



Earth Environmental
& Geotechnical

GeoEnvironmental Investigation

Busker Lane

Scissett

March 2017

On behalf of

Elements Construction Ltd

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**GEOENVIRONMENTAL
INVESTIGATION**

BUSKER STREET

SCISSETT

Report Ref: A1819/17

March 2017

Prepared on Behalf of:

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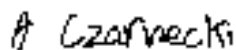
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1.0 INTRODUCTION

1.1 Background

A GeoEnvironmental Site Investigation has been commissioned by KDP Architects Ltd on behalf of Elements Construction Ltd (the Client) to examine ground conditions and retrieve soil samples for chemical and geotechnical testing at a site off Busker Lane, Scissett.

Ground gas and groundwater monitoring has also been undertaken as part of the site investigation strategy.

1.2 Reference & Scope of Work

Earth Environmental and Geotechnical Ltd were commissioned to undertake a GeoEnvironmental Investigation of the site in accordance with proposal (A1819/17) dated 2nd February 2017.

The objectives of the investigation outlined within the proposal were as follows:

- Assess the presence and likely extent of any potential environmental hazards (soil, groundwater and ground gas contamination) associated within the areas of the site investigated.
- Assessment of ground conditions for foundation solutions.
- Assessment of soils for off-site disposal.

This report should be read in conjunction with an earlier Phase I GeoEnvironmental Desk Study report by Earth Environmental & Geotechnical, dated December 2016 (report reference: A1819/16).

1.3 Limitations of the Study

The report is written in the context of an agreed scope of work and budget and should not be used in a different context. New information, improved practices or changes in legislation may require a reinterpretation of the report in whole or in part. Earth Environmental and Geotechnical Ltd reserves the right to amend either conclusions or recommendations in light of any further information that may become available. The report is provided for the sole use by the client and is confidential to them.

Recommendations within this report are also based on exploratory records and examination of samples and, where applicable, laboratory tests. No liability can be accepted for conditions not revealed by the probeholes, particularly at intervening locations.

Whilst every effort is made to ensure accuracy of data supplied, all opinions expressed as to the spatial distribution of strata between sampling locations is for guidance only and no responsibility is accepted as to its accuracy.

2.0 SITE LOCATION & INFORMATION

2.1 Site Location & Description

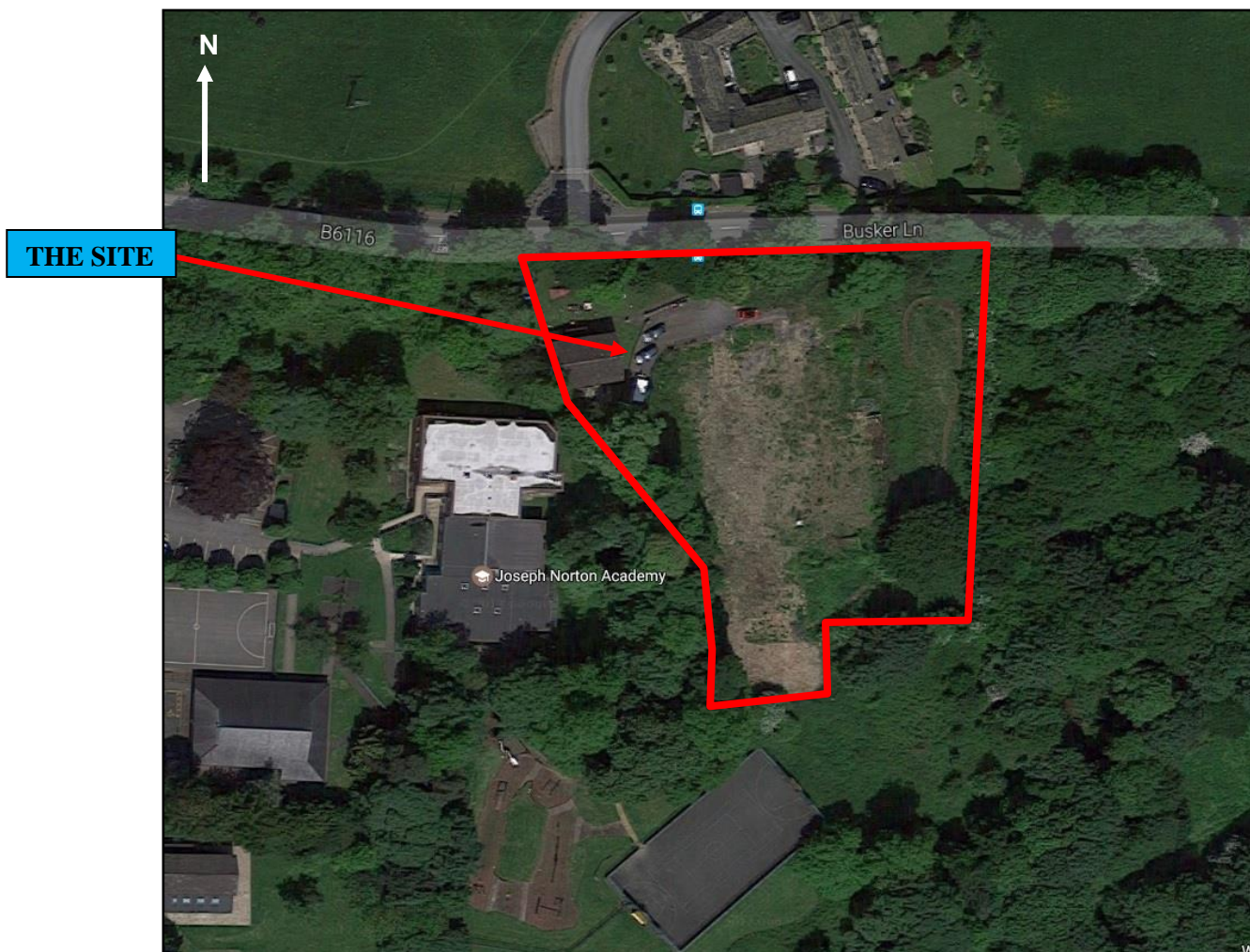
The site is vacant, and is colonised with scrub, grass, mature trees and demolition rubble. Heras fencing has been installed but the site is open to access. The site was previously a retirement home which has subsequently been demolished.

The site is located off Busker Lane, Scissett, approximately 0.25km west of Scissett and 1.3km south east of Skelmanthorpe. The site occupies approximately 0.59ha of land and is within the district of Kirklees Council. The approximate National Grid Reference for the centre of the site is SE 2465 1031 (Easting:424655, Northing: 410314) and the entrance is off Busker Lane, the closest postcode being HD8 9JU.

The site is approximately square, with land gradient falling to the east and south, with average dimensions of 60m east to west and 85m north to south. Joseph Norton Academy School lies immediately west of the site with a hard-ground tennis court immediately south-west of the site. Residential dwellings lie immediately north-west of the site with the surrounding areas consisting of agricultural land, woodland and residential dwellings.

A location plan is shown below as Figure 1.

Figure 1: Site Location Plan



Right of access is from Busker Lane north of the site.

The site and surrounding areas slope moderately to the south and south-east.

2.2 Proposed Development

The proposed site development plan is shown in Figure 2, below. It is understood the construction of a 2-storey retirement home with car parking facilities and communal gardens are proposed.

See Figure 2 below for the proposed development layout plan provided by the client with red dashed outline highlighting the previous building footprint prior to demolition.

Figure 2: Development Layout Plan



3.0 SITE INVESTIGATION

3.1 Exploratory Fieldwork

The ground investigation works took place on the 24th February 2017 and comprised of the drilling of six probeholes (WS101 to WS106) by use of a windowless sampling technique to a nominal depth of 5.00m bgl.

Four boreholes (WS101, WS103, WS104 and WS105) were fitted with combined ground-gas and groundwater installations.

The exploratory hole positions were determined and set out (by hand held GPS) by an Earth Environmental & Geotechnical Ltd engineer.

All site investigation work was supervised full time by a representative of Earth Environmental & Geotechnical Ltd, with logging of soils in accordance with BS5930: 2015 Code of Practice for Site Investigations.

Soil samples destined for chemical testing were sealed in 1 litre plastic containers and 250ml amber glass jars and stored in a cool box, with samples intended for geotechnical testing sealed in 1 litre plastic containers. Details of the strata encountered and the samples taken are listed in the exploratory hole logs in Appendix I.

The sampling locations are illustrated in Figure 3 (below) and the installations are detailed in Table 3.2.1 overleaf.

Figure 3: Sampling Location Plan



3.2 Summary of Site Investigation Observations

3.2.1 Ground Conditions

The exploratory holes revealed made ground across the whole site to a maximum depth of between 0.30m bgl (WS103) and 2.30m bgl (WS101) underlain by siltstone and mudstone in all exploratory holes (WS101 to WS106).

All six holes were terminated at shallow depths between 0.70m bgl (WS106) and 2.70m bgl (WS101) at each location due to the shallow depth to bedrock, with gas and water monitoring installations placed in four holes (WS101, WS103, WS104 and WS105).

Made ground generally comprised of gravelly clay and fine sand with red brick, concrete, ash, clinker and limestone subbase angular gravel.

See Appendix I for detailed logs.

A summary of the thickness of made ground and ground conditions at each sampling location is provided in Table 3.2.1 below.

Table 3.2.1 Summary of Ground Conditions

Location	Base of Made Ground (m bgl)	Base of Clay (m bgl)	Base of Bedrock (m bgl)	Installation Response Zones (m bgl)
WS101	2.30	-	2.70+	0.40-2.70
WS102	0.32	-	1.30+	-
WS103	0.30	1.00	1.80+	0.80-1.80
WS104	1.70	-	1.80+	0.80-1.80
WS105	2.00	-	2.30+	1.00-2.00
WS106	0.60	-	0.70+	-

Notes for Table 3.2.1

+ = indicates full thickness not determined
 - = indicates not encountered

3.2.2 Observable Indications of Contamination

A thin mantle of made ground was recorded across the entire site and consists of ash, brick, clinker, concrete and general demolition rubble. No visual or olfactory evidence of contamination was noted across the site.

3.2.3 Groundwater and Ground Gas Monitoring

Four probeholes were fitted with monitoring installations for groundwater and ground gas monitoring.

Ground gas monitoring has been conducted on three occasions by use of a portable GA2000 infra-red analyser with a GFM610 flow meter. During monitoring, water levels were also recorded by use of an electronic dipmeter.

Groundwater samples were unable to be obtained due to the slow recharge in each installation and insufficient water after purging.

At the time of writing this report three of four monitoring visits have been undertaken.

The monitoring results are presented in Table 3.2.3 (overleaf).

Table 3.2.3 Summary of Ground Gas and Groundwater Monitoring Results

Location	Date	Max Methane (% vol/vol)	Max Carbon Dioxide (% vol/vol)	Min Oxygen (% vol/vol)	Flow Rate (litres/hour)	Water Level (m bgl)	Atmospheric Pressure (mB)
WS101	07-03-17	0.0	3.5	18.2	0.0	2.04	1001, Rising
WS103		0.0	3.5	18.3	0.0	1.86	
WS104		0.0	0.1	17.6	0.0	0.96	
WS105		0.0	0.9	9.5	0.0	1.93	
WS101	14-03-17	0.0	3.6	18.2	0.0	DRY	1012, Falling
WS103		0.0	4.1	18.4	0.0	1.88	
WS104		0.0	2.1	18.4	0.0	1.60	
WS105		0.0	1.0	13.4	0.0	1.82	
WS101	21-03-17	0.0	3.9	18.0	0.0	DRY	990, Rising
WS103		0.0	4.7	17.6	0.0	1.99	
WS104		0.0	2.5	17.7	0.0	1.89	
WS105		0.0	1.1	11.4	0.0	1.73	
WS101	TBC						
WS103							
WS104							
WS105							

Carbon Dioxide concentrations greater than 5.0% vol/vol shown in ***bold and italics***.
 Methane concentrations greater than 1% shown in **bold**.

3.2.4 Rockhead

Rockhead was encountered at each of the probehole locations, consisting of siltstone and mudstone between 0.70m bgl (WS106) and 2.70m bgl (WS101).

3.2.5 In-Situ Testing

In-situ standard penetration testing was undertaken (in accordance with BS1377 Part 9, 1990) within probeholes at 1m centres. The results are shown on the exploratory hole logs in Appendix I.

3.3 Laboratory Testing Programme

Based upon the existing land use, chemical testing was performed on seven selected soil samples for a wide range of analytes including asbestos, metals, pH, sulphate and sulphide, cyanide, phenols, total organic carbon (TOC), speciated polycyclic aromatic hydrocarbons (PAH) and speciated petroleum hydrocarbons (TPHCWG).

The chemical testing was conducted by QTS Environmental a UKAS/MCERTS accredited laboratory based in Kent. Test certificates are included in Appendix II.

Geotechnical testing was undertaken on selected representative samples chosen by Earth Environmental Ltd by Murray Rix in accordance with UKAS procedures. Test certificates are included in Appendix III.

4.0 CONTAMINATION ASSESSMENT

4.1 Soil Guidelines

At a Tier I stage the long term (chronic) human health toxicity of the soil has been assessed with reference to DEFRA/Environment Agency Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGV) for generic site land uses, soils and exposure. Where Environment Agency generic guidance is absent, reference has been made to the Chartered Institute of Environmental Health (CIEH) S4ULs for human health risk assessment.

The derivation of all assessment criteria for a residential end use (with plant uptake) have been listed in Appendix IV.

In the case of arsenic, cadmium, hexavalent chromium, lead and benzo(a)pyrene DEFRA Category 4 Screening Levels have been adopted.

4.2 Tier I Human Health Soil Data Assessment

Table 4.2 Soil Assessment

Parameter	WS101	WS101	WS102	WS103	WS104	WS105	WS106	Assessment Criteria (mg/kg)
	0.40	1.20	1.00	0.20	0.50	0.40	0.40	
	MG	MG	MG	MG	MG	MG	MG	
Arsenic	19	20	8	17	13	11	4	37
Boron	1.2	< 1	1.1	< 1	< 1	< 1	< 1	290
Beryllium	0.9	1.1	0.8	1	1.3	1.1	1.5	1.7
Cadmium	0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	22
Chromium	20	25	26	21	25	21	26	910
Free Cyanide	< 2	< 2	< 2	< 2	< 2	< 2	< 2	41
Hexavalent Chromium	< 2	< 2	< 2	< 2	< 2	< 2	< 2	21
Copper	67	76	27	27	33	24	34	2400
Lead	92	142	237	44	24	23	27	200
Mercury	< 1	< 1	< 1	< 1	< 1	< 1	< 1	40
Nickel	19	29	17	21	27	24	42	130
Selenium	< 3	< 3	< 3	< 3	< 3	< 3	< 3	250
Vanadium	29	32	29	30	29	26	26	1200
Zinc	166	115	84	91	90	72	98	3700
pH	8.1	8.0	9.0	5.9	5.7	6.3	5.5	N/A
Naphthalene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	2.3
Acenaphthylene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	170
Acenaphthene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	210
Fluorene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	170
Phenanthrene	0.32	< 0.1	0.14	< 0.1	< 0.1	< 0.1	< 0.1	95
Anthracene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	2400
Fluoranthene	0.98	0.17	0.49	< 0.1	< 0.1	< 0.1	< 0.1	280
Pyrene	1.05	0.19	0.45	< 0.1	< 0.1	< 0.1	< 0.1	620
Benzo(a)anthracene	0.65	< 0.1	0.17	< 0.1	< 0.1	< 0.1	< 0.1	7.2

Chrysene	0.68	< 0.1	0.21	< 0.1	< 0.1	< 0.1	< 0.1	15
Benzo(b)fluoranthene	1.09	< 0.1	0.14	< 0.1	< 0.1	< 0.1	< 0.1	2.6
Benzo(k)fluoranthene	0.36	< 0.1	0.13	< 0.1	< 0.1	< 0.1	< 0.1	77
Benzo(a)pyrene	0.83	< 0.1	0.12	< 0.1	< 0.1	< 0.1	< 0.1	5
Indeno(1,2,3-cd)pyrene	0.45	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	27
Di-benz (a,h) anthracene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	3.5
Benzo(ghi)perylene	0.35	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	320
Phenol	< 2	< 2	< 2	< 2	< 2	< 2	< 2	280
Benzene	< 2	< 2	< 2	< 2	< 2	< 2	< 2	0.87
Toluene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	130
Ethylbenzene	< 2	< 2	< 2	< 2	< 2	< 2	< 2	47
Xylene	< 2	< 2	< 2	< 2	< 2	< 2	< 2	56
Aliphatic >C5 - C6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	42
Aliphatic >C6 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	100
Aliphatic >C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2	< 2	27
Aliphatic >C10 - C12	< 2	< 2	< 2	< 2	< 2	< 2	< 2	130
Aliphatic >C12 - C16	< 3	< 3	< 3	< 3	< 3	< 3	< 3	1100
Aliphatic >C16 - C21	< 3	< 3	< 3	< 3	< 3	< 3	< 3	65000
Aliphatic >C21 - C34	86	< 10	82	< 10	< 10	< 10	< 10	65000
Aromatic >C5 - C7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	70
Aromatic >C7 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	130
Aromatic >C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2	< 2	34
Aromatic >C10 - C12	< 2	< 2	< 2	< 2	< 2	< 2	< 2	74
Aromatic >C12 - C16	< 2	< 2	< 2	< 2	< 2	< 2	< 2	140
Aromatic >C16 - C21	10	< 3	3	< 3	< 3	< 3	< 3	260
Aromatic >C21 - C35	332	< 10	132	< 10	< 10	< 10	< 10	1100
Asbestos	ND	ND	ND	ND	ND	ND	ND	-

Notes for Table 4.2

Concentrations in **red** above assessment criteria
 Sandy soil with 1% Soil Organic Matter assumed

Elevated lead has been recorded at sample location WS102 1.00m within the made ground.

No further contaminants have been identified with respect to the long-term protection of human health, when compared to residential assessment criteria.

Asbestos has not been identified in any of the eight samples tested.

4.3 Soil Disposal Waste Assessment

Technical Guidance WM3: Hazardous Waste; "Guidance on the classification and assessment of waste", May 2015, published by Environment Agency of England and Wales, SEPA, NIEA and Natural Resources Wales has been used to characterise soil materials.

HazWasteOnline™ a cloud-based software application for the management, analysis and reporting of hazardous waste materials has been used to make the assessment.

All samples have been classified as non-hazardous (Appendix V).

4.4 Ground Gas Assessment

The potential impact on the development from ground gases has been assessed with reference to CIRIA guidance C665 “*Assessing risks posed by hazardous ground gases to buildings*”, Situation A and BS 8485 (residential buildings) for methane and carbon dioxide.

No elevated carbon dioxide and methane were recorded on any of the three gas monitoring visits so far. Barometric pressure was recorded between 990mB and 1012mB.

The site has been assessed against CIRIA Situation A and BS 8485 (residential buildings) for methane and carbon dioxide. A Characteristic Situation 1 has been assigned to the site, requiring no gas protection measures.

4.5 Groundwater Assessment

Groundwater samples were unable to be obtained due to the slow recharge in each installation and insufficient water after purging.

5.0 GEOTECHNICAL ASSESSMENT

5.1 Geotechnical Testing

Geotechnical testing has been undertaken as part of this investigation, all laboratory testing results are available within Appendix III.

Table 5.1 (below) provides a summary of the geotechnical test data.

Table 5.1 Geotechnical Test Data

Location	Depth (m bgl)	Description	Classification	Undrained Shear Strength kN/m ²	Passing 425 micron (%)	Modified Plasticity Index	Volume Change Potential
WS102	1.00	Sandstone	Non-Plastic	-	28	-	-
WS103	1.80	Sandy silty CLAY	Clay of Low to Intermediate Plasticity	86 (High)	56	8.96	Low
WS104	1.80	Sandy silty CLAY	Clay of Low to Intermediate Plasticity	79 (High)	85	15.3	Low
WS105	0.60-1.00	Sandy silty CLAY	Clay of Low Plasticity	77 (High)	40	6	Low
Average				81 (High)			

Notes for Table 5.1

Undrained Shear Strength classification definition C_u , in kPa (From BS EN ISO 14688 2:2004, 5.3, Table 5)

The plasticity index results indicate a sandy silty clay of low to intermediate plasticity with a low volume change potential and high undrained shear strength.

5.2 Foundation Design

Ground conditions are suitable for the placement of shallow foundations to support the proposed structures.

Table 5.2 (below) provides a summary of proposed foundations at each location.

Table 5.2 Proposed Foundations

Location	Thickness of Made Ground (m bgl)	Depth of Foundation (m bgl)	Foundation Type
WS101	2.30	2.30	TF
WS102	0.32	0.50	S/PA
WS103	0.30	1.00	S/PA
WS104	1.70	1.70	S/PA
WS105	2.00	2.00	TF
WS106	0.60	0.60	S/PA

Notes for Table 5.2

TF trench fill
 PA Pad
 P piled foundation
 S strip foundation
 V vibro-treatment
 VCC vibro-concrete columns

The above foundation depths do not take into account the proximity to existing or recently felled trees.

Foundation loadings will need to be transferred to competent strata.

An allowable bearing capacity of 100kN/m² would be appropriate for a 1m wide square foundation at a depth of 1m.

5.3 Groundwater Control

Shallow groundwater has been observed across the site. An allowance should be made for groundwater pumping from excavations.

5.4 Roads and Car Parking

At this stage a design CBR value of 2% should be adopted pending further assessment by dynamic cone penetration testing or plate load testing.

5.5 Soakaways

Due to the presence of shallow bedrock beneath the site, soakaways are not deemed feasible for the site.

5.6 Sub-Surface Concrete

The results of pH and soluble sulphate testing in soils is summarised below in Table 5.6.

Table 5.6 Summary of Sulphate Testing

Location	Depth (m)	Sulphate 2:1 Water Extract (g/l)	pH	Classification
WS102	1.00	0.09	7.0	DS-1 AC-1s
WS103	1.80	0.16	6.9	DS-1 AC-1s
WS104	1.80	0.27	7.2	DS-2 AC-1s
WS105	0.60-1.00	0.22	7.3	DS-1 AC-1s

Based upon the testing results sub-surface concrete should be designed as Design Sulphate Class DS- 1 and ACEC class AC-1s, in accordance with BRE Special Digest 1.

5.7 Construction Activity and Inspection

It is recommended that allowance be made for the inspection of foundation materials, proof rolling of slab areas and road subgrade conditions during construction. All such inspections should be carried out by appropriately qualified and experienced geotechnical engineers.

The exposed formation should be quickly blinded with concrete to avoid softening during periods of inclement weather.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The exploratory holes revealed made ground across the whole site to a maximum depth of between 0.30m bgl (WS103) and 2.30m bgl (WS101) underlain by siltstone and mudstone in all exploratory holes (WS101 to WS106).

All six holes were terminated at shallow depths between 0.70m bgl (WS106) and 2.70m bgl (WS101) at each location due to the shallow depth to bedrock, with gas and water monitoring installations placed in four holes (WS101, WS103, WS104 and WS105).

Made ground generally comprised of gravelly clay and fine sand with red brick, concrete, ash, clinker and limestone subbase angular gravel.

Elevated lead has been recorded at sample location WS102 1.00m within the made ground.

No further contaminants have been identified with respect to the long-term protection of human health, when compared to residential assessment criteria.

Asbestos has not been identified in any of the eight samples tested.

The site has been assessed against CIRIA Situation A and BS 8485 (residential buildings) for methane and carbon dioxide. A Characteristic Situation 1 has been assigned to the site, requiring no gas protection measures.

Based upon the testing results sub-surface concrete should be designed as Design Sulphate Class DS- 1 and ACEC class AC-1s, in accordance with BRE Special Digest 1.

Due to the presence of shallow bedrock beneath the site, soakaways are not deemed feasible for the site.

All samples have been classified as non-hazardous.

6.2 Recommendations

It is recommended that the area of elevated lead highlighted in WS102 1.00m is further delineated via shallow soil sampling in order to determine its lateral extent.

Ground conditions are suitable for the use of shallow foundations.

Based on the current monitoring data there is no need for any ground gas mitigation measures.

Upon receipt of a tree survey the depth and nature of foundations will be reassessed.

APPENDIX I
EXPLORATORY HOLE LOGS

APPENDIX II
CHEMICAL TESTING RESULTS

APPENDIX III
GEOTECHNICAL TESTING RESULTS

APPENDIX IV
RISK ASSESSMENT CRITERIA FOR SOILS

Soil Assessment Criteria for Residential Use (with plant uptake)
Based on Sandy Soil

Arsenic	mg/kg	37	Category 4 Screening level based on 6% SOM
Boron	mg/kg	290	CIEH S4UL based on 6% SOM
Beryllium	mg/kg	1.7	CIEH S4UL based on 6% SOM
Cadmium	mg/kg	22	Category 4 Screening level based on 6% SOM
Chromium (III)	mg/kg	910	CIEH S4UL based on 6% SOM
Chromium (IV)	mg/kg	21	Category 4 Screening level based on 6% SOM
Lead	mg/kg	200	Category 4 Screening level based on 6% SOM
Mercury (Inorganic)	mg/kg	40	CIEH S4UL based on 6% SOM
Selenium	mg/kg	250	CIEH S4UL based on 6% SOM
Nickel	mg/kg	130	CIEH S4UL based on 6% SOM (Revised, Aug 2015)
Copper	mg/kg	2400	CIEH S4UL based on 6% SOM
Toluene	mg/kg	130	CIEH S4UL based on 1% SOM
Benzene	mg/kg	0.87	Category 4 Screening level based on 6% SOM
Ethylbenzene	mg/kg	47	CIEH S4UL based on 1% SOM
Xylene	mg/kg	56	CIEH S4UL based on 1% SOM
Trichlorethene (TCE)	mg/kg	0.016	CIEH S4UL based on 1% SOM
Tetrachloroethene (PCE)	mg/kg	0.18	CIEH S4UL based on 1% SOM
Zinc	mg/kg	3700	CIEH S4UL based on 6% SOM
Cyanide - Free	mg/kg	41	Based on acute risk to 0-6yr old child, HPA

Phenols	mg/kg	280	CIEH S4UL based on 1% SOM
PCB	mg/kg	1.4	CLEA 1.06 modelling with 1% SOM
Naphthalene	mg/kg	2.3	Category 4 Screening level based on 6% SOM
Acenaphthylene	mg/kg	170	CIEH S4UL based on 1% SOM
Acenaphthene	mg/kg	210	CIEH S4UL based on 1% SOM
Fluorene	mg/kg	170	CIEH S4UL based on 1% SOM
Phenanthrene	mg/kg	95	CIEH S4UL based on 1% SOM
Anthracene	mg/kg	2400	CIEH S4UL based on 1% SOM
Fluoranthene	mg/kg	280	CIEH S4UL based on 1% SOM
Pyrene	mg/kg	620	CIEH S4UL based on 1% SOM
Benzo(a)anthracene	mg/kg	7.2	CIEH S4UL based on 1% SOM
Chrysene	mg/kg	15	CIEH S4UL based on 1% SOM
Benzo(b)fluoranthene	mg/kg	2.6	CIEH S4UL based on 1% SOM
Benzo(k)fluoranthene	mg/kg	77	CIEH S4UL based on 1% SOM
Benzo(a)pyrene	mg/kg	5.0	Category 4 Screening Levels based on 6% SOM
Indeno(1,2,3-cd)pyrene	mg/kg	27	CIEH S4UL based on 1% SOM
Di-benz (a,h) anthracene	mg/kg	0.24	CIEH S4UL based on 1% SOM
Benzo(ghi)perylene	mg/kg	320	CIEH S4UL based on 1% SOM

Vanadium	mg/kg	410	CIEH S4UL based on 6% SOM
TPH Ali C5-C6	mg/kg	42	CIEH S4UL based on 1% SOM
TPH Ali C6-C8	mg/kg	100	CIEH S4UL based on 1% SOM
TPH Ali C8-C10	mg/kg	27	CIEH S4UL based on 1% SOM
TPH Ali C10-C12	mg/kg	130	CIEH S4UL based on 1% SOM
TPH Ali C12-C16	mg/kg	1100	CIEH S4UL based on 1% SOM
TPH Ali C16-C35	mg/kg	65000	CIEH S4UL based on 1% SOM
TPH Ali C35-C44	mg/kg	65000	CIEH S4UL based on 1% SOM
TPH Aro C5-C7	mg/kg	70	CIEH S4UL based on 1% SOM
TPH Aro C7-C8	mg/kg	130	CIEH S4UL based on 1% SOM
TPH Aro C8-C10	mg/kg	34	CIEH S4UL based on 1% SOM
TPH Aro C10-C12	mg/kg	74	CIEH S4UL based on 1% SOM
TPH Aro C12-C16	mg/kg	140	CIEH S4UL based on 1% SOM
TPH Aro C16-C21	mg/kg	260	CIEH S4UL based on 1% SOM
TPH Aro C21-C35	mg/kg	1100	CIEH S4UL based on 1% SOM
TPH Aro C35-C44	mg/kg	1100	CIEH S4UL based on 1% SOM

APPENDIX V
SOIL WASTE ASSESSMENT

APPENDIX VI
REPORT LIMITATIONS

REPORT LIMITATIONS

This contract was completed by Earth Environmental & Geotechnical Ltd on the basis of a defined programme and scope of works and terms and conditions agreed with the client. This report was compiled with all reasonable skill, and care, bearing in mind the project objectives, the agreed scope of works, the prevailing site conditions, the budget and staff resources allocated to the project.

Other than that expressly contained in the above paragraph, Earth Environmental & Geotechnical Ltd provides no other representation or warranty whether express or implied, is made in relation to the services. Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon, or transferred to, by any other party without the written agreement of a Director of Earth Environmental & Geotechnical Ltd.

If a third party relies on this report, it does so wholly at its own and sole risk and Earth Environmental & Geotechnical Ltd disclaims any liability to such parties.

It is Earth Environmental & Geotechnical Ltd understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was an important factor in determining the scope and level of the services. Should the purpose for which the report is used, or the proposed use of the site change, this report will no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without Earth Environmental & Geotechnical Ltd review and advice shall be at the client's sole and own risk.

The report was written in 2017 and should be read in light of any subsequent changes in legislation, statutory requirements and industry best practices. Ground conditions can also change over time and further investigations or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of Earth Environmental & Geotechnical Ltd. In the absence of such written advice of Earth Environmental & Geotechnical Ltd, reliance on the report in the future shall be at the client's own and sole risk. Should Earth Environmental & Geotechnical Ltd be requested to review the report in the future, Earth Environmental & Geotechnical Ltd shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between Earth Environmental & Geotechnical Ltd and the client.

The observations and conclusions described in this report are based solely upon the services that were provided pursuant to the agreement between the client and Earth Environmental & Geotechnical Ltd. Earth Environmental & Geotechnical Ltd has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report.

Earth Environmental & Geotechnical Ltd is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, Earth Environmental & Geotechnical Ltd did not seek to evaluate the presence on or off the site of electromagnetic fields, lead paint, radon gas or other radioactive materials.

The services are based upon Earth Environmental & Geotechnical Ltd observations of existing physical conditions at the site gained from a walkover survey of the site together with Earth Environmental & Geotechnical Ltd interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The findings and recommendations contained in this report are based in part upon information provided by third parties, and whilst Earth Environmental & Geotechnical Ltd have no reason to doubt the accuracy and that it has been provided in full from those it was requested from, the items relied on have not been verified.

No responsibility can be accepted for errors within third party items presented in this report. Further Earth Environmental & Geotechnical Ltd was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the services. Earth Environmental & Geotechnical Ltd is not liable for any inaccurate information, misrepresentation of data or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to Earth Environmental & Geotechnical Ltd and including the doing of any independent investigation of the information provided to Earth Environmental & Geotechnical Ltd save as otherwise provided in the terms of the contract between the client and Earth Environmental & Geotechnical Ltd.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable and as investigation excavations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this report. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and Earth Environmental & Geotechnical Ltd] based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.