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CONSULTANCY

Phase 2 Intrusive Site Investigation Report

LOCATION	Proposed Development, Land at Redworth Road / Dale Road, Shildon, DL4 2JT
ISSUE DATE	23rd December 2019
FOR	JSRE Ltd.
CLIENT REF.	
OUR REF.	G19416

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1. Introduction

In accordance with your instruction, Geoinvestigate Ltd. has carried out a Phase 2 investigation on a plot of land situated between Redworth Road and Dale Road, Shildon. The site currently comprises a car dealership at the front/southwest, and open grassed land at the rear/northeast. The site gently slopes down from southwest to northeast.

It is proposed to construct two new retail units at the front of the site and four detached bungalows in the northeast of the site. The boundary of the current study area is shown on the site plan presented in Appendix 1 of this report.

A phase 1 desk study investigation was carried out for the site by FWS Consultants Ltd (report ref. 3604OR01 issued March 2019). This investigation found that the northeast of the site had previously been developed with small structures and later private garages and that the southwest of the site had formerly comprised a filling station. The report found evidence that there had been 5 USTs* at the site and all had been filled with concrete when the site was decommissioned. The report also identified a potential for shallow coal mine workings below the site.

*Underground Storage Tanks

The purpose of this Phase 2 investigation was to establish the true nature of the ground conditions at the site with regard to; the potential for contamination and hazardous gas to occur, determining appropriate foundation types, and to further investigate the risk regarding the potential presence of shallow coal mine workings.

2. Scope of Phase 2 Investigation

2.1 Scope of Works

Given the above the following investigation was carried out to assess the potential risks highlighted in the previous desk study:

The sinking of ten (10) boreholes (BH1 to BH10) to depths of between 3.80m and 4.00m with associated soil sampling and supervision of the works by a suitably qualified geo-environmental engineer. The boreholes were sunk using a Dando Terrier 2002 window sampling drilling rig.

The sinking of four (4) rotary open hole boreholes (RH1 to RH4) to depths of between 35.00m and 38.00m under licence from the Coal Authority to probe for shallow mine workings. The boreholes were sunk using Geoinvestigate's Microdrill® with water flush.

The installation of three (3) gas monitoring wells in boreholes BH2, BH4 and BH6 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 sixty nine (69) moisture determinations and eight (8) Atterberg Limit plasticity tests to provide information with regard to soil conditions and shrinkage potential at the site.

Contamination analyses of ten (10) samples of near-surface made ground and deeper natural soils recovered at depths up to 2.00m to investigate whether or not various potential contaminants are present within acceptable limits (metals, Asbestos, polycyclic aromatic hydrocarbons (PAHs) and petroleum hydrocarbons (including BTEX*); chemical analyses based on the attending engineer's assessment of soils and ground conditions at the site). Leachate from two (2) samples was 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 soil analysis results, together with advice on the contamination, gas and the coal mining situation at the site.

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.

The results of geotechnical soil testing and soil moisture profiles are included in Appendix 2.

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

The two parts of the site are to be considered separately in parts of this report, particularly the contamination risk assessment, given the differing proposed end uses; residential in the northeast and commercial in the southwest.

2.2 Sampling Rationale

The borehole positions were chosen to give an indication of the ground conditions generally throughout the site, which includes positions close to or within most or all of the proposed building footprints. Boreholes BH6 to BH8 were specifically sunk around the location of the former USTs and interceptor to investigate the deeper ground conditions around these particularly potentially contaminative features.

RH1 to RH4 were sunk throughout both the proposed residential and commercial areas to explore for potential shallow historical mine workings below and close to the footprints of the proposed structures.

3. Phase 2 Investigation Findings

3.1 Encountered Ground Conditions

3.1.1 Window Sampling Boreholes

Made Ground

Made ground extended to depths of between 0.30m (BH2) and 1.45m (BH9) but generally to 1.10m or less.

Broadly speaking four distinct types of made ground were encountered by the boreholes. Broad descriptions of these strata and depths at which they were encountered in each borehole are shown on Table A on the following page. The final two made ground ‘types’ on the table were fairly comparable, however. Concrete and asphalt surfaces, where present, have been omitted from the table.

Where these are highlighted yellow, samples representative of those strata were recovered for contamination analysis.

Table A: Made ground strata encountered at the site

Made Ground Description	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH9	BH10
Black, dark grey and/or dark brown sandy gravel (clayey or silty in places). Gravel content variably including sandstone, coal, brick, and slate with glass or ash found once each.	0.00m-0.40m and 0.50m-0.70m	0.00m-0.05m	0.00m-0.10m	0.00m-0.75m	0.00m-0.40m	0.40m-0.60m	0.40m-0.50m			
Red and yellow or grey sandy gravel of brick rubble and variably including sandstone and concrete.		0.05m-0.15m and 0.20m-0.30m				0.05m-0.40m	0.14m-0.40m	0.10m-0.90m	0.08m-0.25m	0.05m-0.60m
									Sandstone only, no brick noted.	
Dark brown, brown, greyish brown or brownish grey sandy gravelly clay with gravel of sandstone, coal and/or brick. Silty and/or very sandy in places.	0.40m-0.50m (pale brown)	0.15m-0.20m	0.10m-0.25m	0.75m-1.10m						0.60m-1.10m
Dark grey and/or greyish brown very sandy gravelly clay with gravel of sandstone, coal and brick. Identified as a possible old topsoil horizon in places.	0.70m-1.00m				0.40m-0.75m				0.25m-1.45m	
TOTAL DEPTH of MADE GROUND	1.00m	0.30m	0.25m	1.10m	0.75m	0.60m	0.50m	0.90m	1.45m	1.10m

No clear visual or olfactory evidence of contamination was noted in any of the made ground strata.

Below the made ground, the boreholes encountered fairly variable natural subsoils generally comprising interbedded sandy gravelly clay and clayey gravelly sand strata with some silty horizons. Sandy gravel or gravelly sand was found at the base of a number of the boreholes, being clayey or slightly clayey in places.

A summary of the natural strata and their strengths is presented in Table B below:

Table B: Natural Strata encountered at the site

Made Ground Description	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8	BH9	BH10
DEPTH of MADE GROUND	1.00m	0.30m	0.25m	1.10m	0.75m	0.60m	0.50m	0.90m	1.45m	1.10m
Interbedded sandy gravelly clay and clayey gravelly sand	1.00m to 3.70m	0.30m to 3.60m	0.25m to 3.30m	1.10m to 3.50m	0.75 to 3.80m	0.60m to 3.80m	0.50m to 4.00m	0.90m to 3.80m	1.45m to 4.00m	1.10m to 4.00m
Sandy gravel or gravelly sand at base of boreholes.	3.70m to 4.00m	3.60m to 4.00m	3.30m to 3.80m	3.50m to 4.00m	3.80m to 4.00m	3.80m to 4.00m	N/A	3.80m to 4.00m	N/A	Cobble at 4.00m
Lowest and highest shear vane value (made ground excluded) (kNm^{-2})	70 (1.0m) 140 (1.5m)	40 (2.4m) 84 (2.5m)	39 (3.2m) 93 (1.5m)	33* (2.0m) 64 (2.5m)	58 (1.0m) 108 (2.5m)	50 (2.0m) >140 (2.5m)	55 (1.0m) >140 (several)	20 (3.2m) 140 (2.0m)	24* (3.5m) 125 (4.0m)	48 (3.5m) 120 (2.5m)
Standard Penetration Test N values (where undertaken)										
1.00m-1.45m	15							7	0	
2.00m-2.45m		8				11		11	10	
3.00m-3.45m	10	12				10				
4.00m-4.45m	27	12	Refusal		Refusal	11				

*Essentially granular strata meaning the vane result is lower than true strength of the material.

All of the boreholes remained open and dry on completion save for BH2 in which a water level of 3.90m below ground level (BGL) was recorded.

Roots were noted to a depth of 1.60m at BH1, 1.10m at BH3 and 0.90m at BH4, with decayed roots also noted at BH1 to 3.50m BGL.

though no strata were seen to exhibit any visual or olfactory signs of contamination, samples from a depth of 2.00m were recovered from boreholes BH7 and BH8 for contamination analysis regardless. The boreholes were positioned close to the bulk of the UST(s) and the interceptor at the site (the fifth UST was located close to BH9).

3.1.2 Rotary Open Hole Boreholes

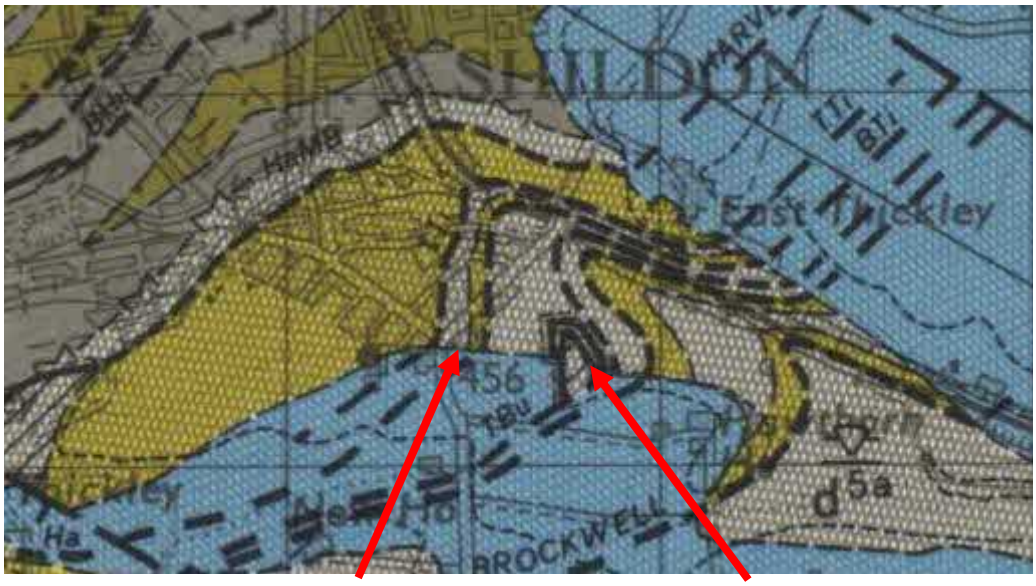
3.1.2.1 Background

A possible risk to the new development from possible unrecorded shallow coal mine workings has been highlighted. The Desk study investigation carried out by FGS Consultants suggested a potential for up to three coal seams to be present within 35m depth of the site surface; the Bottom Tilley (BTi), Top Busty TBu), and Bottom Busty (BBu) coal seams.

The Coal Authority (CA) report used in that study stated that, "The site is within the likely zone of influence of workings in 2 seams of coal at depths between 30 m (Bottom Busty) to 70 m (Brockwell), and last worked in 1926. Any movement in the ground due to coal mining activity in these seams should now have stopped" perhaps suggesting that the actual risk was less severe.

However, the CA report also stated that, "The site may be within the zone of influence from ancient (unrecorded) workings in two coal seams (Bottom Tilley and Top Busty) at shallow to 30 m depth", perhaps referring to the obviously man-made feature to the east of the site on the BGS map (Sheet 32, Barnard Castle), see figure 1 below:

Figure 1: Extract of BGS map sheet 32



Study site Evidence of ancient workings?

Consequently, it was considered prudent to sink boreholes at the site to depths of up to 40.0m, though 35m-38m was achieved in practice (see below).

The CA permit to drill identified the following as prudent considerations:

> The bottom Tilley and Top Tilley coal seams outcrop locally (though not necessarily below the site). "The Busty Q seam is recorded as worked adjacent and in places beneath the site. Although not indicated as at shallow depth below the site, the workings may be shallow in reference to depth below rockhead. Recorded workings of the seam locally indicate a seam thickness of 2.35m."

3.1.2.2 Current Investigation Works

Four (4) rotary open hole boreholes have been sunk at the site as part of this investigation. These were drilled using Geoinvestigate's custom-built and trademarked Microdrill system, a lightweight tracked drilling rig which uses water flush. The logs of these boreholes are presented in Appendix 1 of this report.

The rock descriptions are tentative and generally based on the contents of returned water flush, drilling progress (speed of advance) and water pressures observed during drilling; no cores were recovered from the boreholes to verify these though at several times during excavation the drill-string is withdrawn from the ground to inspect the composition of the build-up on the drill bit.

Gas readings were taken in the boreholes during and following drilling. These are shown on the logs in Appendix 1 (no hazardous gas concentrations were detected).

3.1.3.3 Strata Encountered

All four boreholes (RH1 to RH4) encountered similar ground conditions comprising what was inferred to be drift (a generalised description which includes both made ground and natural subsoils) to between 4.20m to 4.60m; this probably includes weathered and highly weathered bedrock as well as this would allow similarly easy progress with the Microdrill. Therefore, the actual commencement of weathered bedrock may be shallower than these depths but the strata recovered from the shallow window sampling boreholes might suggest they are actually fairly accurate.

The finding so the boreholes are summarised in Table C below:

Table C: Findings of Rotary Open Hole Boreholes

Strata	RH1	RH2	RH3	RH4
Drift (inc. made ground)	0.0m to 4.6m	0.0m to 4.5m	0.0m to 4.2m	0.0m to 4.4m
Sandstone / possible Limestone	4.6m to 15.2m	4.5m to 17.6m	4.2m to 14.1m	4.4m to 16.2m
Sandstone with mudstone inclusions	15.2m to 27.5m	17.6m to 28.1m		16.2m to 29.5m
Mudstone with sandstone inclusions	37.5m to 36.0m	28.1m to 38.0m	14.1m to 22.8m	29.5m to 35.0m
Sandstone with mudstone inclusions			22.8m to 36.0m	
Flush	Lost in drift	Lost in drift	Full to 15.3m, Intermittent below	Lost in drift, returned 34.1m
Coal	NONE	NONE	NONE	NONE
Voids / broken ground	NONE	NONE	NONE	NONE
Continuous solid rock strata	31.4m	33.5m	31.8m	30.6m

As can be seen in Table C, the four boreholes encountered very comparable strata with the only inconsistency being that the 'sandstone with mudstone inclusions' and 'mudstone with sandstone inclusions' appear to have been encountered in reverse order in the RH3 but this does not mean that the strata are reversed just the thickness of the various bedding is somewhat variable within these mixed sandstone/mudstone strata.

None of the boreholes encountered voids or broken ground indicative of shallow mine workings, nor were any coal or coal-containing seams encountered.

3.1.2.4 Conclusions with respect to Coal Mining Risk

The boreholes encountered no coal or coal-containing seams.

No voiding or broken ground was encountered in any of the boreholes.

At least 30m of unbroken rock cover was proven in all three boreholes.

No elevated levels of hazardous gas were recorded in the boreholes.

It is apparent that the Bottom Tilly does not outcrop below the site. This may occur further to the northwest or may not be present at all due to weathering.

The Busty seams are likely to be present below the site but are not present at shallow depth, either with respect to the surface or the commencement of rockhead. At least 30m of unbroken rock have been confirmed throughout the study area at all four borehole locations. Even if a seam thickness of 2.35m is assumed, this is more than ample rock cover if a 'ten-times seam thickness' safety factor is applied.

Given the above, there is concluded to be no risk to the proposed development posed by historical coal mining.

3.2 Soil Plasticity and Vegetation Influence

Cohesive soils at the site generally classify as Clay of Intermediate (CI) Plasticity according to BS 5930 with some classifications of Clay of Low (CL) Plasticity and Clay of High (CH) Plasticity. With Plasticity Indices of between 11.2% and 34.4% these equate to NHBC Low and Medium Shrinkage Potential Soils. The moisture profiles do not offer any clear evidence of potential moisture depletion but the variability of the encountered strata make comparison quite difficult. The peak in strength at 1.50m BGL in BH1 might reflect some degree of vegetation influence, especially given the presence of roots at this location to greater depth than any other part of the site.

Given the presence of roots to depths of 1.60m (BH1), 1.10m (BH3) and 0.90m (BH4) in the boreholes, the presence of sporadic vegetation in the northeast part of the site, and the Low and Medium shrinkage potential of soils at the site, there is some potential for shrinkage and swelling of soils due to vegetation influence as the site exists currently.

Given that some vegetation removal will presumably take place prior to development (the vegetation is largely buddleia, an invasive species), a limited potential for soil heave is also identified but this is likely to be almost entirely around the perimeter of the site and as such not likely to occur within or close to the proposed building footprint(s).

There is not likely to be any possibility of vegetation influence in the proposed commercial development in the southwest of the study area unless significant planting is undertaken.

Therefore, some consideration to possible root/vegetation influence on soils will be required when designing foundations for the new structures in the residential development in the northeast of the study area, possibly including consideration to the potential for soil heave to occur (but considered less likely given the current outline development layout).

4. Contamination Testing

The site has undergone previous development and use; in the northeast section with limited small buildings and garages (nor removed), and in the southwest of the site as a filling station. Therefore, it was considered prudent to determine whether or not these activities could have resulted in contamination of both near-surface and deeper soils by way of a sampling and analysis exercise.

The presence of dark granular fill in a number of the boreholes which contained coal and very occasionally ash was inferred to perhaps be representative of an increased likelihood of contaminants such as trace metals and/or PAHs being present at elevated concentrations. No evidence of leakage or spillage associated with the former filling station could be identified in any of the excavations.

Therefore, it was assumed that if former land uses within and near to the site had caused contamination the contaminants would most likely be present in the near-surface made ground horizons, and that these soils would be the most relevant regarding human health risk assessment. No reason has been found to date to suspect that the underlying undisturbed natural subsoils might contain elevated levels of potential contaminants but, given the presence of USTs and an interceptor at the site (now filled with concrete), representative samples of natural subsoils from appropriate depths/locations were submitted for analysis to confirm this.

Based on the findings of the site works eight (8) samples of near-surface (≤1.00m) made ground recovered from across the site 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 PAHs and Asbestos. In addition, analysis was included in the testing for petroleum hydrocarbons and BTEX (benzene, toluene, ethyl benzene and xylene) where appropriate (re. presence of USTs/interceptor), including analysis of two (2) additional samples of natural subsoils from a depth of 2.00m. Leachate from two (2) of the samples was analysed also to check for potential contaminant mobility.

As can be seen in Table A (Section 3.1.1), representative samples of every type of made ground encountered at the site have been analysed to ensure a robust risk assessment.

The results of the contamination testing are included in Appendix 3 of this report (Chemtech Environmental Ltd. report 82985) and have been used in the contamination risk assessment, set out in the following sections.

5. Risk Assessment

5.1 Method

Geoinvestigate Ltd. uses a combination of assessment criterion provided by the Environment Agency, DEFRA and by the Chartered Institute of Environmental Health in order to assess the presence of potentially harmful chemicals within soils and water. These include; Environment Agency Environmental Quality Standards (EQSs) Soil Guideline Values (SGVs), Site Specific Assessment Criteria (SSAC) generated using CLEA software version 1.06 site specific risk assessment modelling, DEFRA Category 4 Screening Levels (C4SLs), and Land Quality Management / Chartered Institute of Environmental Health (LQM/CIEH) Safe for Use Levels (S4ULs).

The site is to be developed with two different land uses, in two distinct and separate parts of the site:

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

The southwest of the site (car dealers / former filling station area) is to comprise a commercial development and as such falls into the commercial end-use category.

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 residential 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.

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

Made ground was found to extend to 1.45m at BH9 but generally to 1.10m or less throughout the site.

As discussed in section 3.1.1, the made ground can be grouped, generally speaking, into three (perhaps four) types and all of these have been analysed as part of the following risk assessment.

No obvious visual or olfactory evidence of possible contamination was identified in any soils at the site and no visible evidence of asbestos contamination such as roofing board was noted in any of the soils encountered in the boreholes. The presence of coal gravel and very occasional ash in a dark granular made ground deposit was considered potentially suspect and so representative samples of this material were analysed from BH1, BH4 and BH6.

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

The results of the analyses of ten (10) samples of soil recovered from the site from depths up to 2.00m returned concentrations of a range of substances falling for the most part below respective assessment criteria adopted from the sources named above with some notable exceptions discussed later. Further discussion is presented in the following sections.

A summary of the returned soil concentrations together with the adopted assessment criteria is presented in Tables 1a and 1b on the following page. Table 1a compares the soil analysis results with residential target values and Table 1b compares them with commercial target values so that the two parts of the proposed development can be appropriately risk assessed.

A mean Total Organic Carbon Content (TOC) of 7.53% and mean Soil Organic Matter Content (SOM) estimated from the TOC of 12.95% were returned from the soil analyses. These mean values are relatively high due to the samples of dark granular fill from BH4 and BH6 (but not BH1) having elevated organic content, probably due to the coal content of the material. If those two samples are excluded, the mean TOC becomes 3.68% and the mean SOM becomes 6.32%. Therefore, the LQM/CIEH GAC for PAHs and Hydrocarbons were chosen using the highest Soil Organic Matter (SOM) option of 6.0%, which is broadly representative of much of the mad ground at the site and a conservative estimate given the presence of made ground of higher organic content.

Table 1a: Chemical Determinands in Soils vs. Residential Assessment Criteria

	Range of Returned concentrations (mg/kg)	SGV (EA)* (mg/kg)	S4UL (LQM/CIEH)* (mg/kg)	C4SL (DEFRA)* (mg/kg)
Asbestos	None detected (all 5)	Any presence unacceptable		
Arsenic	7.8-18	32	37	37
Boron	1.1-3.6		290	
Cadmium	0.2-0.7	10	11	26
Chromium VI	<1 (all 8)		6	21
Chromium III	33-41		910	
Copper	16-113		2,400	
Lead	69-275			200
Mercury (elemental)	<0.5 (all 8)	1	1.2	
Nickel	16-59		180	
Selenium	1.1-2.7	350	250	
Zinc	56-261		2,700	
pH	7.8-9.3			
Water Soluble SO_4	16-434			
Phenol	<0.5 (all 8)	420	1,100	
Total PAH	<0.34-229			
PAH Naphthalene	<0.02-0.77		13	
PAH Acenapthylene	<0.02-1.04		920	
PAH Acenapthene	<0.02-0.47		1,100	
PAH Fluorene	<0.02-1.09		860	
PAH Phenanthrene	0.06-14.06		440	
PAH Anthracene	<0.02-4.08		11,000	
PAH Fluoranthene	<0.02-43.10		890	
PAH Pyrene	<0.02-36.57		2,000	
PAH Benzo[a]anthracene	<0.02-23.8		13	
PAH Chrysene	<0.03-22.55		27	
PAH Benzo(b)fluoranthene	<0.02-24.76		3.7	
PAH Benzo(k)fluoranthene	<0.03-10.80		100	
PAH Benzo(a)pyrene	<0.02-19.29		3.0	5
PAH Dibenzo(a,h)anthracene	<0.02-3.41		0.30	
PAH Indeno(123-cd)pyrene	<0.02-12.19		41	
PAH Benzo(ghi)perylene	<0.02-10.68		350	
Benzene	<0.01 (all 6)	0.33	300 (aromatic C5-C7)	0.87
Toluene	<0.01 (all 6)	610	660 (aromatic C7-C8)	
Ethylbenzene	<0.01 (all 6)	350		
m & p-Xylene (combined)	<0.02 (all 6)	240 (m-) & 230 (p-)		
o-Xylene	<0.01 (all 6)	250		
TPH Aromatic C5-C7	<0.01 (all 6)		300	
TPH Aromatic C7-C8	<0.01 (all 6)		660	
TPH Aromatic C8-C10	<0.01-0.3		190	
TPH Aromatic C10-C12	<1-1		380	
TPH Aromatic C12-C16	<1-4		660	
TPH Aromatic C16-C21	<1-98		930	
TPH Aromatic C21-C35	<1-112		1,700	
TPH Aromatic C35-C44	<1-13		1,700	
TPH Aliphatic C5-C6	<0.1 (all 6)		160	
TPH Aliphatic C6-C8	<0.1 (all 6)		530	
TPH Aliphatic C8-C10	<0.1-0.1		150	
TPH Aliphatic C10-C12	<4 (all 6)		760 (283**)	
TPH Aliphatic C12-C16	<4-42		4,300 (142**)	
TPH Aliphatic C16-C35	<4-910		110,000	
TPH Aliphatic C35-C44	<10-84		110,000	

*For residential use with 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.

Table 1b: Chemical Determinands in Soils vs. Commercial Assessment Criteria

	Range of Returned concentrations (mg/kg)	SGV (EA)* (mg/kg)	S4UL (LQM/CIEH)* (mg/kg)	C4SL (DEFRA)* (mg/kg)
Asbestos	None detected (all 5)	Any presence unacceptable		
Arsenic	7.8-18	640	640	640
Boron	1.1-3.6		240,000	
Cadmium	0.2-0.7	230	190	410
Chromium VI	<1 (all 8)		33	49
Chromium III	33-41		8,600	
Copper	16-113		68,000	
Lead	69-275			2,330
Mercury (elemental)	<0.5 (all 8)	26	58 (25.8)	
Nickel	16-59		980	
Selenium	1.1-2.7	13,000	12,000	
Zinc	56-261		730,000	
pH	7.8-9.3			
Water Soluble SO_4	16-434			
Phenol	<0.5 (all 8)	3,200	3,200 (37,000)	
Total PAH	<0.34-229			
PAH Naphthalene	<0.02-0.77		1,100 (432**)	
PAH Acenapthylene	<0.02-1.04		100,000	
PAH Acenapthene	<0.02-0.47		100,000	
PAH Fluorene	<0.02-1.09		71,000	
PAH Phenanthrene	0.06-14.06		23,000	
PAH Anthracene	<0.02-4.08		640,000	
PAH Fluoranthene	<0.02-43.10		23,000	
PAH Pyrene	<0.02-36.57		54,000	
PAH Benzo[a]anthracene	<0.02-23.8		180	
PAH Chrysene	<0.03-22.55		350	
PAH Benzo(b)fluoranthene	<0.02-24.76		45	
PAH Benzo(k)fluoranthene	<0.03-10.80		1,200	
PAH Benzo(a)pyrene	<0.02-19.29		36	76
PAH Dibenzo(a,h)anthracene	<0.02-3.41		3.6	
PAH Indeno(123-cd)pyrene	<0.02-12.19		510	
PAH Benzo(ghi)perylene	<0.02-10.68		4,000	
Benzene	<0.01 (all 6)	95	90	98
Toluene	<0.01 (all 6)	4,400	180,000 (4,360**)	
Ethylbenzene	<0.01 (all 6)	2,800	27,000 (2,840**)	
m & p-Xylene (combined)	<0.02 (all 6)	3,500 (m-) & 3,200(p-)	31,000 (3,460**) (m-) 30,000 (3,170**) (p-)	
o-Xylene	<0.01 (all 6)	2,600	30,000 (3,170**)	
TPH Aromatic C5-C7	<0.01 (all 6)		86,000 (4,710**)	
TPH Aromatic C7-C8	<0.01 (all 6)		180,000 (4,360**)	
TPH Aromatic C8-C10	<0.01-0.3		17,000 (3,580**)	
TPH Aromatic C10-C12	<1-1		34,000 (2,150**)	
TPH Aromatic C12-C16	<1-4		38,000	
TPH Aromatic C16-C21	<1-98		28,000	
TPH Aromatic C21-C35	<1-112		28,000	
TPH Aromatic C35-C44	<1-13		28,000	
TPH Aliphatic C5-C6	<0.1 (all 6)		12,000 (1,150**)	
TPH Aliphatic C6-C8	<0.1 (all 6)		40,000 (736**)	
TPH Aliphatic C8-C10	<0.1-0.1		11,000 (451**)	
TPH Aliphatic C10-C12	<4 (all 6)		47,000 (283**)	
TPH Aliphatic C12-C16	<4-42		90,000 (142**)	
TPH Aliphatic C16-C35	<4-910		1,800,000	
TPH Aliphatic C35-C44	<10-84		1,800,000	

*For commercial use 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 Tables 1a and 1b and the detailed results presented in Chemtech Environmental Ltd. report 82985 (Appendix 3) the majority of the returned results are less than the adopted assessment criteria, though not without exception. No exceedances of commercial target values were returned by the analyses but the following exceedances of residential target values are noted:

The lead (Pb) concentration in four of the eight analysed samples of made ground were between 236mgkg^{-1} and 275mgkg^{-1} which are slightly in excess of the adopted assessment criterion of 200mgkg^{-1} (C4SL for residential use with allowance for homegrown produce).

One sample of the dark granular made ground (from BH4) contained elevated levels of PAHs, with four PAH species being present at levels in excess of their respective target values. These results will require some consideration with respect to their potential impacts on the proposed development and other receptors.

No asbestos was detected in any of the five samples inspected and no results of any significant concern were returned for petroleum hydrocarbons.

5.2.2 Contamination Risk to Controlled Waters

Given the possible sources of historical contamination, leachate was analysed from two samples of made ground obtained from BH4 and BH7 (at 0.50m and 0.20nm respectively). This screening returned negligible concentrations and concentrations below detectable limits and/or safe levels for domestic water supply or the protection of aquatic life levels as published by the Environment Agency which were used as the assessment criteria. The results of the testing and the assessment criteria are shown Table 2 on the following page.

Table 2: Chemical Determinands in Leachate

	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	1.40-3.47	50-100 (DW, range: 50-100) / 50 (Aq)
Boron	53-60	1000 (DW & Aq)
Cadmium	<0.07 (both)	5 (DW & Aq)
Chromium	0.2-0.7	50 (DW) / 5-250 (Aq, range: 5-250)
Copper	0.8-2.2	50 (DW) / 5-112 (Aq, range: 5-112)
Lead	<0.2-1.3	50 (DW) / 4-250 (Aq, range: 4-250
Mercury (elemental Hg)	<0.008 (both)	1 (DW & Aq)
Nickel	<0.5 (both)	20** (DW) / 50-200 (Aq, range: 50-200)
Selenium	0.17-1.33	10 (DW) (No Aq standard)
Zinc	<1 (both)	3000-5000 (DW, range: 3000-5000) / 30-2000 (Aq, range: 30-2000)
pH	7.8-8.7	Range 5.5 to 10 (UK drinking water standards)
Organic Chemicals		
Cyanide	<20 (all 4)	50 (DW) / 5 (Aq)
Phenols	<10 (all 4)	50**(DW) / 300 (Aq)
PAHs (total)	<1.6***-9.7	0.2 (DW, range: 0.2-1.0) (No Aq standard)
Individual PAH species were present at detectable concentrations:		
Acenaphthene	<0.1-2.0	No applicable UK standard
Anthracene	<0.1-0.3	0.4 (inland surface waters – max. allowable concentration)
Fluoranthene	<0.1-0.3	1 (inland surface waters – max. allowable concentration)
Fluorene	<0.1-1.5	No applicable UK standard
Naphthalene	<0.1-3.7	10 (Aq) / 2.4 (inland surface waters)
Phenanthrene	0.2-1.9	No applicable UK 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.
***Sum of USEPA 16, each at Lower Limit of Detection of <0.1

As can be seen from Table 2 and the detailed results presented in Chemtech Environmental Ltd report 82985 (Appendix 3), soils at the site have been shown to not be leaching any potential contaminants at elevated levels, including where samples have returned elevated soil concentrations of various contaminants (BH4, 0.50m), and as such would not be considered to pose a potential risk to the local ground or surface water features through leaching.

5.3 Review of Results

Commercial development

All samples returned concentrations of all tested potential contaminants within acceptable limits for commercial land use and as such no remedial works will be required in the southwest part of the site where the redevelopment will be for commercial use.

Residential Development

Four of the eight samples of made ground have been found to contain lead (Pb) content above that normally acceptable in residential developments, two of which were recovered from within the area outlined for residential redevelopment.

One of the eight samples has returned elevated PAH concentrations which would also be unacceptable in a residential setting. This sample was also taken from within the area outlined for residential redevelopment (BH4).

Three of the four samples returning elevated levels of contaminants comprise the dark granular fill discussed earlier in this report. As such it can safely be assumed that this material is generally not acceptable in a residential setting. This material was present in most of the boreholes sunk at the site and certainly throughout the area proposed for residential redevelopment, though in very variable thicknesses.

No discernible risk can be identified to local ground or surface waters and the identified contaminants are not expected to pose any vapour risk. As such, remedial works will only be required where gardens / soft landscaping are to be present in the finished development.

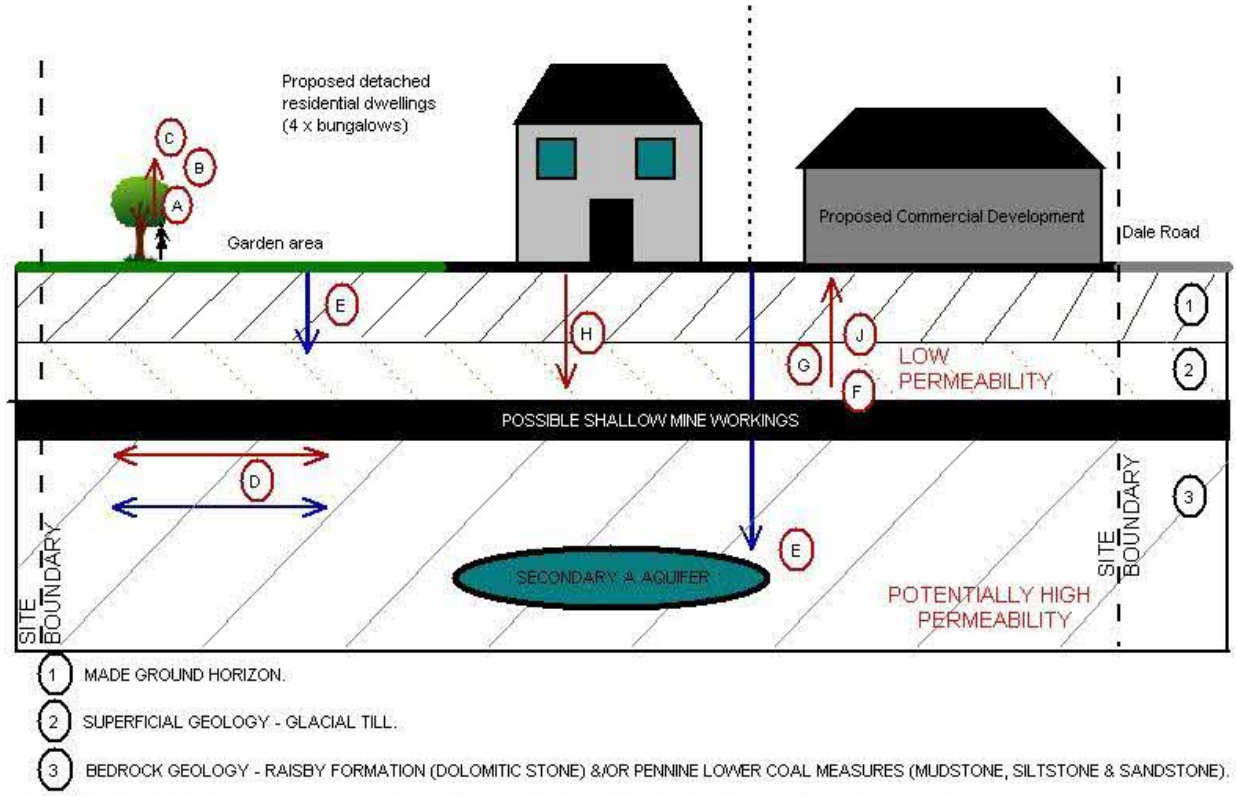
Given the largely gravel nature of this material it would be unsuitable as a growing medium in proposed gardens / soft landscaping area regardless and would require some degree of replacement irrespective of its contaminant levels.

The most appropriate remedial solution will most likely be the removal of the top 600mm of made ground and its subsequent replacement with proven uncontaminated soils to create a 'cover system' or 'capping layer'. This will ensure that any soils which human receptors are likely to come into contact with in the future are safe, and also ensure any residual potentially contaminated soils are confined at depth, while minimising the requirements for waste disposal and soil transport.

5.3.1 CGHM

The conceptual ground hazard model (CGHM) presented on the following page shows the potential hazards and pollutant linkages (including geotechnical considerations) which have been considered at the site and includes a summary of the findings of this investigation for each pollutant linkage.

Figure 2: CGHM – Conceptual cross section of site including a Source, Pathway and Receptor Model



IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES

-Minor development and demolition in northeast part of site (small buildings and garages).
-Former filling station in southwest part of site (USTs filled with concrete).
-Current car dealership on site.
-Ground surface instability due potential shallow mine collapse, weak made ground or shrink-swell clays.
-Potential hazardous gas sourced from probable shallow mining activity and/or made/in-filled ground near to or within site.

IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

A - End Users through Direct Contact / Inhalation / Ingestion. Buildings and hard-standing will 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. Possible given the intended end use of the site.
Linkages A-C considered disproven in proposed commercial development in southwest part of site due to levels of potential contaminants falling comfortably within commercial target values. However, Linkages A-C potentially complete in proposed residential development in northeast section of site due to levels of potetnial contaminants exceeding residential target values.
D - Neighbouring Sites through lateral migration (in soil and water, including surface water run-off).
E - Ground water through leaching of sub-soil.
F - Buildings and services through direct contact.
Linkages D-F considered disproven throughout the site save for possibility of soil movement.
G -End users and buildings through ground gas migration.
Gas monitoring exercise ongoing though no risk identified to date.
H - Ground surface instability due to potential shallow mine collapse.
Linkage H considered disproven beacuse no voids, coal or broken ground were encountered during the rotary borehole investigation.
J - Ground surface instability due to potential shrink-swell clays.
Potential limited risk identified with respect to possible vegetation influence and also changable ground conditions but easily mitigated by the recommended foundation design.

6 Hazardous Gas

6.1 Gas Regime

Given the presence of made ground and the potential for shallow coal mining below the site, a ground gas monitoring exercise is being undertaken at the site. Gas monitoring wells were installed in boreholes BH2, BH4 and BH6.

The results of the first gas monitoring visit at the site are presented in Table 3 below. A further set of up to five (5) 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 (%)	Flow Rate (l/hr)	Atmospheric Pressure (mb)
BH2	1	<0.1	2.7	17.0	<0.1	961
BH4		<0.1	1.6	18.4	<0.1	
BH6		<0.1	0.3	20.4	<0.1	

The first and only gas monitoring visit carried out to date at an atmospheric pressure of 961mb returned:

- Near normal levels of O_2 of between 17.0% and 20.4%.
- Levels of CH_4 consistently below detectable limits.
- Low levels of CO_2 between 0.3% and 2.7%.
- Levels of H_2S and CO consistently below detectable limits (<1ppm).
- Flow rates consistently below detectable limits (<0.1 l/hr).

6.2 Radon Gas

Radon protection is not necessary for new buildings at the site. The desk study concluded that, “the site does not fall within an area for which basic or full radon protection measures should be provided. The property is in a lower probability radon area, as less than 1% of buildings are above the action level.”.

7. Conclusions

7.1 Contamination

Commercial Development (southwest of site)

Analysis of the ground conditions at the site and an assessment of the potential pathways have confirmed that soils at the site are generally uncontaminated and fit for purpose in the proposed commercial end use of the site.

As such no remedial works are required in this part of the development site.

Residential Development (northeast of site)

Elevated levels of contaminants have been found in near surface made ground at the site which are in excess of the target values for residential land-use.

As such some remedial works will be required prior to completion of the development in the northeast section of the site where residential redevelopment is proposed.

No discernible risk can be identified to local ground and surface waters through leaching and contaminant mobility, nor can any significant vapour risk be identified to buildings.

As such, remedial works will only be required where gardens / soft landscaped areas are proposed.

The Local Planning Authority will require a formal remediation and validation strategy document for review prior to commencing remedial works and will also require a validation report on completion of the works to confirm their success.

The most appropriate remedial solution will most likely be the removal of the top 600mm of made ground and its subsequent replacement with proven uncontaminated soils to create a 'cover system' or 'capping layer'.

7.2 Hazardous Gas

Gas monitoring is ongoing at the site with just one of a potential six monitoring visits having been undertaken to date. The monitoring undertaken to date has returned no unusual results, however.

If the continued monitoring returns comparable data the site is expected fall into Characteristic situation 1 (CS1) of the Modified Wilson and Card classification or "Green" of the NHBC Traffic Light System for low rise housing with a ventilated under-floor void (min 150mm) (CIRIA C665). Therefore, assuming monitoring results remain unchanged, no special gas protection measures will be required in the new building(s).

No radon protection measures are required for the new development.

A Gas Monitoring Addendum Report containing final recommendations will subsequently be issued on completion of the gas monitoring exercise which will include details of gas protection options (if required).

7.3 Historical Coal Mining

As discussed in section 3.1.3.4, no voids, or broken ground indicative of mine-workings were encountered in any of the rotary boreholes, nor were any coal seams.

As such, there is concluded to be no risk at the site with regard to potential unrecorded shallow coal mine workings.

Mine workings are likely to be present in the Busty coal seams at greater depth but these are expected to be too deep to influence the site surface.

7.4 Foundations and Floors

Pertinent information:

Made ground was generally ≤1.10m thick. Made ground extended to 1.45m at BH9, and 1.10m at BH4 and BH10, and was ≤0.90m otherwise.

Natural soils at the site were quite variable in strength and composition. Shear vanes in clay strata were as low as 39kNm^{-1} (3.20m at BH3) and as low as 20kNm^{-1} where granular soils were unrepresentatively negatively affecting results (BH4 and BH8).

SPT results in natural granular soils were no less than N=7 (1.00m at BH8) with a value of N=0 returned for the made ground at 1.00m at BH9.

Roots were noted to 1.60m at BH1, 1.10m at BH3 and 0.90m at BH4. Clay soils classify as low and medium shrinkage potential according to NHBC.

Some potential for vegetation influence has been identified in the far northeast of the site. Potential for heave is low but not necessarily negligible following the anticipated removal of vegetation.

The variable strength of the natural strata will necessitate that either reinforced strip or reinforced raft foundations will be required to account for potential differential settlement that could feasibly occur. The available bearing capacities are relatively low but should be adequate for bungalows, which are proposed (check anticipated building loadings with your structural engineer).

To avoid any vegetation influence or heave in the north of the site (bungalows 1 and 2 on the site plan in Appendix 1), deeper strip foundations should be adopted seated at 2.00m below the current ground level. At this depth, the natural strata should comfortably provide bearing capacities for 1m wide strip foundations of at least 75kPa.

Because no significant vegetation removal will be undertaken from within the majority of the new building footprints, foundations will not require anti-heave protection on their internal faces but are recommended for Bungalow 1 due to its proximity to the most heavily vegetated part of the site.

For the remaining proposed structures (commercial development and bungalows 3 and 4), similar foundations could be adopted seated at 1.50m (due to the potential for more minor root influence) with ‘unit 1’ (at BH6) able to be seated at shallower depth of 1.00m. At these depths, the natural strata should comfortably provide bearing capacities for 1m wide strip foundations of at least 90kPa.

A suspended floor will be required in the new structures due to the potential for differential settlement.

7.5 Concrete Design

The results of chemical analyses of the fill returned Water Soluble Sulphate levels of between 16mgl^{-1} and 434mgl^{-1} and pH levels of between 7.8 and 9.3. Additionally, the site is inferred to classify as brownfield with no mobile water.

On this basis concrete in contact with the ground may be designed to ACEC Class DS-1 AC-1s (DC1) of "BRE Special Digest 1 – Concrete in aggressive ground".

7.6 Soakaways

The largely clay nature of the natural subsoils at the site would be expected to exhibit intrinsically low permeability and as such soakaways will not offer a suitable means of water disposal at this site.

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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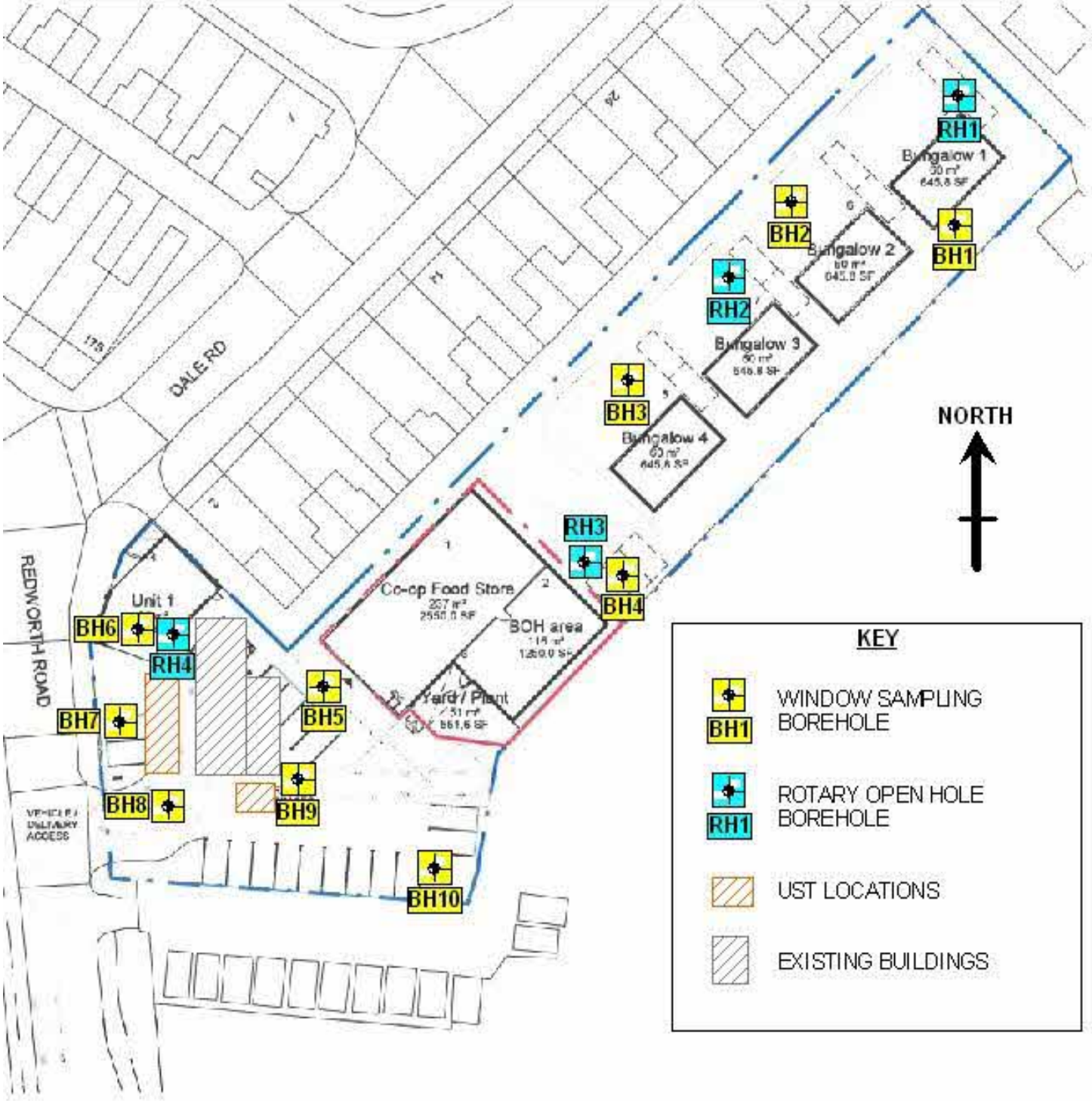
APPENDIX 1

Site Plan,

and

Borehole Logs

OUR REF: G19416	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE: 28-29/11/2019	LOCATION: Land at Dale Road / Redworth Road, Shildon, DL4 2JT	



GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH No.1** **Sheet No. 1 of 1**
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE**: 29/11/19

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	TURF and MADE GROUND. Loose yellow, black and brown sandy gravel. Gravel is fine to coarse of sandstone, coal and brick.	400			O	Cv kN/m^2			0.25
0.40									
0.50	MADE GROUND. Firm pale brown sandy gravelly clay. Gravel is fine to coarse of sandstone and coal.	100				68			0.50
		200			O				
0.70									0.75
	MADE GROUND. Loose dark grey and pale greyish brown slightly silty sandy gravel. Gravel is fine to coarse of coal sandstone, brick and possible ash.	300					1.00m - 1.45m 1/1/2/3/5/5 N = 15		
1.00					O	70			1.00
	MADE GROUND. Firm greyish brown very sandy gravelly clay. Gravel is fine to coarse of sandstone and coal. Possibly an old topsoil horizon, contains many roots.	1600							1.25
					O	>140			1.50
	Firm to stiff pale brown mottled orange and grey sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal. Becomes stiff below 1.30m Becoming very stiff and greyish brown mottled orangish brown and grey below 1.40m. Becoming firm to stiff below 1.90m Stiff inclusion 2.25m to 2.50m								1.75
					O	83			2.00
									2.25
					O	80			2.50
2.60									
	Loose brown and orangish brown clayey gravelly SAND. Gravel is fine to coarse of sandstone. Sand is fine to medium.	700					3.00m - 3.45m 1/1/2/2/3/3 N = 10		2.75
					O				3.00
3.30									3.25
	Firm brownish grey sandy gravelly CLAY. Gravel is fine to coarse sandstone and coal.	400			O	78			3.50
3.70									3.75
	Medium dense pale brownish yellow gravelly SAND. Gravel is fine to coarse of sandstone. Sand is medium.	300					4.00m - 4.45m 4/3/6/6/7/8 N = 27		
4.00					O				4.00
	Borehole terminated at 4.00m								
	Roots to 1.60m, decayed roots to 3.50m								

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

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

BH1

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH No.2** **Sheet No. 1 of 1**

Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE:** 28-29/11/2019

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.05	MADE GROUND. Loose very dark brown	50				Cv kN/m^2			
0.15	silty sandy gravel. Gravel is fine to coarse	100			O				0.25
0.20	sandstone.	50							
0.30	MADE GROUND. Brick Rubble.	100							
	MADE GROUND. Firm dark brown silty very sandy gravelly clay. Gravel is fine to coarse brick and coal.	700			O	48			0.50
	MADE GROUND. Brick Rubble.								0.75
1.00	Firm dark greyish brown silty sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.				O	47			1.00
	Firm to stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.								1.25
	Mixed brown and pale brown mottled orangish brown and grey to 1.60m	1000			O	73			1.50
							2.00m - 2.45m		1.75
							5/4/2/2/2/2		
2.00	Becoming very gravelly below 1.90m				O	77	N = 8		2.00
	Loose pale yellowish brown slightly clayey sandy GRAVEL. Gravel is fine to coarse	300							2.25
2.30	sandstone. Very wet.					40			
	Soft to firm/firm brown very sandy gravelly CLAY. Gravel is fine to coarse of sandstone.				O	84			2.50
	Gravelly sand inclusion at 2.50m	700							2.75
	Becoming firm to stiff from 2.45m						3.00m - 3.45m		
	Becoming firm from 2.80m						2/2/2/3/3/4		
3.00					O	71	N =12		3.00
	Loose to medium dense very pale yellowish brown very clayey SAND.	600							3.25
3.60					O				3.50
	Weak very pale yellowish brown sandy GRAVEL / gravelly SAND. Gravel is fine to coarse of sandstone.	400					4.00m - 4.45m	SWL at 3.90m	3.75
4.00					O		2/2/2/3/3/4 N = 12		4.00
	Borehole terminated at 4.00m								

Remarks: Casing to 3.00m
Dynamic windowless sampling by Terrier Rig to 4.00m
Borehole remained open on completion.
Standing water level at 3.90m on completion
Gas well installed to 4.00m with gas bung and cover

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH2

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH No.3** **Sheet No. 1 of 1**
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE**: 28-29/11/2019

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF and MADE GROUND. Loose dark	100			O	Cv kN/m^2			
0.25	grey silty slightly clayey sandy gravel.	150			O				0.25
	Gravel is fine to coarse of sandstone, brick and coal. Underlain by geotextile.								
	MADE GROUND. Firm greyish brown silty sandy gravelly clay. Gravel is fine to coarse of sandstone, coal and occasional brick & glass. Possibly old topsoil.				O	50			0.50
									0.75
	Firm pale brown mottled oranish brown and grey slightly silty sandy gravelly CLAY. Gravel is fine to coarse of sandstone.	1950			O	55			1.00
									1.25
	Becoming firm to stiff and greyish brown mottled grey and orangish brown below 1.40m				O	93			1.50
									1.75
2.20					O	68			2.00
	Loose pale brown and yellowish brown clayey gravelly SAND. Sand is fine to medium. Slightly moist.	600			O				2.25
									2.50
2.80									2.75
	Firm greyish brown very sandy gravelly CLAY. Gravel is fine to coarse of sandstone and occasional coal.	500			O	66			3.00
						39			
3.30	Becomes stiff to firm and very gravelly below 3.15m.								3.25
	Loose pale brown and orangish brown sandy gravel/gravelly sand. Gravel is fine to coarse and cobbles of sandstone.	500			O				3.50
3.80	Clayey inclusions to 3.40m and also below 3.70m.				O		3.80m - 4.25m N = REFUSAL		3.75
	Borehole terminated at 3.80m due to refusal								
	Roots to 1.10m								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.80m
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

BH3

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH No.4** **Sheet No. 1 of 1**
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE**: 28-29/11/2019

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	TURF and MADE GROUND. Loose very dark grey silty sandy gravel. Gravel is fine to coarse of sandstone and coal with occasional brick, glass and slate.	750			O	Cv kN/m^2			0.25 0.50
0.75									0.75
1.10	MADE GROUND. Soft to firm brown very sandy gravelly clay. Gravel is fine to coarse of sandstone, coal and occasional metal.	350			O	58			1.00
1.50	POOR SAMPLE RECOVERY. Partial sample of pale brown mottled grey and orangish brown sandy gravelly clay.	400			O	40			1.25 1.50
2.10	Loose to medium dense very pale brown mottled yellow and grey clayey sandy GRAVEL. Gravel is fine to coarse of sandstone.	600			O	33			1.75 2.00
	Firm greyish brown occasionally mottled grey and orangish brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal. Occasional soft to firm inclusions.	1400			O	64			2.25 2.50
	Soft very sandy inclusion from 2.90m to 3.00m				O	48			2.75 3.00
3.50					O	60			3.25 3.50
4.00	Medium dense pale brownish yellow slightly clayey gravelly SAND. Gravel is fine to coarse of sandstone. Sand is fine to medium.	500			O				3.75 4.00
	Borehole terminated at 4.00m Roots to 0.90m								

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

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH4

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH No.5** **Sheet No. 1 of 1**
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE**: 28-29/11/2019

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
	Decorative gravel over MADE GROUND. Loose dark grey/black sandy gravel. Gravel is fine to coarse of sandstone, coal and slate.	400			O	Cv kN/m^2			0.25
0.40									
	MADE GROUND. Firm greyish brown very sandy gravelly clay. Gravel is fine to coarse sandstone, coal and occasional brick. Possible old top soil.	350			O	56			0.50
0.75									0.75
	Firm greyish brown occasionally mottled grey and orangish brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.				O	58			1.00
									1.25
					O	60			1.50
	Becoming greyish brown below 1.55m Firm to stiff from 1.60m to 1.80m								1.75
					O	62			2.00
	Becoming stiff below 2.00m								2.25
		3050			O	108			2.50
									2.75
	Becoming firm to stiff below 2.75m				O	86			3.00
									3.25
					O	95			3.50
3.80									3.75
	Medium dense pale brownish yellow slightly clayey gravelly SAND. Gravel is fine to coarse of sandstone. Sand is fine to medium.	200			O		4.00m - 4.45m 3/5/8/Refusal N > 50		
4.00	Borehole terminated at 4.00m								4.00

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

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

BH5

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH No.6** **Sheet No. 1 of 1**
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE**: 28-29/11/2019

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.05	Weak ASPHALT	50				Cv kN/m^2			
0.40	MADE GROUND. Compact red and yellow sandy gravel. Gravel is fine to coarse and cobbles of sandstone and brick.	350							0.25
0.60	MADE GROUND. Loose very dark grey sandy gravel. Gravel is fine to coarse of sandstone and coal.	200			O				0.50
1.00	Firm greenish brownish grey sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.	400			O	74			0.75 1.00
	Firm to stiff brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal. Very gravelly in places. Pale brown and brown to 1.70m				O	68			1.25 1.50
					O	50	2.00m - 2.45m 1/1/2/2/3/4 N = 11		1.75 2.00
	Becoming brown mottled grey below 2.00m	2000			O	>140			2.25 2.50
3.00					O	52	3.00m - 3.45m 1/0/1/2/3/4 N = 10		2.75 3.00
3.25	Loose/soft to firm brown very sandy CLAY / very clayey SAND.	250							3.25
3.80	Firm brown gravelly CLAY. Gravel is fine to coarse of sandstone.	550			O	64			3.50 3.75
4.00	Medium dense brown very clayey sandy GRAVEL. Gravel is fine to coarse of sandstone.	200			O		4.00m - 4.45m 0/0/1/2/4/4 N = 11		4.00
	Borehole terminated at 4.00m								

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

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH6

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH No.7** **Sheet No. 1 of 1**
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE**: 28-29/11/2019

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.14	CONCRETE. No Damp-proof membrane. 5mm reinforcement at 112mm.	140			O	Cv kN/m^2			0.25
0.40	MADE GROUND. Loose red and grey sandy gravel. Gravel is fine to coarse of brick and concrete.	260							
0.50		100			O	70			0.50
	MADE GROUND. Loose very dark grey sandy gravel. Gravel is fine to coarse of sandstone and coal.								0.75
	Firm greyish brown mottled orangish brown and grey sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.				O	55			1.00
	Becoming firm to stiff below 1.00m	1500							1.25
	Becoming dark brownish grey and very stiff below 1.50m				O	>140			1.50
									1.75
2.00					O	>140			2.00
	Firm greyish brown very sandy gravelly CLAY. Gravel is fine to coarse of	300							2.25
2.30	sandstone.								
	Sand or gravelly sand horizons at 2.10m and 2.25m				O	65			2.50
	Stiff grey and brown silty slightly sandy CLAY with occasional sandstone gravel. Sand horizon noted at 2.60m.	700							2.75
3.00					O	>140			3.00
	Stiff greyish brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone.								3.25
		1000			O	122			3.50
									3.75
	Becomes firm to stiff below 3.90m.								
4.00					O	82			4.00
	Borehole terminated at 4.00m								

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

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH7

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH No.8** **Sheet No. 1 of 1**
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE**: 28-29/11/2019

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	ASPHALT.	100				Cv kN/m^2			
	MADE GROUND. Loose red, yellow and grey sandy gravel. Gravel is fine to coarse and cobbles of brick, sandstone and concrete.	800			O				0.25 0.50 0.75
0.90							1.00m-1.45m 1/1/1/2/2/2 N = 7		
1.10	Loose dark brownish grey clayey sandy GRAVEL. Gravel is fine to coarse of sandstone and coal.	200			O				1.00
	Firm brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal. Mixed brown and pale brown mottled orangish brown and grey to 1.80m Becoming firm to stiff below 1.50m	1200			O	72			1.25 1.50 1.75
	Becoming stiff below 1.90m				O	140	2.00m-2.45m 0/1/1/1/2/7 N = 11		2.00
2.30									2.25
	Loose to medium dense orangish brown very clayey gravelly SAND. Gravel is fine to coarse of sandstone.	550			O	28			2.50
2.85									2.75
	Soft to firm greyish brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal. Very gravelly in places. Becoming firm below 3.30m	950			O	40			3.00
						20			3.25
					O	56			3.50
3.80									3.75
3.95	Loose to medium dense very pale brown	150							
4.00	very clayey SAND.	50			O				4.00
	sandstone COBBLE.								
	Borehole terminated at 4.00m								

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

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH8

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH 9** **Sheet No. 1 of 1**
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE**: 28-29/11/2019

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.08	ASPHALT.	80				Cv kN/m^2			
0.25	MADE GROUND. Loose yellow sandy gravel. Gravel is fine to coarse and cobbles of sandstone.	170							0.25
	MADE GROUND. Loose/firm dark grey very clayey sandy gravel / very gravelly sandy clay. Gravel is fine to coarse of sandstone and coal.	1200			O		1.00m-1.45m 0/0/0/0/0/0 N = 0		0.50
					O	50			0.75
1.45									1.00
	Firm brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.	1550			O	53			1.25
	Mixed brown and pale brown mottled orangish brown and grey to 2.25m						2.00m-2.45m 2/2/3/3/2/2 N = 10		1.50
					O	65			1.75
	Becoming firm to stiff below 2.25m								2.00
					O	90			2.25
	Becoming firm below 2.80m								2.50
3.00					O	46			2.75
3.25	Loose to medium dense pale brown and yellow clayey sandy GRAVEL. Gravel is fine to coarse of sandstone.	250							3.00
	Loose to medium dense orangish brown very clayey gravelly SAND. Gravel is fine to coarse of sandstone.	250							3.25
3.50					O	24			3.50
	Stiff greyish brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.	500							3.75
4.00					O	125			4.00
	Borehole terminated at 4.00m								

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

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

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

BH9

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **BH No.10 Sheet No. 1 of 1**

Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT **DATE**: 28-29/11/2019

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.08	ASPHALT.	80				Cv kN/m^2			
0.25	MADE GROUND. Loose yellow sandy gravel. Gravel is fine to coarse and cobbles of sandstone.	170							0.25
	MADE GROUND. Soft to firm and firm brownish grey silty very sandy gravelly CLAY. Gravel is fine to coarse of sandstone, coal and occasional brick.	850			O				0.50
									0.75
1.10					O	29			1.00
	Firm brown and brownish grey sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.								1.25
	Becoming pale brown mottled oranish brown and grey below 1.50m				O	86			1.50
									1.75
	Becoming greyish brown occasionally mottled orangish brown and grey below 2.00m.	1850			O	65			2.00
									2.25
	Becoming firm to stiff below 2.10m Becoming stiff below 2.30m				O	120			2.50
									2.75
2.95	Becoming firm to stiff below 2.90m					86			
	Loose brown and yellowish brown clayey gravelly SAND. Gravel is fine to coarse of sandstone. Sand is fine to medium.	450			O				3.00
									3.25
3.40	Becoming very clayey below 3.15m								
	Firm greyish brown sandy gravelly CLAY. Gravel is fine to coarse of sandstone and coal.	600			O	48			3.50
									3.75
4.00	Sandstone cobble at 4.00m				O	82			4.00
	Borehole terminated at 4.00m								

Remarks:

Casing to 1.00m

Dynamic windowless sampling by Terrier Rig to 4.00m

Borehole remained open and dry on completion

Key:

- Slotted Pipe
- Plain Pipe
- Bentonite
- Gravel Filter

O Disturbed sample

Cv Shear vane

W Water sample

S Standard Penetration Test

BH10

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **RH No.1** **Sheet No. 1 of 2**
Location: Land at Redworth Road/Dale Road, Shildon, DL4 2JT **DATE:** 26/11/19

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
	TURF and TOPSOIL on to light brown DRIFT.	4600							2.50
4.60							Flush lost at 4.60m		
	SANDSTONE, potentially limestone.	10600							5.00
									7.50
									10.00
									12.50
15.2									15.00
	SANDSTONE with MUDSTONE inclusions	12300							17.50
									20.00
									22.50
27.5									25.00

Remarks: Casing to 1.00m
Microdrill rotary open hole borehole to 36.00m
No cores recovered from borehole
No gas detected from borehole on completion
Lost flush at 4.60m. No voids encountered.

RH1

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **RH No.1** **Sheet No. 2 of 2**
Location: Land at Redworth Road/Dale Road, Shildon, DL4 2JT **DATE**: 26-11-19

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
	SANDSTONE with MUDSTONE inclusions	12300							
27.5									27.50
	MUDSTONE with SANDSTONE inclusions. Some sandstone boulders noted.	8500							30.00
									32.50
36.0									35.00
	Rotary hole terminated at 36.00m								

Remarks: Casing to 1.00m
Microdrill rotary open hole borehole to 36.00m
No cores recovered from borehole
No gas detected from borehole on completion
Lost flush at 4.60m. No voids encountered.

RH1

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **RH No.2** **Sheet No. 1 of 2**
Location: Land at Redworth Road/Dale Road, Shildon, DL4 2JT **DATE:** 28/11/19

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
	TURF and TOPSOIL on to light brown DRIFT.	4500					Flush lost at 4.20m		2.50
4.50									
	SANDSTONE, potentially limestone.	13100							5.00
									7.50
									10.00
									12.50
									15.00
17.6									17.50
	SANDSTONE with MUDSTONE inclusions. Sandstone boulders noted.	10500							20.00
									22.50
28.1									25.00

Remarks: Casing to 1.00m
Microdrill rotary open hole borehole to 38.00m
No cores recovered from borehole
No gas detected from borehole on completion
Lost flush at 4.20m. No voids encountered.

RH2

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **RH No.2** **Sheet No. 2 of 2**
Location: Land at Redworth Road/Dale Road, Shildon, DL4 2JT **DATE**: 28-11-19

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
	SANDSTONE with MUDSTONE inclusions. Sandstone boulders noted.	10500							27.50
28.1	MUDSTONE with SANDSTONE inclusions. Some sandstone boulders noted.	9900							30.00 32.50 35.00 37.50
38.0	Rotary hole terminated at 38.00m								

Remarks: Casing to 1.00m
Microdrill rotary open hole borehole to 38.00m
No cores recovered from borehole
No gas detected from borehole on completion
Lost flush at 4.20m. No voids encountered.

RH2

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **RH No.3** **Sheet No. 1 of 2**
Location: Land at Redworth Road/Dale Road, Shildon, DL4 2JT **DATE:** 28/11/19

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
	TURF and TOPSOIL on to light brown DRIFT	4200							2.50
4.20									
	Light brown and yellow SANDSTONE, potentially limestone.	9900							5.00
									7.50
	Becomes orange from 10.40m								10.00
									12.50
14.1							Intermittent flush from 15.30m		
	Light grey MUDSTONE with SANDSTONE inclusions	8700							15.00
									17.50
									20.00
22.8									22.50
	Light grey and brown SANDSTONE with MUDSTONE inclusions. Some sandstone boulders noted.	13200							
36.0									25.00

Remarks: Casing to 1.00m
Microdrill rotary open hole borehole to 36.00m
No cores recovered from borehole
No gas detected from borehole on completion
Flush intermittent from 15.30m. No voids encountered.

RH3

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **RH No.3** **Sheet No. 2 of 2**
Location: Land at Redworth Road/Dale Road, Shildon, DL4 2JT **DATE**: 28-11-19

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
	Light grey and brown SANDSTONE with MUDSTONE inclusions. Some sandstone boulders noted.	13200							27.50 30.00 32.50 35.00
36.0	Rotary hole terminated at 36.00m								

Remarks: Casing to 1.00m
Microdrill rotary open hole borehole to 36.00m
No cores recovered from borehole
No gas detected from borehole on completion
Flush intermittent from 15.30m. No voids encountered.

RH3

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **RH No.4** **Sheet No. 1 of 2**
Location: Land at Redworth Road/Dale Road, Shildon, DL4 2JT **DATE**: 29/11/19

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
	TARMAC on to light brown DRIFT.	4400					Flush lost at 3.60m		2.50
4.40									
	SANDSTONE, potentially limestone.	11800							5.00
									7.50
									10.00
									12.50
									15.00
16.2									
	SANDSTONE with MUDSTONE inclusions. Sandstone boulders noted.	13300							17.50
									20.00
									22.50
29.5									25.00

Remarks: Casing to 1.00m
Microdrill rotary open hole borehole to 35.00m
No cores recovered from borehole
No gas detected from borehole on completion
Lost flush between 3.60m and 34.10m. No voids encountered.

RH4

GEOINVESTIGATE Ltd.

Your Ref. **Our Ref.** G19416 **RH No.4** **Sheet No. 2 of 2**
Location: Land at Redworth Road/Dale Road, Shildon, DL4 2JT **DATE**: 29-11-19

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
	SANDSTONE with MUDSTONE inclusions. Sandstone boulders noted.	13300							27.50
29.5	MUDSTONE with SANDSTONE inclusions. Some sandstone boulders noted.	5500					Flush returned at 34.10m		30.00 32.50
35.0	Rotary hole terminated at 35.00m								35.00

Remarks: Casing to 1.00m
Microdrill rotary open hole borehole to 35.00m
No cores recovered from borehole
No gas detected from borehole on completion
Lost flush between 3.60m and 34.10m. No voids encountered.

RH4

APPENDIX 2

Geotechnical Soil Analysis Results (Table 4)

and

Soil Moisture and Shear Strength Profiles

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G19416
Your ref.

Table 4
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT

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	1.00	34.9						
	1.50	17.2	80.7	21.3	22.0	36.9	14.9	CI
	2.00	15.5						
	2.50	15.9						
	3.00	18.1						
	3.50	24.8						
	4.00	10.4						
2	1.00	30.5						
	1.50	25.1	71.6	35.1	23.4	36.1	12.7	CI
	2.00	17.1						
	2.50	15.7						
	3.00	17.7						
	3.50	17.5						
	4.00	14.2						

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G19416
Your ref.

Table 4
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification BS5930 [1999]
3	0.50	30.9						
	1.00	17.8	73.4	19.1	20.5	40.8	20.3	CI
	1.50	20.5						
	2.00	20.1						
	2.50	18.8						
	3.00	14.8						
	3.50	11.3						
	4.00	16.1						
4	2.00	15.8						
	2.50	21.4						
	3.00	16.3						
	3.50	18.4						
	4.00	12.2						

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G19416
Your ref.

Table 4
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification BS5930 [1999]
5	1.00	32.7	>95		23.6	58.0	34.4	CH
	1.50	17.3						
	2.00	20.0						
	2.50	18.1						
	3.00	20.6						
	3.50	18.9						
	4.00	9.9						

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G19416
Your ref.

Table 4
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification BS5930 [1999]
6	1.00	28.6						
	1.50	19.9						
	2.00	18.1						
	2.50	16.8						
	3.00	20.8						
	3.50	20.8						
	4.00	13.7						
7	0.50	24.4						
	1.00	29.8	>95		26.1	47.1	21.0	CI
	1.50	16.9						
	2.00	17.8						
	2.50	18.0						
	3.00	20.6						
	3.50	17.8						
	4.00	23.8						

GEOINVESTIGATE Ltd.

Atterberg Limit Test Results

Our ref. G19416
Your ref.

Table 4
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification BS5930 [1999]
8	1.00	32.7						
	1.50	21.4	85.7	25.0	20.6	31.8	11.2	CL
	2.00	15.9						
	2.50	16.9						
	3.00	15.8						
	3.50	17.8						
	4.00	11.6						
9	1.00	25.2						
	1.50	28.0						
	2.00	20.9	65.5	39.1	24.2	35.4	11.2	CI
	2.50	21.1						
	3.00	34.2						
	3.50	18.2						
	4.00	17.9						

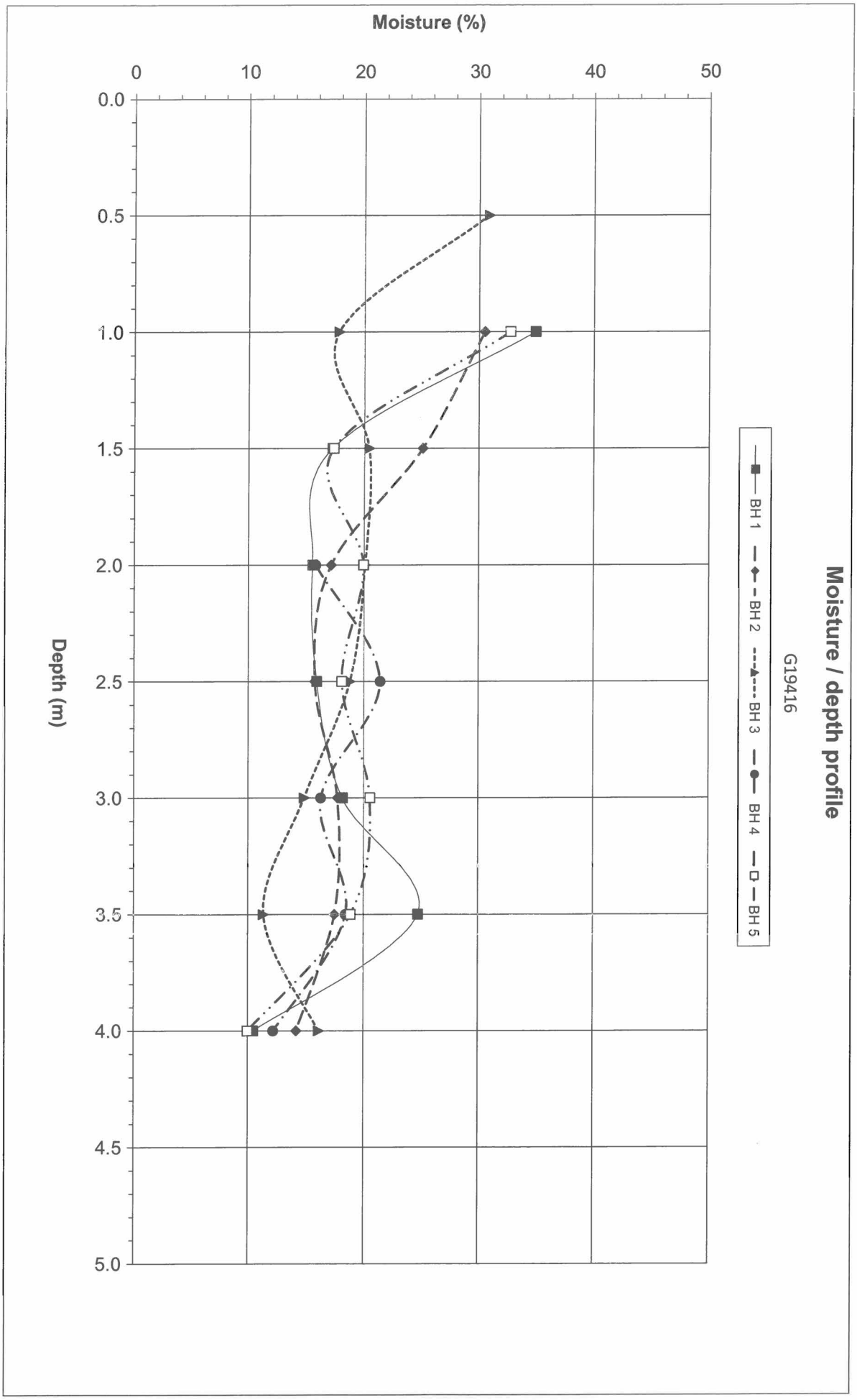
GEOINVESTIGATE Ltd.

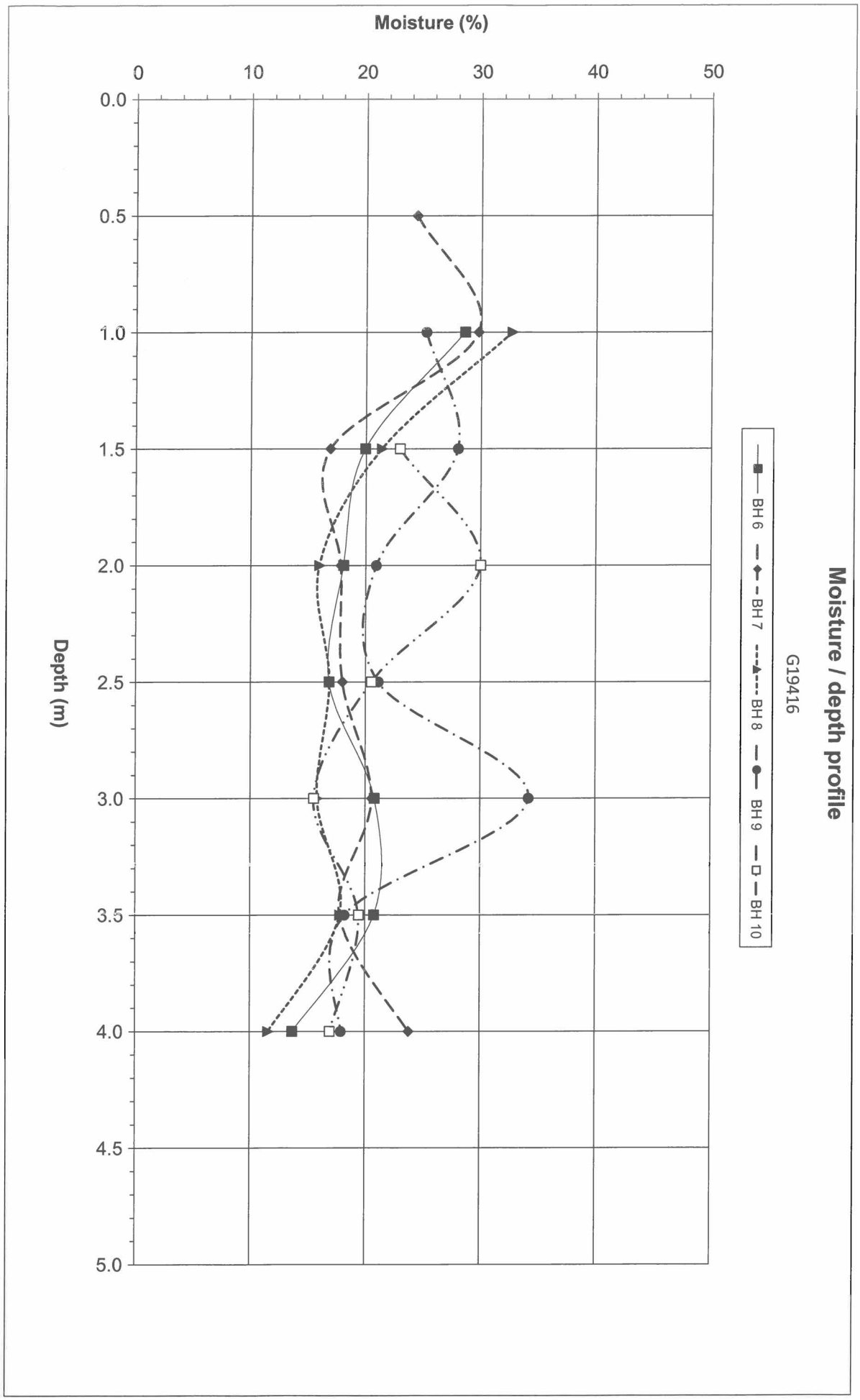
Atterberg Limit Test Results

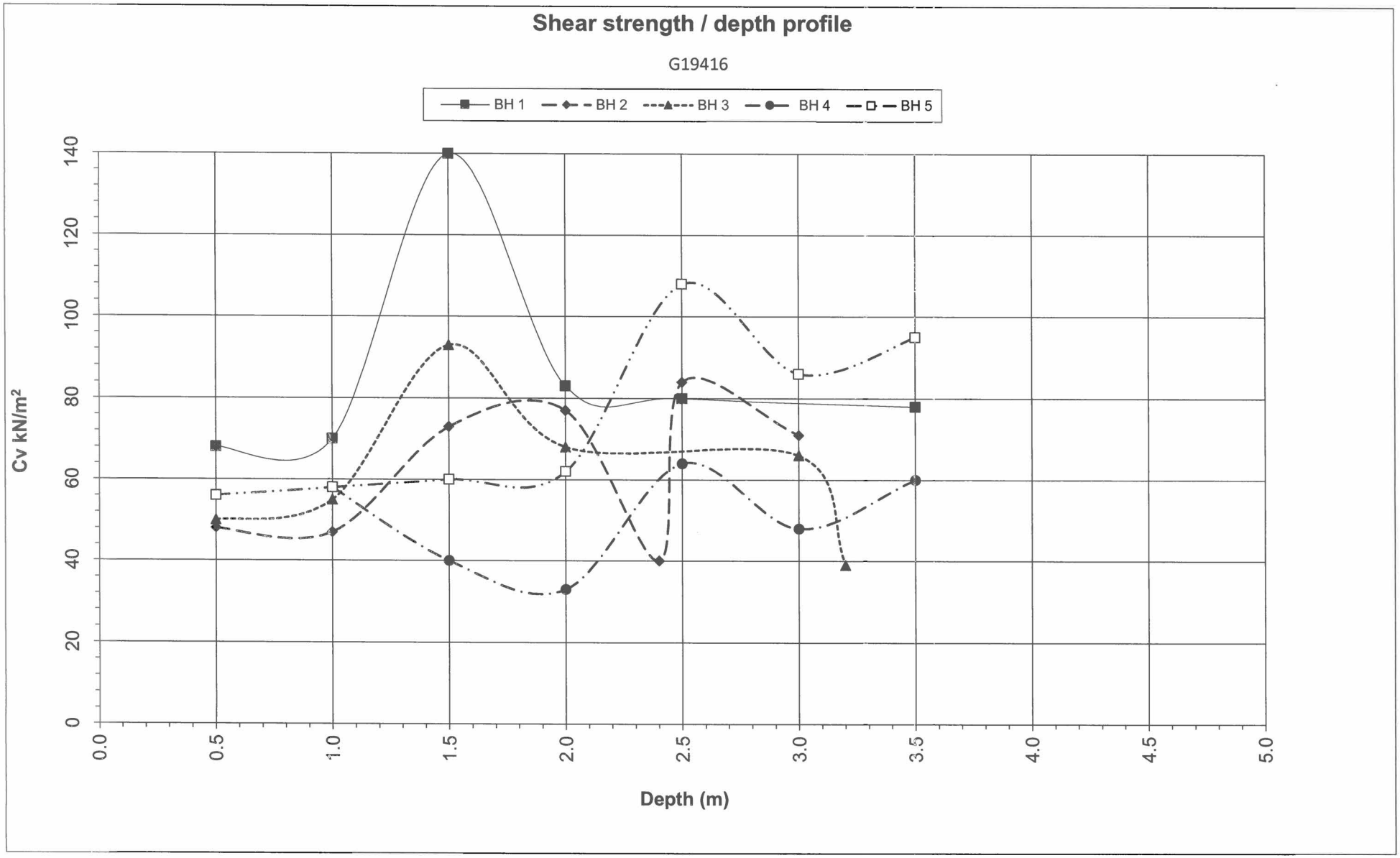
Our ref. G19416
Your ref.

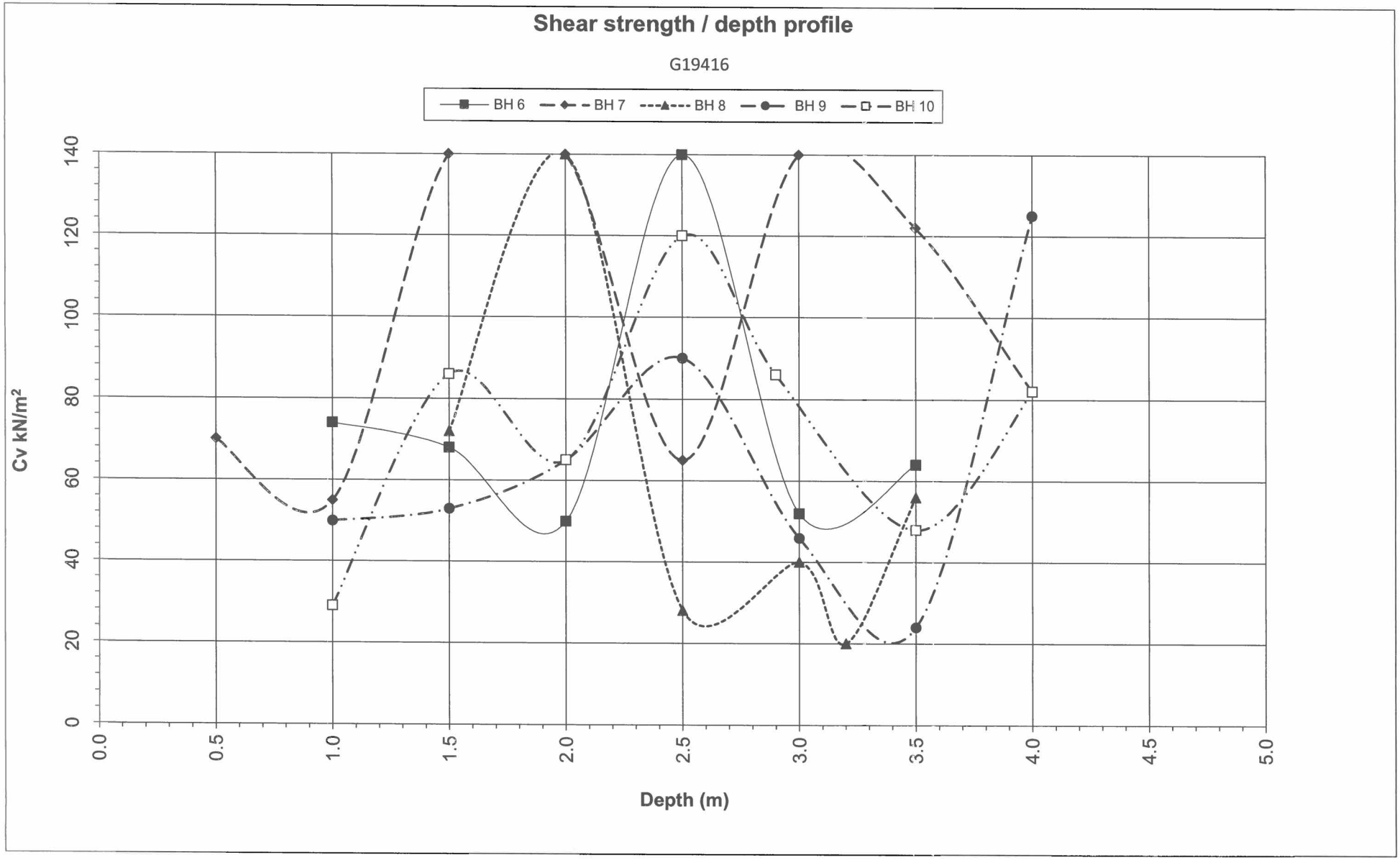
Table 4
Location: Land at Redworth Rd/Dale Rd, Shildon, DL4 2JT

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]
10	1.50	23.0						
	2.00	30.0	>95		27.1	58.6	31.5	CH
	2.50	20.5						
	3.00	15.5						
	3.50	19.4						
	4.00	16.9						


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
G19416


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)
BH6
BH7
BH8
BH9
BH10
Moisture / depth profile
G19416


Shear strength / depth profile
G19416
BH 1
BH 2
BH 3
BH 4
BH 5
Cv kN/m²
0
20
40
60
80
100
120
140
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Depth (m)


Shear strength / depth profile
G19416
BH 6
BH 7
BH 8
BH 9
BH 10
Cv kN/m²
0
20
40
60
80
100
120
140
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Depth (m)

APPENDIX 3

Chemtech Analytical Test Reports

ANALYTICAL TEST REPORT

Contract no: 82985

Contract name: Proposed Development, Land at Redworth Road/Dale Road, Shildon, DL4 2JT

Client reference: G19416

Clients name: Geo Investigate

Clients address: Units 3a & 4 Terry Dicken Industrial Estate
Ellerbeck Way, Stokesley
North Yorkshire
TS9 7AE

Samples received: 05 December 2019

Analysis started: 05 December 2019

Analysis completed: 12 December 2019

Report issued: 12 December 2019

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: [redacted]
Dave Bowerbank
Customer Support Hero

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
82985-1	BH1	0.60	Clayey Sand with Gravel	-	-	22.9
82985-2	BH3	0.15	Sandy Clay with Gravel	-	-	21.4
82985-3	BH4	0.50	Sand with Gravel	-	-	22.3
82985-4	BH5	0.60	Sandy Clay with Gravel	-	-	22.0
82985-5	BH6	0.50	Sand with Gravel	-	-	22.6
82985-6	BH7	0.20	Sand with Gravel	-	-	17.0
82985-7	BH7	2.00	Clay with Gravel	-	-	13.7
82985-8	BH8	0.50	Sand with Gravel	-	-	15.4
82985-9	BH8	2.00	Clay with Gravel	-	-	12.6
82985-10	BH10	1.00	Clay with Gravel	-	-	27.3

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SOILS

Lab number			82985-1	82985-2	82985-3	82985-4	82985-5	82985-6
Sample id			BH1	BH3	BH4	BH5	BH6	BH7
Depth (m)			0.60	0.15	0.50	0.60	0.50	0.20
Date sampled			28/11/2019	28/11/2019	28/11/2019	28/11/2019	28/11/2019	28/11/2019
Test	Method	Units						
Arsenic (total)	CE127 M	mg/kg As	11	8.7	15	7.8	18	11
Boron (water soluble)	CE063 M	mg/kg B	3.6	1.3	1.1	2.1	1.8	1.7
Cadmium (total)	CE127 M	mg/kg Cd	0.5	0.3	0.6	0.2	0.6	0.2
Chromium (total)	CE127 M	mg/kg Cr	38	33	34	37	33	35
Chromium (III)	CE208	mg/kg CrIII	38	33	34	37	33	35
Chromium (VI)	CE146	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	49	26	88	27	113	24
Lead (total)	CE127 M	mg/kg Pb	261	73	259	82	236	69
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127 M	mg/kg Ni	21	18	59	19	46	18
Selenium (total)	CE127 M	mg/kg Se	1.5	1.1	1.7	1.2	2.7	1.1
Zinc (total)	CE127 M	mg/kg Zn	177	117	206	94	204	56
pH	CE004 M	units	8.8	7.8	7.9	8.3	7.9	9.3
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	35	16	24	34	112	242
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Thiocyanate	CE145 M	mg/kg SCN	<1	<1	<1	<1	<1	<1
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total Organic Carbon (TOC)	CE072 M	% w/w C	2.7	8.3	18.9	6.1	19.2	1.7
Estimate of OMC (calculated from TOC)	CE072 M	% w/w	4.6	14.3	32.6	10.5	33.1	2.9
PAH								
Acenaphthene	CE087 M	mg/kg	<0.02	<0.02	0.47	<0.02	0.09	0.09
Acenaphthylene	CE087 M	mg/kg	<0.02	<0.02	1.04	<0.02	<0.02	<0.02
Anthracene	CE087 U	mg/kg	0.40	<0.02	4.08	0.05	0.63	0.34
Benzo(a)anthracene	CE087 U	mg/kg	0.89	<0.02	23.80	0.05	1.04	1.32
Benzo(a)pyrene	CE087 U	mg/kg	0.95	<0.02	19.29	0.12	0.81	1.21
Benzo(b)fluoranthene	CE087 M	mg/kg	1.45	<0.02	24.76	0.13	1.09	1.61
Benzo(ghi)perylene	CE087 M	mg/kg	1.00	<0.02	10.68	0.08	0.51	0.82
Benzo(k)fluoranthene	CE087 M	mg/kg	0.54	<0.03	10.80	0.10	0.55	0.73
Chrysene	CE087 M	mg/kg	0.99	<0.03	22.55	0.11	0.87	1.17
Dibenz(ah)anthracene	CE087 M	mg/kg	0.25	<0.02	3.41	<0.02	0.13	0.23
Fluoranthene	CE087 M	mg/kg	1.68	<0.02	43.10	0.12	2.24	2.96
Fluorene	CE087 U	mg/kg	0.04	<0.02	1.09	<0.02	0.13	0.09
Indeno(123cd)pyrene	CE087 M	mg/kg	0.82	<0.02	12.19	0.10	0.55	0.85
Naphthalene	CE087 M	mg/kg	<0.02	<0.02	0.77	<0.02	0.05	<0.02
Phenanthrene	CE087 M	mg/kg	0.90	0.06	14.06	0.09	1.48	0.97
Pyrene	CE087 M	mg/kg	1.53	<0.02	36.57	0.15	1.79	2.47
PAH (total of USEPA 16)	CE087	mg/kg	11.4	<0.34	229	1.10	12.0	14.9

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SOILS

Lab number			82985-1	82985-2	82985-3	82985-4	82985-5	82985-6
Sample id			BH1	BH3	BH4	BH5	BH6	BH7
Depth (m)			0.60	0.15	0.50	0.60	0.50	0.20
Date sampled			28/11/2019	28/11/2019	28/11/2019	28/11/2019	28/11/2019	28/11/2019
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	<0.01	-	<0.01	-	<0.01	-
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	-	4	-	2	-
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	8	-	98	-	7	-
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	10	-	112	-	8	-
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	3	-	13	-	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	-	7	-	11	-
EPH Aliphatic (>C16-C35)	CE068	mg/kg	199	-	419	-	116	-
EPH Aliphatic (>C35-C44)	CE068	mg/kg	36	-	44	-	10	-
Subcontracted analysis								
Asbestos (qualitative)	$	-	NAD	NAD	NAD	-	-	NAD

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SOILS

Lab number			82985-7	82985-8	82985-9	82985-10
Sample id			BH7	BH8	BH8	BH10
Depth (m)			2.00	0.50	2.00	1.00
Date sampled			28/11/2019	28/11/2019	28/11/2019	28/11/2019
Test	Method	Units				
Arsenic (total)	CE127 M	mg/kg As	-	10	-	17
Boron (water soluble)	CE063 M	mg/kg B	-	1.2	-	2.7
Cadmium (total)	CE127 M	mg/kg Cd	-	0.4	-	0.7
Chromium (total)	CE127 M	mg/kg Cr	-	36	-	41
Chromium (III)	CE208	mg/kg CrIII	-	36	-	41
Chromium (VI)	CE146	mg/kg CrVI	-	<1	-	<1
Copper (total)	CE127 M	mg/kg Cu	-	16	-	79
Lead (total)	CE127 M	mg/kg Pb	-	130	-	275
Mercury (total)	CE127 M	mg/kg Hg	-	<0.5	-	<0.5
Nickel (total)	CE127 M	mg/kg Ni	-	16	-	32
Selenium (total)	CE127 M	mg/kg Se	-	1.2	-	1.8
Zinc (total)	CE127 M	mg/kg Zn	-	140	-	261
pH	CE004 M	units	-	8.6	-	8.0
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	-	434	-	94
Sulphide	CE079	mg/kg S^{2-}	-	<10	-	
Cyanide (free)	CE077	mg/kg CN	-	<1	-	<1
Cyanide (total)	CE077	mg/kg CN	-	<1	-	<1
Thiocyanate	CE145 M	mg/kg SCN	-	<1	-	<1
Phenols (total)	CE078	mg/kg PhOH	-	<0.5	-	<0.5
Total Organic Carbon (TOC)	CE072 M	% w/w C	-	2.5	-	0.8
Estimate of OMC (calculated from TOC)	CE072 M	% w/w	-	4.2	-	1.4
PAH						
Acenaphthene	CE087 M	mg/kg	-	0.17	-	<0.02
Acenaphthylene	CE087 M	mg/kg	-	<0.02	-	<0.02
Anthracene	CE087 U	mg/kg	-	0.72	-	0.09
Benzo(a)anthracene	CE087 U	mg/kg	-	1.51	-	0.41
Benzo(a)pyrene	CE087 U	mg/kg	-	1.05	-	0.44
Benzo(b)fluoranthene	CE087 M	mg/kg	-	1.45	-	0.61
Benzo(ghi)perylene	CE087 M	mg/kg	-	0.68	-	0.32
Benzo(k)fluoranthene	CE087 M	mg/kg	-	0.81	-	0.31
Chrysene	CE087 M	mg/kg	-	1.34	-	0.41
Dibenz(ah)anthracene	CE087 M	mg/kg	-	0.19	-	<0.02
Fluoranthene	CE087 M	mg/kg	-	3.92	-	0.83
Fluorene	CE087 U	mg/kg	-	0.14	-	<0.02
Indeno(123cd)pyrene	CE087 M	mg/kg	-	0.71	-	0.31
Naphthalene	CE087 M	mg/kg	-	<0.02	-	<0.02
Phenanthrene	CE087 M	mg/kg	-	2.12	-	0.30
Pyrene	CE087 M	mg/kg	-	3.04	-	0.78
PAH (total of USEPA 16)	CE087	mg/kg	-	17.8	-	4.82

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SOILS

Lab number			82985-7	82985-8	82985-9	82985-10
Sample id			BH7	BH8	BH8	BH10
Depth (m)			2.00	0.50	2.00	1.00
Date sampled			28/11/2019	28/11/2019	28/11/2019	28/11/2019
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	<0.01	<0.01	<0.01	-
o-Xylene	CE192 U	mg/kg	<0.01	0.02	<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	0.03	<0.01	-
EPH Aromatic (>EC10-EC12)	CE068	mg/kg	<1	<1	<1	-
EPH Aromatic (>EC12-EC16)	CE068	mg/kg	<1	2	<1	-
EPH Aromatic (>EC16-EC21)	CE068	mg/kg	<1	10	1	-
EPH Aromatic (>EC21-EC35)	CE068	mg/kg	<1	13	2	-
EPH Aromatic (>EC35-EC44)	CE068	mg/kg	<1	3	<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	1.1	<0.1	-
EPH Aliphatic (>C10-C12)	CE068	mg/kg	<4	<4	<4	-
EPH Aliphatic (>C12-C16)	CE068	mg/kg	<4	42	<4	-
EPH Aliphatic (>C16-C35)	CE068	mg/kg	<4	910	13	-
EPH Aliphatic (>C35-C44)	CE068	mg/kg	<10	84	<10	-
Subcontracted analysis						
Asbestos (qualitative)	$	-	-	-	-	NAD

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PREPARED LEACHATES

Lab number			82985-3L	82985-6L
Sample id			BH4	BH7
Depth (m)			0.50	0.20
Test	Method	Units		
Arsenic (dissolved)	CE128 U	µg/l As	1.40	3.47
Boron (dissolved)	CE128 U	µg/l B	53	60
Cadmium (dissolved)	CE128 U	µg/l Cd	<0.07	<0.07
Chromium (dissolved)	CE128 U	µg/l Cr	0.2	0.7
Copper (dissolved)	CE128 U	µg/l Cu	2.2	0.8
Lead (dissolved)	CE128 U	µg/l Pb	1.3	<0.2
Mercury (dissolved)	CE128 U	µg/l Hg	<0.008	<0.008
Nickel (dissolved)	CE128 U	µg/l Ni	<0.5	<0.5
Selenium (dissolved)	CE128 U	µg/l Se	0.17	1.33
Zinc (dissolved)	CE128 U	µg/l Zn	<1	<1
pH	CE213 U	units	7.8	8.7
Sulphate	CE049 U	mg/l SO_4	1.7	16
Sulphur (dissolved)	CE128 U	mg/l S	1.1	6.6
Sulphide	CE079	µg/l S^{2-}	<100	<100
Cyanide (free)	CE147	µg/l CN	<20	<20
Cyanide (total)	CE147	µg/l CN	<20	<20
Thiocyanate	CE014	µg/l SCN	<200	<200
Phenols (total)	CE148	µg/l PhOH	<10	<10
PAH				
Acenaphthene	CE051	µg/l	<0.1	2.0
Acenaphthylene	CE051	µg/l	<0.1	<0.1
Anthracene	CE051	µg/l	<0.1	0.3
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	0.2	0.3
Fluorene	CE051	µg/l	<0.1	1.5
Indeno(123cd)pyrene	CE051	µg/l	<0.1	<0.1
Naphthalene	CE051	µg/l	<0.1	3.7
Phenanthrene	CE051	µg/l	0.2	1.9
Pyrene	CE051	µg/l	<0.1	<0.1
PAH (total of USEPA 16)	CE051	µg/l	<1.6	9.7

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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)
82985-1	BH1	0.60	N	
82985-2	BH3	0.15	N	
82985-3	BH4	0.50	N	
82985-4	BH5	0.60	N	
82985-5	BH6	0.50	N	
82985-6	BH7	0.20	N	
82985-7	BH7	2.00	N	
82985-8	BH8	0.50	N	
82985-9	BH8	2.00	N	
82985-10	BH10	1.00	N	