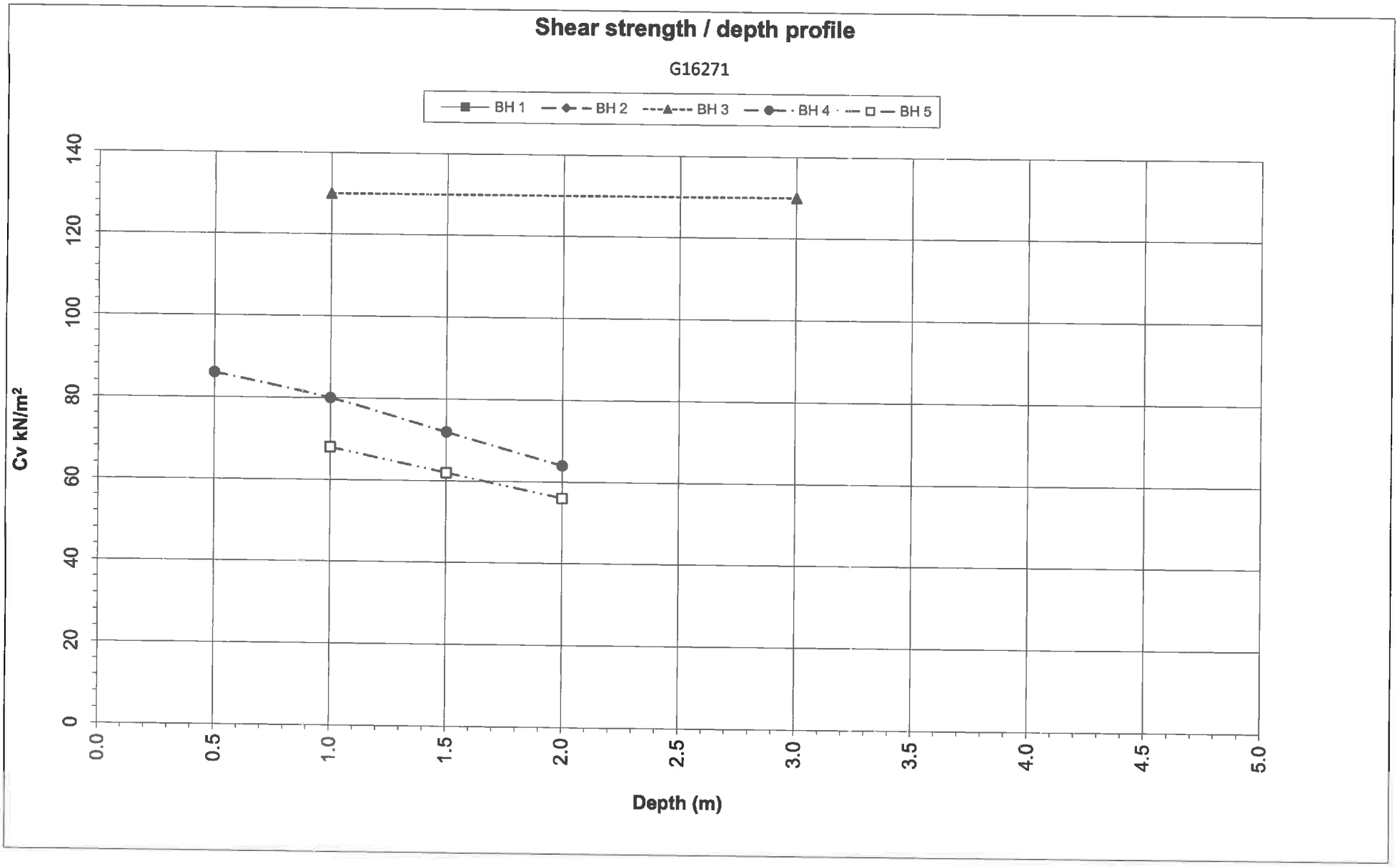
O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

TP D

APPENDIX 2

MOISTURE CONTENT and ATTERBERG LIMIT TEST RESULTS (TABLE 4)


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 2
BH 3
BH 4
BH 5
Moisture / depth profile
G16271


Shear strength / depth profile
G16271
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)

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G16271
Your ref.

Table 1
Location: 301 Altrincham Road, Manchester M22 4NY

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification
1	0.50	12.9						
	1.00	9.8						
	1.50	21.3						
	2.00	23.2						
	2.50	23.5						
	3.00	20.8						
	3.50	19.8						
	4.00	11.2						
2	0.20	34.5						
	0.50	13.6						
	1.00	16.9						
	1.50	21.3						
	2.00	22.3						
	2.50	20.8						
	3.00	20.0						
	3.50	20.8						
	3.90	12.0						

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G16271
Your ref.

Table 1
Location: 301 Altrincham Road, Manchester M22 4NY

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
3	0.20	8.4						
	0.50	12.0						
	1.00	16.7	>95	16.7	22.9	48.7	25.8	CI
	1.50	6.0						
	2.00	3.9						
	2.50	11.6						
	3.00	9.1						
4	0.20	22.9						
	0.50	16.8						
	1.00	28.3						
	1.50	33.2	>95	33.2	23.9	59.2	35.3	CH
	2.00	10.9						
	2.50	22.0						
	3.00	10.5						
	3.50	17.4						
	4.00	19.6						

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G16271
Your ref.

Table 1
Location: 301 Altrincham Road, Manchester M22 4NY

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
5	0.20	33.6						
	1.00	23.1						
	1.50	24.0	>95	24.0	15.0	30.2	15.2	CL
	2.00	13.7						
	2.50	19.0						
	3.00	18.5						

APPENDIX 3
CHEMTECH ANALYTICAL
TEST REPORT

2531

CHEMTECH environmental

ANALYTICAL TEST REPORT

Contract no:	62013
Contract name:	Proposed Development, 301 Altrincham Road, Manchester, N22 4AX
Client reference:	G16271
Clients name:	Geo Investigate
Clients address:	Units 4 & 5, Terry Dicken Industrial Estate Ellerbeck Way, Stokesley North Yorkshire TS9 7AE
Samples received:	31 October 2016
Analysis started:	31 October 2016
Analysis completed	07 November 2016
Report issued:	07 November 2016

Notes:

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, withour 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
62013-1	BH1	0.20	Loamy Sand with Gravel	-	-	10.7
62013-2	BH5	0.50	Sand with Brick	-	-	15.1
62013-3	TPA	0.30	Sand with Gravel	-	-	10.3
62013-4	TPB	0.30	Loam	-	-	23.1
62013-5	TPC	0.30	Loam	-	-	16.9
62013-6	TPD	0.20	Loam	-	-	15.8

Chemtech Environmental Limited

SOILS

Lab number			62013-1	62013-2	62013-3	62013-4	62013-5	62013-6
Sample Id			BH1	BH5	TPA	TPB	TPC	TPD
Depth (m)			0.20	0.50	0.30	0.30	0.30	0.20
Date sampled			20/10/2016	20/10/2016	20/10/2016	20/10/2016	20/10/2016	20/10/2016
Test	**Method**	**Units**						
Arsenic (total)	CE127 M	mg/kg As	11	6.9	16	12	12	11
Boron (water soluble)	CE063 M	mg/kg B	0.5	1.5	1.2	0.7	<0.5	<0.5
Cadmium (total)	CE127 M	mg/kg Cd	0.2	<0.2	<0.2	0.6	0.3	0.3
Chromium (total)	CE127 M	mg/kg Cr	63	63	70	61	80	100
Chromium (III)	-	mg/kg CrIII	63	63	70	61	80	100
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	28	15	37	42	28	25
Lead (total)	CE127 M	mg/kg Pb	98	290	46	267	158	140
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5	<0.5	1.6	0.9	0.8
Nickel (total)	CE127 M	mg/kg Ni	16	14	19	19	14	14
Selenium (total)	CE127 M	mg/kg Se	0.7	0.4	0.8	0.9	0.7	0.7
Zinc (total)	CE127 M	mg/kg Zn	71	125	58	167	96	85
pH	CE004 M	units	5.0	8.1	8.5	7.5	6.6	6.2
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	21	1185	218	95	22	17
Sulphur (total)	CE127	mg/kg S	<100	1244	640	451	<100	<100
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Cyanide (total)	CE077 M	mg/kg CN	<1	<1	<1	<1	<1	<1
Thiocyanate	CE145 M	mg/kg SCN	<1	<1	<1	<1	1.2	<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	2.05	-	3.53	3.67	2.68	-
Estimate of OMC (calculated from TOC)	CE072 M	% w/w	3.53	-	6.09	6.33	4.62	-
PAH								
Naphthalene	CE087 M	mg/kg	0.03	<0.01	1.53	0.05	0.03	0.02
Acenaphthylene	CE087 M	mg/kg	<0.01	<0.01	0.05	<0.01	<0.01	<0.01
Acenaphthene	CE087 M	mg/kg	0.03	<0.01	1.40	0.06	0.02	<0.01
Fluorene	CE087 U	mg/kg	0.02	<0.01	0.81	0.03	0.02	<0.01
Phenanthrene	CE087 M	mg/kg	0.46	0.08	10.13	0.62	0.24	0.13
Anthracene	CE087 U	mg/kg	0.20	0.04	2.98	0.24	0.08	0.05
Fluoranthene	CE087 M	mg/kg	1.28	0.17	15.25	1.56	0.52	0.35
Pyrene	CE087 M	mg/kg	1.19	0.17	11.68	1.47	0.51	0.35
Benzo(a)anthracene	CE087 U	mg/kg	0.71	0.09	7.29	0.88	0.29	0.24
Chrysene	CE087 M	mg/kg	0.61	0.09	6.30	0.76	0.30	0.21
Benzo(b)fluoranthene	CE087 M	mg/kg	0.76	0.08	6.87	0.98	0.31	0.29
Benzo(k)fluoranthene	CE087 M	mg/kg	0.28	0.04	2.87	0.40	0.17	0.09
Benzo(a)pyrene	CE087 U	mg/kg	0.65	0.06	5.67	0.80	0.28	0.23
Indeno(123cd)pyrene	CE087 M	mg/kg	0.33	0.04	3.01	0.52	0.17	0.15
Dibenz(ah)anthracene	CE087 M	mg/kg	0.11	<0.02	0.98	0.14	<0.02	<0.02
Benzo(ghi)perylene	CE087 M	mg/kg	0.36	0.04	2.89	0.52	0.18	0.16
PAH (total of USEPA 16)	CE087	mg/kg	6.99	0.90	79.7	9.04	3.10	2.27

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SOILS

Lab number			62013-1	62013-2	62013-3	62013-4	62013-5	62013-6
Sample id			BH1	BH5	TPA	TPB	TPC	TPD
Depth (m)			0.20	0.50	0.30	0.30	0.30	0.20
Date sampled			20/10/2016	20/10/2016	20/10/2016	20/10/2016	20/10/2016	20/10/2016
Test	**Method**	**Units**						
TPH								
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	-	-	-	<0.01	-	<0.01
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	-	-	-	4	-	<1
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	-	-	-	6	-	1
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	-	-	-	2	-	<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	-	-	-	0.4	-	<0.1
EPH Aliphatic (>C10-C12)	CE068	mg/kg	-	-	-	<4	-	<4
EPH Aliphatic (>C12-C16)	CE068	mg/kg	-	-	-	12	-	<4
EPH Aliphatic (>C16-C35)	CE068	mg/kg	-	-	-	184	-	15
EPH Aliphatic (>C35-C44)	CE068	mg/kg	-	-	-	70	-	<10
Subcontracted analysis								
Asbestos (qualitative)	$	-	-	NAD	NAD	NAD	-	NAD

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PREPARED LEACHATES

Lab number			62013-2L	62013-3L	62013-6L
Sample id			BH5	TPA	TPD
Depth (m)			0.50	0.30	0.20
Test	**Method**	**Units**			
Arsenic (dissolved)	CE128 U	µg/l As	2.26	2.79	0.97
Boron (dissolved)	CE128 U	µg/l B	18	16	<6
Cadmium (dissolved)	CE128 U	µg/l Cd	<0.07	<0.07	<0.07
Chromium (dissolved)	CE128 U	µg/l Cr	0.9	0.4	0.3
Copper (dissolved)	CE128 U	µg/l Cu	1.8	1.8	6.3
Lead (dissolved)	CE128 U	µg/l Pb	0.7	0.3	2.8
Mercury (dissolved)	CE128 U	µg/l Hg	<0.008	<0.008	0.033
Nickel (dissolved)	CE128 U	µg/l Ni	2.9	<0.5	1.1
Selenium (dissolved)	CE128 U	µg/l Se	0.26	0.93	0.11
Zinc (dissolved)	CE128 U	µg/l Zn	<1	<1	1
pH	CE004 U	units	8.9	8.5	7.7
Sulphate	CE049 U	mg/l SO_4	72	16	<10
Sulphur (dissolved)	CE128 U	mg/l S	26.5	7.9	0.4
Sulphide	CE079	µg/l S^{2-}	<100	<100	<100
Cyanide (free)	CE147	µg/l CN	<20	<20	<20
Cyanide (total)	CE147	µg/l CN	<20	<20	23
Thiocyanate	CE014	µg/l SCN	<200	<200	<200
Phenols (total)	CE148	µg/l PhOH	<10	<10	<10
PAH					
Naphthalene	CE051	µg/l	<0.1	<0.1	<0.1
Acenaphthylene	CE051	µg/l	<0.1	<0.1	<0.1
Acenaphthene	CE051	µg/l	<0.1	<0.1	<0.1
Fluorene	CE051	µg/l	<0.1	<0.1	<0.1
Phenanthrene	CE051	µg/l	<0.1	<0.1	<0.1
Anthracene	CE051	µg/l	<0.1	<0.1	<0.1
Fluoranthene	CE051	µg/l	<0.1	<0.1	<0.1
Pyrene	CE051	µg/l	<0.1	<0.1	<0.1
Benzo(a)anthracene	CE051	µg/l	<0.1	<0.1	<0.1
Chrysene	CE051	µg/l	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	CE051	µg/l	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	CE051	µg/l	<0.1	<0.1	<0.1
Benzo(a)pyrene	CE051	µg/l	<0.1	<0.1	<0.1
Indeno(123cd)pyrene	CE051	µg/l	<0.1	<0.1	<0.1
Dibenz(ah)anthracene	CE051	µg/l	<0.1	<0.1	<0.1
Benzo(ghi)perylene	CE051	µg/l	<0.1	<0.1	<0.1
PAH (total of USEPA 16)	CE051	µg/l	<1.6	<1.6	<1.6

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	M	0.5	mg/kg B
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
-	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		1	mg/kg CrIII
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO_4
CE127	Sulphur (total)	Acid extraction, ICP-MS	Dry		100	mg/kg S
CE079	Sulphide	Extraction, Continuous Flow Colorimetry	Wet		10	mg/kg S^{2-}
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet		1	mg/kg CN
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	Wet	M	1	mg/kg CN
CE145	Thiocyanate	Weak acid extraction, Colorimetry	Dry	M	1	mg/kg SCN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	Wet		0.5	mg/kg PhOH
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyser	Dry	M	0.1	% w/w C
CE072	Estimate of OMC (calculated from TOC)	Calculation from Total Organic Carbon	Dry	M	0.1	% w/w
CE087	Naphthalene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Acenaphthene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	Wet	U	0.01	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	Wet	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	Wet		0.27	mg/kg
CE067	VPH Aromatic (>EC5-EC7)	Headspace GC-FID	Wet		0.01	mg/kg
CE067	VPH Aromatic (>EC7-EC8)	Headspace GC-FID	Wet		0.01	mg/kg
CE067	VPH Aromatic (>EC8-EC10)	Headspace GC-FID	Wet		0.01	mg/kg
CE068	EPH Aromatic (>EC10-EC12)	Solvent extraction, GC-FID	Wet		1	mg/kg

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METHOD DETAILS

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

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METHOD DETAILS

METHOD	PREPARED LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE001	Leachate preparation (EA)	L:S 10:1		-	-
CE128	Arsenic (dissolved)	ICP-MS	U	0.06	µg/l As
CE128	Boron (dissolved)	ICP-MS	U	6	µg/l B
CE128	Cadmium (dissolved)	ICP-MS	U	0.07	µg/l Cd
CE128	Chromium (dissolved)	ICP-MS	U	0.2	µg/l Cr
CE128	Copper (dissolved)	ICP-MS	U	0.4	µg/l Cu
CE128	Lead (dissolved)	ICP-MS	U	0.2	µg/l Pb
CE128	Mercury (dissolved)	ICP-MS	U	0.008	µg/l Hg
CE128	Nickel (dissolved)	ICP-MS	U	0.5	µg/l Ni
CE128	Selenium (dissolved)	ICP-MS	U	0.07	µg/l Se
CE128	Zinc (dissolved)	ICP-MS	U	1	µg/l Zn
CE004	pH	Based on BS 1377, pH Meter	U	-	units
CE049	Sulphate	Ion Chromatography	U	10	mg/l SO_4
CE128	Sulphur (dissolved)	ICP-MS	U	0.2	mg/l S
CE079	Sulphide	Continuous Flow Colorimetry		100	µg/l 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

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DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

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

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
62013-1	BH1	0.20	N	
62013-2	BH5	0.50	N	
62013-3	TPA	0.30	N	
62013-4	TPB	0.30	N	
62013-5	TPC	0.30	N	
62013-6	TPD	0.20	N	