





# GeoEnvironmental Investigation

Hardman House

Liverpool

February 2017

On behalf of

Carpenter Investments Ltd

Earth Environmental & Geotechnical Ltd Houldsworth Mill Business & Arts Centre Houldsworth Street Stockport SK5 6DA

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## GEOENVIRONMENTAL INVESTIGATION

## HARDMAN HOUSE

## LIVERPOOL

Report Ref: A1530/16

February 2017

Prepared on Behalf of:

### **Carpenter Investments Ltd**

By:

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## HARDMAN HOUSE LIVERPOOL

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## 1.0 INTRODUCTION

## 1.1 Background

A GeoEnvironmental Site Investigation has been commissioned by Carpenter Investments Ltd (the Client) to examine ground conditions and retrieve soil samples for chemical and geotechnical testing at a site off Hardman Street, Liverpool.

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 (A1530/16) dated 13<sup>th</sup> January 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.
- • Assess ground conditions for foundation design purposes and car-park design.
- • Characterise potential surplus soil materials for offsite disposal.

This report should be read in conjunction with an earlier Phase I GeoEnvironmental Desk Study report by Earth Environmental & Geotechnical, dated October 2016 (report reference: A1530/16).

It should be noted that the site investigation was restricted to external areas due to the presence of basements, narrow corridors and numerous stairs.

### 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 currently occupied by a large block of terraced buildings occupying the entire site.

The site is located 1.5km southeast of Liverpool City centre in the Georgian District within a mixed commercial and residential setting. The approximate National Grid Reference for the site is SJ354899 (335475, 389903) with the nearest postcode L1 9AS.

The site occupies approximately 0.13ha, on a rectangular shaped plot of land approximately 30m width and 40m length and is bound by Hardman Street to the south and South Hunter Street to the east. The site is surrounded by high rise mixed commercial and residential buildings. The western portion of the site is bound by terraced buildings used for commercial and residential use.

A location plan is shown below as Figure 1.



## Figure 1 Site Location Plan

The site is accessed from Hardman Street south of the site and South Hunter Street to the east. The site and surrounding area slopes moderately to the west.



## 2.2 **Proposed Development**

The proposed development consists of the demolition of the building currently on site and the construction of a seven-storey residential complex.

See Figure 2 below for the proposed development layout plan provided by the client.



## Figure 2 Development Layout Plan



## 3.0 SITE INVESTIGATION

## 3.1 Exploratory Fieldwork

The ground investigation works took place on the 27<sup>th</sup> January 2017 and comprised of the drilling of three probeholes (WS01 to WS03) by use of a windowless sampling technique to a nominal depth of 3.9m bgl.

All three boreholes 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).



## 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 0.20m bgl (WS101) and 3.90m bgl (WS103) and loose fine sand to a maximum depth of 1.30m bgl (WS101 and WS103).

All three holes were terminated due to an obstruction (possible sandstone bedrock at WS101 and WS103 and a basement/service at WS102) between 1.35m and 3.90m bgl.

Made ground generally comprised of grey cobbled pavement with dark brown black silty fill underlain by loose red brown fine to medium sand with fine black gravel with hydrocarbon odour.

Loose red brown fine sand was encountered beneath the made ground, overlying red sandstone (WS101 and WS103 at 1.35m bgl) and a red brick obstruction (WS102 at 3.90m bgl).

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.

Location	Base of Made Ground (m bgl)	Base of Sand (m bgl)	Depth to Rockhead (m bgl)	Installation Response Zones (m bgl)
WS101	0.20	1.35	1.35+	0.50-1.30
WS102	0.25	3.80	Obstruction	1.00-3.90
WS103	0.50	1.35	1.35+	0.5-1.30

### Table 3.2.1 Summary of Ground Conditions

#### 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 had a strong hydrocarbon odour.

### 3.2.3 Groundwater and Ground Gas Monitoring

Three boreholes 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 from three locations for groundwater sampling as no groundwater was present across the site.



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

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		0.0	0.4	17.3	0.40	DRY	
WS102	27.01.17	0.0	0.8	17.3	0.6	DRY	1004, Steady
WS103		0.0	0.5	17.2	0.7	DRY	
WS101		0.0	0.1	22.2	0.9	DRY	
WS102	07-02-17	0.0	0	22.3	0.0	DRY	1025, Rising
WS103		0.0	0.2	22.3	0.2	DRY	
WS101		0.0	0.0	21.0	0.0	DRY	
WS102	15-02-17	0.0	0	221.0	0.0	DRY	1025, Rising
WS103		0.0	0.0	21.0	0.0	DRY	]

Table 3.2.3 Summary of Ground Gas and Groundwater Monitoring Results

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 between depths of 1.35m bgl and a possible basement/service obstruction encountered at 3.90m bgl at WS102.

Bedrock recorded beneath the site comprised of red sandstone.

## 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 six selected soil samples and three groundwater 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).

Two samples were also analysed for Waste Acceptance Criteria.

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

	WS101	WS101	WS102	WS102	WS103	WS103	
Parameter	0.20m	1.00m	0.15m	1.60m	0.30m	1.20m	Assessment Criteria (mg/kg)
	MG	MG	MG	MG	MG	SAND	
Arsenic	22	53	48	6	13	8	37
Boron	< 1	< 1	< 1	< 1	< 1	< 1	290
Beryllium	< 0.5	0.8	0.7	< 0.5	< 0.5	0.6	1.7
Cadmium	< 0.2	0.3	0.5	< 0.2	< 0.2	< 0.2	22
Chromium	12	25	15	12	11	5	910
Free Cyanide	< 2	< 2	< 2	< 2	< 2	< 2	41
Hexavalent Chromium	< 2	< 2	< 2	< 2	< 2	< 2	21
Copper	10	6	46	18	15	31	2400
Lead	27	14	158	69	34	6	200
Mercury	< 1	< 1	< 1	< 1	< 1	< 1	40
Nickel	< 3	< 3	7	9	6	< 3	130
Selenium	< 3	< 3	< 3	< 3	< 3	< 3	250
Vanadium	10	13	14	14	13	5	1200
Zinc	27	18	104	24	34	11	3700
рН	7.7	7.7	7.4	7.7	8.0	7.3	N/A
Naphthalene	37.60	0.73	179	0.26	416	1.72	2.3
Acenaphthylene	0.31	< 0.1	0.84	< 0.1	1.27	< 0.1	
Acenaphthene	27	1.34	85	0.35	165	0.58	
Fluorene	16.10	0.66	48.70	0.19	94.50	0.32	170
Phenanthrene	57.50	3.33	174	0.86	295	1.14	
Anthracene	7.91	0.37	20.40	< 0.1	38.40	0.14	
Fluoranthene	34.40	2.36	90.50	0.53	167	0.70	
Pyrene	33.40	2.34	88	0.53	165	0.69	
Benzo(a)anthracene	10.90	0.82	30.20	0.17	57.40	0.27	

### Table 4.2 Soil Assessment



Chrysene	15.30	1.17	39.40	0.27	73	0.37	
Benzo(b)fluoranthene	12.20	1	32.70	0.20	62.50	0.33	
Benzo(k)fluoranthene	3.82	0.36	9.98	< 0.1	17.40	< 0.1	
Benzo(a)pyrene	9.07	0.71	22.50	0.13	44.40	0.23	5
Indeno(1,2,3-cd)pyrene	3.91	0.35	8.41	< 0.1	18.30	0.11	
Di-benz (a,h) anthracene	0.81	< 0.1	1.91	< 0.1	4.78	< 0.1	3.5
Benzo(ghi)perylene	4.11	0.38	8.62	< 0.1	18.90	0.12	
Phenol	< 2	< 2	4	< 2	< 2	< 2	280
Benzene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.87
Toluene	<0.005	<0.005	<0.005	<0.005	112	<0.005	130
Ethylbenzene	< 0.002	< 0.002	96	< 0.002	917	< 0.002	47
Xylene	< 0.002	< 0.002	124	< 0.002	818	< 0.002	56
Aliphatic >C5 - C6	< 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	100
Aliphatic >C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2	27
Aliphatic >C10 - C12	< 2	< 2	< 2	< 2	3	< 2	130
Aliphatic >C12 - C16	< 3	< 3	7	< 3	12	< 3	1100
Aliphatic >C16 - C21	< 3	< 3	6	< 3	10	< 3	65000
Aliphatic >C21 - C34	< 10	< 10	< 10	< 10	< 10	< 10	65000
Aromatic >C5 - C7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	70
Aromatic >C7 - C8	< 0.05	< 0.05	< 0.05	< 0.05	0.11	< 0.05	130
Aromatic >C8 - C10	4	< 2	14	< 2	25	< 2	34
Aromatic >C10 - C12	86	2	383	< 2	696	4	74
Aromatic >C12 - C16	331	11	1104	4	1631	7	140
Aromatic >C16 - C21	281	10	880	4	1305	4	260
Aromatic >C21 - C35	321	< 10	877	< 10	1487	< 10	1100
Asbestos	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 Arsenic, Naphthalene, Acenaphthene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Benzo(ghi)perylene, Benzo(a)pyrene, Di-benz(a,h)anthracene, Ethylbenzene, Xylene, Aromatic >C10 - C12, Aromatic >C12 - C16, Aromatic >C16 - C21, Aromatic >C21 - C35 has been recorded at each of the three window sample location at shallow depths 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<sup>™</sup> 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), with the exception of hazardous waste a WS102 and WS103 due to hydrocarbons.

Waste Acceptance Criteria testing has been performed on two samples. A sample obtained from WS02 has been assessed as stable non-reactive hazardous waste, and a sample from WS07 has been classified as inert waste.

Further waste assessment should be undertaken prior to any offsite disposal.

### 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 each of the three gas monitoring visits so far. Barometric pressure was recorded between 1004mB and 1025mB.

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.

### 4.5 Groundwater Assessment

Groundwater samples were unable to be recovered from the monitoring standpipes due to a lack of groundwater at all three installed locations.



## 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 <sup>2</sup>	Passing 425 micron (%)	Modified Plasticity Index	Volume Change Potential
W101	1.30	Red SAND	Non-Plastic	-	82	N/A	Non-Plastic
W103	1.30	Red SAND	Non-Plastic	-	70	N/A	Non-Plastic

#### Notes for Table 5.1

Undrained Shear Strength classification definition C<sub>u</sub>, in kPa (From BS EN ISO 14688 2:2004, 5.3, Table 5)

The plasticity index results indicate non-plastic red sand.

#### 5.2 Foundation Design

Ground conditions are not suitable for the placement of shallow foundations to support the proposed structures due to the presence of loose sands and unidentified obstructions identified during the site investigation.

Table 5.2 (overleaf) 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	0.20	1.35	TF
WS102	0.25	3.90	TF
WS103	0.50	1.35	TF

#### Notes for Table 5.2 TF trench fill P piled foundation S strip foundation V vibro-treatment VCC vibro-concrete columns

Foundation loadings will need to be transferred to competent strata.



## 5.3 Groundwater Control

Groundwater has been observed at 1.25m bgl at WS102 during the site investigation. 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 loose sand beneath the site, soakaways are feasible for the site. An allowance should be made for infiltration testing across the site.

## 5.6 Sub-Surface Concrete

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

Location	Depth (m)	Sulphate 2:1 Water Extract (g/l)	рН	Classification
W101	1.30	0.16	7.0	DS-1 AC-1
W103	1.30	0.18	6.9	DS-1 AC-1

## Table 5.6 Summary of Sulphate Testing

Based upon the testing results sub-surface concrete should be designed as Design Sulphate Class DS- 1 and ACEC class AC-1, 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 0.20m bgl (WS101) and 3.90m bgl (WS103) and loose fine sand to a maximum depth of 1.30m bgl (WS101 and WS103).

All three holes were terminated due to an obstruction (possible sandstone bedrock at WS101 and WS103 and a basement at WS102) between 1.35m and 3.90m bgl.

Made ground generally comprised of grey cobbled pavement with dark brown black silty fill underlain by loose red brown fine to medium sand with fine black gravel with hydrocarbon odour.

Loose red brown fine sand was encountered beneath the made ground, overlying red sandstone (WS101 and WS103 at 1.35m bgl) and a red brick obstruction (WS102 at 3.90m bgl).

Elevated Arsenic, Naphthalene, Acenaphthene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Benzo(ghi)perylene, Benzo(a)pyrene, Di-benz(a,h)anthracene, Ethylbenzene, Xylene, Aromatic >C10 - C12, Aromatic >C12 - C16, Aromatic >C16 - C21, Aromatic >C21 - C35 has been recorded at each of the three window sample location at shallow depths within the made ground.

These elevated concentrations are due to the material in between cobble-sets on the former roadway. This material should therefore be excavated separately and removed offsite.

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.

Ground conditions are suitable for the use of shallow foundations due to the presence of shallow lying sandstone bedrock from 1.30m bgl.

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

### 6.2 Recommendations

It is recommended that the thin layer (0.20 to 0.50m thick) of made ground is removed from the site to expose the underlying non-contaminated natural material.

Any surplus material destined for offsite disposal should be stockpiled and subject to further waste acceptance criteria, to ensure the material is disposed of in a suitably licensed facility.



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	37	Category 4 Screening level based on 6% SOM		
Boron	290	CIEH S4UL based on 6% SOM		
Beryllium	1.7	CIEH S4UL based on 6% SOM		
Cadmium	22	Category 4 Screening level based on 6% SOM		
Chromium (III)	910	CIEH S4UL based on 6% SOM		
Chromium (IV)	21	Category 4 Screening level based on 6% SOM		
Lead	200	Category 4 Screening level based on 6% SOM		
Mercury (Inorganic)	40	CIEH S4UL based on 6% SOM		
Selenium	250	CIEH S4UL based on 6% SOM		
Nickel	130	CIEH S4UL based on 6% SOM		
Copper	2400	CIEH S4UL based on 6% SOM		
Zinc	3700	CIEH S4UL based on 6% SOM		
Free Cyanide	41	Based on acute risk to 0-6yr old child, HPA		
Phenols	280	CIEH S4UL based on 1% SOM		
Benzo(a)pyrene	5	Category 4 Screening level based on 6% SOM		
Fluorene	170	CIEH S4UL based on 1% SOM		
Naphthalene	2.3	CIEH S4UL based on 1% SOM		
Vanadium	1200	CIEH S4UL based on 6% SOM		



APPENDIX V

SOIL

DISPOSAL

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.