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PHASE 2: GROUND INVESTIGATION REPORT

McCARTHY AND STONE RETIREMENT LIFESTYLES LTD

PROPOSED RESIDENTIAL ACCOMMODATION DEVELOPMENT

FORMER COUNCIL OFFICES,

BERNESLAI CLOSE

BARNSELEY

S70 2HL

Project No: 17-401

Prepared By:

Sean Barrett

A handwritten signature in black ink, appearing to read 'Sean Barrett', written over a horizontal line.

Date:

17th August 2017

Approved By:

Kevin Moir

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Date:

17th August 2017

The information and/or advice contained in this Phase 2: Ground Investigation Report is based solely on, and is limited to, the boundaries of the site, the immediate area around the site, and the historical use(s) unless otherwise stated. This 'Report' has been prepared in order to collate information relating to the physical, environmental and industrial setting of the site, and to highlight, where possible, the likely problems that might be encountered when considering the future development of this site for the proposed end use. All comments, opinions, diagrams, cross sections and/or sketches contained within the report, and/or any configuration of the findings is conjectural and given for guidance only and confirmation of the anticipated ground conditions should be considered before development proceeds. Agreement for the use or copying of this report by any Third Party must be obtained in writing from Arc Environmental Limited (AEL). If a change in the proposed land use is envisaged, then a reassessment of the site should be carried out.

Report Type:- Phase 2: Ground Investigation Report.

Project:- 17-401 Berneslai Close, Barnsley.

Prepared For:- McCarthy & Stone Retirement Lifestyles Ltd.

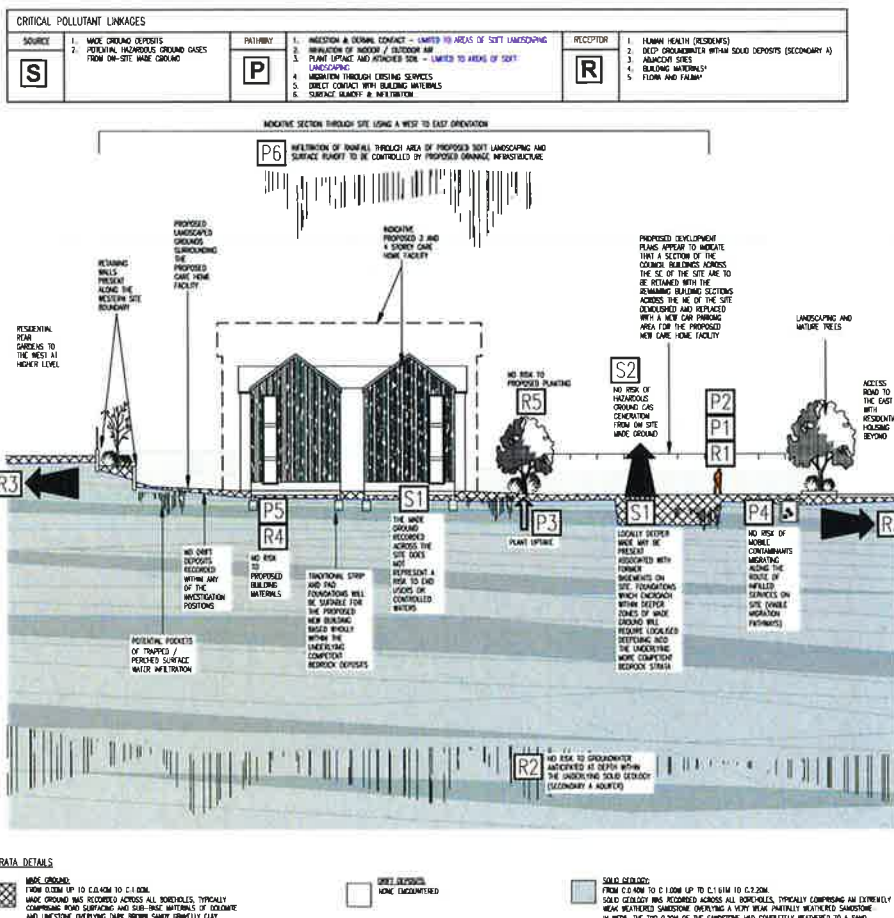


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The contractor shall check all dimensions on site before commencement of any works. No dimensions to be quoted off this drawing.
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Client: **MCCARTHY & STONE
(RETIREMENT LIFESTYLES) LTD**

Project Title: **Proposed Sheltered Accommodation
Barnsley Metropolitan Borough Council Offices
Berneslai Close, Barnsley, South Yorks., S70 2HS**

Drawing Title: **Revised Conceptual Site Model**

Scale of A3: 1:100	Date: 15/05/17	Drawn by: PD	Approved by: AW
17-401			



Ground Contamination Risk Assessment (Cont'd)

Methodology (Cont'd):-

Level 1 - Human Health (Cont'd):-

Where targeted screening is undertaken for suspected organic contamination, etc., the maximum site values recorded (C_{sk}) at each location have been compared to the chosen Level 1 Critical Concentration (C_c), with no requirement for statistical analysis to be undertaken for these samples.



EXECUTIVE SUMMARY

As requested by McCarthy & Stone Retirement Lifestyles Limited and in conjunction with the Phase 1: Geo-Environmental Assessment Report (ref: 17-401, May 2016), a programme of ground investigation works has been carried out for a proposed site located at Berenslai Close, within the Yorkshire Town of Barnsley. The site is currently disused offices of Barnsley Metropolitan Council. It is proposed to construct a new sheltered residential accommodation development, with areas of car parking, hard standing and communal soft landscaping.

The intrusive investigation works undertaken by Arc Environmental Limited comprised the sinking of 9 no. windowless sampling boreholes (WS's 01 – 09) accompanied by the installation of 3 no. ground gas and groundwater monitoring wells (WS03, WS05 and WS08).

Ground Conditions

From the investigation works completed, made ground was recorded to depths of between c.0.45m to c.1.00m below current ground levels (bgl). The made ground comprised variable surface coverings with associated sub base materials, underlain by a dark brown sandy gravelly clay with fragments of brick, concrete and sandstone.

No superficial deposits were encountered.

The underlying weathered bedrock deposits generally comprised an extremely weak weathered sandstone, to depths of between c.1.00m to c.1.60m bgl overlying a very weak brown fine to medium grained sandstone, to depths of between c.1.67m to c.2.20m.

There was no significant visual or olfactory evidence of hydrocarbon contamination (fuel/oil), 'or potential asbestos containing materials (ACM's) within any of the investigation positions. However, ashy materials were noted in the made ground in WS03.

During the investigation period, no groundwater was encountered in any of the exploratory borehole locations. Within the groundwater monitoring wells, standing water levels were recorded in all boreholes, between c.1.95m and c.2.08m.

Foundations

Based on the information gained from these intrusive investigation works, it is felt that conventional strip and pad foundations can be utilised, based within the natural sand deposits and initially completely weathered sandstone deposits below the building footprint, and can be designed to an allowable bearing pressure of 150kN/m². However, where the new build encroaches upon former basement areas, then deeper trench fill will be required to reach undisturbed rock.

From the results of the pH and soluble sulphate testing, it can be seen that future foundations and buried concrete should be constructed utilising a concrete design class of DS-1 and ACEC class of AC-1.



EXECUTIVE SUMMARY (Cont'd)

Contamination & Hazardous Ground Gas

Based on the results to date, it is felt that the site can initially be assessed as Characteristic Situation 1 (CS1), and Green in accordance with the NHBC Traffic Light System, indicating that no gas protection would be required for the proposed residential development, assuming that there are no significant changes in the gas concentrations or flow rates compared to those already recorded. This characterisation will be reassessed following the completion of the remaining 4 no. gas monitoring visits and issued as an addendum Letter Report.

Made ground deposits were encountered, and as can be seen from the results of the contamination screening carried out and the Level 1 Risk Assessments, levels of potential contamination within these deposits do not represent a risk to future end users, and as such no remediation strategy is required for this site.



Ground Contamination Risk Assessment (Cont'd)

Methodology (Cont'd):

ABC ground contamination risk assessments, in accordance with CIRI1, are based on the established *source-pathway-receptor* pollutant linkage methodology and 'suitable for use' approach (Part 11A, EPA 1990 - inserted through Section 57 EA 1995), and adopts the tiered/phased approach beginning with a preliminary assessment (also referred to a desk top study). If potential pollutant linkages are identified from the preliminary assessment, for both Human Health and/or The Water Environment, then Level 1 Quantitative Risk Assessments are appropriate guidance values. For soils these typically comprise Generic Assessment Criteria values (GACs) or site specific assessment criteria (SSAC) and for The Water Environment, Environmental Quality Standards (EQS) or UK Drinking Water Standards.

Where any Level 1 criteria have been exceeded, various courses of action are available for recommendation, in order to try and 'break' the pollutant linkage by designing into the proposed development works and/or by recommending appropriate remediation works, i.e. removal of source, treatment of contaminants, installation of permanent barriers, etc. and/or by carrying out more detailed site specific quantitative risk assessment (DQRA, i.e. Level 2 or above). Completing further DQRA for any contaminants present, can take into account factors such as the introduction of physical barrier and the actual availability of plausible contaminant migration pathways, as well as site specific data such as the type, properties and characteristics (permeability, porosity, density, etc.) of the soil present on site, groundwater depth and flow, site specific exposure criteria and values, and contaminant retardation, attenuation, dilution and degradation. Similarly, when considering potential risks to off-site receptors, these are considered by assessing the potential risks to on-site receptors, as well as the potential mobility of any contaminants present within either the soils or water/groundwater below this site.

For the purpose of this report, the preliminary and level 1 risk assessments considers one main category of receptor, and this is as follows:

- On site Human Health – (CLEA Model)

When considering the risk to construction workforce, the results of the screening can be used by the Main Contractor/Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations, and when assessing the level of PPE required on site. Similarly, when considering the risks to building materials, again the results of the contamination screening can be used to determine the level of protection that may be required, and reference should be made to the utilities suppliers for their comments.

Level 1 - Human Health:

Level 1 human health related assessments are based upon the current CLEA Model, with site values assessed against published Generic Assessment Criteria Values (GACs – CASL's & S4UL's), and where these values are not available against the published CLEM (Chartered Institute of Environmental Health)/IQM Generic Assessment Criteria (GAC), CL:AIRE, Atkins ATRISKsoil[®] SSV values and USEPA Region 9 Screening Values (2009). For statistical analysis, the site is assessed to delineate any potentially differing areas of contamination (averaging areas), based on the results of the preliminary investigation as well as the result of any visual, olfactory or analytical evidence following completion of the intrusive investigation works. Following this geographical delineation of the site, where generic or pervasive contaminants are anticipated, for each averaging area under consideration, the results are assessed using the established methods of statistical analysis given in the CL:AIRE Guidance on Comparing Soil Contamination Data with a Critical Concentration (CC), May 2008. In this case, the results of the sample population are assessed to determine whether they represent a normal or non-normal distribution and the statistical upper confidence limit is (95% percentile – UCL_{0.95}) is calculated and then compared with the chosen Level 1 Critical Concentration (CC) value for the site (i.e. the appropriate GAC or SSV).

In addition, further statistical analysis is undertaken to determine whether the maximum concentration(s) recorded represent statistical outliers, i.e. potential 'hot spots', and where necessary these are removed from the sampling populations and a reassessment of the averaging areas/potential hot spot areas identified.

Report Type:- Phase 2: Ground Investigation Report.

Project:- 17401 Barnesia Close, Barnsley.

Prepared For:- McCarthy & Stone Retirement Lifestyles Ltd.



Ground Contamination Risk Assessment

Assessment Framework:-

Ground contamination risk assessments are undertaken to identify potential risks from historical and recent land contamination on a given site and enable appropriate risk management actions to be undertaken in accordance with the regulatory context of the site and any future development. There are a range of technical approaches to the assessment of chemical contaminants in the UK, all of which broadly fit within a tiered/phased approach and the current UK approach is set out in the Defra and Environment Agency Publication: CLR 11: Model Procedures for the Management of Land Contamination (Defra/EA 2004).

ARC's approach to undertaking ground contamination risk assessments is based on the tiered/phased framework in accordance with CLR11, and for Human Health, the recently updated CLEA (Contaminated Land Exposure Assessment) framework and model for assessing potentially contaminated land in the UK. This framework and model is based primarily on the following publications and software: Science Reports SC050021/SR2 (EA 2008b Human Health toxicological assessment of contaminants in soil) and SC050021/SR3 (Updated technical background to CLEA model – replaces the previous guidance documents CLR9, CLR10 and Briefing notes 1 – 4); Science Report SC050021/SR4 (CLEA Software (version 1.06 beta) handbook) and the new CLEA software (replaces Science Report SC050021/H CLEA UK Handbook (draft) and the CLEA UK Software version 1.0 beta), along with the publication of a review of body weight and height data used within the Contaminated Land Exposure Assessment model (CLEA), Project no. SC050021/Technical Review 1.

All SGV's (Soil Guidance Values) published as part of the CLEA UK Handbook (draft) and software (version 1.0 beta), have been withdrawn along with guidance documents CLR7 and CLR8, and replacement of the SGV values to provide new Generic Assessment Criteria values (GAC's), using the updated model and software (version 1.06) has been derived by a combination of regulatory and non-governmental organisations (Defra, CL:AIRE and IQM). The newly published GAC's are known as Category 4 Screening Levels (C4SL's) and Suitable 4 Use Levels (S4UL's), and where assessment values for certain contaminants are not available the most appropriate alternative values from other sources will be utilised.

When considering ground contamination risk assessments for Controlled Waters (groundwater and surface waters), ARC follows the EA guidance on Remedial Targets Methodology, Hydrogeological Risk Assessment for Land Contamination, 2006.

Methodology:-

ARC consider that the most appropriate methodology for completing a ground contamination risk assessment for soils on this site is to utilise the recently published GAC values (C4SL's – Arsenic, Cadmium, Chromium VI, Lead, Benzo(a)pyrene & Benzene, S4UL's – Chromium III, Copper, Mercury, Nickel, Selenium, Zinc, Toluene, Ethylbenzene, Xylenes, Phenol, speciated PAH's and other organic compounds), combined with other published and recognised GAC's (generic assessment criteria) for the remaining analytes. It is widely recognised by ground contamination risk assessment practitioners that the new CLEA model will generally result in higher SGV and GAC (generic assessment criteria) values for the standard end uses, and consequently continued use of the former CLEA model will result in a slightly more conservative assessment.

For general soil surface contamination, the new S4UL value for inorganic Mercury can be compared with chemical analysis for total mercury content, as the concentrations of elemental and methylmercury compounds are likely to be very low in accordance with Science Report SC050021 / Mercury SGV. In addition, the updated C4SL values are based upon a Soil Organic Matter (SOM) content of 6%, in line with the most recent Defra and EA guidance. Once all the relevant data is available, a reassessment of the ground contamination present on this site can be carried out, if felt necessary, as this may result in a reduction in the scope of remediation works (if required). It should be noted that guidance document CLR11: Model Procedures for the Management of Land Contamination has not been withdrawn.



1.0 Introduction

In conjunction with the completion of the Phase 1: Geo-Environmental Assessment Report (Arc Environmental Ltd., ref. no. 17-401, May 2017), Arc Environmental Ltd. has been instructed by McCarthy & Stone (Retirement Lifestyles) Ltd. to undertake a programme of Phase 2 ground investigation works for a proposed site located on Bemslai Close, within the Yorkshire City of Barnsley. The site is currently disused offices of Barnsley Metropolitan Council. It is proposed to construct a new sheltered residential accommodation development, with areas of car parking, hardstanding and communal soft landscaping.

The intrusive investigation has been designed to provide an assessment of the potential contamination issues across the site as a whole for potential risks to human health and Controlled Waters, in addition to the geotechnical issues associated with the proposed development works, as highlighted from the results of the desk top study data.

The intrusive investigation works comprised the sinking of 9 no. windowless sampling boreholes, accompanied by the installation of 3 no. ground gas and water monitoring wells. All the investigation positions put down can be seen on the Exploratory Location Plan, a copy of which can be seen in Appendix II. It should be noted that the plan should be used for orientating purposes only, as the location of the positions are approximate.

2.0 Site Details

Table 2.1

Site Name & Address:	N = north, S = south, E = east, W = west Council Offices, Bemslai Close, Barnsley S70 2HL
OS Grid Reference:	434207 406744 (representative for the central part of the site) The site is located on Bemslai Close, within the centre of Barnsley.
Description of Location	N, E & W= Residential Properties including sheltered housing S = A park.
Site Boundaries:	Residential & commercial setting in the centre of Barnsley.
Site Setting:	

3.0 Scope of Works

Table 3.1

Client:	McCarthy & Stone (Retirement Lifestyles) Ltd.
Project type:	It is proposed to construct a new sheltered accommodation development, with areas of car parking and areas of communal soft landscaping.
Site Location plan:	See Appendix I.
Layout plans (existing):	See Appendix I.
Layout plans (proposed):	See Appendix I.
Investigation Works:	9 no. windowless sampling boreholes (BH's 01 to 09) accompanied by the installation of 3 no. combined gas and groundwater monitoring wells (BH's 02, 05 and 08).
Laboratory Testing:	Geotechnical & Ground Contamination.
CLEA End-Use Classification:	Residential without plant uptake.
Reporting:	Factual & Interpretative, including Level 1 risk assessments for Human Health and Controlled Waters.
Site History Summary:	Historically, the site was recorded as residential properties with private gardens and Becketts Hospital and grounds between c.1906 and c.1981. From c.1981 the buildings on site have been used as the district council offices for Barnsley Metropolitan Council.



3.0 Scope of Works (Cont'd)

The information contained in this report is limited to the area of the site, as indicated on the Existing & Proposed Site Layout Plans shown in Appendix I, and to those areas accessible during the ground investigation. When considering the full scope of the development any features and / or issues not specifically mentioned in this report cannot be assumed to have been covered.

4.0 Ground Conditions

For an accurate description of the ground conditions encountered at each investigation position, reference should be made to the exploratory borehole logs in Appendix II, and the depths of strata on the record sheets are recorded from current ground levels.

4.1 Soil Profile:

A summary of the soil profile for this site can be found in Table 4.1 below.

Table 4.1

Type of Strata	Depths Recorded (BGL)	Description & General Comments
MADE GROUND:	From 0.00m up to c.0.40m to c.1.00m	Made ground was recorded across all boreholes, typically comprising road surfacing and sub-base materials of dolomite and limestone overlying dark brown sandy gravely clay.
SUPERFICIAL GEOLOGY:	None Encountered	N/A
SOLID GEOLOGY: Kent Thick Sandstone	From c.0.40m to c.1.00m up to c.1.61m to c.2.20m.	Solid geology was recorded across all boreholes, typically comprising an extremely weak weathered sandstone overlying a very weak partially weathered sandstone. In WSO5, the top 0.20m of the sandstone had completely weathered to a sand.

bgl = Below ground levels

During the investigation works, there was no obvious visual or olfactory evidence of potential hydrocarbon contamination (fuel or waste oil), 'silty' materials or asbestos containing materials (ACM's – cemented sheets, lagging, etc.) noted within any of the exploratory positions.

4.2 Groundwater:

No significant groundwater was recorded during the intrusive investigation works, with the boreholes remaining 'dry' upon completion, indicating the absence of a shallow groundwater surface (table) below this site.

However, when considering the nature of the made ground and the natural deposits encountered below the site area, it would be considered prudent to allow for the introduction of appropriate groundwater control measures in order to take care of any potential future shallow water ingresses within the underlying deposits particularly where open excavations are present and are to remain open to the natural elements.

Further groundwater monitoring has been undertaken within the combined gas and groundwater monitoring standpipes installed across the site. The results of the monitoring are discussed in Section 5.2.



APPENDIX V

Ground Contamination Risk Assessment Data: Methodology
Revised Conceptual Site Model (CSM)

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)
TC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
IT	Sample not cooled
OR	Other (specify)

Lab ref	Sample Id	Depth (m)	Deviating	Tests (Reason for deviation)
66117(1)-1	WS01	0.50-1.00	N	
66117(1)-2	WS02	0.60-0.80	N	
66117(1)-3	WS03	0.30-0.60	N	
66117(1)-4	WS03	0.60-1.00	N	
66117(1)-5	WS04	0.10-0.40	N	
66117(1)-6	WS05	0.40-0.60	N	
66117(1)-7	WS06	0.40-0.60	N	
66117(1)-8	WS06	1.00-1.60	N	
66117(1)-9	WS07	0.40-0.60	N	
66117(1)-10	WS08	0.00-0.30	N	
66117(1)-11	WS08	0.30-0.80	N	
66117(1)-12	WS08	1.00-1.20	N	
66117(1)-13	WS09	0.00-0.40	N	
66117(1)-14	WS09	0.40-1.00	N	

5.0 Insitu Testing

5.1 Insitu Standard Penetration Tests:

Insitu standard penetration tests (SPT's) were carried out within the boreholes with the use of either a split spoon sampler or a 60° solid cone penetrometer, in order to determine the relative density and strength of the natural drift and sandstone deposits encountered below the site.

The results are shown as uncorrected 'N' values on the graphic borehole record sheets, adjacent to the appropriate sample level, in Appendix II. Where the full penetration depth, including seating blows (450mm), could not be achieved, the bottom sampling depth is indicated as less than 0.45m from the top (start of test), with the actual depth of penetration and number of blows undertaken also being recorded. A summary of the findings is given below:-

- Tests completed within the sandstone deposits, recorded 'N' values ranging between 6 up to 42 and also blow counts of 25 up to 75 for limited penetration, equating to loose to very dense becoming hard strata.

5.2 Insitu Ground Gas & Groundwater Monitoring:

Combined ground gas & water monitoring standpipes were installed within three boreholes (WS02, WS05 & WS08), to assess the potential for hazardous ground gas from on-site sources (i.e. made ground deposits).

A standard 50mm diameter HDPE standpipe, with gravel and geo-wrap surround, bentonite seal, gas valve cap and security cover, was installed within each borehole, and ground gas and water levels were allowed to reach equilibrium, prior to the first monitoring visit. The bentonite seal was taken to depths of c.0.50m bgl, to prevent excessive surface water ingress or venting of soil gas, with the resulting response zone covering the remaining depths of the installations. Monitoring was undertaken using a Gas Data GFM series infra-red gas analyser, with integral flow meter, and an electronic dipmeter.

Based on the findings of the Phase 1: Geo-Environmental Assessment report and from the completion of the intrusive works, and also in accordance with CIRIA Report C665, November 2007, BS8485:2015, and BS8576:2013, it is felt that an adequate risk assessment can be undertaken based on the following limiting factors:

- The proposed residential development has been characterised as *moderate* sensitivity (Tables 5.5a & 5.5b – Typical/Idealised frequency and period of monitoring, after Wilson et al, 2005).
- The risk associated with the generation potential of a source has been characterised as *very low* (assessment based on the findings of the intrusive works).
- When taking into consideration the sensitivity and the generation potential of a source this equates to monitoring over a minimum of *three* months with *six* recorded readings (Tables 5.5a & 5.5b – Typical/Idealised frequency and period of monitoring after Wilson et al, 2005).
- No detectable concentrations of Methane or Carbon Dioxide have been recorded exceeding the action trigger levels of 1% & 5% respectively. (Table 8.5 – Modified Wilson & Card classification).
- Negligible* (<0.1 l/hr) flow rates have been recorded throughout the monitoring period (Table 8.5 – Modified Wilson & Card classification).



5.0 Insitu Testing (Cont'd)

5.4 Insitu Ground Gas & Groundwater Monitoring (Cont'd):

A summary of the results for the visits undertaken are presented in Table 5.2 below, with a copy of the monitoring results contained in Appendix III.

Table 5.2

Position	Date	Atmospheric Pressure (mbar)	Water (m bgl)	CH ₄ (%w/v)	LEL (%w/v)	CO ₂ (%w/v)	O ₂ (%w/v)	Flow Rate (l/hr)
WS02	21/07/2017	993-994 (Falling)	DRY	0.0	0.0	0.6	20.4	<0.1
WS05			1.95	0.0	0.0	0.2	20.6	<0.1
WS08			DRY	0.0	0.0	0.3	20.5	<0.1
WS02	02/08/2017	990-988 (Falling)	1.98	0.0	0.0	0.9	19.1	<0.1
WS05			2.08	0.0	0.0	0.3	20.1	<0.1
WS08			2.02	0.0	0.0	1.5	19.1	<0.1

Note - Atmospheric trend taken from Windground for Teanik Airport.

As can be seen from the results, no concentrations of Methane (CH₄) have been detected. Concentrations of Carbon Dioxide (CO₂) have been recorded up to a maximum level of 1.5% w/v, with slightly reduced Oxygen (O₂) concentrations (minimum 20.4% w/v). Negligible flow rates (<0.1 l/hr.) have been recorded on all occasions.

For the purposes of the proposed residential development, the site is characterised based on the limiting borehole gas volume flow for Methane and Carbon Dioxide, known as the Gas Screening Value (GSV), which in turn determines the level of any gas protection required. Therefore, in order to complete the risk assessment, the maximum GSV (Gas Screening Value) for the CH₄ and CO₂ levels recorded have been determined as follows:

- Methane (CH₄) - Due to the lack of Methane recorded, a GSV cannot be calculated.
- Carbon Dioxide (CO₂) - multiplying the maximum concentration recorded (taken as 1.5% w/v) by the maximum flow rate (taken as 0.1 l/hr.) which gives a GSV of 0.0015 l/hr. (calculated from 1.5% (0.015) x 0.1 l/hr. maximum flow rate) for CO₂.

From the results it can be seen that the presence of hazardous ground gases do not exceed the GSV assessment value of 0.07 l/hr. (Characteristic Situation 1) or 0.78 l/hr. (Green Classification - NHBC Traffic light system), indicating that no gas protection measures would be required for the proposed residential CA711 development. However this will need to be reassessed following the 4 no. outstanding gas monitoring visits, with the results and risk assessment issued as an addendum report.

From the results of the groundwater monitoring carried out in the standpipes, it can be seen that standing water levels have been recorded at a depth of c.1.95m in WS05, all standpipes were noted as dry.

When considering the water ingresses and strikes encountered during the intrusive works, and the standing water levels recorded during the monitoring visits, this water is likely to be representative of perched surface water drainage within the made ground and the natural drift deposits, rather than representing a natural shallow continuous groundwater surface (water table).

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE STATUS	LOD	UNITS
CE124	Lead (bioaccessible fraction)	Calculation: (Pb (bio)-100)/Pb (total)	Dry	0.1	% w/w
\$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	-	-

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
-	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry	M	1	mg/kg Cr(III)
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry	M	1	mg/kg Cr(VI)
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO ₄
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet	M	1	mg/kg CN
CE072	Total Organic Carbon (TOC)	Removal of IC by acidification, Carbon Analyzer	Dry	M	0.1	% w/w C
CE087	Acenaphthene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(g)herylene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Dibenz(a,h)anthracene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Indeno(1,2,3-cd)pyrene	Solvent extraction, GC-MS	Wet	M	0.01	mg/kg
CE087	Naphthalene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	Wet	M	0.27	mg/kg
CE087	Benzo(j)fluoranthene	Solvent extraction, GC-MS	Wet	M	0.02	mg/kg
CE087	PAH (total of OIL B)	Solvent extraction, GC-MS	Wet	M	0.15	mg/kg
CE067	PHH (>C5-C7)	Headspace GC-FID	Wet	M	0.1	mg/kg
CE067	PHH (>C7-C9)	Headspace GC-FID	Wet	M	0.1	mg/kg
CE067	PHH (>C9-C10)	Headspace GC-FID	Wet	M	0.1	mg/kg
CE033	EPH (>C10-C12)	Solvent extraction, GC-FID	Wet	M	4	mg/kg
CE033	EPH (>C12-C16)	Solvent extraction, GC-FID	Wet	M	4	mg/kg
CE033	EPH (>C16-C21)	Solvent extraction, GC-FID	Wet	M	4	mg/kg
CE033	EPH (>C21-C35)	Solvent extraction, GC-FID	Wet	M	6	mg/kg
CE033	EPH (>C35-C44)	Solvent extraction, GC-FID	Wet	M	10	mg/kg
CE124	Lead (bioaccessible)	Extractions, ICP-MS	Dry	M	1	mg/kg Pb

5.0 Insitu Testing (Cont'd)

5.4 Insitu Ground Gas & Groundwater Monitoring (Cont'd):

As such ingresses of water should be anticipated where construction related excavations are taken down near to or below the depths where standing water has been recorded, and therefore it will be necessary to allow for the introduction of groundwater control measures, in order to take care of any future water ingresses within the underlying deposits and particularly where excavations are to remain open to the elements for any significant period of time.

Falling head testing will be undertaken within the future monitoring visits undertaken to determine the suitability of the ground for soakaways and this information will be included in as an addendum when completed.

6.0 Laboratory Testing

Ground contamination screening was undertaken by Chemtech Environmental of Consett, Co. Durham (UKAS & MCERTS accredited). No additional geotechnical testing was undertaken due to the ground conditions encountered (see section 4.0)

6.1 Determination of Chemical Attack on Buried Concrete:

Representative samples of the made ground, topsoil and natural deposits recovered during the investigation were tested in order to determine their pH value and soluble sulphate (SO₄) levels. The results are shown in Table 6.1 below, and are also contained within the Chemtech Environmental Limited Analytical Report (Ref. no: 66117(1)), a copy of which is contained in Appendix IV.

Position	Depth (m)	Strata	SO ₄ (mg/l)	pH value	Design SO ₄ Class	ACEC Class
WS01	0.50-1.00	NAT	<10	7.8	DS-1	AC-1
WS02	0.60-0.80	MG	23	7.9	DS-1	AC-1
WS03	0.30-0.60	MG	37	7.9	DS-1	AC-1
WS03	0.60-1.00	NAT	<10	8.6	DS-1	AC-1
WS04	0.10-0.40	MG	34	8.1	DS-1	AC-1
WS05	0.40-0.60	MG	<10	8.2	DS-1	AC-1
WS06	0.40-0.60	NAT	21	8.0	DS-1	AC-1
WS06	1.00-1.60	NAT	<10	7.6	DS-1	AC-1
WS07	0.40-0.60	MG	25	7.1	DS-1	AC-1
WS08	0.00-0.30	MG	15	7.5	DS-1	AC-1
WS08	0.30-0.80	MG	194	9.1	DS-1	AC-1
WS08	1.00-1.20	NAT	13	8.4	DS-1	AC-1
WS09	0.00-0.40	MG	33	7.2	DS-1	AC-1
WS09	0.40-1.00	MG	270	8.4	DS-1	AC-1

NAT = Natural Soil, TS = Topsoil, MG = Made Ground, ACEC = Aggressive Chemical Environment for Concrete site classification - MG assessed as brownfield and NAT/TS assessed as natural ground.

From these results for the samples of soil tested, it can be seen that the amount of soluble sulphate present ranges between <10mg/l up to 270mg/l, and the pH values range between 7.2 up to 9.1. Therefore, in accordance with BRE Special Digest 1: 2005, the site can be given a classification of Class DS-1. When considering the nature of the materials tested and assuming mobile groundwater the assessment of the Aggressive Chemical Environment for Concrete (ACEC) is AC-1.



6.0 Laboratory Testing (Cont'd)

6.2 Contamination Screening:

Representative samples of the made ground materials and natural topsoil recovered from the boreholes were passed onto Chemtech Environmental of Stanley, Co. Durham, so that soil screening could be carried out. The catalogue of testing results can be found in the Chemtech Analytical Report (ref no.:66117 (1)), a copy of which is contained in Appendix IV, and the total analysis carried out is summarised below:

Soils:-

- 10 no. Generic Soils Suites – comprising:- Arsenic, Cadmium, Chromium (III & VI), Copper, Lead, Mercury, Nickel, Selenium, Zinc, pH, Soluble Sulphate, free Cyanide, Total Organic Carbon (TOC).
- 10 no. Speciated Poly-cyclic Aromatic Hydrocarbons (PAH's) – based on the current USEPA 16 PAH's + Benzo(a)fluoranthene.
- 10 no. Speciated Total Petroleum Hydrocarbons (TPH – Aliphatic & Aromatic Equivalent Carbon Bands) including Benzene, Toluene, Ethylbenzene & Xylene (BTEX).
- 10 no. Asbestos screens (presence)
- Bioaccessibility testing for Lead on all samples.

When taking into account the environmental site setting and the site history, it is felt that the risk of significant contamination being present below the site and impacting Controlled Waters is negligible, and therefore no further leachate screening has been carried out.

The soil screening contamination results have been used to carryout a risk assessment for Human Health for potential ground contamination present, and this is discussed in Section 7.0 on the following pages.

7.0 Ground Contamination Risk Assessment

7.1 Methodology:

Following completion of the contamination screening undertaken on various samples from this site, a Level 1 generic quantitative risk assessment (GQRA) for the ground contamination present has been undertaken, generally in accordance with CIR11: Model Procedures for the Management of Land Contamination. A detailed description of the Assessment Framework and Methodology used by ARC for these risk assessments can be found in Appendix V. This ground contamination risk assessment uses the current UK practice for assessing the risks from land contamination, which is based on the established *source-pathway-receptor* pollutant linkage methodology and 'suitable for use' approach (Part II.A, EPA 1990 - inserted through Section 57 EA 1995).

Based on the Conceptual Site Model (CSM) for this site (described further in the following Section 7.2), a site-specific screening strategy for the site has been developed (see Section 7.3) and the risks from potential contaminants have been assessed for human health. The results of the risk assessments can be found in Section 7.4 (Human Health).

Chemtech Environmental Limited SOILS

Lab number	66117(1)-13	66117(1)-14
Sample ID	WS09	WS09
Depth (m)	0.00-0.40	0.40-1.00
Date sampled	14/07/2017	14/07/2017
Test	Method	Units
EPH (>C16-C21)	CE033 *	mg/kg
EPH (>C21-C35)	CE033 *	mg/kg
EPH (>C35-C44)	CE033 *	mg/kg
Bioaccessibility		
Lead (total)	CE127 *	mg/kg Pb
Lead (bioaccessible)	CE124	mg/kg Pb
Lead (bioaccessible fraction)	CE124	% w/w
Subcontracted analysis		
Asbestos (qualitative)	\$	-
		NAD
		NAD

SOILS

Lab number	66117(1)-13	66117(1)-14
Sample id	WS09	WS09
Depth (m)	0.00-0.40	0.40-1.00
Date sampled	14/07/2017	14/07/2017
Test	Method	Units
Arsenic (total)	CE127 ^M	mg/kg As
Cadmium (total)	CE127 ^M	mg/kg Cd
Chromium (total)	CE127 ^M	mg/kg Cr
Chromium (III)	-	mg/kg Cr(III)
Chromium (VI)	CE146	mg/kg Cr(VI)
Copper (total)	CE127 ^M	mg/kg Cu
Lead (total)	CE127 ^M	mg/kg Pb
Mercury (total)	CE127 ^M	mg/kg Hg
Nickel (total)	CE127 ^M	mg/kg Ni
Selenium (total)	CE127 ^M	mg/kg Se
Zinc (total)	CE127 ^M	mg/kg Zn
pH	CE004 ^M	units
Sulphate (2:1 water soluble)	CE061 ^M	mg/l SO ₄
Cyanide (free)	CE077	mg/kg CN
Total Organic Carbon (TOC)	CE072 ^M	% w/w C
PAH		
Acenaphthene	CE087 ^M	mg/kg
Acenaphthylene	CE087 ^M	mg/kg
Anthracene	CE087 ^U	mg/kg
Benzo(a)anthracene	CE087 ^U	mg/kg
Benzo(a)pyrene	CE087 ^U	mg/kg
Benzo(b)fluoranthene	CE087 ^M	mg/kg
Benzo(ghi)perylene	CE087 ^M	mg/kg
Benzo(k)fluoranthene	CE087 ^M	mg/kg
Chrysene	CE087 ^M	mg/kg
Dibenz(ah)anthracene	CE087 ^M	mg/kg
Fluoranthene	CE087 ^M	mg/kg
Fluorene	CE087 ^U	mg/kg
Indeno(1,2,3-cd)pyrene	CE087 ^M	mg/kg
Naphthalene	CE087 ^M	mg/kg
Phenanthrene	CE087 ^M	mg/kg
Pyrene	CE087 ^M	mg/kg
PAH (total of USEPA 16)	CE087 ^M	mg/kg
Benzo(j)fluoranthene	CE087 ^M	mg/kg
PAH (total of OIL 8)	CE087 ^M	mg/kg
TPH		
VPH (>C5-C7)	CE067	mg/kg
VPH (>C7-C9)	CE067	mg/kg
VPH (>C9-C10)	CE067	mg/kg
VPH (>C10-C12)	CE033 ^M	mg/kg
EPH (>C12-C16)	CE033 ^M	mg/kg

7.0 Ground Contamination Risk Assessment (Cont'd)

7.2 Conceptual Site Model (CSM):

Following the results of the intrusive investigation works, a Conceptual Site Model (CSM) has been developed, which has identified the potential for land contamination to exist on this site, comprising some limited made ground materials and potential sources of hazardous ground gas generation.

Table 7.1 below summarises the *source(s)*, *pathways* and potentially sensitive *receptors* for this site, assuming no remediation, additional protection measures and/or removal of the sources of contamination takes place, and this is graphically represented in the CSM drawing contained in Appendix V.

* = Not included in the Human Health & Controlled Waters Risk Assessment

Table 7.1

SI	Sources (S)	Pathways (P)		Receptors (R)	
		P1	P2	R1	R2
	Made ground deposits	Ingestion & Dermal Contact - limited to areas of soft landscaping	Inhalation of indoor / outdoor air	Human health (Residents)	Deep groundwater within solid deposits (Secondary A)
S2	Potential hazardous ground gases from on-site made ground	Plant Uptake and attached soil - limited to areas of soft landscaping	Migration through existing services	Building materials*	Adjacent sites
		P5	P6	R5	R6
		Direct contact with building materials	Surface runoff & infiltration	Flora and fauna*	

7.2.1 Sources:

From the completion of these investigation works, the site is covered with up to c.1.00m thick layer of made ground associated with sites historic uses. Natural deposits were recorded below the made ground consisting of a weathered sandstone strata, overlying sandstone bedrock.

During the investigation 'ashy' materials were encountered in WS03 between c.0.30m and 0.60m. In addition there was no significant evidence of potential Asbestos Containing Materials (ACM's) or hydrocarbon contamination (fuel, oil, etc.) recorded within any of the investigation positions.

When considering the localised and limited thickness of made ground present on this site (up to c.1.00m), these deposits are not considered to represent a significant source of potential on-site generation of hazardous ground gases, and as such the risk of gassing from the made ground has been considered as very low.

7.2.2 Pathways:

When considering the proposed end use (*Residential – assisted living & care*), and without considering treatment, removal or protection measures, there are some potential plausible pathways available for direct contact, dermal contact, ingestion, inhalation, wind (dust / particulate), volatilization, and vertical and lateral transportation below the site, where there is no hard cover or vapour barriers present.

Within the CLEA Risk Assessment Model for Human Health, there are 3 exposure mediums considered for on site receptors, comprising ingestion of soil containing contaminants, inhalation of contaminated dust/vapours and dermal contact, with up to 10 no. exposure pathways considered, as show below.



7.0 Ground Contamination Risk Assessment (Cont'd)

7.2 Conceptual Site Model (CSM) (Cont'd):

7.2.2 Pathways (Cont'd):

1. *Ingestion of soil and indoor dust* 2. *Consumption of home-grown produce and attached soil* 3. *Dermal contact (indoor)*
4. *Dermal contact (outdoor)* 5. *Inhalation of dust (indoor)* 6. *Inhalation of dust (outdoor)* 7. *Inhalation of vapour (indoor)*
8. *Inhalation of vapour (outdoor)* 9. *Oral background intake* 10. *Inhalation background intake*

Where the future site layout has hard cover and below the actual new structures, these pathways will not be available, except where building materials / structures and services come into direct contact with the made ground. When considering the proposed development plan, areas of private gardens are not proposed as part of this development and therefore pathway 2 will not be present for this particular site.

7.2.2 Pathways:

In addition, when considering the potential pathways for leachate migration, where either hard cover and/or future surface water drainage systems are present, the potential effects of surface infiltration or contaminated surface water runoff will be greatly reduced.

Similarly, when considering the construction work force, exposure pathways through direct contact, ingestion and dust inhalation will be available during part of the construction process, and therefore appropriate PPE should be provided to protect the work force during this period.

7.2.3 Receptors:

Within the CLEA Risk Assessment Model for Human Health, the potential receptors are assessed initially on site end use, followed by a delineation of age category (i.e. child or adult), with default settings for *Residential*, *Allotment* and *Public Open Space (Park)* end uses based on a child aged 0 to 6 years, *Public Open Space (Residential)* based on a child aged 3 to 9 and *Commercial* end uses based upon an adult working exposure period of up to 49 years (i.e. 16 to 65).

Key generic assumptions for *Residential* and *Public Open Space (Residential)* are based upon a typical residential property, consisting of a two-storey small terraced house, with private garden, and a *Commercial* end use based upon a typical commercial or light industrial property, consisting of a three-storey office building (pre-1970). No buildings are anticipated for *Allotment* or *Public Open Space (Park)* end uses.

Within the CLEA Risk Assessment Model for Human Health there are 6 no. generic end use categories presently in use, as follows:

- 1) *Residential with home-grown produce*, 2) *Residential without home-grown produce*, 3) *Allotments*, 4) *Commercial*
- 5) *Public Open Space – Residential*, 6) *Public Open Space - Park*

When considering the proposed end use of this site (assisted living and care), the Level 1 Risk Assessment has taken the best fit end use category as:

- 2) *Residential without home-grown produce*

Chemtech Environmental Limited SOILS

Lab number	66117(1)-7	66117(1)-8	66117(1)-9	66117(1)-10	66117(1)-11	66117(1)-12
Sample ID	WS06	WS06	WS07	WS08	WS08	WS08
Depth (m)	0.40-0.60	1.00-1.60	0.40-0.60	0.00-0.30	0.30-0.80	1.00-1.20
Date sampled	13/07/2017	13/07/2017	13/07/2017	13/07/2017	13/07/2017	13/07/2017
Test	Method	Units				
EPH (>C16-C21)	CE033 ^M	mg/kg	<4	-	8	17
EPH (>C21-C35)	CE033 ^M	mg/kg	12	-	48	97
EPH (>C35-C44)	CE033 ^M	mg/kg	<10	-	13	32
Bioaccessibility						22
Lead (total)	CE127 ^M	mg/kg Pb	24	-	95	323
Lead (bioaccessible)	CE124	mg/kg Pb	4.2	-	14.9	44.8
Lead (bioaccessible fraction)	CE124	% w/w	17.3	-	15.7	13.9
Subcontracted analysis						
Asbestos (qualitative)	\$	-	NAD	-	NAD	NAD

SOILS

Lab number	66117(1)-7	66117(1)-8	66117(1)-9	66117(1)-10	66117(1)-11	66117(1)-12
Sample ID	WS06	WS06	WS07	WS08	WS08	WS08
Depth (m)	0.40-0.60	1.00-1.60	0.40-0.60	0.00-0.30	0.30-0.80	1.00-1.20
Date sampled	13/07/2017	13/07/2017	13/07/2017	13/07/2017	13/07/2017	13/07/2017
Test	Method	Units				
Arsenic (total)	CE127 ^M	mg/kg As	6.8	12	5.2	5.2
Cadmium (total)	CE127 ^M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2
Chromium (total)	CE127 ^M	mg/kg Cr	99	90	87	87
Chromium (III)	CE127 ^M	mg/kg Cr(III)	99	90	87	87
Chromium (VI)	CE146	mg/kg Cr(VI)	<1	<1	<1	<1
Copper (total)	CE127 ^M	mg/kg Cu	16	28	12	12
Lead (total)	CE127 ^M	mg/kg Pb	24	95	323	320
Mercury (total)	CE127 ^M	mg/kg Hg	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127 ^M	mg/kg Ni	16	17	11	10
Selenium (total)	CE127 ^M	mg/kg Se	0.6	0.8	0.3	0.3
Zinc (total)	CE127 ^M	mg/kg Zn	50	71	112	111
pH	CE004 ^M	units	8.0	7.1	7.5	9.1
Sulphate (2:1 water soluble)	CE061 ^M	mg/l SO ₄	21	25	15	194
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1	<1
Total Organic Carbon (TOC)	CE072 ^M	% w/w C	0.64	3.61	2.78	0.76
PAH						
Acenaphthene	CE087 ^M	mg/kg	0.01	0.02	0.02	<0.01
Acenaphthylene	CE087 ^M	mg/kg	<0.01	<0.01	<0.01	<0.01
Anthracene	CE087 ^M	mg/kg	0.18	0.32	0.17	0.10
Benzo(a)anthracene	CE087 ^M	mg/kg	0.32	0.45	0.42	0.24
Benzo(b)pyrene	CE087 ^M	mg/kg	0.40	0.48	0.51	0.24
Benzo(k)fluoranthene	CE087 ^M	mg/kg	0.46	0.53	0.60	0.26
Benzo(ghi)perylene	CE087 ^M	mg/kg	0.21	0.23	0.29	0.13
Benzo(k)fluoranthene	CE087 ^M	mg/kg	0.20	0.19	0.27	0.12
Chrysene	CE087 ^M	mg/kg	0.42	0.53	0.52	0.28
Dibenz(ah)anthracene	CE087 ^M	mg/kg	0.06	<0.02	0.08	<0.02
Fluoranthene	CE087 ^M	mg/kg	0.83	1.02	1.00	0.49
Fluorene	CE087 ^M	mg/kg	<0.01	0.03	0.02	0.01
Indeno(1,2,3-cd)pyrene	CE087 ^M	mg/kg	0.21	0.23	0.27	0.11
Naphthalene	CE087 ^M	mg/kg	0.16	0.06	0.07	0.03
Phenanthrene	CE087 ^M	mg/kg	0.37	0.42	0.35	0.20
Pyrene	CE087 ^M	mg/kg	0.73	0.91	0.92	0.46
PAH (total of USEPA 16)	CE087 ^M	mg/kg	4.58	5.31	5.53	2.68
Benzo(j)fluoranthene	CE087 ^M	mg/kg	0.06	0.05	0.07	0.03
PAH (total of OIL 8)	CE087 ^M	mg/kg	2.13	2.46	2.75	1.29
TPH						
VPH (>C5-C7)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1
VPH (>C7-C8)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1
VPH (>C8-C10)	CE067	mg/kg	<0.1	<0.1	<0.1	<0.1
EPH (>C10-C12)	CE033 ^M	mg/kg	<4	<4	<4	<4
EPH (>C12-C16)	CE033 ^M	mg/kg	<4	5	<4	<4

7.0 Ground Contamination Risk Assessment (Cont'd)

7.3 Screening Strategy:

Representative samples of the topsoil and made ground were screened using a standard generic contamination suite (metals, metalloids and non-organics), which is used to assess typical made ground (disturbed natural strata mixed with anthropogenic debris) of an unknown source.

Whilst there was no evidence of hydrocarbon impacted soils, selected samples have been screened for speciated PAH's and speciated TPH's (8 carbon band split) in order to determine any potential risks, and also to enable these materials to be assessed for the purposes of off-site disposal.

In addition, although no potential ACM's were noted within any of the exploratory positions or any of the materials sampled, screening for the presence of asbestos has been undertaken in order to determine any potential risks.

When considering the environmental, hydrogeological and hydrological setting of the site, and the findings of the investigation works, it is not felt necessary to carry out leachate/groundwater screening in order to determine if potential contamination on this site represents a potential risk to Controlled Waters or adjacent sites.

7.4 Level 1 Generic Quantitative Risk Assessment - Human Health:

7.4.1 Made Ground Contamination Screening:

The metals, metalloids, non-organics, speciated PAH and speciated TPH results have been risk assessed by comparing the maximum values recorded for each analyte to the critical concentration values identified in the Generic Assessment Criteria (GAC) chosen for this site. The results have identified the following:

- The maximum concentration (C_M) values for lead exceeds the critical concentration (C_C) values for this site. However, additional bio-accessibility testing has been undertaken to assess the direct uptake risk posed by this exceedance (see section 7.4.3)
- None of the remaining C_M values exceed the C_C values taken for this site.

Table 7.2

Analyte	Critical Conc. (C_C)	No. of Samples Screened	Max. Conc. (C_M) Recorded	Has C_M exceeded C_C	No. of Samples C_C
Arsenic	40 ⁽¹⁾	12	24	No	0
Cadmium	85 ⁽¹⁾	12	0.3	No	0
Chromium III	910 ⁽¹⁾	12	142	No	0
Chromium VI	6 ⁽¹⁾	12	<1	No	0
Copper	7,100 ⁽²⁾	12	57	No	0
Lead	310 ⁽²⁾	12	360	YES	3
Mercury	56 ⁽¹⁾	12	0.6	No	0
Nickel	180 ⁽¹⁾	12	25	No	0
Selenium	430 ⁽¹⁾	12	2.7	No	0
Zinc	40,000 ⁽¹⁾	12	112	No	0
Cyanide	34 ⁽³⁾	12	<1	No	0



7.0 Ground Contamination Risk Assessment (Cont'd)

7.4 Level 1 Generic Quantitative Risk Assessment - Human Health (Cont'd):

7.4.1 Made Ground Contamination Screening (Cont'd):

Table 7.2 (Cont'd)

Analyte	Critical Conc. (C _d)	No. of Samples Screened	Max. Conc. (C _m) Recorded	Has C _m exceeded C _d	No. of Samples > C _d
Speciated PAH's					
Acenaphthene	4,700 ⁽⁹⁾	12	0.06	No	0
Acenaphthylene	4,600 ⁽⁹⁾	12	0.05	No	0
Anthracene	35,000 ⁽⁸⁾	12	0.33	No	0
Benzo(a)anthracene	140 ⁽¹⁾	12	0.64	No	0
Benzo(a)pyrene	3,20 ⁽⁹⁾	12	0.67	No	0
Benzo(b)fluoranthene	40 ⁽¹⁾	12	0.70	No	0
Benzo(k)fluoranthene	3,600 ⁽¹⁾	12	0.35	No	0
Chrysene	1100 ⁽¹⁾	12	0.33	No	0
Dibenz(a,h)anthracene	310 ⁽¹⁾	12	0.71	No	0
Fluorene	0.320 ⁽¹⁾	12	0.11	No	0
Indeno(1,2,3cd)pyrene	1,600 ⁽⁹⁾	12	1.44	No	0
Naphthalene	3,800 ⁽⁹⁾	12	0.09	No	0
Phenanthrene	460 ⁽¹⁾	12	0.35	No	0
Pyrene	130 ⁽¹⁾	12	0.16	No	0
	1,500 ⁽⁹⁾	12	0.85	No	0
	3,800 ⁽⁹⁾	12	1.27	No	0
Speciated TPH's					
TPH (C5-C7)	1600 ⁽⁹⁾	12	<0.1	No	0
TPH (C7-C8)	3900 ⁽⁹⁾	12	<0.1	No	0
TPH (C8-C10)	2700 ⁽¹⁾	12	<0.1	No	0
TPH (C10-C12)	1200 ⁽⁹⁾	12	14	No	0
TPH (C12-C16)	2500 ⁽⁹⁾	12	126	No	0
TPH (C16-C21)	1900 ⁽⁹⁾	12	703	No	0
TPH (C21-C35)	1900 ⁽⁹⁾	12	1259	No	0
TPH (C35-C44)	1900 ⁽⁹⁾	12	275	No	0

$\pi = \text{ICM SeLH's (2014 \& 2015)}$ – Potential either from grain products most sensitive. No/No value used – based on the SOM. $\sigma = \text{CI_AIRP_CASI's}$ – Relative without home grown produce, $\theta = \text{ATRISK}_{\text{SOIL}}$, SSV, Bold = result exceeds critical concentration, Note = All units are mg/kg

7.4.4.2 Made Ground - Asbestos Screening:

The results have identified the following:

- As can be seen from the results, the samples screened have not identified the presence of any asbestos fibres.
- Consequently, there is no requirement for removal, treatment, protection measures and/or further risk assessment in order to protect the existing end users (i.e. no risk to human health) from potential Asbestos fibres.

Chemtech Environmental Limited
SOILS

Lab number	66117(1)-1	66117(1)-2	66117(1)-3	66117(1)-4	66117(1)-5	66117(1)-6
Sample id	WS01	WS02	WS03	WS03	WS04	WS05
Depth (m)	0.50-1.00	0.60-0.80	0.30-0.60	0.60-1.00	0.10-0.40	0.40-0.60
Date sampled	14/07/2017	14/07/2017	13/07/2017	13/07/2017	13/07/2017	13/07/2017
Test	Method	Units				
EPH (>Cl-6-Cl2)	CE033 * ^a	mg/kg	703	110	5	39
EPH (>Cl-1-Cl3)	CE033 * ^a	mg/kg	1259	355	34	39
EPH (>Cl-3-Cl4)	CE033 *	mg/kg	275	122	28	29
Bioaccessibility						
Lead (total)	CE127 * ^a	mg/kg Pb	64	360	117	19
Lead (bioaccessible)	CE124	mg/kg Pb	13.7	52.6	19.4	3.5
Lead (bioaccessible fraction)	CE124	% w/w	21.2	14.6	16.6	18.0
Subcharacterised analysis						
Asbestos (qualitative)	\$	*	NAD	NAD	NAD	NAD

SOILS

Lab number	Sample id	Depth (m)	Date sampled	Method	Units	66117(1)-1	66117(1)-2	66117(1)-3	66117(1)-4	66117(1)-5	66117(1)-6
						WS01	WS02	WS03	WS04	WS05	WS06
						0.50-1.00	0.60-0.80	0.60-1.00	0.10-0.40	0.40-0.60	0.40-0.60
						14/07/2017	13/07/2017	13/07/2017	13/07/2017	13/07/2017	13/07/2017
Test	Method	Units	66117(1)-1	66117(1)-2	66117(1)-3	66117(1)-4	66117(1)-5	66117(1)-6	66117(1)-7	66117(1)-8	66117(1)-9
Asbestos (total)	CE127	mg/kg As	-	16	24	-	-	16	5.3	-	-
Cadmium (total)	CE127	mg/kg Cd	-	<0.2	0.3	-	-	0.3	<0.2	-	-
Chromium (total)	CE127	mg/kg Cr	-	98	89	-	-	97	99	-	-
Chromium (III)	-	mg/kg Cr(III)	-	98	89	-	-	97	99	-	-
Chromium (VI)	CE146	mg/kg Cr(VI)	-	<1	<1	-	-	<1	<1	-	-
Copper (total)	CE127	mg/kg Cu	-	39	57	-	-	29	18	-	-
Lead (total)	CE127	mg/kg Pb	-	64	360	-	-	117	19	-	-
Mercury (total)	CE127	mg/kg Hg	-	<0.5	0.6	-	-	<0.5	<0.5	-	-
Nickel (total)	CE127	mg/kg Ni	-	18	25	-	-	14	12	-	-
Selenium (total)	CE127	mg/kg Se	-	0.8	1.0	-	-	0.6	0.6	-	-
Zinc (total)	CE127	mg/kg Zn	-	49	108	-	-	244	44	-	-
pH	CE004	units	7.8	7.9	7.9	8.6	8.1	8.2	<10	-	-
Sulphate (2:1 water soluble)	CE061	mg/l SO ₄	<10	23	37	<10	34	<10	<1	-	-
Cyanide (free)	CE077	mg/kg CN	-	<1	<1	-	-	<1	<1	-	-
Total Organic Carbon (TOC)	CE072	% w/w C	-	5.00	9.19	-	3.32	0.59	0.59	-	-
PAH	Method	Units	66117(1)-1	66117(1)-2	66117(1)-3	66117(1)-4	66117(1)-5	66117(1)-6	66117(1)-7	66117(1)-8	66117(1)-9
Acenaphthene	CE087	mg/kg	-	0.06	<0.01	-	<0.01	<0.01	<0.01	-	-
Acenaphthylene	CE087	mg/kg	-	0.05	<0.01	-	<0.01	<0.01	<0.01	-	-
Anthracene	CE087	mg/kg	-	0.33	0.04	-	0.05	<0.02	<0.02	-	-
Benzo(a)anthracene	CE087	mg/kg	-	0.64	<0.02	-	<0.02	<0.02	<0.02	-	-
Benzo(a)pyrene	CE087	mg/kg	-	0.67	<0.02	-	<0.02	<0.02	<0.02	-	-
Benzo(b)fluoranthene	CE087	mg/kg	-	0.70	<0.02	-	<0.02	<0.02	<0.02	-	-
Benzo(ghi)perylene	CE087	mg/kg	-	0.35	<0.02	-	0.03	<0.02	<0.02	-	-
Benzo(k)fluoranthene	CE087	mg/kg	-	0.33	<0.02	-	<0.02	<0.02	<0.02	-	-
Chrysene	CE087	mg/kg	-	0.71	<0.01	-	0.07	<0.01	<0.01	-	-
Dibenz(a,h)anthracene	CE087	mg/kg	-	0.11	<0.02	-	<0.02	<0.02	<0.02	-	-
Fluoranthene	CE087	mg/kg	-	1.44	<0.02	-	0.12	<0.02	<0.02	-	-
Fluorene	CE087	mg/kg	-	0.09	<0.01	-	<0.01	<0.01	<0.01	-	-
Indene(123cd)pyrene	CE087	mg/kg	-	0.35	<0.02	-	<0.02	<0.02	<0.02	-	-
Naphthalene	CE087	mg/kg	-	0.13	<0.01	-	0.02	<0.01	<0.01	-	-
Phenanthrene	CE087	mg/kg	-	0.85	<0.02	-	0.06	<0.02	<0.02	-	-
Pyrene	CE087	mg/kg	-	1.27	0.05	-	0.13	<0.02	<0.02	-	-
PAH (total of USEPA 16)	CE087	mg/kg	-	8.07	<0.27	-	0.47	<0.27	<0.27	-	-
Benzo(j)fluoranthene	CE087	mg/kg	-	0.09	<0.02	-	<0.02	<0.02	<0.02	-	-
PAH (total of OIL 8)	CE087	mg/kg	-	3.60	<0.15	-	<0.15	<0.15	<0.15	-	-
TPH	Method	Units	66117(1)-1	66117(1)-2	66117(1)-3	66117(1)-4	66117(1)-5	66117(1)-6	66117(1)-7	66117(1)-8	66117(1)-9
VPH (>C5-C7)	CE057	mg/kg	-	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	-
VPH (>C7-C8)	CE057	mg/kg	-	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	-
VPH (>C8-C10)	CE057	mg/kg	-	<0.1	<0.1	-	<0.1	<0.1	<0.1	-	-
EPH (>C10-C12)	CE033	mg/kg	-	5	4	-	<4	<4	14	-	-
EPH (>C12-C16)	CE033	mg/kg	-	126	25	-	<4	<4	16	-	-

7.0 Ground Contamination Risk Assessment (Cont'd)

7.4 Level 1 Generic Quantitative Risk Assessment - Human Health (Cont'd):

7.4.2 Made Ground - Asbestos Screening (Cont'd):

Table 7.4

Position	Depth (m)	Chrysotile (white)	Amosite (brown)	Crocidolite (blue)	Anthophyllite	Actinolite	Tremolite
WS02	0.60-0.80	NAD	NAD	NAD	NAD	NAD	NAD
WS03	0.30-0.60	NAD	NAD	NAD	NAD	NAD	NAD
WS04	0.10-0.40	NAD	NAD	NAD	NAD	NAD	NAD
WS05	0.40-0.60	NAD	NAD	NAD	NAD	NAD	NAD
WS06	0.40-0.60	NAD	NAD	NAD	NAD	NAD	NAD
WS07	0.40-0.60	NAD	NAD	NAD	NAD	NAD	NAD
WS08	0.00-0.30	NAD	NAD	NAD	NAD	NAD	NAD
WS09	0.30-0.80	NAD	NAD	NAD	NAD	NAD	NAD
WS09	0.00-0.40	NAD	NAD	NAD	NAD	NAD	NAD
WS09	0.40-1.00	NAD	NAD	NAD	NAD	NAD	NAD

NAD = No Asbestos detected, Y = Asbestos Identified, N = Asbestos not identified

7.4.3 Lead Bio-accessibility Testing

Due to the exceedances noted for lead in the made ground contamination screening, additional Lead Bio-Accessibility Testing was undertaken by Chemtech Environmental of Stanley, Co. Durham. The catalogue of additional testing results can be found in the Chemtech Analytical Report (ref no:66117 (1)), a copy of which is contained in Appendix IV, and the total analysis carried out is summarised below:

Position	Depth (m)	Strata	Total Lead (mg/kg)	Bioaccessible Fraction (% w/w)	Bioaccessible Lead (mg/kg)	Exceeds C _c
WS02	0.60-0.80	MG	64	21.2	13.7	NO
WS03	0.30-0.60	MG	360	14.6	52.6	NO
WS04	0.10-0.40	MG	117	16.6	19.4	NO
WS05	0.40-0.60	MG	19	18.0	3.5	NO
WS06	0.40-0.60	NAT	24	17.3	4.2	NO
WS07	0.40-0.60	MG	95	15.7	14.9	NO
WS08	0.00-0.30	MG	323	13.9	44.8	NO
WS08	0.30-0.80	MG	310	15.0	48.0	NO
WS09	0.00-0.40	MG	123	13.6	16.7	NO
WS09	0.40-1.00	MG	28	19.3	5.3	NO

The bio-accessibility test simulates the human digestive processes in the stomach and digestive tract to determine what fraction of the Lead contamination is truly available by biological digestion.

The results indicate the following: -

- The bio-accessible fraction of Lead does not exceed the critical concentration value for this analyte.
- From the results of this testing, the bio-accessible fraction of Lead recorded within the made ground present on this site does not represent a risk to human health and these materials can remain within the garden area without the need for removal or the implementation of clean cover.

Precautions will need to be taken with regards to protect the health of construction workers during any groundwork preparation. These will include, suitable PPE (typically dust masks, disposable overalls, etc.).

Report Type:- Phase 2: Ground Investigation Report

Project:- 17-401 Barnes Close, Barnsley

Prepared For:- McCarthy & Stone Retirement Lifestyles Ltd.



8.0 Conclusions & Recommendations

8.1 Ground Conditions:

From the investigation works completed, made ground was recorded to depths of between c.0.45m to c.1.00m below current ground levels (bogl). The made ground comprised variable surface coverings with associated sub base materials, underlain by a dark brown sandy gravely clay with fragments of brick, concrete and sandstone.

No superficial deposits were encountered.

The underlying weathered bedrock deposits generally comprised an extremely weak weathered sandstone, to depths of between c.1.00m to c.1.60m bogl overlying a very weak brown fine to medium grained sandstone, proven to depths of between c.1.67m to c.2.20m.

There was no significant visual or olfactory evidence of hydrocarbon contamination (fuel/oil), or potential asbestos containing materials (ACM's) within any of the investigation positions. However, ash² materials were noted in the made ground in WS03.

8.0 Conclusions & Recommendations (Cont'd)

8.2 Groundwater

During the investigation period, no groundwater was encountered in any of the exploratory borehole locations.

Within the groundwater monitoring wells, standing water levels were recorded in all boreholes, between c.1.95m and c.2.08m.

Therefore, when foundation and drainage excavations are undertaken which extend down to and below the depths of where groundwater has been recorded, an allowance for the introduction of groundwater control measures (i.e. sump pumping equipment) and adequate excavation support should be allowed, in order to take care of any localised ingresses of groundwater during the construction period, and especially during the wetter periods of the year.

Falling head testing will be undertaken within the future monitoring visits to determine the suitability of the ground for soakaways and this information will be included in as an addendum when completed.

8.3 Hazardous Ground Gas Risk Assessment

From the results of the gas monitoring visits completed on site to date, no detectable concentrations of Methane (CH₄) have been recorded. Concentrations of Carbon Dioxide (CO₂) have been recorded up to a maximum level of 0.6%, with negligible flow rates being recorded (<0.11/hr) on all occasions.

Based on these results, it is felt that the site can initially be assessed as Characteristic Situation 1 (CS1), and Green in accordance with the NHBC Traffic Light System, indicating that no gas protection would be required for the proposed residential development, assuming that there are no significant changes in the gas concentrations or flow rates compared to those already recorded. This characterisation will be reassessed following the completion of the remaining 4 no. gas monitoring visits and issued as an addendum Letter Report.

Chemtech Environmental Limited SAMPLE INFORMATION

MCERTS (Solids):

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
66117(1)-1	WS01	0.50-1.00	Sandy Clay with Gravel	-	-	11.2
66117(1)-2	WS02	0.60-0.80	Loamy Clay with Gravel & Coal	-	-	15.6
66117(1)-3	WS03	0.30-0.60	Loamy Clay with Gravel & Coal	-	-	16.2
66117(1)-4	WS03	0.60-1.00	Sandy Clay with Gravel	-	-	12.2
66117(1)-5	WS04	0.10-0.40	Sandy Clay with Gravel	-	-	15.1
66117(1)-6	WS05	0.40-0.60	Sandy Clay with Gravel	-	-	10.7
66117(1)-7	WS06	1.00-1.60	Sandy Clay with Gravel	-	-	11.1
66117(1)-8	WS06	1.00-1.60	Sandy Clay with Gravel	-	-	12.9
66117(1)-9	WS07	0.40-0.60	Loamy Sandy Clay with Gravel	-	-	14.2
66117(1)-10	WS08	0.00-0.30	Loam with Roots	-	-	14.2
66117(1)-11	WS08	0.30-0.80	Loamy Sand with Gravel & Brick	-	-	5.6
66117(1)-12	WS08	1.00-1.20	Sand with Gravel	-	-	9.5
66117(1)-13	WS09	0.00-0.40	Loam with Roots	-	-	9.9
66117(1)-14	WS09	0.40-1.00	Sand with Shingle & Gravel	-	-	8.2



ANALYTICAL TEST REPORT

Contract no: 66117(1)
Contract name: Berwessal Close, Barnsley
Client reference: 17-401
Clients name: ARC Environmental
Clients address: Solum House, Unit 1 Elliott Court
St Johns Road
Meadowfield
DH7 8PN

Samples received: 19 July 2017
Analysis started: 02 August 2017
Analysis completed: 10 August 2017
Report issued: 10 August 2017

This is a supplementary report to report number 66117 issued 26 July 2017.

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope. Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling. Methods, procedures and performance data are available on request. Results reported herein relate only to the material supplied to the laboratory. This report shall not be reproduced except in full, without prior written approval. Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:
U UKAS accredited test
M MCERTS & UKAS accredited test
\$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing

Approved by:

Dave Bowerbank
Customer Services Co-ordinator

8.0 Conclusions & Recommendations (Cont'd)

8.4 Foundation Options:

Based on the information gained from these intrusive investigation works, it is felt that conventional strip and pad foundations can be utilised, based within the weathered sandstone deposits below the building footprint, and can be designed to an allowable bearing pressure of 150kN/m². Foundations should be maintained at depths of 0.60m below finished ground levels to maintain frost protection.

However, where the new build encroaches upon former basement areas, then deeper trench fill will be required to reach undisturbed rock.

During the construction phase, it would be beneficial for a suitably qualified Geotechnical Engineer / Engineering Geologist to attend site in order to confirm the correct founding strata has been achieved within all foundation excavations, as some variations have been duly noted.

From the results of the pH and soluble sulphate testing, it can be seen that future foundations and buried concrete should be constructed utilising a concrete design class of DS-1 and ACEC class of AC-1.

8.5 Ground Contamination:

Made Ground

From the results of the contamination screening carried out and the Level 1 Risk Assessments (Section 7.0) undertaken, the results have not identified any elevated levels within the made ground materials and as such topsoil and shallow made ground present do not pose a significant risk to human health.

Off-Site Disposal

If during future development works, any excavated materials are to be discarded and removed from this site as a waste to landfill, these materials will need to be classified in accordance with the 'Guidance on the Classification and Assessment of Waste (1st Edition 2015) - Technical Guidance WM3'.

Where possible, removal of materials from site as a 'waste' should be kept to a minimum and ideally excavated materials should all be reused on site. However, if excavated materials must be discarded it should be noted that additional analysis and screening is likely to be required once each specific waste stream has been identified and the volume of material to be disposed of has been calculated, since the amount of screening required, including any pre-disposal WAC screening, will be dependent upon the final volume of material to be disposed of.

Construction Workforce

When considering the risks to any future maintenance or construction workforce, appropriate PPE should be provided to protect against the levels of potential contaminants recorded during these investigation works. Similarly, the results can also be used by the Main Contractor / Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations. For further guidance reference should be made to the Health and Safety Executive (HSE) document EH40/2005 (2nd Edition, 2011) Workplace exposure limits.



8.0 Conclusions & Recommendations (Cont'd)

8.6 General Comments:-

Bearing in mind the nature of the materials encountered on this site, as well as the presence of shallow groundwater seepages and ingresses, lateral trench support will be required for excavations, including drainage, service runs, tank removal, etc., in order to prevent trench wall collapse or over excavation, as well as to provide a safe working environment below a depth of 1.20m. Reference to CIRIA 97 'Trenching Practice' would be beneficial to establish a suitable means of support or battering of excavation sides during construction.

It should be noted that the natural strata below the site is likely to be susceptible to weathering when exposed to the natural elements, and any excavations on this site should remain open for as short a period as possible, since some of these materials may be susceptible to deterioration, if left open to the natural elements even for short periods of time.

It is also recommended for any new developments, adequate surface drainage should be designed and installed by a competent contractor, in order to prevent surface water 'ponding' or collection, during and post construction, particularly where existing surface drainage systems are disrupted or damaged.

Furthermore, for deeper excavations, drainage, service runs or the like that may pass close to or beneath any proposed new foundations, these should be undertaken with care and completed prior to the preparation of any new foundations, so as not to allow any loose or granular material to move or 'flow', thus causing settlement to occur to any new foundations based at a higher level.

From the findings of the Phase 1: Desk Top Study Report, this site is not considered to be at risk from radon gas exposure and therefore protection measures are not required with respect to this issue for this development. The site is also not considered to be at risk from future instability issues associated with shallow coal mining activities.

An "observational technique" can be applied to the design and construction of this site, and where ground conditions seem to vary from that indicated from the conceptual ground model derived from works to date, then advice from a suitably qualified Engineering Geologist/Geotechnical Engineer should be sought.

END OF REPORT



APPENDIX IV

Laboratory testing Results

Contamination Testing Results: Chemtech, 66117 (1)

Valid	Date	Type	Equipment	Weather	Notes	Comments	Depth to Water (m bgl)	CO	H ₂	CH ₄	Other Gases (PPM)	Depth to Water (m bgl)
1	21/07/2017	1.05m	GP4410	Overcast	RC		1.95					1.95
2	02/08/2017	2.10m	GP4410	Light Rain	RC		2.00					2.00
3												
4												
5												
6												

GENERAL REFERENCES

- Arc Environmental Ltd, Geo-Environmental Desk Top Study Report, 17-401, March 2017
- DoE, DEFRA & EA - Contaminated Land Reports
- CLR 1: A framework for assessing the impact of contaminated land on groundwater and surface water. Report by Aspinwall & Co. Volumes 1 & 2. DoE, 1994.
- CLR 2: Guidance on preliminary site inspection of contaminated land. Report by Applied Environmental Research Centre Ltd. Volume 1. DoE, 1994.
- CLR 3: Documentary research on industrial sites. Report by RPS Group plc. DoE, 1994.
- CLR 4: Sampling strategies for contaminated land. Report by The Centre for Research into the Built Environment, The Nottingham Trent University. DoE, 1994.
- CLR 5: Information systems for land contamination. Report by Mera Genetics Ltd. DoE, 1994.
- CLR 6: Prioritisation & categorisation procedure for sites which may be contaminated. Report by M J Carter Associates. DoE, 1995.
- CLR11: Model Procedures for the Management of Land Contamination. DEFRA/EA, 2004.
- Science Report Final SC050021/SR2: Human Health Toxicological Assessment of Contaminants in Soils, 2009.
- Science Report Final SC050021/SR3: Updated Technical Background to the CLEA Model, 2009.
- Science Report SC050021/SR4: CLEA software (version 1.05) handbook, 2009.
- BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution (BS 1377-9:1990 is partially superseded by BS EN 1997-2: 2007)
- BS 5930: 2015: Code of Practice for Ground Investigations. British Standards Institution
- BS10175:2011 + A1:2013: Investigation of potentially contaminated sites – Code of practice
- BS EN 1997-1: 2004: Eurocode 7 - Geotechnical design. Part 1: General rules. British Standards Institution
- BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design. Part 2: Ground investigation and testing. British Standards Institution
- BS EN ISO 9001: 2000: Quality Management Systems - requirements. British Standards Institution
- BS EN ISO 14688-1: 2002: Geotechnical investigation and testing. Identification and classification of soil. Identification and description.
- BS EN ISO 14688-2: 2004: Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification.
- BS EN ISO 14689-1: 2003: Geotechnical investigation and testing - Identification and classification of rock. Identification and description. British Standards Institution. Amended 2007 (Partially superseded BS 5930:1999)
- BS EN ISO 22476-3: 2005 + A1: 2011: Geotechnical investigation and testing. Field testing. Standard penetration test. British Standards Institution
- BS837: 2012: Trees in relation to design, demolition and construction - recommendations
- NIHBC Standards 2007: Chapter 4.2 – Building near trees
- BRE Special Digest 1 2005: Concrete in Aggressive Ground 3rd Edition
- Guidance for the Safe Development of Housing on Land Affected by Contamination, R&D66, 2008 (NIHBC, EA, CIEH)
- Asbestos in soil and made ground: a guide to understanding and managing risks, CIRIA C733, 2014
- Assessing Risks Posed by Hazardous Ground Gases to Buildings, CIRIA C665, 2007
- Methane and Associated Hazards to Construction - CIRIA Reports 149/150/151 & 152
- BS8485: 2015: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings
- BS8576:2013: Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds
- Guidance on Comparing Soil Contamination Data with Critical Concentrations, CL:AIRE/CIEH, May 2008



APPENDIX I

Site Location Plan

Aerial Photographs

Existing and Proposed Site Layout Plans.



APPENDIX III

Insitu Testing (Gas & Groundwater Monitoring Certificate)



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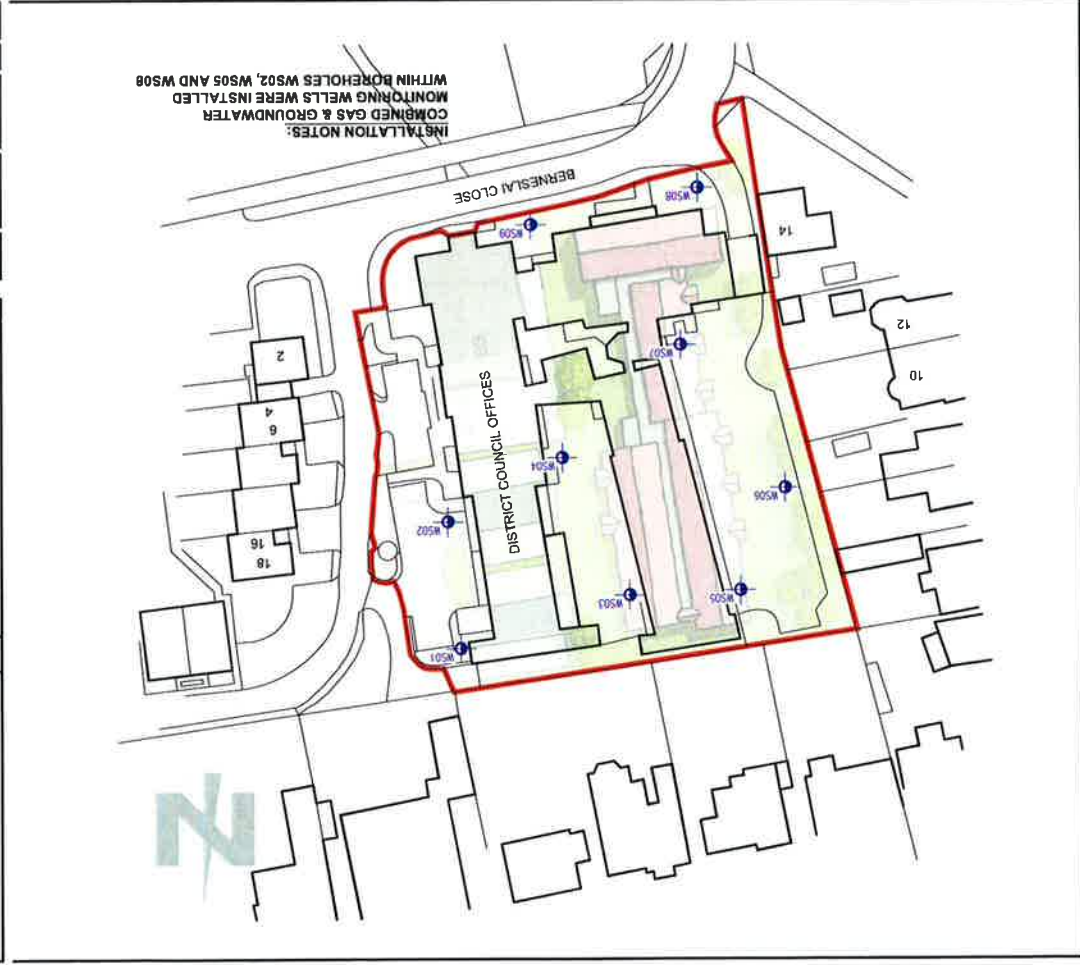
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LEGEND

- WINDOWLESS SAMPLES
- APPROXIMATE SITE BOUNDARY
- BORING LOCATION PLAN

CLIENT: MCCARTHY & STONE (RETIREMENT LIFESTYLES) LIMITED
PROJECT TITLE: Proposed Sheltered Accommodation
LOCATION: Barnsley Metropolitan Borough Council Offices
PROPOSED SHELTERED ACCOMMODATION: Barnsley Close, Barnsley, South Yorkshire, S70 2HS
DRAWING TITLE: Borehole Location Plan
SCALE: 1:20,000 @ A4
DATE: 17-401





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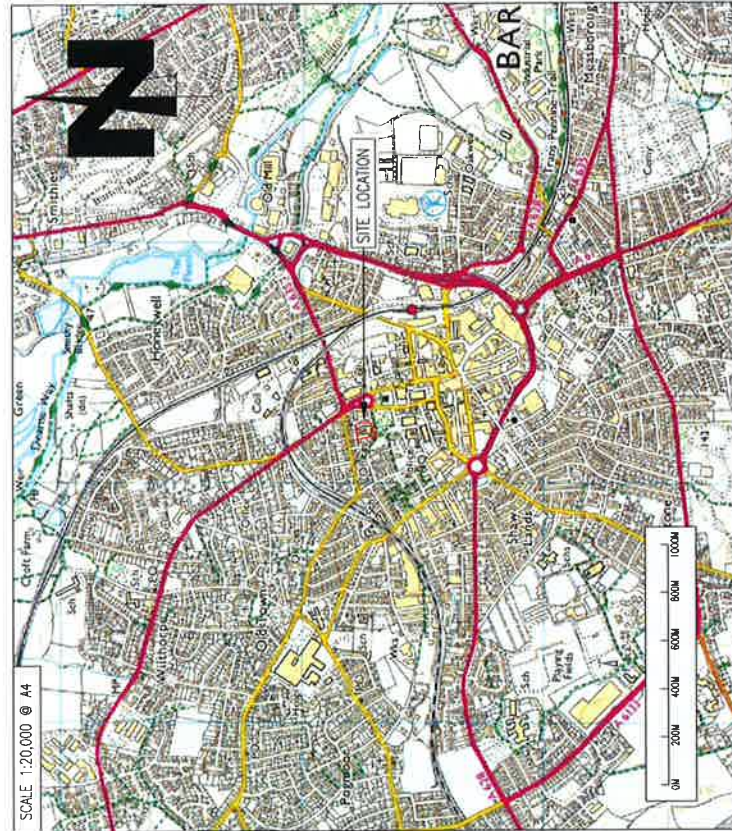
Project Title: Proposed Sheltered Accommodation
Location: Barnsley Metropolitan Borough Council Offices, Barnsley Close
Drawing Title: Location Plan
Drawing Number: 17-401
Revision:

Drawn by: P.D.
Date: 30.05.17
Scale at A4: As Shown

Checked by: A.M.
Approved by: A.M.

The contractor shall ensure that all drawings are up to date and that any amendments are made in accordance with the drawing.

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SCALE: 1:20,000 @ A4

Map Labels: Barnsley, Barnsley Close, District Council Offices, Borehole Locations (WS01-WS08), Installation Notes.



ARC ENVIRONMENTAL LTD
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Durham, DH7 8PN
Tel: (0191) 378 6380
Fax: (0191) 378 0484
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web: www.arc-environmental.com

The contractor shall check all dimensions on site before commencement of any work. No dimensions to be scaled off the drawing.
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LEGEND	
APPROXIMATE SITE BOUNDARY	

Client: **MCCARTHY & STONE (RETIREMENT LIFESTYLES) LIMITED**

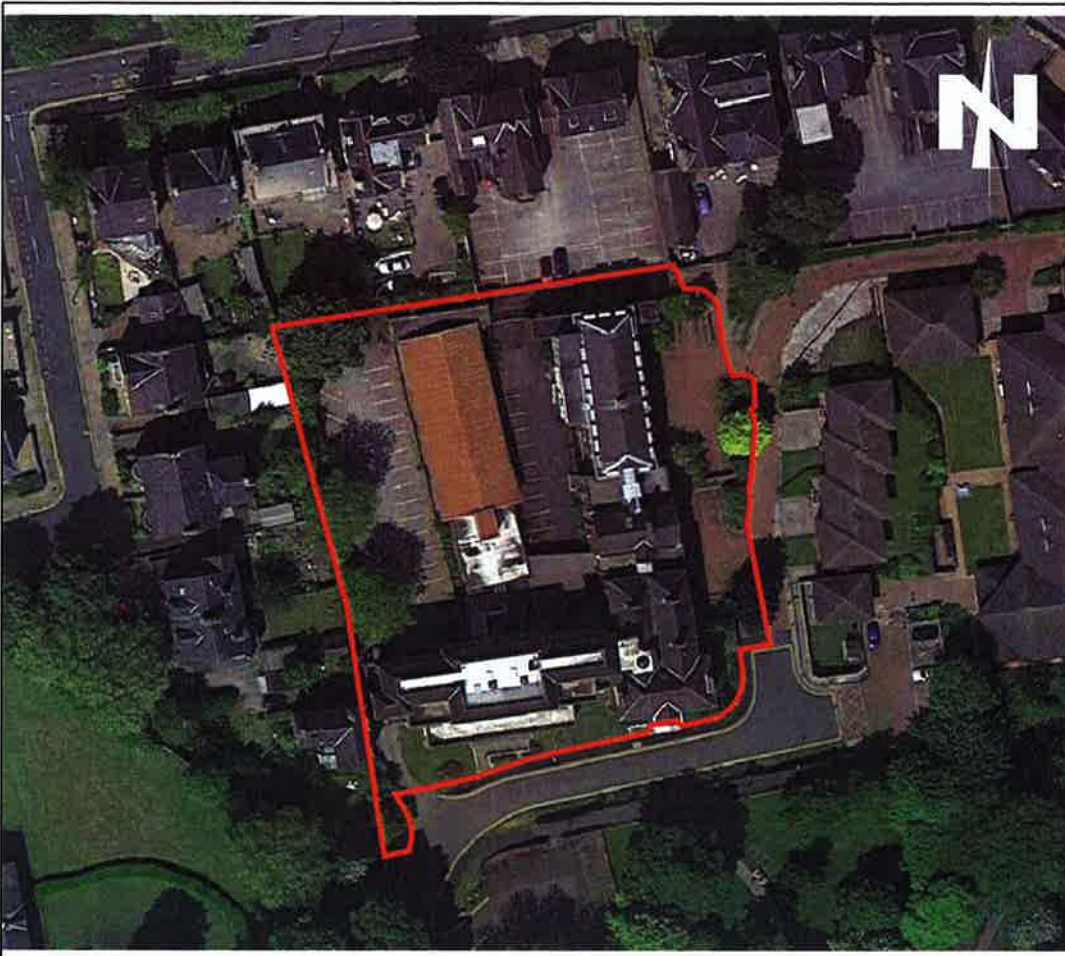
Project Title: **Proposed Sheltered Accommodation**
Barnsley Metropolitan Borough Council Offices
Barnesdale Close, Barnsley, South Yorks., S70 2HS

Drawing Title: **Aerial Photograph**

Scale of A3: 1:3000
N15 @ A3: 30.05.17

1. Drawn by: A.M.
1. Checked by: A.M.

Job Ref: 17-401



Solihull House, Unit 1 Elliott Court
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Durham, DH7 8PN
Telephone: 0191 378 6380

BOREHOLE LOG

BOREHOLE No

WS09

Project	Barnesdale Close, Barnsley	Date	14-07-17	Ground Level (m)	C-o-Ordinate (i)	Sheet	1 of 1
Job No	17-401						
Contractor	Arc Environmental Ltd						

SAMPLES & TESTS

Depth

Type

Test

Result

Water

Geology

0.00-0.40

J/D

Reduced Level

Legend

Depth (Thick)

DESCRIPTION

Instrument/Backfill

0.40-1.00

B

(0.40)

(0.60)

1.00

Extremely weak yellowish brown mottled orange staining weathered SANDSTONE

1.00-2.00

B

N=10

(1.20)

2.20

7.5 Blows

2.00-2.20

SPT

Blows

From

To

Hours

From

To

Date

Time

Depth

Water

Chiselling

Water Added

GENERAL REMARKS

1. WATER: No groundwater encountered. 2. Borehole backfilled with arisings

Method/ C130 Windowless Sampling

Plan Used

Rig

Logged By

SAB

Client

McCarthy & Stone Retirement Lifestyles Ltd

All dimensions in metres

Scale 1:18.75

Method/ C130 Windowless Sampling

Plan Used

Rig

Logged By

SAB

Client

McCarthy & Stone Retirement Lifestyles Ltd

Method/ C130 Windowless Sampling

Plan Used

Rig

Logged By

SAB

Method/ C130 Windowless Sampling

Plan Used

Rig

Logged By

SAB

Client

McCarthy & Stone Retirement Lifestyles Ltd

Method/ C130 Windowless Sampling

Plan Used

Rig

Logged By

SAB

Client

McCarthy & Stone Retirement Lifestyles Ltd

Method/ C130 Windowless Sampling

Plan Used

Rig

Logged By

SAB

Client

McCarthy & Stone Retirement Lifestyles Ltd

Method/ C130 Windowless Sampling

Plan Used

Rig

Logged By

SAB

Client

McCarthy & Stone Retirement Lifestyles Ltd

Method/ C130 Windowless Sampling

Plan Used

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McCarthy & Stone Retirement Lifestyles Ltd

Method/ C130 Windowless Sampling

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McCarthy & Stone Retirement Lifestyles Ltd

Method/ C130 Windowless Sampling

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Method/ C130 Windowless Sampling

Plan Used

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Client

McCarthy & Stone Retirement Lifestyles Ltd

Method/ C130 Windowless Sampling

Plan Used

Rig

Logged By

SAB

Client

McCarthy & Stone Retirement Lifestyles Ltd



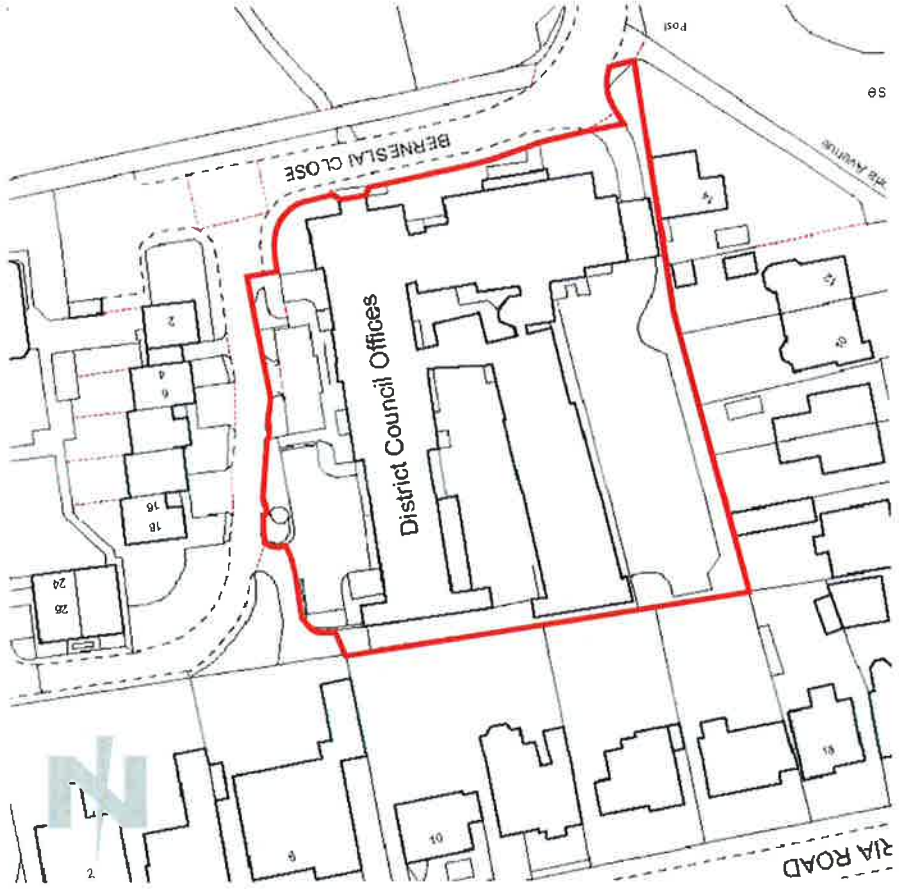
Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913785380

BOREHOLE LOG

Project				BOREHOLE NO					
Berneslai Close, Barnsley				WS08					
Job No	17-401	Date	13-07-17	Ground Level (m)	Co-Ordinates ()				
Contractor				Sheet					
Arc Environmental Ltd				1 of 1					
SAMPLES & TESTS				STRATA					
Depth	Type	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Geology	Instrument/Backfill
0.00-0.30	J/D					(0.30)	Grass over dark brown TOPSOIL (MADE GROUND)		
0.30-0.80	J/D					0.30	Brown sandy gravelly CLAY. Gravel is fine to coarse brick fragments (MADE GROUND)		
0.80-1.00	B					0.80	Extremely weak light brown weathered SANDSTONE.		
1.00-1.20	B	N-25				(0.40)			
1.00-1.45	SPT					1.20	Very weak yellowish brown occasionally stained orange partially weathered SANDSTONE.		
1.20-1.80	B					(0.64)			
1.80-1.84	SPT	75 Blows				1.84			
Boring Progress and Water Observations				Chiselling		Water Added		GENERAL REMARKS	
Date	Time	Depth	Water Depth	From	To	Hours	From	To	
									1. WATER: No groundwater encountered. 2. Borehole installed with monitoring installation.
All dimensions in metres Scale 1:18.75				Client		Method/ C130 Windowless Sampling Rig		Logged By	
McCarthy & Stone Retirement Lifestyles Ltd				SAB				SAB	

AG53 JH BH 17-401 L005.dwg AG53 ALL DBT 18/7/17

ARC ENVIRONMENTAL LTD		McCarthy & Stone	
Solum House Unit 1 Elliott Court St Johns Road Durham, DH7 8PN Tel: (0191) 378 6380 Fax: (0191) 378 6494 e-mail: admin@arc-environmental.com web: www.arc-environmental.com		Proposed Sheltered Accommodation Barnsley Metropolitan Borough Council Offices Barnsley Close, Barnsley, South Yorks, S70 2HS	
© Copyright Reserved		Existing Site Layout Plan	
17-401		17-401	





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LEGEND	
	APPROXIMATE SITE BOUNDARY

Client: **McCARTHY & STONE
(RETIREMENT LIFESTYLES) LIMITED**

Project Title:
Proposed Sheltered Accommodation
Barnsley Metropolitan Borough Council Offices
Berneslai Close, Barnsley, South Yorks, S70 2HS

Drawing Title: Proposed Development Layout Plan

Scale of A3	Date	Drawn by	Approved by
MIS R A3	30.05.17	P.D	A.M

Job Ref:	Org. ref:	Rev:
17-401	—	—



ATC
Solum House, Unit 1 Elliott Court
St Johns Road, Meadowfield
Durham, DH7 8PN
Telephone: 01913786380

BOREHOLE LOG

Project

Berneslai Close, Barnsley	
Job No	Date
17 401	13

Ground Level (m)	Co-Ordinates (U)
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BOREHOLE NO
WS07

Arc Environmental Ltd

SAMPLES & TESTS	
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STRATA

1 of 1

SAMPLES & TESTS										STRATA									
Depth	Type No	Test Result	Water		Reduced Level	Legend	Depth (metres)	DESCRIPTION		Geology									
0.10-0.40	J/D						0.10	Tarmic (MADE GROUND)											
0.40-0.60	J/D						(0.30)	Yellow sandy gravel of diatomic and limestone chippings. (MADE GROUND) (sub-base)											
0.60-1.00	B						0.40 (0.20) 0.60	Dark brown sandy CLAY. (MADE GROUND)											
1.00-1.60	B	N=42					(1.01)	Extremely weak, yellowish brown mottled orange staining weathred SANDSTONE.											
1.60-1.61	SPT	75 Blows					1.61												

Boring Progress and Water Observations					Chiselling					Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To			
											1. WATER: No groundwater encountered. 2 Borehole backfilled with arisings	

A053 UK BH 17-401 (GGS GPJ A053) ALL LOG 19/7/11

All dimensions in metres
Scale 1:18.75

Client McCarthy & Stone
Retirement Lifestyles Ltd

Method/ C130 Windowless Sampling
Plant Used Rug

Logged By SAB



BOREHOLE LOG

BOREHOLE LOG

Project										BOREHOLE No	
Barneslai Close, Barnsley										WS06	
Job No		Date		Ground Level (m)		Co-Ordinates ()		Sheet		1 of 1	
17-401		13-07-17									
Contractor											
Arc Environmental Ltd											
SAMPLES & TESTS										STRATA	
Date	Time	Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Geology	Instrument/
0.10-0.40		J/D						0.10	Tarmac (MADE GROUND)		
0.40-0.60		B						(0.30)	Yellow sandy gravel of dolomite and limestone chippings. (MADE GROUND) (sub-base)		
0.60-1.00		B						0.40	Dark brown sandy CLAY. (MADE GROUND)		
1.00-1.45		B		N-18				0.60	Extremely weak yellowish brown mottled orange staining weathered SANDSTONE.		
1.60-2.00		B						1.60	Very weak yellowish brown occasionally stained orange partially weathered SANDSTONE.		
2.00-2.10		SPT		75 Blows				2.10			
										GENERAL REMARKS	
										1. WATER: No groundwater encountered. 2. Borehole backfilled with groutings	

Report Type:- Phase 2: Ground Investigation Report.
Project:- 17-401 Berneslai Close, Barnsley.
Prepared For:- McCarthy & Stone Retirement Lifestyles Ltd.



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LEGEND	
	APPROXIMATE SITE BOUNDARY
	WINDOWLESS SAMPLING BOREHOLE POSITION

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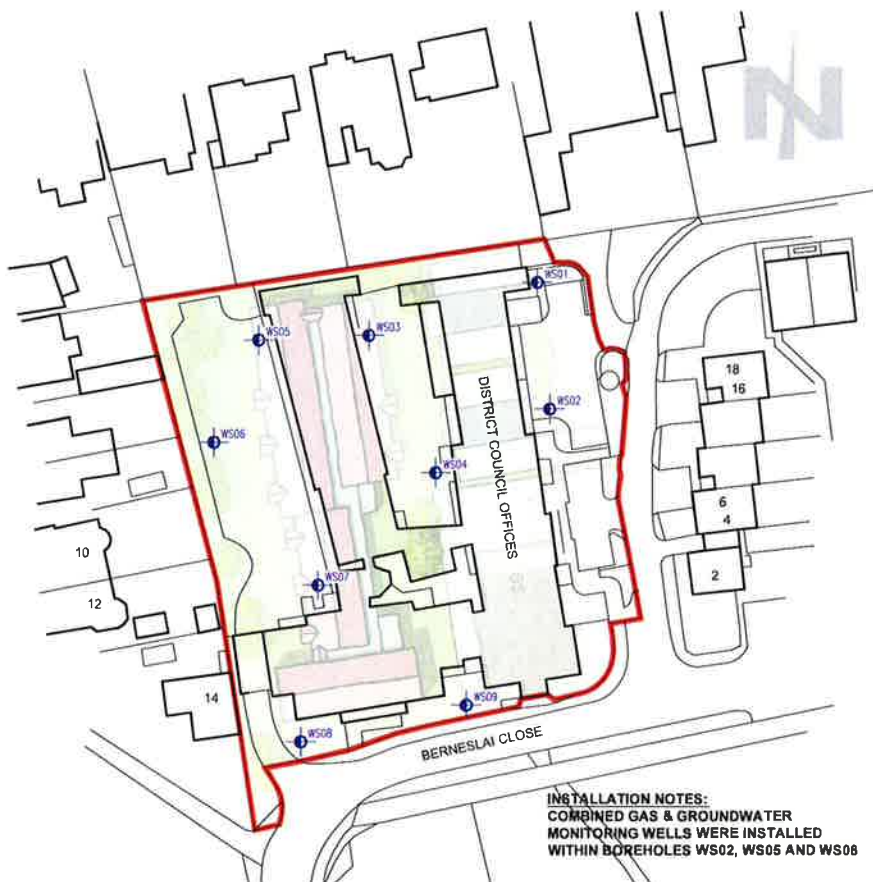
Client: **McCARTHY & STONE
(RETIREMENT LIFESTYLES) LIMITED**

Proposed Sheltered Accommodation
Barnsley Metropolitan Borough Council Offices
Barneslai Close, Barnsley, South Yorks., S70 2HS

Drawing Title: _____
Barcode Location: _____

Scale of AS:	Date:	Drawn by:	Approved by:
NYS 9 AS	18.02.12	P.D	AM

Job Ref.	Org. Ref.	Ref.
17-401		



INSTALLATION NOTES:
COMBINED GAS & GROUNDWATER
MONITORING WELLS WERE INSTALLED
WITHIN BOREHOLES WS02, WS05 AND WS08



BOREHOLE LOG

Project

Barneslai Close, Barnsley

17-4

7-17

Ground Level (m)	Co-Ordinates (
------------------	----------------

WS05

Arc Environmental Ltd

1 of 1

SAMPLES & TESTS				STRATA				Geology	Instrument/ Backfill
Depth	Type	Test Result	Water	Reduced Level	Legend (Thickness)	Depth (m)	DESCRIPTION		
0.10-0.40	J/D					0.10	Tarmac (MADE GROUND)		
0.40-0.60	B					(0.30)	Yellow sandy gravel of dolomite and limestone chippings (MADE GROUND) (sub-base)		
0.60-0.80	B					0.40	Dark brown sandy CLAY (MADE GROUND)		
0.80-1.00	B					(0.20)	Brown gravelly SAND with sandstone lithofracts		
1.00-1.40	B					0.60	Extremely weak brown mottled orange staining weathered SANDSTONE		
1.40-2.00	B					1.40	Very weak yellowish brown occasionally stained orange partially weathered SANDSTONE.		
2.00-2.12	SPT	75 Blows				2.12			

[illegible]

BOREHOLE LOG

Project				BOREHOLE No			
Barneslai Close, Barnsley				WS04			
Job No	Date	Ground Level (m)	Co-Ordinates ()				
17-401	13-07-17						
Contractor				Sheet			
Arc Environmental Ltd				1 of 1			

SAMPLES & TESTS				STRATA				Geology	Instrument/Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
0.10-0.40	J/D					0.10 (0.30) 0.40	Tarmac (MADE GROUND) Dark brown sandy gravelly CLAY (MADE GROUND)		
0.40-1.00	B						Extremely weak light brown mottled orange staining weathered SANDSTONE.		
1.00-1.50 1.00-1.45	B SPT	N-14				(1.10)			
1.50-2.00	B					1.50	Very weak yellowish brown occasionally stained orange partially weathered SANDSTONE.		
2.00-2.20	SPT	75 Blows				(0.70) 2.20			

Boring Progress and Water Observations				Chiselling				Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	From	To	Hours	From	To		
									1 WATER: No groundwater encountered. 2. Borehole backfilled with arisings	
Client: McCarthy & Stone Retirement Lifestyles Ltd				Method: C/130 Windowless Sampling Rig				Logged By: SAB		

BOREHOLE LOG

Project				BOREHOLE No			
Barneslai Close, Barnsley				WS01			
Job No	Date	Ground Level (m)	Co-Ordinates ()				
17-401	14-07-17						
Contractor				Sheet			
Arc Environmental Ltd				1 of 1			

SAMPLES & TESTS				STRATA				Geology	Instrument/Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						0.10 0.15 (0.35) 0.50	Block Paving (MADE GROUND) Sand bedding (MADE GROUND) Grey sub-base (MADE GROUND)		
0.50-1.00 0.50-0.50	B J/D						Extremely weak light brown mottled orange staining weathered SANDSTONE.		
1.00-2.00 1.00-1.45	B SPT	N-14				(0.50) 1.00			
						(1.12)	Very weak yellowish brown occasionally stained orange partially weathered SANDSTONE.		
2.00-2.12	SPT	25 Blows				2.12			

Boring Progress and Water Observations				Chiselling				Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	From	To	Hours	From	To		
									1 WATER: No groundwater encountered. 2. Borehole backfilled with arisings	
Client: McCarthy & Stone Retirement Lifestyles Ltd				Method: C/130 Windowless Sampling Rig				Logged By: SAB		



BOREHOLE LOG

Project:

Berneslai Close, Barnsley

BOREHOLE No

WS02

Job No

17-401

Date

14-07-17

Ground Level (m)

Co-Ordinates ()

Contractor

Arc Environmental Ltd

Sheet

1 of 1

SAMPLES & TESTS		Water		STRATA		Geology	Instrument/ Backfill
Depth	Type No	Test Result	Reduced Level	Legend	Depth (Thick- ness)	DESCRIPTION	
0.15-0.60	J/D				0.10 0.15	Block Paving (MADE GROUND) Sand bedding (MADE GROUND) Grey sub-base (MADE GROUND)	
0.60-0.80	J/D				0.60 (0.20)	Black sandy clay (MADE GROUND)	
0.80-1.00	B				0.80 (0.40)	Extremely weak light brown mottled orange staining weathered SANDSTONE.	
1.00-1.20	B				1.20	Very weak yellowish brown occasionally stained orange partially weathered SANDSTONE.	
1.00-1.45	SPT	N-21					
1.20-2.00	B						
2.00-2.13	SPT	75 Blows			2.13 (0.93)		
Boring Progress and Water Observations				Chiselling		Water Added	
Date	Time	Depth	Water Capillary Rise, mm	From	To	From	To
				GENERAL REMARKS			
				1 WATER: No groundwater encountered. 2 Borehole installed with monitoring installation.			
All dimensions in metres Scale 1:18.75				Client	Method	Logged By	
				McCarthy & Stone Retirement Lifestyles Ltd	C130 Windowless Sampling Rig	SAB	

AGS3 UK BH 17-401 LOGS.GPJ AGS3 ALL.GDT 19/7/17



BOREHOLE LOG

Project:

Berneslai Close, Barnsley

BOREHOLE No

WS03

Job No

17-401

Date

13-07-17

Ground Level (m)

Co-Ordinates ()

Contractor

Arc Environmental Ltd

Sheet

1 of 1

SAMPLES & TESTS		Water		STRATA		Geology	Instrument/ Backfill
Depth	Type No	Test Result	Reduced Level	Legend	Depth (Thick- ness)	DESCRIPTION	
0.10-0.30	J/D				0.10 (0.20)	Turner (MADE GROUND) Yellow sandy gravel of dolomite and limestone chippings (MADE GROUND) (sub-base)	
0.30-0.60	J/D				0.30 (0.30)	Dark brown mottled black sandy gravelly CLAY (Gravel is fine to coarse brick with sand of ash (MADE GROUND)	
0.60-1.00	B				0.60	Extremely weak light brown mottled orange staining weathered SANDSTONE.	
1.00-1.40	B				1.40 (0.80)		
1.00-1.45	SPT	N-6					
1.40-2.00	B				1.40	Very weak yellowish brown occasionally stained orange partially weathered SANDSTONE.	
2.00-2.19	SPT	75 Blows			2.19 (0.79)		
Boring Progress and Water Observations				Chiselling		Water Added	
Date	Time	Depth	Water Capillary Rise, mm	From	To	From	To
				GENERAL REMARKS			
				1 WATER: No groundwater encountered. 2 Borehole installed with monitoring installation.			
All dimensions in metres Scale 1:18.75				Client	Method	Logged By	
				McCarthy & Stone Retirement Lifestyles Ltd	C130 Windowless Sampling Rig	SAB	

AGS3 UK BH 17-401 LOGS.GPJ AGS3 ALL.GDT 19/7/17