

**GEO-ENVIRONMENTAL ASSESSMENT
(GROUND INVESTIGATION)
REPORT**

FOR

**1-3 CASTLE CRESCENT
READING
RG1 6AQ**



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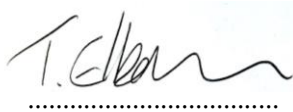
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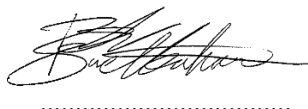
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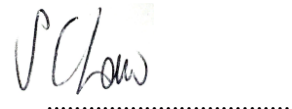
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EXECUTIVE SUMMARY

Lucas Design commissioned Jomas Associates Ltd to undertake a geo-environmental ground investigation at the site 1-3 Castle Crescent, Reading

The principle objectives of the study were as follows:

- To determine the nature and where possible, the extent of contaminants potentially present at the site;
- To establish the presence of significant pollutant linkages, in accordance with the procedures set out within the Environment Agency (EA) report R&D CLR11 and relevant guidance within the National Planning Policy Framework (NPPF);
- To assess whether the site is safe and suitable for the purpose for which it is intended, or can be made so by remedial action.

It should be noted that the table below is an executive summary of the findings of this report and is for briefing purposes only. Reference should be made to the main report for detailed information and analysis.

Site History and Ground Investigation	
Desk Study Overview	A Desk Study report has been produced for the site and issued separately (Listers Geotechnical Consultants, August 2015). A brief overview of the desk study findings is presented below. Reference should be made to the full report for detailed information. A review of historical ordnance survey maps indicates that the site was developed as early as 1879 with a large detached house in the centre, and a row of terraced properties along the eastern boundary (similar to the current site layout). A row of garages are noted from 1976 trending north-south through the centre of the site, to the south of the detached house. The surrounding area has been utilised predominantly for residential use, with some commercial uses recorded including a brick, tile and pottery works 300m south-west. A possible area of worked ground is shown approximately 100m south-east, with two others shown 100m south-east. Approaching the 1970s an industrial estate is shown from approximately 100m to 1km south-east of the site including numerous factories and industrial units. The British Geological Survey indicates that the site is directly underlain by superficial deposits of the Lynch Hill Gravel above the Lambeth Group. These are further underlain at depth by the Seaford and Newhaven Chalk Formations. The superficial deposits directly underlying the site are identified as a Secondary A Aquifer, with the underlying solid deposits also identified as a Secondary A Aquifer. The underlying chalk is designated as a Principal Aquifer. A review of the EnviroInsight report indicates that the site is not located directly within a groundwater source protection zone. There is one groundwater abstraction located 720m north of site. The nearest surface watercourse is the Holy Brook, which flows north approximately 263m to the east of site. The River Kennet is also located approximately 380m east of site. The conceptual site model provided within the report identifies the following potential sources, pathways and receptors. The report indicates the following potential sources of contamination: • Made Ground is likely to be present at the site associated with historical

Site History and Ground Investigation	
	construction and demolition work • Potential for deep Made Ground associated with historical chalk mining • Contaminants associated with the burning of waste on site or the storage of contaminants such as oils in the garages on site. • Migrating ground gases from unrecorded landfilling of nearby chalk pits. The conceptual site model identifies the following potential pathways: • Direct soil ingestion of soil in exposed soft landscaped areas • Inhalation of indoor and outdoor vapours particularly volatile organic compounds • Inhalation of indoor and outdoor dust • Migration of ground gases into the buildings • Migration of contaminants through the unsaturated zone • Migration of contaminants through the groundwater • Movement of contaminants through drains or services runs The conceptual site model identifies the following potential receptors: • End users of the site (residents) • Surrounding residents • Construction workers for the new development/demolition contractors • Controlled waters (Holy Brook) • Controlled waters (Aquifers)
Intrusive Investigation	The ground investigation was undertaken on 21st July 2017 and comprised of: • 6 No window sample boreholes • 3 No combined gas and groundwater monitoring wells.
Ground Conditions	The ground conditions on site were found to comprise brown sandy gravelly clay with brick and concrete (Made Ground) to a maximum depth of 1.20mbgl, overlying medium dense to dense orange and brown sandy fine to coarse flint gravel to terminal depth in WS2-WS6, and to a maximum depth of 2.80mbgl in WS1, overlying orange and yellow mottled silty clay to the base of the borehole at 3.50mbgl.
Environmental Considerations	Following generic risk assessments, a single elevated concentration of lead has been reported with regards to human health receptors within the proposed residential without private gardens end use scenario. No asbestos fibres were detected in the samples analysed in the laboratory. UBM BARGE bioavailability testing has been undertaken on the sample displaying elevated lead levels to determine whether the elevated lead levels pose a risk to human health. The results indicate that a significant proportion of the lead content is biologically available, and therefore the quantity of bioavailable lead exceeds the generic screening criteria and poses a credible risk to human health. To address the risks posed by the elevated lead, remedial measures will be required in areas of soft landscaping, most likely in the form of a topsoil and subsoil cover layer placed above a geotextile membrane or other demarkation layer. Where hardstanding or building footprint is proposed, no further action is required. Groundwater analysis has not reported any elevated levels of contaminants contained within the testing suite. On this basis the site is not considered to pose a risk to controlled waters. As part of this consideration, the guidance published within the CL:AIRE RB17 (2012) document has been studied and, it is considered that it may be acceptable to consider

Site History and Ground Investigation	
	the site as CS1 on the basis of the Gas Screening Value, despite the elevated carbon dioxide levels. Characteristic Situation 1 sites require no formal gas protection measures. As with any ground investigation, the presence of further hotspots between sampling points cannot be ruled out. Should any contamination be encountered, a suitably qualified environmental consultant should be informed immediately, so that adequate measures may be recommended.

1 INTRODUCTION

1.1 Terms of Reference

- 1.1.1 Lucas Design ("The Client") has commissioned Jomas Associates Ltd, to assess the risk of contamination posed by the ground conditions at a site referred to as 1-3 Castle Crescent, Reading, prior to the redevelopment of the site.
- 1.1.2 A Desk Study has been produced for the site (Listers Geotechnical Consultants, August 2015) and provided for information, followed by an intrusive investigation (detailed in this report).
- 1.1.3 The intrusive investigation was undertaken in accordance with Jomas proposal dated 14th July 2017.

1.2 Proposed Development

- 1.2.1 It is understood that the existing central building is to be redeveloped, to provide residential apartments. The outbuildings are to be demolished and 8No residential dwellings along the eastern boundary of the site are to be constructed. Communal soft landscaping is understood to be proposed.
- 1.2.2 For the purposes of the contamination risk assessment, the proposed development is classified as 'residential without plant uptake'.

1.3 Objectives

- 1.3.1 The objectives of Jomas' investigation were as follows:
- To present a description of the present site status, based upon the published geology, hydrogeology and hydrology of the site and surrounding area;
 - To provide an assessment of the environmental sensitivity at the site and the surrounding area, in relation to any suspected or known contamination which may significantly affect the site and the proposed development;
 - To conduct an intrusive investigation, to determine the nature and extent of contaminants potentially present at the site;
 - To establish the presence of significant pollutant linkages, in accordance with the procedures set out within Part IIA of the Environmental Protection Act 1990, associated statutory guidance and current best practice including the EA report R&D CLR 11.

1.4 Scope of Works

- 1.4.1 The following tasks were undertaken to achieve the objectives listed above:
- Intrusive ground investigation to determine shallow ground conditions, and potential for contamination at the site;
 - Undertaking of laboratory chemical testing upon samples obtained;
 - The compilation of this report, which collects and discusses the above data, and presents an assessment of the site conditions, conclusions and recommendations.

1.5 Supplied Documentation

- 1.5.1 A number of reports previously prepared by third parties were supplied to Jomas Associates at the commencement of this investigation. Table 1.1 details the documents supplied:

Table 1.2: Supplied Reports

Title	Author	Reference	Date
Phase 1 Geoenvironmental Desk Study Report	Listers Geotechnical Consultants	15.07.030	August 2015

1.6 Limitations

- 1.6.1 Jomas Associates Ltd has prepared this report for the sole use of Lucas Design, in accordance with the 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 by any other party without the explicit written agreement of Jomas Associates Limited. No other third party warranty, expressed or implied, is made as to the professional advice included in this report. This report must be used in its entirety.
- 1.6.2 The records search was limited to information available from public sources; this information is changing continually and frequently incomplete. Unless Jomas Associates Limited has actual knowledge to the contrary, information obtained from public sources or provided to Jomas Associates Limited by site personnel and other information sources, have been assumed to be correct. Jomas Associates Limited does not assume any liability for the misinterpretation of information or for items not visible, accessible or present on the subject property at the time of this study.
- 1.6.3 Whilst every effort has been made to ensure the accuracy of the data supplied, and any analysis derived from it, there may be conditions at the site that have not been disclosed by the investigation, and could not therefore be taken into account. As with any site, there may be differences in soil conditions between exploratory hole positions. Furthermore, it should be noted that groundwater conditions may vary due to seasonal and other effects and may at times be significantly different from those measured by the investigation. No liability can be accepted for any such variations in these conditions.
- 1.6.4 Any reports provided to Jomas Associates Limited have been reviewed in good faith. Jomas Associates Limited cannot be held liable for any errors or omissions in these reports, or for any incorrect interpretation contained within them.
- 1.6.5 This investigation and report has been carried out in accordance with the relevant standards and guidance in place at the time of the works. Future changes to these may require a re-assessment of the recommendations made within this report.
- 1.6.6 ***This report is not an engineering design and the figures and calculations contained in the report should be used by the Structural Engineer, taking note that variations may apply, depending on variations in design loading, in techniques used, and in site conditions. Our recommendations should therefore not supersede the Engineer's design.***

2 SITE SETTING

2.1 Site Information

2.1.1 The site location plan is appended to this report in Appendix 1.

Table 2.1: Site Information

Name of Site	-
Address of Site	1-3 Castle Crescent, Reading, RG1 6AQ
Approx. National Grid Ref.	470940, 172790
Site Area (Approx)	0.26Ha
Site Ownership	Unknown
Site Occupation	Disused residential properties and garages/storage bays.
Local Authority	Reading Borough Council
Proposed Site Use	Residential

2.2 Desk Study Overview

- 2.2.1 A Desk Study report has been produced for the site and issued separately, by others (Listers Geotechnical Consultants, August 2015). A brief overview of the desk study findings is presented below. Reference should be made to the full report for detailed information.
- 2.2.2 A review of historical ordnance survey maps indicates that the site was developed as early as 1879 with a large detached house in the centre, and a row of terraced properties along the eastern boundary (similar to the current site layout). A row of garages are noted from 1976 trending north-south through the centre of the site, to the south of the detached house.
- 2.2.3 The surrounding area has been utilised predominantly for residential use, with some commercial uses recorded including a brick, tile and pottery works 300m south-west. A possible area of worked ground is shown approximately 100m south-east, with two others shown 100m south-east. Approaching the 1970s, an industrial estate is shown from approximately 100m to 1km south-east of the site including numerous factories and industrial units.
- 2.2.4 Information provided by the British Geological Survey indicates that the site is directly underlain by superficial deposits of the Lynch Hill Gravel above Lambeth Group clays. There are further underlain at depth by the Seaford and Newhaven Chalk Formations.
- 2.2.5 The superficial deposits directly underlying the site are identified as a Secondary A Aquifer, with the underlying solid deposits also identified as a Secondary A Aquifer. The underlying chalk is designated as a Principal Aquifer.
- 2.2.6 A review of the EnviroInsight report indicates that the site is not located directly within a groundwater source protection zone.
- 2.2.7 There is one groundwater abstraction located 720m north of site.
- 2.2.8 The nearest surface watercourse is the Holy Brook, which flows north approximately 263m to the east of site. The River Kennet is also located approximately 380m east of site.

- 2.2.9 The conceptual site model provided within the report identifies the following potential sources, pathways and receptors. The report indicates the following potential sources of contamination:
- Made Ground is likely to be present at the site associated with historical construction and demolition work
 - Potential for deep Made Ground associated with historical chalk mining
 - Contaminants associated with the burning of waste on site or the storage of contaminants such as oils in the garages on site.
 - Migrating ground gases from unrecorded landfilling of nearby chalk pits.
- 2.2.10 The conceptual site model identifies the following potential pathways:
- Direct soil ingestion of soil in exposed soft landscaped areas
 - Inhalation of indoor and outdoor vapours particularly volatile organic compounds
 - Inhalation of indoor and outdoor dust
 - Migration of ground gases into the buildings
 - Migration of contaminants through the unsaturated zone
 - Migration of contaminants through the groundwater
 - Movement of contaminants through drains or services runs
- 2.2.11 The conceptual site model identifies the following potential receptors:
- End users of the site (residents)
 - Surrounding residents
 - Construction workers for the new development/demolition contractors
 - Controlled waters (Holy Brook)
 - Controlled waters (Aquifers)

3 GROUND INVESTIGATION

3.1 Rationale for Ground Investigation

3.1.1 The site investigation has been undertaken generally in accordance with Contaminated Land Report 11, BS10175, NHBC Standards Chapter 4.1, and other associated Statutory Guidance. If required, further targeted investigations and remedial option appraisal would be dependent on the findings of this site investigation.

3.1.2 The soil sampling rationale for the site investigation was developed with reference to EA guidance 'Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination' (Technical Report P5-066/TR).

3.1.3 The sampling proposal was designed in order to gather data representative of the site conditions.

3.2 Scope of Ground Investigation

3.2.1 The ground investigation was undertaken on 21st July 2017

3.2.2 The work was undertaken in accordance with BS5930 'Code of Practice for Site Investigation' and BS10175 'Investigation of Potentially Contaminated Sites'. All works were completed without incident.

3.2.3 The investigation focused on collecting data on the following:

- Quality of Made Ground/ natural ground within the site boundaries;
- Presence of groundwater beneath the site (if any), perched or otherwise;
- Determination of the presence or absence of hazardous ground gases

3.2.4 A summary of the fieldwork carried out at the site, with justifications for exploratory hole positions, are offered in Table 3.1 below.

Table 3.1: Scope of Intrusive Investigation

Investigation Type	Number of Exploratory Holes Achieved	Exploratory Hole Designation	Depth Achieved (m bgl)	Justification
Window Sample Boreholes	6	WS1-6	Up to 3.5mbgl	Obtain shallow samples for contamination testing.
Monitoring Wells	3	WS1, WS4, WS6	Up to 2mbgl	Combined soil gas and groundwater monitoring wells. WS1 - response zone in gravels WS2 - response zone in gravel and Made Ground WS6 - response zone in gravel and Made Ground

3.2.5 The exploratory holes were completed to allow soil samples to be taken in the areas of interest identified in Table 3.1 above. In all cases, all holes were logged in accordance with BS5930:2015.

3.2.6 Exploratory hole positions were located with reference to known features on site, as shown in the exploratory hole location plan presented in Appendix 1. The exploratory hole records are included in Appendix 2.

3.2.7 Where monitoring well installations were not installed, the exploratory holes were backfilled with the arisings (in the reverse order in which they were drilled) and the ground surface was reinstated so that no depression was left.

3.3 Sampling Rationale

3.3.1 Our soil sampling rationale for the site investigation was developed with reference to EA guidance 'Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination' (Technical Report P5-066/TR).

3.3.2 The exploratory holes were positioned by applying a combined non-targeted sampling strategy, as well as sample locations positioned with reference to sources identified from the desk study.

3.3.3 Soil samples were taken from across the site at various depths as shown in the exploratory hole logs.

3.3.4 Jomas Associates Limited's engineers normally collect samples at appropriate depths based on field observations such as:

- appearance, colour and odour of the strata and other materials, and changes in these;
- the presence or otherwise of sub-surface features such as pipework, tanks, foundations and walls; and,
- areas of obvious damage, e.g. to the building fabric.

3.3.5 A number of the samples were taken from the top 0-1m to aid in the assessment of the pollutant linkages identified at the site. In addition, some deeper samples were taken to aid in the interpretation of fate and transport of any contamination identified.

3.3.6 During return groundwater monitoring visits, where groundwater samples are taken, all boreholes were purged of three well volumes prior to obtaining the sample for testing. This removes stagnant groundwater from the monitoring well.

3.3.7 Samples were stored in cool boxes (<4°C) and preserved in accordance with laboratory guidance.

3.3.8 Groundwater strikes noted during drilling, are recorded within the exploratory hole records in Appendix 2.

3.4 Sampling Limitations

3.4.1 WS2 was terminated at 1.4mbgl, where the sampler refused on very dense gravels.

3.4.2 WS3 was terminated at 1.4mbgl, where the sampler refused on very dense gravels.

3.4.3 WS4 was terminated at 1.3mbgl, where the sampler refused on very dense gravels.

3.4.4 WS5 was terminated at 1.0mbgl, where the sampler refused on very dense gravels

3.5 Laboratory Chemical Analysis

3.5.1 A programme of chemical laboratory testing, scheduled by Jomas Associates Limited, was carried out on selected samples of Made Ground and natural strata. Soil samples were submitted to i2 Analytical (a UKAS and MCerts accredited laboratory), for analysis.

3.5.2 The samples were analysed for a wide range of contaminants as shown in Table 3.2 below:

Table 3.2: Chemical Tests Scheduled

Test Suite	No. of tests	
	Made Ground / Topsoil	Natural
Basic Suite S3	2	2
Total Organic Carbon	2	2
Water Soluble Sulphate	2	2
Reduced Suite S5	3	1
Hydrocarbon suite	3	1
Asbestos Screen & ID	5	0

3.5.3 The determinands contained in the basic suite are as detailed in Table 3.3 below:

Table 3.3: Basic Suite of Determinands

DETERMINAND	LIMIT OF DETECTION (mg/kg)	UKAS ACCREDITATION	TECHNIQUE
Arsenic	1	Y (MCERTS)	ICPMS
Cadmium	0.2	Y (MCERTS)	ICPMS
Chromium	1	Y (MCERTS)	ICPMS
Chromium (Hexavalent)	4	Y (MCERTS)	Colorimetry
Lead	1	Y (MCERTS)	ICPMS
Mercury	0.3	Y (MCERTS)	ICPMS
Nickel	1	Y (MCERTS)	ICPMS
Selenium	1	Y (MCERTS)	ICPMS
Copper	1	Y (MCERTS)	ICPMS
Zinc	1	Y (MCERTS)	ICPMS
Boron (Water Soluble)	0.2	Y (MCERTS)	ICPMS
pH Value	0.1 units	Y (MCERTS)	Electrometric
Sulphate (Water Soluble)	0.0125g/l	Y (MCERTS)	Ion Chromatography
Total Cyanide	1	Y (MCERTS)	Colorimetry
Speciated/Total PAH	0.05/0.80	Y (MCERTS)	GCFID
Phenols	1	Y (MCERTS)	HPLC
Total Petroleum Hydrocarbons (banded)	-	N Y (MCERTS)	Gas Chromatography

- 3.5.4 To support the selection of appropriate tier 1 screening values, 4No samples were analysed for total organic carbon.
- 3.5.5 In addition samples of groundwater recovered from the groundwater / ground gas monitoring wells were subjected to a similar suite to that outlined above.
- 3.5.6 Samples from around the site were also analysed for a suite of Volatile Organic Compounds (VOCs).
- 3.5.7 Laboratory test results are summarised in Section 6, with raw laboratory data included in Appendix 3.

4 GROUND CONDITIONS

4.1 Soil

4.1.1 Ground conditions were logged in accordance with the requirements of BS5930:2015. Detailed exploratory hole logs are provided in Appendix 2. The ground conditions encountered are summarised in Table 4.1 below, based on the strata observed during the investigation.

Table 4.1: Ground Conditions Encountered

Stratum and Description	Encountered from (m bgl)	Base of strata (m bgl)	Thickness range (m)
Asphalt over concrete over soft to firm consistency brown sandy gravelly clay. Gravel is brick and concrete. (MADE GROUND).	GL	0.60-1.20	0.60-1.20
Medium dense to very dense orange and brown sandy fine to coarse flint GRAVEL. (terminal depth in WS2-WS6)	0.60-1.20	>1.00-2.80	>0.20-1.80
High strength orange and yellow mottled silty CLAY with occasional fine rootlets. (WS1 only)	2.80	>3.50	>0.70

4.1.2 Given the likely ground strata profile identified in the Desk Study it is considered that the encountered strata represent Made Ground overlying Taplow Gravel and Lambeth Group. It is also known that Chalk is present at relatively shallow depth beneath the site.

4.1.3 The BGS describes the Taplow Gravel as follows:

“Sand and gravel, locally with lenses of silt, clay or peat.”

4.1.4 The BGS describes the Lambeth Group as follows:

“Vertically and laterally variable sequences mainly of clay, some silty or sandy, with some sands and gravels, minor limestones and lignites and occasional sandstone and conglomerate.”

4.1.5 No materials considered to represent the expected Chalk beneath the site were encountered.

4.2 Hydrogeology

4.2.1 Groundwater was not encountered in the exploratory holes during drilling.

4.2.2 During return monitoring visits, water was only reported within WS1, at depths between 2.69mbgl and 2.73mbgl.

4.3 Physical and Olfactory Evidence of Contamination

- 4.3.1 Visual or olfactory evidence of contamination was not observed during the course of the investigation.

5 RISK ASSESSMENT – ANALYTICAL FRAMEWORK

5.1 Context and Objectives

- 5.1.1 This section seeks to evaluate the level of risk pertaining to human health and the environment which may result from both the existing use and proposed future use of the site. It makes use of the site investigation findings, as described in the previous sections, to evaluate further the potential pollutant linkages identified in the desk study. A combination of qualitative and quantitative techniques is used, as described below.
- 5.1.2 The purpose of generic quantitative risk assessment is to compare concentrations of contaminants found on site against screening level generic assessment criteria (GAC) to establish whether there are actual or potential unacceptable risks. It also determines whether further detailed assessment is required. The approaches detailed all broadly fit within a tiered assessment structure in line with the framework set out in the Department of Environment, Food and Rural Affairs (DEFRA), EA and Institute for Environment and Health Publication, Guidelines for Environmental Risk Assessment and Management.
- 5.1.3 It should be noted that the statistical tests carried out in this report in accordance with CL:AIRE and CIEH (2008) recommendations, are for guidance purposes only and the conclusions of this report should be approved by the local authority prior to any redevelopment works being undertaken.

5.2 Analytical Framework – Soils

- 5.2.1 There is no single methodology that covers all the various aspects of the assessment of potentially contaminated land and groundwater. Therefore, the analytical framework adopted for this investigation is made up of a number of procedures, which are outlined below. All of these are based on a Risk Assessment methodology centred on the identification and analysis of Source – Pathway – Receptor linkages.
- 5.2.2 The CLEA model provides a methodology for quantitative assessment of the long term risks posed to human health by exposure to contaminated soils. Toxicological data have been used to calculate Soil Guideline Values (SGV) for individual contaminants, based on the proposed site use; these represent minimal risk concentrations and may be used as screening values.
- 5.2.3 In the absence of any published SGVs for certain substances, or where the assumptions made in generating the SGVs do not apply to the site, Jomas Associates Limited have obtained Tier 1 screening values for initial assessment of the soil, based on available current UK guidance including the LQM/CIEH S4ULs and DEFRA C4SL. Site-specific assessments are undertaken wherever possible and/or applicable. All assessments are carried out in accordance with the CLEA protocol.
- 5.2.4 CLEA requires a statistical treatment of the test results to take into account the normal variations in concentration of potential contaminants in the soil and allow comparisons to be made with published guidance.
- 5.2.5 The assessment criteria used for the screening of determinands within soils are identified within Table 5.1.

Table 5.1: Selected Assessment Criteria – Contaminants in Soils

Substance Group	Determinand(s)	Assessment Criteria Selected
<u>Organic Substances</u>		
Non-halogenated Hydrocarbons	Total Petroleum Hydrocarbons (TPHCWG banded)	S4UL
	Total Phenols	S4UL
Polycyclic Aromatic Hydrocarbons (PAH-16)	Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenzo(a,h)anthracene, Benzo(ghi)perylene	S4UL
Volatile Organic Compounds (VOCs/sVOCs).	Toluene, Ethylbenzene, Benzene, Xylenes	S4UL
<u>Inorganic Substances</u>		
Heavy Metals and Metalloids	Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Selenium, Copper, Zinc	S4UL
	Copper, Zinc, Nickel	BS: 3882 (2015).
Cyanides	Free Cyanide	CLEA v1.06
Sulphates	Water Soluble Sulphate	BRE Special Digest 1:2005

5.3 BRE

- 5.3.1 The BRE Special Digest 1:2005, 'Concrete in Aggressive Ground' is used with soluble sulphate and pH results to assess the aggressive chemical environment of future underground concrete structures at the site.

5.4 Analytical Framework – Groundwater and Leachate

- 5.4.1 The requirement to protect groundwater from pollution is outlined in Groundwater protection: Principles and practice (GP3, EA, August 2013, v1.1).
- 5.4.2 Where undertaken, the groundwater quality analysis comprises a Level 1 assessment in accordance with the EA Remedial Targets Methodology Document (EA, 2006).
- 5.4.3 The criteria used by Jomas' in the Level 1 assessment of groundwater and leachate quality are shown in Table 5.2.

Table 5.2: Selected Assessment Criteria – Contaminants in Water

Substance Group	Determinand(s)	Assessment Criteria Selected
Metals	Arsenic, Copper, Cyanide, Mercury, Nickel, Lead, Zinc, Chromium	EQS/DWS
	Selenium	DWS
PAHs	Sum of Four – benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene	DWS
PAHs	Benzo(a)pyrene,	DWS
PAHs	Remainder	LEC
Total Petroleum Hydrocarbons	Aliphatic C5-C6, Aliphatic >C6-C8, Aliphatic >C8-C10, Aliphatic >C10-C12, Aliphatic >C12-C16, Aliphatic >C16-C21, Aromatic C5-C7, Aromatic >C7-C8, Aromatic >C8-C10, Aromatic >C10-C12, Aromatic >C12-C16, Aromatic >C16-C21, Aromatic > C21-C35	DWS/WHO
Benzene	Benzene	DWS
Toluene	Toluene	EQS
Ethylbenzene	Ethylbenzene	EQS
Xylene	Xylene	EQS
Oxygen Demand	Chemical Oxygen Demand and Biological Oxygen Demand	Urban Waste Water Treatment (England and Wales) Regulations

Environmental Quality Standards EQS

Environmental Quality Standards (EQS) have been released by the EA for dangerous substances, as identified by the EC Dangerous Substances Directive. EQS can vary for each substance, for the hardness of the water and can be different for fresh, estuarine or coastal waters.

Lowest Effect Concentration (LEC)

These criteria relate to the concentration of PAHs in groundwater. They are taken from the EA R&D Technical Report P45 – Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environmental Quality Standard Development (2001).

WHO Health

These screening criteria have been taken from the World Health Organisation Guidelines for Drinking Water Quality (1984). The health value is a guideline value representing the concentration of a contaminant that does not result in any significant risk to the receptor over a lifetime of exposure.

Further criteria have been obtained from 'Petroleum Products in Drinking-water' - Background document for development of WHO Guidelines for Drinking-water Quality (2005).

UK Drinking Water Standards (DWS)

These comprise screening criteria provided by the Drinking Water Inspectorate (DWI) in the Water Supply (Water Quality) Regulations 2006,

Urban Waste Water Treatment (England and Wales) Regulations - UWWT Regs

The Urban Waste Water Treatment (England and Wales) Regulations SI/1994/2841 as amended by SI/2003/1788 sets down minimum standards for the discharge of treated effluent from waste water treatment works to inland surface waters, groundwater, estuaries or coastal waters. Standards of (125mg/L) COD and (25mg/L) BOD have been set.

5.5 Site Specific Criteria

- 5.5.1 The criteria adopted in the selection of correct screening criteria from published reports as previously described, are provided within Tables 5.3.

Table 5.3: Site Specific Data

Input Details	Value
Land Use	Residential without plant uptake
Soil Organic Matter	1%

- 5.5.2 As the published reports only offer the option of selecting an SOM value of 1%, 2.5% or 6%, an SOM value of 1% has been used for the generation of generic assessment criteria, as 0.9% was the mean value obtained from laboratory analysis.
- 5.5.3 It is understood that the site is to be redeveloped to provide residential properties with communal soft landscaping. On this basis, the site use is considered to be “residential without plant uptake” for the purposes of risk assessment.

6 GENERIC QUANTITATIVE RISK ASSESSMENT

6.1 Screening of Soil Chemical Analysis Results – Human Health Risk Assessment

6.1.1 To focus on the contaminants of potential concern (COPC), the results have been compared with the respective SGV/GAC. Those contaminants which exceed the SGV/GAC are considered to be the COPC. Those which do not exceed the respective SGV/GAC are not considered to be COPC and as such do not require further assessment in relation to the proposed development of the site.

6.1.2 Laboratory analysis for soils are summarised in Tables 6.1 to 6.3. Raw laboratory data is included in Appendix 3.

Table 6.1: Soil Laboratory Analysis Results – Metals, Metalloids, Phenol, Cyanide

Determinand	Unit	No. samples tested	Screening Criteria	Min	Max	No. Exceeding
Arsenic	mg/kg	8	40 S4UL	15	33	0
Cadmium	mg/kg	8	85 S4UL	<0.2	<0.7	0
Chromium	mg/kg	8	910 S4UL	<4.0	<4.0	0
Lead	mg/kg	17	310 C4SL	15	950	2No (WS1@0.25mbgl, WS2@0.25)
Mercury	mg/kg	8	56 S4UL	<0.3	0.4	0
Nickel	mg/kg	8	180 S4UL	8.2	33	0
Copper	mg/kg	8	7100 S4UL	9.8	43	0
Zinc	mg/kg	8	40000 S4UL	37	410	0
Total Cyanide ^A	mg/kg	8	33 CLEA v 1.06	<1.0	<1.0	0
Selenium	mg/kg	8	430 S4UL	<1.0	<1.0	0
Boron Water Soluble	mg/kg	8	11000 S4UL	0.5	1.8	0
Phenols	mg/kg	8	440 S4UL	<1.0	<1.0	0

Notes: ^A Generic assessment criteria derived for free inorganic cyanide.

Table 6.2: Soil Laboratory Analysis Results – Polycyclic Aromatic Hydrocarbons (PAHs)

Determinand	Unit	No. Samples Tested	Screening Criteria	Min	Max	No. Exceeding
Naphthalene	mg/kg	8	S4UL 2.3	<0.05	0.18	0
Acenaphthylene	mg/kg	8	S4UL 2900	<0.05	0.17	0
Acenaphthene	mg/kg	8	S4UL 3000	<0.05	0.38	0
Fluorene	mg/kg	8	S4UL 2800	<0.05	1.3	0
Phenanthrene	mg/kg	8	S4UL 1300	<0.05	7.2	0
Anthracene	mg/kg	8	S4UL 2300	<0.05	2.2	0

Determinand	Unit	No. Samples Tested	Screening Criteria	Min	Max	No. Exceeding
Fluoranthene	mg/kg	8	S4UL 1500	<0.05	8.4	0
Pyrene	mg/kg	8	S4UL 3700	<0.05	6.9	0
Benzo(a)anthracene	mg/kg	8	S4UL 11.0	<0.05	3.1	0
Chrysene	mg/kg	8	S4UL 30	<0.05	2.3	0
Benzo(b)fluoranthene	mg/kg	8	S4UL 3.9	<0.05	2.5	0
Benzo(k)fluoranthene	mg/kg	8	S4UL 110	<0.05	1.5	0
Benzo(a)pyrene	mg/kg	8	S4UL 3.2	<0.05	2.2	0
Indeno(123-cd)pyrene	mg/kg	8	S4UL 45	<0.05	1.3	0
Dibenzo(ah)anthracene	mg/kg	8	S4UL 0.31	<0.05	0.29	0
Benzo(ghi)perylene	mg/kg	8	S4UL 360	<0.05	1.4	0
Total PAH	mg/kg	8	-	<0.80	42.2	-

Table 6.3: Soil Laboratory Analysis Results – Total Petroleum Hydrocarbons (TPH)

TPH Band	Unit	No. Samples Tested	Screening Criteria	Min	Max	No. Exceeding
C ₈ -C ₁₀	mg/kg	4	S4UL 27	<0.1	<0.1	0
>C ₁₀ -C ₁₂	mg/kg	4	S4UL 130	<2.0	<2.0	0
>C ₁₂ -C ₁₆	mg/kg	4	S4UL 1100	<4.0	<4.0	0
>C ₁₆ -C ₂₁	mg/kg	4	S4UL 1900	<10	3.3	0
>C ₂₁ -C ₃₅	mg/kg	4	S4UL 1900	<10	29	0
Total TPH	mg/kg	4	-	-	-	-

Note: *The lower value of guidelines for Aromatic/Aliphatics has been selected

Table 6.4: Soil Laboratory Analysis Results – Total Petroleum Hydrocarbons (TPHCWG)

TPH Band	Unit	No. Samples Tested	Screening Criteria	Min	Max	No. Exceeding
>C ₅ -C ₆ Aliphatic	mg/kg	4	S4UL 42	<0.001	<0.001	0
>C ₆ -C ₈ Aliphatic	mg/kg	4	S4UL 100	<0.001	<0.001	0
>C ₈ -C ₁₀ Aliphatic	mg/kg	4	S4UL 27	<0.001	<0.001	0
>C ₁₀ -C ₁₂ Aliphatic	mg/kg	4	S4UL 130	<1.0	<1.0	0
>C ₁₂ -C ₁₆ Aliphatic	mg/kg	4	S4UL 1100	<2.0	<2.0	0
>C ₁₆ -C ₃₅ Aliphatic	mg/kg	4	S4UL 65000	<16	110	0
>C ₅ -C ₇ Aromatic	mg/kg	4	S4UL 370	<0.001	<0.001	0
>C ₇ -C ₈ Aromatic	mg/kg	4	S4UL 860	<0.001	<0.001	0
>C ₈ -C ₁₀ Aromatic	mg/kg	4	S4UL 47	<0.001	<0.001	0
>C ₁₀ -C ₁₂ Aromatic	mg/kg	4	S4UL 250	<1.0	<1.0	0

TPH Band	Unit	No. Samples Tested	Screening Criteria		Min	Max	No. Exceeding
>C ₁₂ -C ₁₆ Aromatic	mg/kg	4	S4UL	1800	<2.0	6.9	0
>C ₁₆ -C ₂₁ Aromatic	mg/kg	4	S4UL	1900	<10	46	0
>C ₂₁ -C ₃₅ Aromatic	mg/kg	4	S4UL	1900	<10	350	0
Total TPH (Ali/Aro)	mg/kg	4	S4UL	1900	11	480	0

6.1.3 It is not considered appropriate to undertake a statistical assessment of the lead concentrations within the made ground, despite the exceedance of the C4SL for lead detected within the samples obtained from WS1 at 0.25m bgl. This is due to the number of samples of made ground soils equalling 4No, which is less than the required 6No. in order to allow confident statistical evaluation.

6.2 Volatile Organic Compounds (VOCs)

6.2.1 In addition to the suites outlined previously, 4No samples were analysed for the presence of VOCs.

6.2.2 No VOCs were reported above detection limit within any of the samples tested.

6.3 Asbestos in Soil

6.3.1 5No samples of the Made Ground were screened in the laboratory for the presence of asbestos. The results of the analyses are summarised below in Table 6.5 below

Table 6.5: Asbestos Analysis – Summary

Sample	Screening result.	Quantification result (%)	Comments
WS1 – 0.25mbgl	Not-detected	-	-
WS2 – 0.50mbgl	Not-detected	-	-
WS3 – 1.00mbgl	Not-detected	-	-
WS4 – 0.50mbgl	Not-detected	-	-
WS6 – 0.50mbgl	Not-detected	-	-

6.3.2 No asbestos was detected in any of the samples tested.

6.4 Bioavailability Analysis Overview

6.4.1 In light of the elevated concentrations of lead recorded during the site investigation, samples were submitted for UBM BARGE analysis.

6.4.2 The UBM BARGE analysis is used to simulate the conditions present within the human gastrointestinal tract to assess the human bioavailability of potentially harmful elements by ingestion. The test provides an indication as to whether a contaminant (in this case lead) is freely available to be absorbed via ingestion (and is therefore presenting a risk to human health) or is in effect 'bound up' within the existing soil chemistry.

- 6.4.3 In order to simulate the conditions of digestion, test submits the sample in question to differing pH conditions and different time periods, with each test run and analysed to establish the extent of bioavailability within each condition. The full results of the UBM BARGE analysis are contained within Appendix 2 of this report.
- 6.4.4 While the use of bioavailability analysis has no formal standing within the UK regulatory framework, the Environment Agency acknowledges that the use of bioavailability testing can form a useful element of a robust risk assessment for certain contaminants, such as lead, where bioavailability can be a significant issue.
- 6.4.5 2No samples displaying elevated concentrations of lead were submitted for bioavailability testing. The samples selected both had total lead levels that exceeded the screening criteria. It should be noted that when the analysis is undertaken, a sub-sample of the original sample is taken and retested for its total lead content, which may lead to a different total lead content being reported than that included in the original assessment.

6.5 Bioavailability Analysis Results

- 6.5.1 The results are summarised in the table below:

Table 6.6: UBM BARGE Results

Sample	Total Lead (mg/kg)	Bioavailable Percentage	Average Bioavailable Percentage
WS1 – 0.25mbgl	950	81	45.95
WS2 – 0.25mbgl	730	10.9	

- 6.5.2 As shown in the table above, a maximum bioavailability of 81% was recorded, with an average bioavailability of 45.95% calculated. Even if the lower average value is used (not a conservative approach) to calculate the quantity of bioavailable lead in the sample containing the highest total lead, this would give a bioavailable quantity of 436mg/kg, in excess of the 310mg/kg screening criteria.
- 6.5.3 More accurately than the average value, the actual bioavailable content of the sample with the highest total lead content is 769mg/kg, in excess of the screening criteria.
- 6.5.4 On the basis of the above bioavailability information, lead must be considered to pose a possible significant risk to human health post development.

6.6 Screening of Groundwater Chemical Analysis Results

- 6.6.1 Samples of groundwater obtained from the borehole installation WS1 were submitted for chemical analysis. These samples were subjected to a similar suite of determinands as laid out in Table 3.3 and have been assessed against the criteria laid out in Table 5.2.
- 6.6.2 The results of the laboratory testing are summarised in Tables 6.6 to 6.8 below, with the raw chemical testing data presented in Appendix 3.

Table 6.7: Groundwater Analysis Results – Metals, Phenol, Sulphate, pH

Determinand	Unit	No. samples tested	Screening Criteria		Result	No of Exceedances
Arsenic	µg/l	1	10	DWS	1.80	0
Cadmium	µg/l	1	5	DWS	0.02	0
Chromium	µg/l	1	50	DWS	0.5	0
Lead	µg/l	1	10	DWS	0.2	0
Nickel	µg/l	1	20	DWS	2.4	0
Copper	µg/l	1	12 2000	EQS DWS	2.5	0
Zinc	µg/l	1	50 5000	EQS DWS	5.4	0
Mercury	µg/l	1	1	DWS	<0.05	0
Selenium	µg/l	1	10	DWS	0.7	0
Boron	µg/l	1	1000	DWS	160	0
Cyanide (Total)	µg/l	1	50	EQS	<1.0	0
Phenols (Total)	µg/l	1	0.5	DWS	<10	0
Sulphate	mg/l	1	250	DWS	24400	0
pH Value	Units	1	6-9	EQS	7.1	0

Table 6.8: Groundwater Analysis Results – Polycyclic Aromatic Hydrocarbons (PAHs)

Determinand	Unit	No. samples tested	Screening Criteria		Result	No. of Exceedances
Naphthalene	µg/l	1	2	EQS	<0.01	0
Acenaphthylene	µg/l	1	580	LEC	<0.01	0
Acenaphthene	µg/l	1	-	-	<0.01	0
Fluorene	µg/l	1	210	LEC	<0.01	0
Phenanthrene	µg/l	1	300	LEC	<0.01	0
Anthracene	µg/l	1	0.02	EQS	<0.01	0
Fluoranthene	µg/l	1	0.02	EQS	<0.01	0
Pyrene	µg/l	1	4	LEC	<0.01	0
Benzo(a)anthracene	µg/l	1	1.8	LEC	<0.01	0
Chrysene	µg/l	1	0.7	LEC	<0.01	0
Sum of four Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(ghi)perylene Indeno(123-cd)pyrene	µg/l	1	0.1	DWS	<0.01	0
Benzo(a)pyrene	µg/l	1	0.03	EQS	<0.01	0
Dibenzo(ah)anthracene	µg/l	1	0.4	LEC	<0.01	0
Total PAH	µg/l	1	-	-	<0.01	0

Table 6.9: Groundwater Analysis Results (Round 2) – TPHCWG – Controlled Waters

Determinand	Unit	No. Samples tested	Screening Criteria		Result	No. of Exceedances
>C5-C6 Aliphatic	µg/l	1	10	DWS	<0.01	0
>C6-C8 Aliphatic	µg/l	1	10	DWS	<0.01	0
>C8-C10 Aliphatic	µg/l	1	300	WHO	<0.01	0
>C10-C12 Aliphatic	µg/l	1	100	WHO	<0.01	0
>C12-C16 Aliphatic	µg/l	1	100	WHO	<0.01	0
>C16-C21 Aliphatic	µg/l	1	90	WHO	<0.01	0
>C21-C35 Aliphatic	µg/l	1	90	WHO	<0.01	0
Total (>C5-C40) Aliphatic	µg/l	1	300	WHO	<0.01	0
>C5-C7 Aromatic	µg/l	1	10	DWS	<0.01	0
>C7-C8 Aromatic	µg/l	1	10	DWS	<0.01	0
>C8-C10 Aromatic	µg/l	1	300	WHO	<0.01	0
>C10-C12 Aromatic	µg/l	1	100	WHO	<0.01	0
>C12-C16 Aromatic	µg/l	1	100	WHO	<0.01	0
>C16-C21 Aromatic	µg/l	1	90	WHO	<0.01	0
>C21-C35 Aromatic	µg/l	1	90	WHO	<0.01	0
Total (>C5-C40) Aromatic	µg/l	1	300	WHO	<0.01	0
Total (>C5-C40) Ali/Aro	µg/l	1	300	WHO	<0.01	0

6.6.3 In addition to the suite outlined above, the water sample was also analysed for a suite of volatile organic compounds. None of the compounds analysed for were reported above the laboratory method detection limit.

6.6.4 Similarly for the BTEX (Benzene, Toluene, Ethylbenzene and Xylene) compounds, none of the results were reported above the laboratory method of detection.

6.7 Screening of Soil Chemical Analysis Results – Potential Risks to Plant Growth

6.7.1 Zinc, copper and nickel are phytotoxins and could therefore inhibit plant growth in soft landscaped areas. Concentrations measured in soil for these determinands have been compared with the pH dependent values given in BS: 3882 (2015).

6.7.2 Adopting a pH value of greater than 7, as indicated by the results of the laboratory analysis, the following is noted;

Table 6.10: Soil Laboratory Analysis Results – Phytotoxic Determinands

Determinand	Threshold level (mg/kg)	Min (mg/kg)	Max (mg/kg)	No. Exceeding
Zinc	300	37	410	1No (WS1@0.25mbgl)
Copper	200	9.8	43	0
Nickel	110	8.2	33	0

6.8 Screening for Water Pipes

6.8.1 The results of the analysis have been assessed for potential impact upon water supply pipes. Table 6.11 below summarises the findings of the assessment:

Table 6.11: Screening Guide for Water Pipes

Determinand	Threshold adopted for PE (mg/kg)	Min Value for site data	Max Value from site data
Total VOCs	0.5	<0.055	<0.055
BTEX	0.1	<0.05	<0.055
MTBE	0.1	-	-
EC5-EC10	1	<0.1	<0.003
EC10-EC16	10	<6.0	6.9
EC16-EC40	500	<16	369
Naphthalene	5	<0.05	0.18
Phenols	2	<1.0	<1.0

6.8.2 The above results indicate that standard pipework is likely to be sufficient.

6.8.3 The water supply pipe requirements for this site should be discussed at an early stage with the relevant utility provider.

7 SOIL GAS RISK ASSESSMENT

7.1 Soil Gas Results

7.1.1 Four return monitoring visits were undertaken from 1st August 2017 to 25th August 2017, to monitor wells installed within boreholes at the site for soil gas concentrations and groundwater levels.

7.1.2 The results of the monitoring undertaken are summarised in Table 7.1 below, with the monitoring records presented in Appendix 4.

Table 7.1: Summary of Gas Monitoring Data

Hole No.	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	H ₂ S (ppm)	VOCs (ppm)	Peak Flow Rate (l/hr)	Depth to water (m bgl)	Depth of installation (m bgl)
WS1	0.0-0.1	5.4-5.6	13.8-14.4	0	0	+0.1- +0.5	2.69-2.73	3.03
WS4	0.0-0.1	5.0-8.0	11.9-15.7	0	0	+0.2- +0.4	DRY	1.24
WS6	0.0-0.1	3.9-8.1	13.0-15.7	0	0	+0.2- +0.4	DRY	1.36

7.2 Screening of Results

7.2.1 As shown in Table 7.1, methane has been reported to a maximum concentration of 0.1%. Carbon dioxide has been reported to a maximum concentration of 8.1% v/v. Volatile organic compounds (VOCs) have not been detected.

7.2.2 In the assessment of risks posed by hazardous ground gases and selection of appropriate mitigation measures, BS8485 (2015) identifies four types of development, termed Type A to Type D.

7.2.3 Type A buildings are defined as

“private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present. Probably conventional building construction (rather than civil engineering). Examples include private housing and some retail premises.”

7.2.4 Type A has been adopted as the relevant category for the proposed development.

7.2.5 The soil gas assessment method is based on that proposed by Wilson & Card (1999), which was a development of a method proposed in CIRIA publication R149 (CIRIA, 1995). The method uses both gas concentrations and borehole flow rates to define a characteristic situation based on the limiting borehole gas volume flow for methane and carbon dioxide. In both these methods, the limiting borehole gas volume flow is renamed as the Gas Screening Value (GSV).

7.2.6 The Gas Screening Value (litres of gas per hour) is calculated by using the following equation

$$\text{GSV} = (\text{Concentration}/100) \times \text{Flow rate}$$

Where concentration is measured in percent (%)
and flow rate is measured in litres per hour (l/hr)

- 7.2.7 The Characteristic Situation is then determined from Table 8.5 of CIRIA C665.
- 7.2.8 To accord with C665, worst case conditions are used in the calculation of GSVs for the site.
- 7.2.9 A worst case flow rate of +0.5l/hr (maximum reported) will be used in the calculation of GSVs for the site. The Characteristic Situation is then determined from Table 8.5 of CIRIA C665.
- 7.2.10 To accord with C665, worst case conditions are used in the calculation of GSVs for the site. These have been summarised below in Table 7.2

Table 7.2: Summary of Gas Monitoring Data

Gas	Concentration (v/v %)	Peak Flow Rate (l/hr)	GSV (l/hr)	Characteristic Situation (after CIRIA C665)
CO ₂	8.1	+0.5	0.0405	1
CH ₄	0.1	+0.5	0.0005	1

- 7.2.11 Although the site is a CS1 in terms of the GSV, the concentrations of carbon dioxide recorded (>5%) mean that consideration must be given to increasing this to CS2.
- 7.2.12 As part of this consideration, the guidance published within the CL:AIRE RB17 (2012) document has been studied. It is stated within this document that carbon dioxide production by natural soils such as chalk (present at depth beneath this site) can often be recorded up to 15%, but this does not pose a risk to development. It also states (Table A1, Appendix A) that where natural soils are the source of gas (including chalk) that no gas protection is required.
- 7.2.13 It is suggested that due to the ground profile identified on site comprising clay based Made Ground, overlying granular material, that ground gas from the diffuse chalk source would preferentially enter the monitoring well from the granular material as a "path of least resistance", concentrating the ground gas within the well and resulting in artificially elevated carbon dioxide levels when monitoring.
- 7.2.14 On the basis of the above, it is considered that it may be acceptable to consider the site as CS1 on the basis of the Gas Screening Value, despite the elevated carbon dioxide levels.
- 7.2.15 Characteristic Situation 1 sites require no formal gas protection measures.
- 7.2.16 Should renovations to the existing structure on site allow for the installation of a new damp proof membrane, then this would also afford some level of gas protection, albeit not required for a CS1 site.
- 7.2.1 During construction, where personnel are required to enter excavations of greater than 1.2m the air quality (carbon dioxide, methane and oxygen as a minimum) should be regularly checked prior and during person entry. Appropriate precautions, including but not limited to, venting, PPE and gas alarms should be undertaken.

- 7.2.2 Any permanent excavations such as manholes, inspection chambers or other void spaces formed beneath the sites ground surface are potential ground gas traps and precautions, as per above, are considered the minimum necessary prior to person entry.
- 7.2.3 BS 8576:2013 has been used to derived threshold levels for Carbon Monoxide and Volatile Organic Compounds.
- 7.2.4 Given the recorded levels it is not considered that additional protection measures need to be incorporated to protect end users from the recorded carbon monoxide or VOC concentrations.

8 SUMMARY OF RESULTS

8.1 Land Quality Impact Summary

8.1.1 Following the ground investigation, the following is noted:

- It is understood that the proposed development will comprise the refurbishment of the exiting central building on site to residential apartments. In addition, the demolition of existing outbuildings to be replaced by new residential properties. No private soft landscaping is understood to be proposed, however communal soft landscaping is proposed.
- Following generic risk assessments, a single elevated concentration of lead has been reported.
- UBM BARGE bioavailability testing has been undertaken on the sample displaying elevated lead levels to determine whether the elevated lead levels pose a risk to human health. The results indicate that a significant proportion of the lead content is biologically available, and therefore the quantity of bioavailable lead exceeds the generic screening criteria and poses a credible risk to human health.
- To address the risks posed by the elevated lead, remedial measures will be required in areas of soft landscaping, most likely in the form of a topsoil and subsoil cover layer placed above a geotextile membrane or other demarkation layer. Where hardstanding or building footprint is proposed, no further action is required.
- No asbestos fibres were detected in the samples analysed in the laboratory.
- Groundwater analysis has not reported elevated levels of contaminants contained within the testing suite. On this basis, the site is not considered to pose a risk to controlled waters.
- A gas classification of CS1 has been calculated for the site. Whilst some concentrations of carbon dioxide above 5% have been reported, it is considered that this may relate to underlying natural soils, and no further action is considered necessary.
- Where personnel are required to enter excavations open excavations of greater than 1.2m or enclosed permanent excavations (man holes etc) the air quality (carbon dioxide, methane and oxygen as a minimum) should be regularly checked prior and during person entry. Appropriate precautions, including but not limited to, venting, PPE and gas alarms may be required.
- As with any ground investigation, the presence of further hotspots between sampling points cannot be ruled out. Should any contamination be encountered, a suitably qualified environmental consultant should be informed immediately, so that adequate measures may be recommended.

8.1.2 The above conclusions are made subject to approval by the statutory regulatory bodies.

8.2 Review of Pollutant Linkages Following Site Investigation

- 8.2.1 The site CSM has been revised and updated from that suggested in the Listers Geotechnical desk study in view of the ground investigation data, including soil laboratory analysis results. Table 8.1 highlights whether pollutant linkages identified in the original CSM are still relevant following the risk assessment, or whether pollutant linkages, not previously identified, exist.

SECTION 8 SUMMARY OF RESULTS



Table 8.1: Plausible Pollutants Linkages Summary (Pre Remediation)

Potential Source (from desk study)	Pathway	Receptor	Relevant Pollutant Linkage?	Comment
- Made Ground is likely to be present at the site associated with historical construction and demolition work - Potential for deep Made Ground associated with historical chalk mining - Contaminants associated with the burning of waste on site or the storage of contaminants such as oils in the garages on site. - Migrating ground gases from unrecorded landfilling of nearby chalk pits	- Direct soil ingestion of soil in exposed soft landscaped areas - Inhalation of indoor and outdoor vapours particularly volatile organic compounds - Inhalation of indoor and outdoor dust - Migration of ground gases into the buildings - Migration of contaminants through the unsaturated zone - Migration of contaminants through the groundwater - Movement of contaminants through drains or services runs	- End users of the site (residents) - Surrounding residents - Construction workers for the new development/demolition contractors. - Controlled waters (Holy Brook) - Controlled waters (Aquifers)	Y X X	See 8.1 above for remedial measures. No further action considered necessary No risk to controlled waters identified.

9 REFERENCES

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British Standards Institution (2015) BS 5930:2015 *Code of practice for site investigations*. Milton Keynes: BSI

CIEH & CL:AIRE (2008) *Guidance on comparing soil contamination data with a critical concentration*. London: Chartered Institute of Environmental Health (CIEH) and CL:AIRE

Environment Agency (2004) *Model procedures for the management of land contamination*. CLR11. Bristol: Environment Agency

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Environment Agency (2006) *Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination* Environment Agency

LQM/CIEH S4ULs. LQM, 2014

National Planning Policy Framework. Department for Communities and Local Government, March 2012

Phase I Geoenvironmental Desk Study Report for 1-3 Castle Crescent, Reading, RG1 6AQ, Listers Geotechnical Consultant, Report No: 15.07.030, August 2015

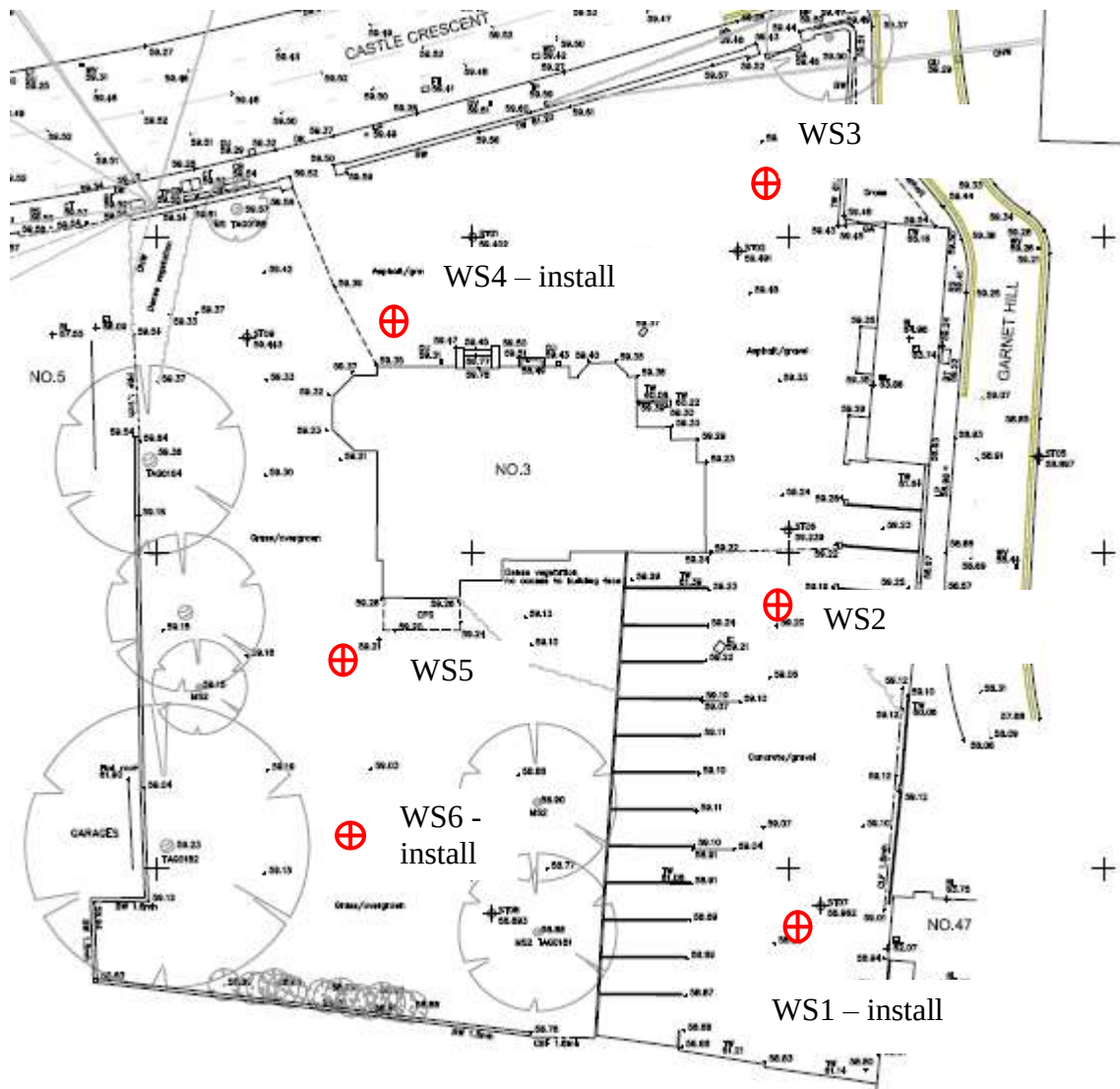
CL:AIRE RB17 (November 2012) *A Pragmatic Approach to Ground Gas Risk Assessment*

APPENDICES

APPENDIX 1 – FIGURES

Project Name	1-3 Castle Crescent	Client	Lucas Design
Project No.	P9864J1122	Date	August 2017
Title	Completed GI Plan		

North



APPENDIX 2 – EXPLORATORY HOLE RECORDS

Exploratory Hole No:

WS2

Site Address:	Castle Crescent
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Client:	Lucas Design
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Logged By:	SB
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Checked By:	TME
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Type and diameter of equipment:	Windowless Sampler
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Project No:	P9864J1122
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Ground Level:	
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Date Commenced:	21/07/2017
-----------------	------------

Date Completed:	21/07/2017
-----------------	------------

Sheet No:	1 Of 1
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Water levels recorded during boring, m
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Date:

Hole depth:

Casing depth:

Level water on strike:

Water Level after 20mins:

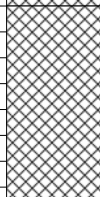
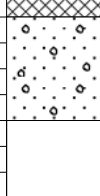
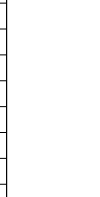
Remarks

1:

2:

3:

4:

Sample or Tests										Strata			Strata Description	Installation
Type	Depth (mbgl)	Result								Legend	Depth (mbgl)	Water Strikes (mbgl)		
		75	75	75	75	75	75	N						
P + J P + J P + J D CPT D	0.25								0.00		0.20		Asphalt over concrete. (MADE GROUND)	
	0.50								0.50				Soft to firm consistency brown sandy gravelly clay. Gravel is brick and concrete. (MADE GROUND).	
	1.00								1.00		1.00			
	1.40	12	18	20	20	26	30	96	1.40		1.40		Orange and brown sandy GRAVEL composed of fine to coarse subangular flint.	
									1.50					
									2.00					
									2.50					
									3.00					
									3.50					
									4.00					
									4.50					
									5.00					

Exploratory Hole No:

WS4

Site Address:	Castle Crescent
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Client:	Lucas Design
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Logged By:	SB
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Checked By:	TME
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Type and diameter of equipment:	Windowless Sampler
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Project No:

P9864J1122

Ground Level:

Date Commenced:	
-----------------	--

21/07/2017

Date Completed:

21/07/2017

Sheet No:

1 Of 1

Water levels recorded during boring, m
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Date:

Hole depth:	
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Casing depth:

Level water on strike:

Water Level after 20mins:	
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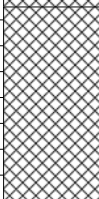
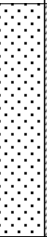
Remarks

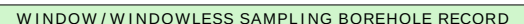
1:

2:

3:

4:

Sample or Tests									Strata			Strata Description	Installation		
Type	Depth (mbgl)	Result							Legend	Depth (mbgl)	Water Strikes (mbgl)				
		75	75	75	75	75	75							N	
P + J	0.25								0.00		0.25		Grass over loose* light pinkish brown fine to coarse sandy GRAVEL.		
P + J	0.50								0.50				Soft to firm consistency brown sandy gravelly clay. Gravel is brick and concrete. (MADE GROUND).		
CPT P + J D	1.00	2	7	15	20	18	19	72	1.00		1.30		Very dense orange and brown sandy GRAVEL composed of fine to coarse subangular flint.		
									1.50						
									2.00						
									2.50						
									3.00						
									3.50						
									4.00						
									4.50						
									5.00						



WS5

Project No:	P9864J1122
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Ground Level:

Date Commenced:	21/07/2017
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Date Completed:	21/07/2017
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Sheet No:	1 Of 1
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Date:					
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Casing depth:					
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Water Level after 20mins:					
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1: *Driller's description.

3:	
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Sample or Tests		Strata	
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Sampling Code: U- Undisturbed B - Large Disturbed D - Small Disturbed W - Water (U*) Non recovery of Sample
 Jomas Associates Ltd - Lakeside House, 1 Furzeground Way, Stockley Park, UB11 1BD
 T: 0843 289 2187 E: info@jomasassociates.com W: www.jomasassociates.com

T: 0843 289 2187 E: info@jomasassociates.com W: www.jomasassociates.com

APPENDIX 3 – CHEMICAL LABORATORY TEST RESULTS

**Emma Hucker**

Jomas Associates Ltd
Lakeside House
1 Furzeground Way
Stockley Park
UB11 1BD

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

e: Jomas Group

Analytical Report Number : 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Samples received on: 02/08/2017

Your job number: JJ1122

Samples instructed on: 02/08/2017

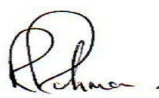
Your order number: P9864JJ1122.2

Analysis completed by: 08/08/2017

Report Issue Number: 1

Report issued on: 08/08/2017

Samples Analysed: 11 soil samples

Signed: 

Rexona Rahman
Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Analytical Report Number: 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.2

Lab Sample Number				792294	792295	792296	792297	792298
Sample Reference				WS1	WS1	WS2	WS2	WS3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.25	3.50	0.50	1.40	0.25
Date Sampled				21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	26	-	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	8.0	3.5	-	3.5	9.1
Total mass of sample received	kg	0.001	NONE	1.7	1.1	-	1.3	1.7

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	-	-
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.7	10.8	-	8.2	8.0
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	-	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	510	510	-	130	540
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.013	0.088	-	0.013	0.048
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	13.2	88.4	-	13.0	47.5
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.9	-	-	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	0.18
Acenaphthylene	mg/kg	0.05	MCERTS	0.17	< 0.05	-	< 0.05	0.16
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	1.5
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	1.3
Phenanthrene	mg/kg	0.05	MCERTS	0.46	< 0.05	-	< 0.05	7.2
Anthracene	mg/kg	0.05	MCERTS	0.15	< 0.05	-	< 0.05	2.2
Fluoranthene	mg/kg	0.05	MCERTS	1.2	< 0.05	-	< 0.05	8.4
Pyrene	mg/kg	0.05	MCERTS	1.1	< 0.05	-	< 0.05	6.9
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.71	< 0.05	-	< 0.05	3.1
Chrysene	mg/kg	0.05	MCERTS	0.52	< 0.05	-	< 0.05	2.3
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.79	< 0.05	-	< 0.05	2.5
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.31	< 0.05	-	< 0.05	1.5
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.58	< 0.05	-	< 0.05	2.2
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.41	< 0.05	-	< 0.05	1.3
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.10	< 0.05	-	< 0.05	0.29
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.39	< 0.05	-	< 0.05	1.4

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	6.85	< 0.80	-	< 0.80	42.2
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Analytical Report Number: 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.2

Lab Sample Number				792294	792295	792296	792297	792298
Sample Reference				WS1	WS1	WS2	WS2	WS3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.25	3.50	0.50	1.40	0.25
Date Sampled				21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	25	15	-	27	19
Boron (water soluble)	mg/kg	0.2	MCERTS	1.7	0.8	-	0.6	0.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	-	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	-	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	23	25	-	33	21
Copper (aqua regia extractable)	mg/kg	1	MCERTS	43	10	-	12	23
Lead (aqua regia extractable)	mg/kg	1	MCERTS	420	15	-	23	180
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.4	< 0.3	-	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	28	21	-	33	17
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	410	37	-	50	99

Monoaromatics

Benzene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Toluene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Ethylbenzene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
p & m-xylene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
o-xylene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0

Petroleum Hydrocarbons

Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	< 0.1	-	-	< 0.1	-
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TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	< 2.0	-	-	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	< 8.0	-	-	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	13	-	-	13
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	13	-	-	14

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	< 2.0	-	-	6.9
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	< 10	-	-	46
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	33	-	-	120
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	33	-	-	170

TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	-	-	< 2.0	-
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	-	-	< 4.0	-
TPH (C16 - C21)	mg/kg	1	MCERTS	3.3	-	-	< 1.0	-
TPH (C21 - C40)	mg/kg	10	MCERTS	14	-	-	< 10	-



Analytical Report Number: 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.2

Lab Sample Number				792294	792295	792296	792297	792298
Sample Reference				WS1	WS1	WS2	WS2	WS3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.25	3.50	0.50	1.40	0.25
Date Sampled				21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

VOCs

Chloromethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Chloroethane	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
Bromomethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Vinyl Chloride	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
Trichlorofluoromethane	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
1,1-Dichloroethene	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1-Dichloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
2,2-Dichloropropane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Trichloromethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2-Dichloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1-Dichloropropene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
Benzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Tetrachloromethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2-Dichloropropane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Trichloroethene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Dibromomethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Bromodichloromethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Toluene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Dibromochloromethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Tetrachloroethene	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Chlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
p & m-Xylene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Styrene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Tribromomethane	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
o-Xylene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Isopropylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Bromobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
n-Propylbenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
2-Chlorotoluene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
4-Chlorotoluene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
tert-Butylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
sec-Butylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Butylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Hexachlorobutadiene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0

Analytical Report Number: 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.2

Lab Sample Number	792299	792300	792301	792302	792303
Sample Reference	WS3	WS4	WS4	WS5	WS6
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	1.00	0.25	0.50	1.00	0.25
Date Sampled	21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	2.7	6.5
Total mass of sample received	kg	0.001	NONE	2.0	1.7

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected	-	-
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.2	8.7	-	7.8	7.3
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	-	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	150	1100	-	170	510
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0075	0.056	-	0.016	0.026
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	7.5	55.9	-	16.3	26.3
Total Organic Carbon (TOC)	%	0.1	MCERTS	0.2	-	1.2	0.3	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.38	-	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	0.39	-	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	2.4	-	< 0.05	0.19
Anthracene	mg/kg	0.05	MCERTS	< 0.05	0.67	-	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	3.2	-	< 0.05	0.49
Pyrene	mg/kg	0.05	MCERTS	< 0.05	2.7	-	< 0.05	0.48
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	1.4	-	< 0.05	0.33
Chrysene	mg/kg	0.05	MCERTS	< 0.05	1.2	-	< 0.05	0.26
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	1.2	-	< 0.05	0.38
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.80	-	< 0.05	0.15
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	1.3	-	< 0.05	0.28
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.65	-	< 0.05	0.23
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	-	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.88	-	< 0.05	0.27

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	17.1	-	< 0.80	3.06
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Analytical Report Number: 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.2

Lab Sample Number				792299	792300	792301	792302	792303
Sample Reference				WS3	WS4	WS4	WS5	WS6
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.25	0.50	1.00	0.25
Date Sampled				21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	30	15	-	33	19
Boron (water soluble)	mg/kg	0.2	MCERTS	0.8	0.9	-	0.7	1.8
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	0.7	-	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	-	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	31	11	-	24	17
Copper (aqua regia extractable)	mg/kg	1	MCERTS	9.8	14	-	11	40
Lead (aqua regia extractable)	mg/kg	1	MCERTS	17	160	-	22	190
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	-	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	32	8.2	-	29	23
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	-	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	54	85	-	57	87

Monoaromatics

Benzene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Toluene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Ethylbenzene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
p & m-xylene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
o-xylene	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	-	< 1.0	-	-	< 1.0

Petroleum Hydrocarbons

Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	< 0.1	-	-	< 0.1	-
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	< 2.0	-	-	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	< 8.0	-	-	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	110	-	-	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	110	-	-	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	< 0.001	-	-	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	< 2.0	-	-	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	19	-	-	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	350	-	-	< 10
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	370	-	-	11
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	-	-	< 2.0	-
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	-	-	< 4.0	-
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	-	-	< 1.0	-
TPH (C21 - C40)	mg/kg	10	MCERTS	< 10	-	-	29	-



Analytical Report Number: 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.2

Lab Sample Number				792299	792300	792301	792302	792303
Sample Reference				WS3	WS4	WS4	WS5	WS6
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.25	0.50	1.00	0.25
Date Sampled				21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
VOCs								
Chloromethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Chloroethane	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
Bromomethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Vinyl Chloride	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
Trichlorofluoromethane	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
1,1-Dichloroethene	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1-Dichloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
2,2-Dichloropropane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Trichloromethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2-Dichloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1-Dichloropropene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
Benzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Tetrachloromethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2-Dichloropropane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Trichloroethene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Dibromomethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Bromodichloromethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Toluene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Dibromochloromethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Tetrachloroethene	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
Chlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
p & m-Xylene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Styrene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Tribromomethane	µg/kg	1	NONE	-	< 1.0	-	-	< 1.0
o-Xylene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Isopropylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Bromobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
n-Propylbenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
2-Chlorotoluene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
4-Chlorotoluene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
tert-Butylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
sec-Butylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Butylbenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
Hexachlorobutadiene	µg/kg	1	MCERTS	-	< 1.0	-	-	< 1.0
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	< 1.0	-	-	< 1.0

Analytical Report Number: 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.2

Lab Sample Number				792304				
Sample Reference				WS6				
Sample Number				None Supplied				
Depth (m)				0.50				
Date Sampled				21/07/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	-				
Moisture Content	%	N/A	NONE	-				
Total mass of sample received	kg	0.001	NONE	-				

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected				
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-				
Total Cyanide	mg/kg	1	MCERTS	-				
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-				
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-				
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-				
Total Organic Carbon (TOC)	%	0.1	MCERTS	-				

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-				
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-				
Acenaphthylene	mg/kg	0.05	MCERTS	-				
Acenaphthene	mg/kg	0.05	MCERTS	-				
Fluorene	mg/kg	0.05	MCERTS	-				
Phenanthrene	mg/kg	0.05	MCERTS	-				
Anthracene	mg/kg	0.05	MCERTS	-				
Fluoranthene	mg/kg	0.05	MCERTS	-				
Pyrene	mg/kg	0.05	MCERTS	-				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-				
Chrysene	mg/kg	0.05	MCERTS	-				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-				

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-				
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Analytical Report Number: 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.2

Lab Sample Number				792304				
Sample Reference				WS6				
Sample Number				None Supplied				
Depth (m)				0.50				
Date Sampled				21/07/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-				
Boron (water soluble)	mg/kg	0.2	MCERTS	-				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-				
Chromium (hexavalent)	mg/kg	4	MCERTS	-				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-				

Monoaromatics

Benzene	ug/kg	1	MCERTS	-				
Toluene	ug/kg	1	MCERTS	-				
Ethylbenzene	ug/kg	1	MCERTS	-				
p & m-xylene	ug/kg	1	MCERTS	-				
o-xylene	ug/kg	1	MCERTS	-				
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	1	MCERTS	-				

Petroleum Hydrocarbons

Petroleum Range Organics (C6 - C10)	mg/kg	0.1	MCERTS	-				
TPH-CWG - Aliphatic >EC5 - EC6								
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-				
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-				
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-				
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-				
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-				
TPH-CWG - Aromatic >EC5 - EC7								
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-				
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-				
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-				
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-				
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-				
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-				
TPH (C10 - C12)								
TPH (C12 - C16)	mg/kg	4	MCERTS	-				
TPH (C16 - C21)	mg/kg	1	MCERTS	-				
TPH (C21 - C40)	mg/kg	10	MCERTS	-				



Analytical Report Number: 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.2

Lab Sample Number				792304				
Sample Reference				WS6				
Sample Number				None Supplied				
Depth (m)				0.50				
Date Sampled				21/07/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
VOCs								
Chloromethane	µg/kg	1	ISO 17025	-				
Chloroethane	µg/kg	1	NONE	-				
Bromomethane	µg/kg	1	ISO 17025	-				
Vinyl Chloride	µg/kg	1	NONE	-				
Trichlorofluoromethane	µg/kg	1	NONE	-				
1,1-Dichloroethene	µg/kg	1	NONE	-				
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-				
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-				
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-				
1,1-Dichloroethane	µg/kg	1	MCERTS	-				
2,2-Dichloropropane	µg/kg	1	MCERTS	-				
Trichloromethane	µg/kg	1	MCERTS	-				
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-				
1,2-Dichloroethane	µg/kg	1	MCERTS	-				
1,1-Dichloropropene	µg/kg	1	MCERTS	-				
Trans-1,2-dichloroethene	µg/kg	1	NONE	-				
Benzene	µg/kg	1	MCERTS	-				
Tetrachloromethane	µg/kg	1	MCERTS	-				
1,2-Dichloropropane	µg/kg	1	MCERTS	-				
Trichloroethene	µg/kg	1	MCERTS	-				
Dibromomethane	µg/kg	1	MCERTS	-				
Bromodichloromethane	µg/kg	1	MCERTS	-				
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-				
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-				
Toluene	µg/kg	1	MCERTS	-				
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-				
1,3-Dichloropropane	µg/kg	1	ISO 17025	-				
Dibromochloromethane	µg/kg	1	ISO 17025	-				
Tetrachloroethene	µg/kg	1	NONE	-				
1,2-Dibromoethane	µg/kg	1	ISO 17025	-				
Chlorobenzene	µg/kg	1	MCERTS	-				
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-				
Ethylbenzene	µg/kg	1	MCERTS	-				
p & m-Xylene	µg/kg	1	MCERTS	-				
Styrene	µg/kg	1	MCERTS	-				
Tribromomethane	µg/kg	1	NONE	-				
o-Xylene	µg/kg	1	MCERTS	-				
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-				
Isopropylbenzene	µg/kg	1	MCERTS	-				
Bromobenzene	µg/kg	1	MCERTS	-				
n-Propylbenzene	µg/kg	1	ISO 17025	-				
2-Chlorotoluene	µg/kg	1	MCERTS	-				
4-Chlorotoluene	µg/kg	1	MCERTS	-				
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-				
tert-Butylbenzene	µg/kg	1	MCERTS	-				
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-				
sec-Butylbenzene	µg/kg	1	MCERTS	-				
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-				
p-Isopropyltoluene	µg/kg	1	ISO 17025	-				
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-				
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-				
Butylbenzene	µg/kg	1	MCERTS	-				
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-				
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-				
Hexachlorobutadiene	µg/kg	1	MCERTS	-				
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-				



Analytical Report Number : 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
792294	WS1	None Supplied	0.25	Brown loam and clay with gravel.
792295	WS1	None Supplied	3.50	Light brown clay and sand with gravel and stones.
792296	WS2	None Supplied	0.50	-
792297	WS2	None Supplied	1.40	Light brown sand with gravel.
792298	WS3	None Supplied	0.25	Brown clay and sand with rubble and gravel
792299	WS3	None Supplied	1.00	Light brown sand with gravel.
792300	WS4	None Supplied	0.25	Brown gravelly loam with vegetation.
792301	WS4	None Supplied	0.50	Brown loam and sand with gravel and vegetation.
792302	WS5	None Supplied	1.00	Brown clay and sand with gravel and stones.
792303	WS6	None Supplied	0.25	Brown loam and clay with gravel and vegetation.
792304	WS6	None Supplied	0.50	-

Analytical Report Number : 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
PRO (Soil)	Determination of hydrocarbons C6-C10 by headspace GC-MS.	In-house method based on USEPA8260	L088-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L009-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L038-PL	D	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L076-PL	D	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L088/76-PL	W	MCERTS

Iss No 17-56074-1 1-3 Castle Crescent, Reading JJ1122

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The results included within the report are representative of the samples submitted for analysis.

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Analytical Report Number : 17-56074

Project / Site name: 1-3 Castle Crescent, Reading

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample Deviation Report



Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
WS1		S	17-56074	792294	b	PRO (Soil)	L088-PL	b
WS1		S	17-56074	792295	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS1		S	17-56074	792295	b	Monohydric phenols in soil	L080-PL	b
WS1		S	17-56074	792295	b	Speciated EPA-16 PAHs in soil	L064-PL	b
WS1		S	17-56074	792295	b	TPHCWG (Soil)	L088/76-PL	b
WS1		S	17-56074	792295	b	Volatile organic compounds in soil	L073B-PL	b
WS2		S	17-56074	792297	b	Monohydric phenols in soil	L080-PL	b
WS2		S	17-56074	792297	b	PRO (Soil)	L088-PL	b
WS2		S	17-56074	792297	b	Speciated EPA-16 PAHs in soil	L064-PL	b
WS2		S	17-56074	792297	b	TPH in (Soil)	L076-PL	b
WS3		S	17-56074	792298	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS3		S	17-56074	792298	b	TPHCWG (Soil)	L088/76-PL	b
WS3		S	17-56074	792298	b	Volatile organic compounds in soil	L073B-PL	b
WS3		S	17-56074	792299	b	Monohydric phenols in soil	L080-PL	b
WS3		S	17-56074	792299	b	PRO (Soil)	L088-PL	b
WS3		S	17-56074	792299	b	Speciated EPA-16 PAHs in soil	L064-PL	b
WS3		S	17-56074	792299	b	TPH in (Soil)	L076-PL	b
WS4		S	17-56074	792300	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS4		S	17-56074	792300	b	TPHCWG (Soil)	L088/76-PL	b
WS4		S	17-56074	792300	b	Volatile organic compounds in soil	L073B-PL	b
WS5		S	17-56074	792302	b	Monohydric phenols in soil	L080-PL	b
WS5		S	17-56074	792302	b	PRO (Soil)	L088-PL	b
WS5		S	17-56074	792302	b	Speciated EPA-16 PAHs in soil	L064-PL	b
WS5		S	17-56074	792302	b	TPH in (Soil)	L076-PL	b
WS6		S	17-56074	792303	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS6		S	17-56074	792303	b	TPHCWG (Soil)	L088/76-PL	b
WS6		S	17-56074	792303	b	Volatile organic compounds in soil	L073B-PL	b

**Emma Hucker**

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e: Jomas Group

Analytical Report Number : 17-57797

Project / Site name: 1-3 Castle Crescent, Reading

Samples received on: 18/08/2017

Your job number: JJ1122

Samples instructed on: 18/08/2017

Your order number: P9846JJ1122.3

Analysis completed by: 24/08/2017

Report Issue Number: 1

Report issued on: 24/08/2017

Samples Analysed: 1 water sample

Signed:

Dr Irma Doyle
Senior Account Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 17-57797

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9846JJ1122.3

Lab Sample Number				801650					
Sample Reference				WS1					
Sample Number				None Supplied					
Depth (m)				None Supplied					
Date Sampled				17/08/2017					
Time Taken				None Supplied					
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status						

General Inorganics

pH	pH Units	N/A	ISO 17025	7.1					
Electrical Conductivity at 20 °C	µS/cm	10	NONE	690					
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0					
Sulphate as SO ₄	µg/l	45	ISO 17025	24400					
Ammonium as NH ₄	µg/l	15	ISO 17025	71					
Hardness - Total	mgCaCO ₃ /l	1	ISO 17025	329					

Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10					
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01					
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01					
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01					
Fluorene	µg/l	0.01	ISO 17025	< 0.01					
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01					
Anthracene	µg/l	0.01	ISO 17025	< 0.01					
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01					
Pyrene	µg/l	0.01	ISO 17025	< 0.01					
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01					
Chrysene	µg/l	0.01	ISO 17025	< 0.01					
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01					
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01					
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01					
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01					
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01					
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01					

Total PAH

Total EPA-16 PAHs	µg/l	0.16	NONE	< 0.16					
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.80					
Boron (dissolved)	µg/l	10	ISO 17025	160					
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.02					
Calcium (dissolved)	mg/l	0.012	ISO 17025	120					
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.5					
Copper (dissolved)	µg/l	0.5	ISO 17025	2.5					
Lead (dissolved)	µg/l	0.2	ISO 17025	0.2					
Magnesium (dissolved)	mg/l	0.005	ISO 17025	7.0					
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05					
Nickel (dissolved)	µg/l	0.5	ISO 17025	2.4					
Selenium (dissolved)	µg/l	0.6	ISO 17025	0.7					
Zinc (dissolved)	µg/l	0.5	ISO 17025	5.4					



Analytical Report Number: 17-57797

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9846JJ1122.3

Lab Sample Number				801650					
Sample Reference				WS1					
Sample Number				None Supplied					
Depth (m)				None Supplied					
Date Sampled				17/08/2017					
Time Taken				None Supplied					
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status			

Monoaromatics

Benzene	µg/l	1	ISO 17025	< 1.0					
Toluene	µg/l	1	ISO 17025	< 1.0					
Ethylbenzene	µg/l	1	ISO 17025	< 1.0					
p & m-xylene	µg/l	1	ISO 17025	< 1.0					
o-xylene	µg/l	1	ISO 17025	< 1.0					
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0					

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0					
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0					
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0					
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10					
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10					
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10					
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10					
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10					

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0					
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0					
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0					
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10					
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10					
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10					
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10					
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10					



Analytical Report Number: 17-57797

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9846JJ1122.3

Lab Sample Number				801650					
Sample Reference				WS1					
Sample Number				None Supplied					
Depth (m)				None Supplied					
Date Sampled				17/08/2017					
Time Taken				None Supplied					
Analytical Parameter (Water Analysis)				Units	Limit of detection	Accreditation Status			

VOCs

Chloromethane	µg/l	1	ISO 17025	< 1.0					
Chloroethane	µg/l	1	ISO 17025	< 1.0					
Bromomethane	µg/l	1	ISO 17025	< 1.0					
Vinyl Chloride	µg/l	1	NONE	< 1.0					
Trichlorofluoromethane	µg/l	1	NONE	< 1.0					
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0					
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0					
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0					
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0					
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0					
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0					
Trichloromethane	µg/l	1	ISO 17025	< 1.0					
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0					
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0					
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0					
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0					
Benzene	µg/l	1	ISO 17025	< 1.0					
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0					
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0					
Trichloroethene	µg/l	1	ISO 17025	< 1.0					
Dibromomethane	µg/l	1	ISO 17025	< 1.0					
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0					
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0					
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0					
Toluene	µg/l	1	ISO 17025	< 1.0					
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0					
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0					
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0					
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0					
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0					
Chlorobenzene	µg/l	1	ISO 17025	< 1.0					
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0					
Ethylbenzene	µg/l	1	ISO 17025	< 1.0					
p & m-Xylene	µg/l	1	ISO 17025	< 1.0					
Styrene	µg/l	1	ISO 17025	< 1.0					
Tribromomethane	µg/l	1	ISO 17025	< 1.0					
o-Xylene	µg/l	1	ISO 17025	< 1.0					
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0					
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0					
Bromobenzene	µg/l	1	ISO 17025	< 1.0					
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0					
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0					
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0					
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0					
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0					
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0					
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0					
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0					
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0					
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0					
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0					
Butylbenzene	µg/l	1	ISO 17025	< 1.0					
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0					
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0					
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0					
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0					

U/S = Unsuitable Sample I/S = Insufficient Sample

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The results included within the report are representative of the samples submitted for analysis.

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Analytical Report Number : 17-57797

Project / Site name: 1-3 Castle Crescent, Reading

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammonium as NH ₄ in water	Determination of Ammonium/Ammonia/Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method. Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	ISO 17025
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Electrical conductivity at 20oC of water	Determination of electrical conductivity in water by electrometric measurement.	In-house method	L031-PL	W	NONE
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water followed by electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L0102B-PL	W	NONE
Sulphate in water	Determination of sulphate in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW, PrW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Total Hardness of water	Determination of hardness in waters by calculation from calcium and magnesium. Accredited Matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L045-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample Deviation Report



Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
WS1		W	17-57797	801650	c	Ammoniacal Nitrogen as N in water	L082-PL	c
WS1		W	17-57797	801650	c	Ammonium as NH4 in water	L082-PL	c
WS1		W	17-57797	801650	c	Electrical conductivity at 20oC of water	L031-PL	c
WS1		W	17-57797	801650	c	pH at 20oC in water (automated)	L099-PL	c

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Analytical Report Number : 17-59033

Project / Site name:	1-3 Castle Crescent	Samples received on:	01/09/2017
Your job number:	JJ1122	Samples instructed on:	01/09/2017
Your order number:	P9864JJ1122.4	Analysis completed by:	07/09/2017
Report Issue Number:	1	Report issued on:	07/09/2017
Samples Analysed:	9 soil samples		

Signed: 

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 17-59033
Project / Site name: 1-3 Castle Crescent
Your Order No: P9864JJ1122.4

Lab Sample Number				809077	809078	809079	809080	809081
Sample Reference				WS1	WS2	WS2	WS3	WS4
Sample Number				P,J	P,J	P,J	P,J	P,J
Depth (m)				0.50	0.25	0.50	0.50	0.50
Date Sampled				21/07/2017	21/07/2017	21/07/2017	21/07/2017	21/07/2017
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	45	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	9.1	11	5.5	11	7.9
Total mass of sample received	kg	0.001	NONE	1.4	1.9	1.8	1.9	2.0

Heavy Metals / Metalloids

Lead (aqua regia extractable)	mg/kg	1	MCERTS	240	480	59	140	200
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Analytical Report Number: 17-59033

Project / Site name: 1-3 Castle Crescent

Your Order No: P9864JJ1122.4

Lab Sample Number	809082	809083	809084	809085	
Sample Reference	WS5	WS5	WS6	WS6	
Sample Number	P.J	P.J	P.J	P.J	
Depth (m)	0.25	0.50	0.50	1.00	
Date Sampled	21/07/2017	21/07/2017	21/07/2017	21/07/2017	
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	42	43
Moisture Content	%	N/A	NONE	8.6	2.4
Total mass of sample received	kg	0.001	NONE	1.8	2.0

Heavy Metals / Metalloids

Lead (aqua regia extractable)	mg/kg	1	MCERTS	280	60	180	170	
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Analytical Report Number : 17-59033

Project / Site name: 1-3 Castle Crescent

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
809077	WS1	P,J	0.50	Brown clay and sand with stones.
809078	WS2	P,J	0.25	Brown loam and clay with gravel.
809079	WS2	P,J	0.50	Brown gravelly sand.
809080	WS3	P,J	0.50	Brown clay and sand with gravel.
809081	WS4	P,J	0.50	Brown clay and sand with gravel.
809082	WS5	P,J	0.25	Brown loam and clay with stones and vegetation.
809083	WS5	P,J	0.50	Light brown sand with gravel and stones.
809084	WS6	P,J	0.50	Brown clay and sand with gravel and stones.
809085	WS6	P,J	1.00	Brown clay and sand with stones and gravel

Analytical Report Number : 17-59033

Project / Site name: 1-3 Castle Crescent

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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e: Jomas Group

Analytical Report Number : 17-59032

Project / Site name:	1-3 Castle Crescent, Reading	Samples received on:	01/09/2017
Your job number:	JJ1122	Samples instructed on:	01/09/2017
Your order number:	P9864JJ1122.4	Analysis completed by:	Not complete
Report Issue Number:	1	Report issued on:	14/09/2017
Samples Analysed:	1 soil sample		

Signed: 

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 17-59032

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.4

Lab Sample Number				809076				
Sample Reference				WS1				
Sample Number				P,J				
Depth (m)				0.25				
Date Sampled				21/07/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	75				
Moisture Content	%	N/A	NONE	8.7				
Total mass of sample received	kg	0.001	NONE	1.7				

Heavy Metals / Metalloids

Lead (aqua regia extractable)	mg/kg	1	MCERTS	950				
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Bioaccessibility Testing - Unified BARGE Bioaccessibility Method Data

Stomach Phase

Lead (Bioaccessible)	mg/kg	1	None	768				
Lead Bioaccessible Fraction	%	-	None	81				

Stomach and Intestine Phase

Lead (Bioaccessible)	mg/kg	1	None	541				
Lead Bioaccessible Fraction	%	-	None	57				

Bioaccessibility Summary Data (Maximum value) Stomach Phase (S) or Stomach and Intestine Phase (SI)

Lead Bioaccessible Fraction	%	-	None	81 % (S)				
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Analytical Report Number : 17-59032

Project / Site name: 1-3 Castle Crescent, Reading

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
809076	WS1	P,J	0.25	Brown loam and clay with stones and gravel

Analytical Report Number : 17-59032

Project / Site name: 1-3 Castle Crescent, Reading

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
BARGE-UBM Bioaccessibility Test for Metals	Bioaccessibility extraction method for metals. Test portion sieved to < 250 um. Analytes as defined on the report.	BARGE UBM Method: https://www.bgs.ac.uk/barge/docs/BARGE_UBM_DEC_2010.pdf	UBM-PL	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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e: Jomas Group

Analytical Report Number : 17-59032

Project / Site name:	1-3 Castle Crescent, Reading	Samples received on:	01/09/2017
Your job number:	JJ1122	Samples instructed on:	01/09/2017
Your order number:	P9864JJ1122.4	Analysis completed by:	Not complete
Report Issue Number:	1	Report issued on:	14/09/2017
Samples Analysed:	1 soil sample		

Signed: 

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 17-59032

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.4

Lab Sample Number				809076				
Sample Reference				WS1				
Sample Number				P,J				
Depth (m)				0.25				
Date Sampled				21/07/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	75				
Moisture Content	%	N/A	NONE	8.7				
Total mass of sample received	kg	0.001	NONE	1.7				

Heavy Metals / Metalloids

Lead (aqua regia extractable)	mg/kg	1	MCERTS	950				
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Bioaccessibility Testing - Unified BARGE Bioaccessibility Method Data

Stomach Phase

Lead (Bioaccessible)	mg/kg	1	None	768				
Lead Bioaccessible Fraction	%	-	None	81				

Stomach and Intestine Phase

Lead (Bioaccessible)	mg/kg	1	None	541				
Lead Bioaccessible Fraction	%	-	None	57				

Bioaccessibility Summary Data (Maximum value) Stomach Phase (S) or Stomach and Intestine Phase (SI)

Lead Bioaccessible Fraction	%	-	None	81 % (S)				
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Analytical Report Number : 17-59032

Project / Site name: 1-3 Castle Crescent, Reading

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
809076	WS1	P,J	0.25	Brown loam and clay with stones and gravel

Analytical Report Number : 17-59032

Project / Site name: 1-3 Castle Crescent, Reading

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
BARGE-UBM Bioaccessibility Test for Metals	Bioaccessibility extraction method for metals. Test portion sieved to < 250 um. Analytes as defined on the report.	BARGE UBM Method: https://www.bgs.ac.uk/barge/docs/BARGE_UBM_DEC_2010.pdf	UBM-PL	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.



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Analytical Report Number : 17-59622

Project / Site name: 1-3 Castle Crescent, Reading

Samples received on: 01/09/2017

Your job number: JJ1122

Samples instructed on: 07/09/2017

Your order number: P9864JJ1122.5

Analysis completed by: 21/09/2017

Report Issue Number: 1

Report issued on: 21/09/2017

Samples Analysed: 1 soil sample

Signed: 

Dr Claire Stone
Quality Manager

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 17-59622

Project / Site name: 1-3 Castle Crescent, Reading

Your Order No: P9864JJ1122.5

Lab Sample Number				812166				
Sample Reference				WS2				
Sample Number				P,J				
Depth (m)				0.25				
Date Sampled				21/07/2017				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		
Stone Content				%	0.1	NONE	50	
Moisture Content				%	N/A	NONE	11	
Total mass of sample received				kg	0.001	NONE	1.9	

Heavy Metals / Metalloids

Lead (aqua regia extractable)	mg/kg	1	MCERTS	730				
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Bioaccessibility Testing - Unified BARGE Bioaccessibility Method Data

Stomach Phase

Lead (Bioaccessible)	mg/kg	1	None	80				
Lead Bioaccessible Fraction	%	-	None	10.9				

Stomach and Intestine Phase

Lead (Bioaccessible)	mg/kg	1	None	17				
Lead Bioaccessible Fraction	%	-	None	2.3				

Bioaccessibility Summary Data (Maximum value) Stomach Phase (S) or Stomach and Intestine Phase (SI)

Lead Bioaccessible Fraction	%	-	None	10.9 % (S)				
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Analytical Report Number : 17-59622

Project / Site name: 1-3 Castle Crescent, Reading

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
812166	WS2	P,J	0.25	Brown loam and clay with gravel.

Analytical Report Number : 17-59622

Project / Site name: 1-3 Castle Crescent, Reading

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
BARGE-UBM Bioaccessibility Test for Metals	Bioaccessibility extraction method for metals. Test portion sieved to < 250 um. Analytes as defined on the report.	BARGE UBM Method: https://www.bgs.ac.uk/barge/docs/BARGE_UBM_DEC_2010.pdf	UBM-PL	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

APPENDIX 4 – SOIL GAS MONITORING TEST RESULTS

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET					
Site: Castle Crescent	Operative(s): JWT	Date: 01/08/17	Time: 12:00	Round: 1	Page: 1
MONITORING EQUIPMENT					
Instrument Type	Instrument Make	Serial No.	Date Last Calibrated		
Analox	GA5000		19/06/2017		
PID	Phocheck tiger		20/05/2016		
Dip Meter	GeoTech				
MONITORING CONDITIONS					
Weather Conditions: Sunny		Ground Conditions: Dry		Temperature: 19 °C	
Barometric Pressure (mbar): 1008		Barometric Pressure Trend (24hr): Steady		Ambient Concentration: 0.0%CH ₄ , 0.1%CO ₂ , 20.8%O ₂	

MONITORING RESULTS													
Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	Methane %	Methane % LEL	Carbon Dioxide %	Oxygen %	VOC (ppm)		Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Average						Peak	Average				
WS1	+0.1	+0.1	1008	0.0	-	5.4	14.4	0	0	0	0	2.69	3.03
WS4	+0.2	+0.2	1008	0.0	-	5.6	14.5	0	0	0	0	DRY	1.24
WS6	+0.2	+0.2	1008	0.0	-	3.9	15.7	0	0	0	0	DRY	1.36

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET					
Site: Castle Crescent	Operative(s): JWT	Date: 10/08/17	Time: 12:20	Round: 2	Page: 1
MONITORING EQUIPMENT					
Instrument Type	Instrument Make	Serial No.	Date Last Calibrated		
Analox	GA5000		19/06/2017		
PID	Phocheck tiger		20/05/2016		
Dip Meter	GeoTech				
MONITORING CONDITIONS					
Weather Conditions: Sunny		Ground Conditions: Dry		Temperature: 17 °C	
Barometric Pressure (mbar): 1017		Barometric Pressure Trend (24hr): Steady		Ambient Concentration: 0.0%CH ₄ , 0.1%CO ₂ , 20.8%O ₂	

MONITORING RESULTS													
Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	Methane %	Methane % LEL	Carbon Dioxide %	Oxygen %	VOC (ppm)		Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Average						Peak	Average				
WS1	+0.3	+0.3	1018	0.0	-	5.5	14.1	0	0	0	0	2.71	3.03
WS4	+0.2	+0.2	1017	0.0	-	5.0	15.7	0	0	0	0	DRY	1.24
WS6	+0.2	+0.2	1018	0.0	-	5.9	14.1	0	0	0	0	DRY	1.36

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET					
Site: Castle Crescent	Operative(s): JWT	Date: 17/08/17	Time: 11:00	Round: 3	Page: 1
MONITORING EQUIPMENT					
Instrument Type	Instrument Make	Serial No.	Date Last Calibrated		
Analox	GA5000		19/06/2017		
PID	Phocheck tiger		20/05/2016		
Dip Meter	GeoTech				
MONITORING CONDITIONS					
Weather Conditions: Intermittent sun		Ground Conditions: Dry		Temperature: 18°C	
Barometric Pressure (mbar): 1004		Barometric Pressure Trend (24hr): Steady		Ambient Concentration: 0.0%CH ₄ , 0.1%CO ₂ , 20.5%O ₂	

MONITORING RESULTS													
Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	Methane %	Methane % LEL	Carbon Dioxide %	Oxygen %	VOC (ppm)		Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Average						Peak	Average				
WS1	+0.5	+0.5	1004	0.1	-	5.6	13.9	0	0	0	0	2.73	3.03
WS4	+0.4	+0.4	1005	0.0	-	7.6	12.7	0	0	0	0	DRY	1.24
WS6	+0.4	+0.4	1005	0.0	-	7.1	13.2	0	0	0	0	DRY	1.36

Water sample obtained from WS1.

GAS AND GROUNDWATER MONITORING BOREHOLE RECORD SHEET					
Site: Castle Crescent	Operative(s): JWT	Date: 25/08/17	Time: 11:15	Round: 4	Page: 1
MONITORING EQUIPMENT					
Instrument Type	Instrument Make	Serial No.	Date Last Calibrated		
Analox	GA5000		19/06/2017		
PID	Phocheck tiger		20/05/2016		
Dip Meter	GeoTech				
MONITORING CONDITIONS					
Weather Conditions: Sunny		Ground Conditions: Dry		Temperature: 18°C	
Barometric Pressure (mbar): 1011		Barometric Pressure Trend (24hr): Steady		Ambient Concentration: 0.1%CH ₄ , 0.1%CO ₂ , 20.9%O ₂	

MONITORING RESULTS													
Monitoring Point Location	Flow		Atmospheric Pressure (mbar)	Methane %	Methane % LEL	Carbon Dioxide %	Oxygen %	VOC (ppm)		Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (mbgl)	Depth to Base of well (mbgl)
	Peak	Average						Peak	Average				
WS1	+0.1	-	1011	0.1	-	5.6	13.8	24	24	0	0	2.72	3.03
WS4	+0.3	-	1011	0.1	-	8.0	11.9	11	8	0	0	DRY	1.24
WS6	+0.4	-	1011	0.1	-	8.1	13.0	9	7	0	0	DRY	1.36