Report on a

PHASE 2 GEOENVIRONMENTAL GROUND INVESTIGATION

Ref: 21/34496 | Date: December 2021

64 Hamilton Terrace
London
NW8 9UJ

Prepared for:
Regency Grove Limited

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	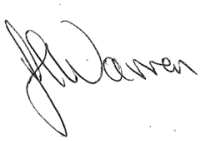	
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1.0 EXECUTIVE SUMMARY

Site Location	64 Hamilton Terrace, London, NW8 9UJ
Proposed Development	Partial demolition, excavation below the building to create basement, erection of single storey rear extension, fenestration alterations to north elevation and at lower ground floor level on the front facade.
Environmental Setting	• Bedrock Geology: London Clay (Unproductive Aquifer) • No Groundwater Source Protection Zones Within 250m • No Water Abstraction Licences Within 250m • No Surface Water Within 250m • No Landfill Sites Within 250m

ENVIRONMENTAL INVESTIGATION

Soil Contamination	The findings of the Phase 2 site investigation have demonstrated that in the context of a proposed residential use of the site without private gardens, the contaminant of concern with respect to end-user protection was elevated Lead encountered across the site. A potential risk to other receptors including potable water supply pipe may exist as detailed in this report.
Recommendations	In respect to soil contamination, it is anticipated that the protection of the end-user may be achieved by the following: • **Areas of proposed hardstanding (e.g. building footprint, roadways etc.)** In areas of permanent hardstanding such as the building footprint and roadways etc., the development itself would adequately break exposure pathways to human health and therefore further remedial measures may not be required in these areas. • **Sensitive end use areas (garden areas, patio's etc.)** In areas of sensitive end use such as gardens, patio's, soft-landscaping etc. soils should be removed from the site to mitigate the risks to end users and break exposure pathways. It would be recommended that the soils be excavated down to at least 600mm and replaced with a geotextile and/or mesh underlying a 200mm thick layer of gap graded crushed concrete (5-75mm) or the like with geotextile underlying 400mm thickness of clean certified Topsoil. In addition, barrier pipe should be used on-site for any potable water supply.

Contaminant Linkages

Potential Contaminants / Source	Pathway	Receptor	Site specific settings	Risk Classification: Based on Phase II Investigation	Action Required
LEAD	Inhalation, ingestion and dermal contact.	Human Health Residents	Residential use with gardens	Low/Medium	Further action required – Soil Remediation required
LEAD	Inhalation, ingestion and dermal contact	Human Health Workers	Workers and the general public should follow regulation on health and safety during development (HSE, 1991).	Low	Further action required – Soil Remediation required
NO SOURCES	Through high permeability strata, fissures and shafts, and by Inhalation by humans	Human Health Inhalation of Gases	Elevated ground gas not encountered	None	No further action
NO SOURCES	Negligible groundwater flow	Shallow groundwater Surface Water contamination via groundwater flow	Unproductive Strata underlying the site.	None	No further action
NO SOURCES	Negligible groundwater flow	Deep groundwater	Unproductive Strata underlying the site.	None	No further action
TPH	Chemical attack, gas accumulation in buildings	Building structures / services	Potential for small amount of Made Ground	Low/Medium	Barrier pipe recommended for potable water pipes.
ZINC	Uptake (root and stomata), ingestion, inhalation and dermal absorption by animal)	Ecological features (i.e. Flora and Fauna)	There are no significant sensitive land uses within 250m of the site. However, there are areas of soft landscaping proposed on site.	Low	No further action

2.0 INTRODUCTION

2.1 Outline and Limitations of Report

At the request of Regency Grove Limited, a ground investigation was carried out in connection with a proposed development at the above site.

The information was required in order to assess whether any remediation was required for the protection of the end-users from the presence of potential contamination within the soils encountered.

The recommendations and comments given in this report are based on the ground conditions encountered in the exploratory holes made during the investigation and the results of the tests made in the field and the laboratory. It must be noted that there may be special conditions prevailing at the site remote from the exploratory hole locations which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

2.2 Report Objectives

This report comprises a Phase 2 - Intrusive Investigation Report to assess potential contamination within the soils and waters encountered and assess potential risks to the end-user of the site from the presence of such contamination.

Planning permission granted by councils for development of Brownfield land often have conditions attached which require the following site investigation to be undertaken and submitted to the local authority for approval:

Phase 1 - Preliminary Risk Assessment

Phase 2 - Intrusive Investigation

Phase 3 - Remediation Strategy

Phase 4 - Validation Report

A Phase 1 - Preliminary Risk Assessment has previously been undertaken at the site by SAS (Project Reference: 21/34202, dated September 2021) and is referenced in this report.

3.0 SITE DETAILS

3.1 Site Location

The site is located on the eastern side of Hamilton Terrace – 40m to the south-east of the crossroads connecting Hall Road and Hamilton Terrace. The site is located in City of Westminster, London, at approximate postcode NW8 9UJ. The site is immediately bound by residential properties of similar character to the north (66 Hamilton Terrace) and south-east (62 Hamilton Terrace) and residential properties to the east (9 - 11 Denning Close).

The site is rectangular in shape covers an approximate area of 0.09 hectares with the general area being under the authority of the City of Westminster.

The site is at National Grid Reference: TQ 264 826.

The site location map is presented below in Figure 1:

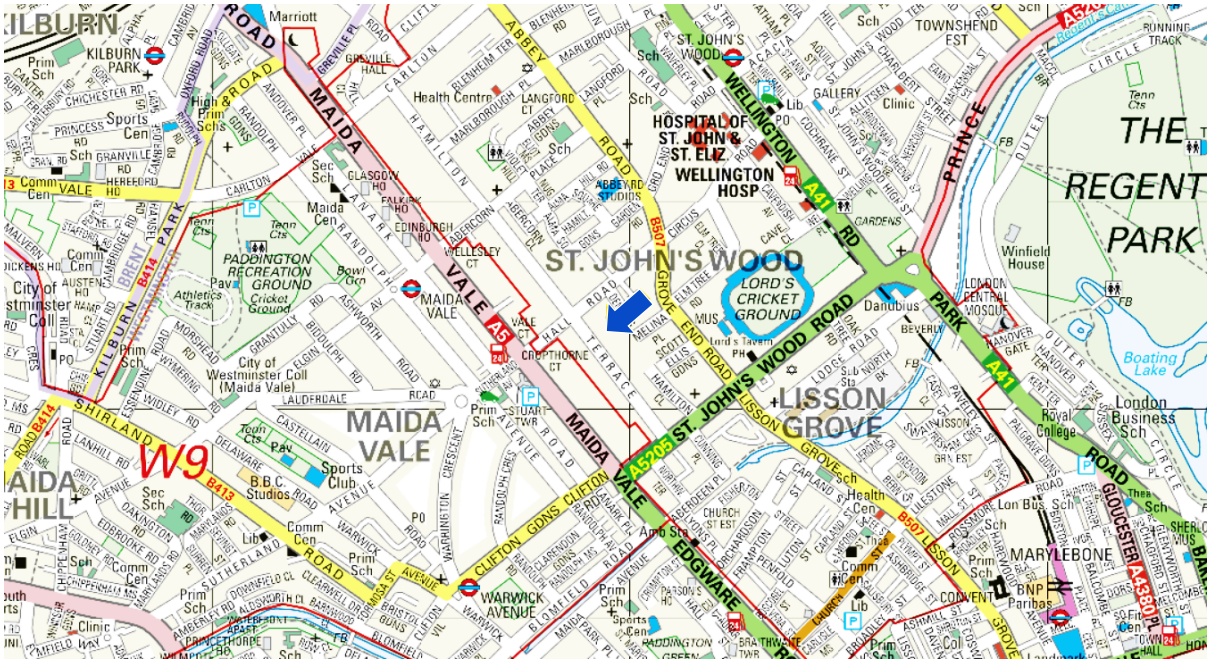

Figure 1 - Site Location Map

3.2 Current Use of the Site and Surrounding Land Uses

The site is currently in use as a residential property. The site comprises a 4-storey terraced house including a basement level. The main building is located in the west and occupies approximately 25% of the site.

The site is located in a largely residential area, along with a cinema, fuel station and supermarket located within 250m. Within the greater 500m lies Regent's Canal, Paddington Basin, Lord's Cricket Ground, a few hotels and a place of worship.

Existing site plans are presented below in Figures 2 and 3:

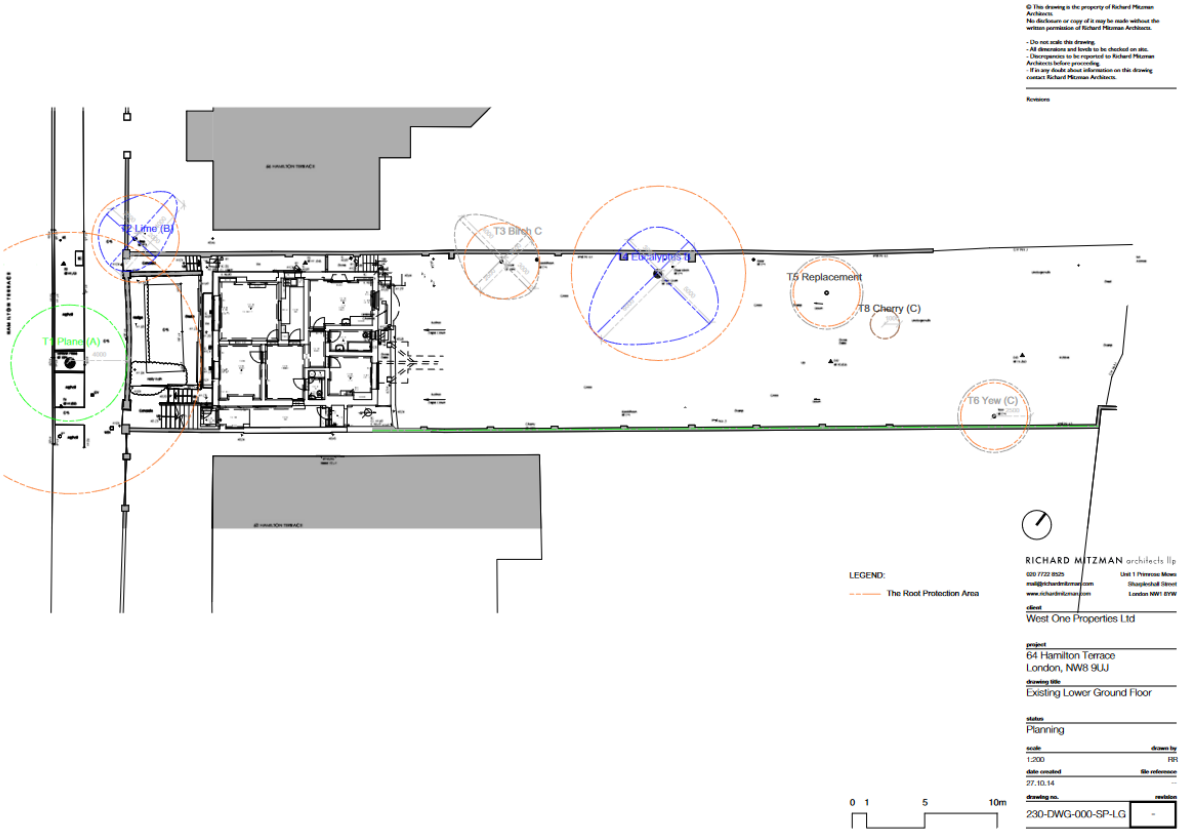

Figure 2 - Existing Site Plan (Lower Ground Floor)

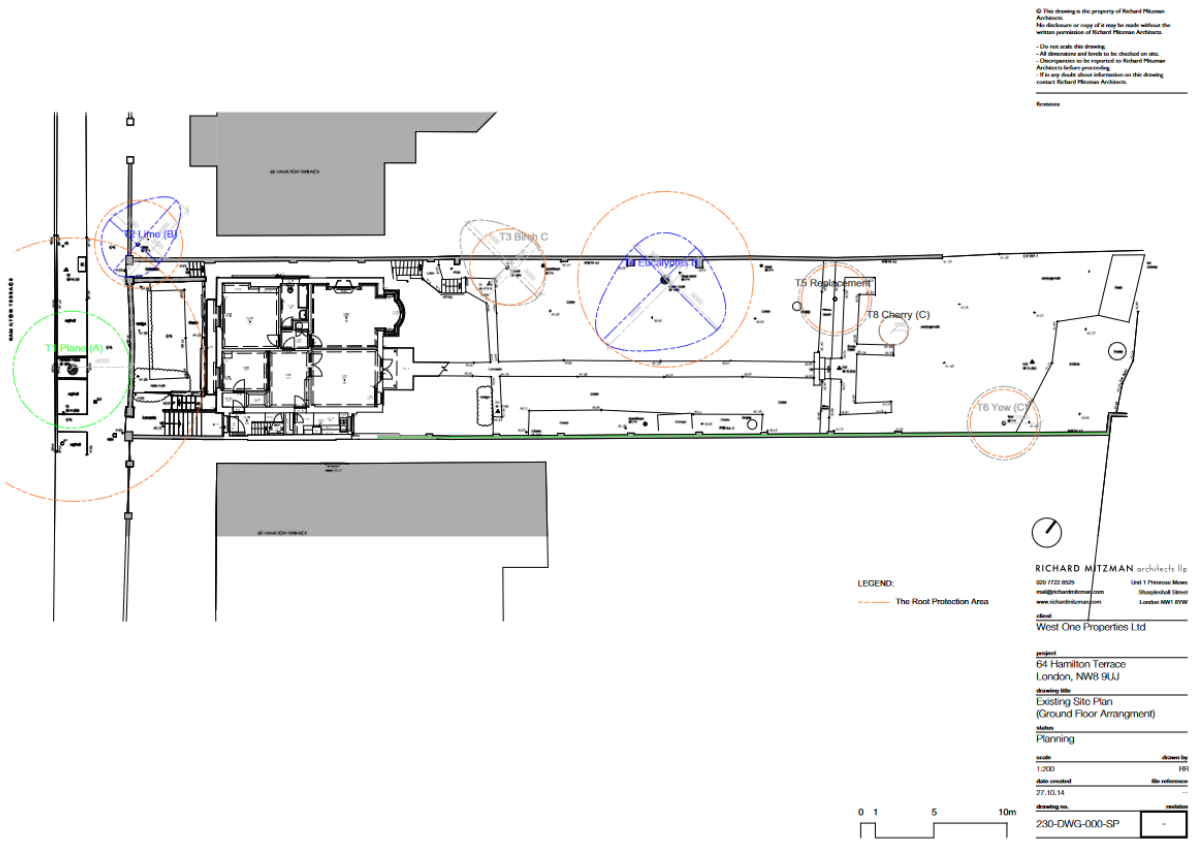

Figure 3 - Existing Site Plan (Ground Floor)

3.3 Details of Intended Future Uses of the Site

At the time of reporting (December 2021), it is proposed to partially demolish, excavate below the building to create basement, erect a single storey rear extension, fenestrate alterations to north elevation and at lower ground floor level on the front facade.

A proposed site plan is presented below in Figure 4:

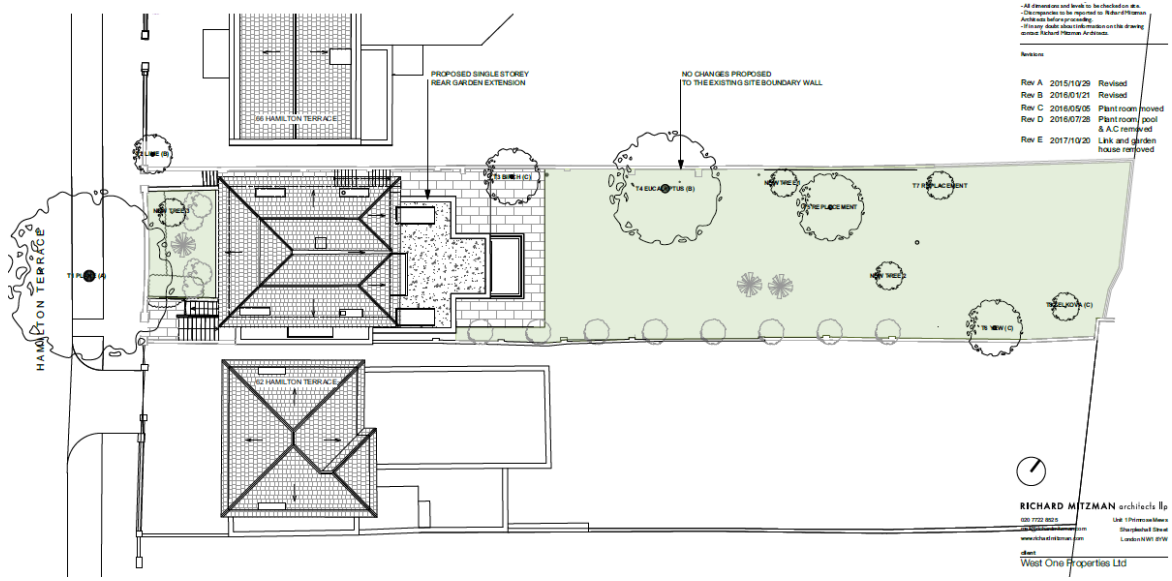

Figure 4 - Proposed Site Plan

3.4 References of Planning Applications

There is a recent and relevant planning application for the site registered on the City of Westminster's planning portal:

Application Number	21/00864/FULL
Validated	Fri 05 Mar 2021
Decision	Application Permitted
Decision Issued	Tue 21 Sep 2021
Address	64 Hamilton Terrace London NW8 9UJ
Proposal	Partial demolition, excavation below the building to create basement, erection of single storey rear extension, fenestration alterations to north elevation and at lower ground floor level on the front facade.

3.5 Published Geology

The 1:50000 Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain by the London Clay Formation at depth. A surface cover of Made Ground should also be expected.

4.0 SCOPE OF WORK

4.1 Site Works

The exploratory investigation included for an inspection of the site and near surface soils in order to: -

- Determine the presence, extent and significance of potential contaminants in the sub-surface strata associated with current and former activities at the site.
- Assess the significance of potential impacts on sensitive receptors at or adjacent to the site.
- Assess the potential environmental liabilities and consequences associated with the site.
- Identify requirements for further works, including the design of any additional investigative/monitoring works and remedial measures if deemed necessary.

The proposed scope of works was agreed by the client prior to the commencement of the investigations. To achieve this, the following works were undertaken: -

- The drilling of one continuous auger borehole to a depth of 5.00m below ground level (Borehole 1).
- The installation of a combined gas/groundwater monitoring standpipe to a depth of 5.00m depth in Borehole 1, together with four return monitoring visits.
- The hand excavation of four trial pits to a depth of 1.00m below ground level to obtain additional samples for contamination testing (Trial Pits 1 to 4 inclusive).
- Sampling and in-situ testing as appropriate to the ground conditions encountered in the borehole and trial pits.
- A study into the possibility of the presence of toxic substances in the soil, together with limited comment on any remediation required.

5.0 CONTAMINATION TESTING

5.1 Site Conceptual Model

In accordance with current UK guidance on contaminated land risk assessment (CLR7, CLR11 and BS10175), the following Conceptual Site Model has been generated to summarise the primary sources, receptors and migration and exposure pathways present on the site and to aid in the decision-making process.

For an environmental risk to exist there has to be a source of contamination, receptor or receptors at risk from the contamination and one or more pathway which links the two. Such contaminant – pathway – receptor relationships are termed pollutant linkages.

The subject site has been assessed within the source – pathway – receptor methodology as described above in the framework of a conceptual site model. A conceptual site model can be defined as a testable representation of environmental processes on a site and its vicinity. Its purpose is to identify potential contaminants, pathways and receptors with a view to, initially identifying potential and eventually, quantifying significant pollutant linkages. It should highlight any limitation and uncertainties present in the risk assessment and be able to communicate the results of the risk assessment to all stakeholders.

A Phase I Desk Study has been undertaken at the site by A-squared Studio Engineers Ltd (Report Ref: 1939-A2S-XX-XX-RP-Y-0001-01, dated November 2021) and the site conceptual model from that report has been adapted by SAS and presented below:

Potential Contaminants / Source	Pathway	Receptor	Site specific settings	Action Required
On Site: **Made Ground** (heavy metals, acids/alkalis, PAHs, asbestos, elevated sulphate, and ground gases), **Current and former residential use** (heavy metals, acids / alkalis, PAHs, and asbestos), **Asbestos** containing materials in the current building fabric. **Off Site:** Former **potentially infilled swimming pool** (heavy metals, acids / alkalis, PAHs, TPHs, BTEX, asbestos, elevated sulphate, and ground gases).	Dust and soil Inhalation, ingestion and dermal contact.	Human Health Residential use	Residential Use with Private Gardens	Further investigation required – Soils.
	Inhalation, ingestion and dermal contact	Human Health Workers	Follow health and safety during development (HSE, 1991).	Further investigation required – Soils.
	Inhalation of vapours	Human Health	Potential for volatile contamination is not expected to be encountered within soils or groundwater.	No further investigation required.
	Chemical attack on water supply pipe	Human Health	Potential for small amount of Made Ground	Further investigation required – Soils.
	Negligible groundwater flow	Shallow groundwater Surface Water contamination via groundwater flow	Unproductive Strata underlying the site.	No further investigation required.

	Negligible groundwater flow	Deep groundwater	Unproductive Strata underlying the site.	No further investigation required.
	Uptake (root and stomata), ingestion, inhalation and dermal absorption by animal)	Environmentally Sensitive Land use	There are no significant sensitive land uses within 250m of the site.	No further investigation required.
Ground Gas	Through high permeability strata, fissures and shafts, and by Inhalation by humans	Human Health Inhalation of Gases Gas accumulation in buildings	There are sources of ground gas (including infilled swimming pool) found within 250m of the site.	Further investigation required – Ground gas monitoring.

Phase 1 Conceptual Site Model

5.2 Made Ground Encountered

The investigation revealed the presence of Made Ground across the site to depths of up to 0.95m bgl.

The Made Ground typically consisted of a surface layer of grass over dark brown sandy topsoil overlying dark brown, silty sandy clay containing brick and other man-made fragments.

Trial Hole	Depth
BH1	0.95m
TP1	0.80m
TP2	0.82m
TP3	0.85m
TP4	0.80m

Depth of Made Ground

5.3 Sampling Strategy

The strategy for selecting the locations of the exploratory positions was based on the conceptual source, pathway and receptor model and potentially contaminating activities identified by the Conceptual Site Model.

A non-targeted sampling strategy is appropriate when there is:

- No adequate information available regarding the likely locations of contamination;
- No sensitive areas where there is a need for a high degree of confidence.

A targeted sampling strategy is appropriate when there is:

- Adequate information available regarding the likely locations of contamination;
- Sensitive areas where there is a need for a high degree of confidence.

No adequate information was available regarding likely locations, so a non-targeted sampling pattern was adopted at the site, designed to provide coverage across the site as a whole. Non-targeted sampling depths were chosen to reflect the receptors of concern including future users of the site, visitors to the site, construction workers on-site, service and maintenance workers, site neighbours and wider public, construction materials, groundwater and surface water and typically comprised a near surface samples within the Made Ground. Samples were analysed from this depth range below ground level as it is felt that these soils will be representative of those of highest end-user exposure through the dermal contact, dust inhalation and soil ingestion pathways.

A total of five sampling locations have been excavated at the site providing a density ranging from circa 5m to 10m grid.

Site Area/Activity	Exploratory Hole Location(s)	Surface
General site coverage where Made Ground of unknown origin is expected.	BH1 TP1 – TP4 inclusive	Made Ground

Sampling Strategy Description

5.4 Determination of Contaminants of Concern

Samples for a full contamination analysis were obtained from 0.25m in BH1, TP2 and TP4, and from 0.50m in TP1 and TP3 – all made at the locations indicated on the site sketch plan below (Figure 4).

Figure 4 – Site Sketch Plan

The samples were submitted for a broad screen of total potential contaminants, including those potential contaminants of concern on-site and included pH, Sulphate, Sulphide, Cyanide, Phenols, Metals & Semi-Metals: Cd, Cr, Pb, Hg, Ni, Se, Cu, Zn, V, B, As, Asbestos Screening and Quantification, Organics: USEPA 16 speciated Polycyclic Aromatic Hydrocarbons, Aromatic /Aliphatic Carbon Banded Petroleum Hydrocarbons, BTEX and MTBE Compounds and Soil Organic Matter (SOM).

The samples selected for contamination assessment were sub-contracted to i2 Analytical Limited (a UKAS and MCERTS accredited laboratory) and their reports are contained in Appendix B.

5.5 Qualitative Risk Assessment

The hazard caused by the presence of a substance or element is not absolute but depends on the proposed end use of the site.

It is understood that the site is to be developed for residential use with areas of private garden. As such the S4UL screening levels for residential use with home-grown produce and Category 4 Screening Level for residential use have been used in the following soil assessment.

Site data has been assessed against current generic assessment criteria (GAC) / guideline values in accordance with current industry practice and statutory guidance; chemical toxicology (TOX), Soil Guideline Value (SGV) reports developed using the new Contaminated Land Exposure Assessment (CLEAv1.06) framework, CLR 11 (Environment Agency, 2009) and SP1010: Development of Category 4 screening levels for assessment of land affected by contamination (DEFRA, 2014).

However, it must be remembered that GAC are not binding standards but can be useful in forming judgements regarding the level of risk i.e. unacceptable or acceptable. Exceedance of GAC does not automatically result in the requirement for remedial / risk management work but would warrant further assessment.

5.6 Suitable 4 Use Levels, Category 4 Screening Levels, Soil Guideline Values, CLR Documents & Chartered Institute of Environmental Health Values

Under Part 2A of the Environmental Protection Act 1990, land is determined as contaminated if it is deemed to be causing significant harm, or where there is a Significant Possibility of Significant Harm to human health.

From January 2009 revised Soil Guidance Values for certain contaminants were issued in the Contaminated Land Reports (CLR) by the Environment Agency in conjunction with Department of the Environment, Food, Agriculture and Rural Affairs. These values and the CLEA methodology used to derive them have superseded CLEA and TOX reports for soil contaminants.

The CLR Documents are a series of contaminated land guidance documents developed by various past and present government agencies involved with protection of the environment.

These documents aim to provide a set of generic Soil Guideline Values and a site specific modelling programme based upon tolerable predicted uptakes from experimental data for a variety of common industrial toxic contaminants. In instances of carcinogenic and mutanagenic substances the guideline values are set on the basis of "As Low As Reasonably Practicable" (ALARP), as theoretically mutation can occur on exposure to a single particle of the contaminant.

Revised Statutory Guidance to support Part 2A of the Environmental Protection Act 1990 was published in April 2012, which introduced a new four-category system for classifying land under Part 2A for cases of a Significant Possibility of Significant Harm to human health, where Category 1 includes land where the level of risk is clearly unacceptable and Category 4 includes land where the level of risk posed is acceptably low.

'Category 4 Screening Levels' (C4SLs) have been introduced in March 2014 to provide a simple test for deciding when land is suitable for use and definitely not contaminated land. The Category 4 Screening Levels consist of estimates of contaminant concentrations in soil that are considered to present an 'acceptable' level of risk, within the context of Part 2A.

In response, in November 2014, The Chartered Institute of Environmental Health Generic Assessment Criteria for Human Health Risk Assessment adopt the Environment Agency's CLEA UK (Beta) Model and Category 4 Screening Levels and as such have derived guideline values that are compatible with current English legislation, policy and technical guidance in the form of LQM/CIEH S4ULS's (Suitable 4 Use Levels).

The methodology for deriving both the previous Soil Guideline Values and the new Suitable 4 Use Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology.

At the time of writing this report Suitable 4 Use Levels are in place for some heavy metals, BTEX Substances, Petroleum Hydrocarbons and Polycyclic Aromatic Hydrocarbons as well as a number of selected organic compounds.

Generic Assessment Criteria for Human Health Risk Assessment (S4UL's) have been produced by LQM / Chartered Institute of Environmental Health for a residential use with home grown produce. These are Arsenic 37mg/kg, Beryllium 1.7mg/kg, Boron 290mg/kg, Cadmium 11mg/kg, Trivalent Chromium (Chromium III) 910mg/kg, Hexavalent Chromium (Chromium VI) 6mg/kg, Copper 2400mg/kg, Mercury (Elemental) 1.2mg/kg, Mercury (Inorganic) 40mg/kg, Methylmercury 11mg/kg, Nickel 180mg/kg, Selenium 250mg/kg, Vanadium 410mg/kg, Zinc 3700mg/kg, Benzene (2.5% SOM) 0.17mg/kg, Toluene (2.5% SOM) 290mg/kg, Ethylbenzene (2.5% SOM) 110mg/kg, Xylenes (2.5% SOM) from 130mg/kg and Phenols (2.5% SOM) 550mg/kg.

As no generic UK derived guidance is currently available for acceptable concentrations of Total Lead, the Category 4 Screening Level for residential use with home-grown produce of 200mg/kg has been used to identify where potential risks may exist.

The Environment Agency has released the CLEA software and its handbook to help assessors estimate risks. The Chartered Institute of Environmental Health Generic Assessment Criteria for Human Health Risk Assessment (S4UL's) adopt the Environment Agency's CLEA UK (Beta) Model and as such have derived guideline values that are compatible with current English legislation, policy and technical guidance.

Assessment criteria (S4UL's) for selected individual Polycyclic Aromatic Hydrocarbons have been produced by Chartered Institute of Environmental Health; however no values have been attached to Total Polycyclic Aromatic Hydrocarbons. Sixteen individual Polycyclic Aromatic Hydrocarbons with attached screening values include Benzo(a)anthracene 7.2-13mg/kg, Benzo(a)pyrene 2.2-3.0mg/kg, Dibenzo(a,h)anthracene (0.24-0.30mg/kg) and Naphthalene (2.3-13mg/kg) for a residential scenario with home grown produce.

The concentrations of Total Petroleum Hydrocarbons have been assessed against assessment criteria (S4UL's) for individual Aromatic and Aliphatic carbon band ranges produced by Chartered Institute of Environmental Health for a residential scenario with home grown produce.

As no generic UK derived guidance is currently available for acceptable concentrations of Total Cyanide a screening value of 20mg/kg (Thiocyanate) has been used as a preliminary screening tool to identify where potential risks may exist.

As described in Using Soil Guideline Values – Environment Agency 2009, chemical data from the analysis of samples generated during the intrusive investigation have been used to create a data set for the site. The entire data set, as opposed to individual results has been analysed on the assumption that the samples from the site investigation are to some degree representative of the contaminant concentration throughout the area or volume of soil investigated. The most appropriate method for assessing a given dataset is dependent upon a range of specific factors together with the quantity and quality of the data generated.

In accordance with the recommendations provided within Guidance on comparing soil contamination data with a critical concentration – CIEH/CL:AIRE, 2008, we have selected the one sample t-test at a 95% confidence level as the most appropriate statistical tool for generating site representative soil concentration values and have assumed that the data is normally distributed. We have assumed that this statistical test is required to draw conclusions about the condition of the land under scrutiny as part of a planning scenario as opposed to the Part 2A scenario. Under a planning scenario, comparison is made between a value larger than the sample mean, in this case the Upper Confidence Limit and the critical concentration.

In instances where the Upper Confidence Limit exceeded the given critical value, then the Grubbs Test has been used to identify upper outliers to assess whether the highest value belongs to the general population of the dataset or is representative of an outlier.

5.7 Discussion

5.7.1 Human Health Risk Assessment (On-Site Users, Workforce and Neighbouring Residents)

Concentrations of the zootoxic heavy metals Total Arsenic, Total Beryllium, Total Boron, Total Cadmium, Hexavalent Chromium, Trivalent Chromium, Total Selenium, Total Copper, Total Nickel and Total Zinc in the samples analysed did not exceed the S4UL Generic Guideline Values for a residential scenario without home-grown produce. As such there is not considered to be any potentially significant level of end-user risk associated with the concentrations of these contaminants encountered.

The concentrations of Total Lead encountered in all of the samples, ranging from 410mg/kg to 5200mg/kg, were in excess of the Category 4 Screening Level for residential use with home-grown produce of 200mg/kg. It was therefore decided to undertake statistical analysis of the data set, using the arithmetic mean and standard deviation for Lead. An outlier test identified the particularly elevated concentration of Lead encountered in the sample from BH1 as not representative of the rest of the sample population and indicative of a locally affected area or ‘hot-spot’ of contamination and the soil should be treated accordingly. Following a test scenario from a planning perspective, it was concluded that the true mean of the remainder of the sample population exceeded the S4UL Generic Guideline Values for a residential scenario with home-grown produce of 200mg/kg and as such the potential risk to the end-users of the site from the concentrations encountered cannot be discounted at this stage.

Marginally elevated concentrations of Total Mercury were encountered in samples from TP1 and TP2, at 1.3mg/kg and 1.4mg/kg respectively, compared to S4UL Generic Guideline Values for a residential scenario with home-grown produce of 56mg/kg for Inorganic Mercury and 1.2mg/kg for Elemental Mercury. It is considered that in excess of 99% of mercury encountered within soils would be within the inorganic form and as such it is not believed that the concentrations encountered would be sufficient to pose a significant risk to end users of the site in a residential scenario.

The concentrations of Total Cyanide were below the screening value of 20mg/kg and the concentrations of Total Phenol were below the S4UL Generic Guideline Value for a residential scenario with home-grown produce and as such there are not considered to be any significant risks to end-users of the site from these contaminants.

The concentrations of individual Polycyclic Aromatic Hydrocarbons encountered did not exceed the S4UL Generic Guideline Values for a residential scenario with home-grown produce at 6.0% SOM. As such there is not considered to be any potentially significant level of end-user risk associated with the concentrations of these contaminants encountered.

The concentrations of Petroleum Hydrocarbons encountered within individual Aromatic and Aliphatic carbon band ranges in the samples analysed did not exceed the S4UL Generic Guideline Values for a residential scenario with home-grown produce.

The concentrations of Benzene Toluene, Ethylbenzene and Xylenes encountered did not exceed the S4UL Screening Levels for residential use with home grown produce. As such there is not considered to be any potentially significant level of end-user risk associated with the concentrations of these contaminants encountered.

There was no MTBE detected within the samples analysed.

5.7.2 Table Summary of Elevated Contaminants

Contaminant	Sample Locations	Sample Results	Guideline Value	Evaluation
Lead	BH1, TP1, TP2, TP3, TP4	410 mg/kg - 5200 mg/kg	200 mg/kg	**High Risk** - remediation required across the site.
Mercury	TP1, TP2	1.3 mg/kg – 1.4 mg/kg	1.2 mg/kg	No Risk

5.7.3 Asbestos Containing Materials

The Made Ground at each exploratory location was screened for the presence of asbestos containing material. In all of the samples analysed, asbestos containing material was not observed during the investigation or identified during the laboratory analysis.

5.7.4 Assessment of Gas Hazard

Borehole 1 was installed with a standpipe equipped with ground gas monitoring apparatus to a depth of approximately 5m below ground level.

The monitoring installation consisted of a 50mm diameter standpipe, which is in accordance with that prescribed to enable correlation with Gas Screening Values (GSVs) derived by CIRIA and the NHBC.

The installation consisted of 1m of plain pipe with a bentonite seal at the surface in order to prevent surface water ingress that could flood the response zone and to prevent atmospheric leakage/ingress. The standpipe was sealed with a bung and valve with a flush fitting stopcock cover.

The frequency of ground gas monitoring on-site was decided in line with recommendations by CIRIA to provide monitoring data sufficient to allow the prediction of worst-case conditions.

Based on a low generation potential and a low sensitivity development and monitoring which was undertaken during a range of climatic conditions, four monitoring visits at the site were considered appropriate.

Ground gas on-site was measured using the Gas Data GFM Series infra-red analyser, with internal flow pod. The results are presented in the gas tables, contained in Appendix B.

Atmospheric conditions and the results of the ground gas monitoring (maximum values) from all visits are presented below.

Date	Weather Conditions	Temperature (°C)	Pressure (mb)
01/12/21	Cloudy with sunny spells	+9.00	994
07/12/21	Raining	+8.00	989
14/12/21	Cloudy	+13.0	1024
21/12/21	Cloudy	+6.0	1022

Atmospheric Weather Conditions

BH	Flow (l/h)	CH_4 (%)	CO_2 (%)	VOC (ppm)	H_2S (ppm)	CO (ppm)
BH1	<0.1	<0.1	2.4	0.635	<0.1	<0.1

Gas Monitoring Results

Gas flow through soil occurs either by convection or by diffusion. Convection occurs when total gas pressure is not uniform throughout the system (i.e. when a total pressure gradient exists). Convective flow is in the direction in which total pressure decreases, because gases tend to move from regions of high pressure to regions of low pressure.

Diffusive flow of a gas is in the direction in which its concentration (partial pressure) decreases. The relative pressures recorded in the borehole were very low to negligible and therefore the potential for convective flow is considered to be low. Therefore, any gas flow would have to be via diffusion. This is corroborated by the trend of very low steady state flow rates (maximum of <0.1 l/hr), in many cases being below detection limits. In general, low concentrations of carbon dioxide and methane were returned during the monitoring.

Hydrocarbon Vapours

The underlying made and natural ground across the site was found to be free from visual and olfactory indicators of volatile organic (e.g. hydrocarbon) contamination, which was corroborated by hydrocarbon analysis undertaken on each sample analysed.

As such, the probability for generation of VOC vapours from the underlying Made Ground and natural ground is considered to be low, which was verified by low VOC concentrations detected during gas monitoring.

CO and H_2S

There are currently no GSV for CO or H_2S. Thresholds are only available for occupational exposure limits (OEL). For H_2S, the OELST is 10ppm and OELLT is 5ppm. It should be noted that the OELLT is based upon an 8 hour exposure limit converted to an annual mean and the OELST is based upon 15 minute exposures converted to an annual mean. The concentrations of H_2S measured were below threshold values.

National Ambient Air Quality Standards (NAAQS) were developed by the US EPA under the Clean Air Act from 1990. The Clean Air Act primary standards to provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. The EPA air quality standard is 9ppm CO average over 8 hours, not to be exceeded more than once a year. The concentrations of CO encountered did not exceed the EPA air quality standard.

CH_4 and CO_2 GSV

CIRIA (2007b) and NHBC (2007) provide assessments for CO_2 and CH_4 based upon GSV utilising flow rates and concentrations measured in appropriate standpipes. The GSVs within CIRIA (2007b) are based upon all buildings other than standard residential houses. The NHBC (2007) GSV are based upon standard residential houses with precast concrete floors (block and beam). As such, based upon the assumed end use of the site the GSV within the CIRIA guidance should be adopted. The thresholds for GSV based upon NHBC and CIRIA guidance are summarised below.

CIRIA		NHBC		
Classification	**GSV (CH_4 & CO_2)**	**Classification**	**GSV (CH_4)**	**GSV (CO_2)**
CS1	<0.07	Green	<0.13	<0.78
CS2	<0.70	Amber 1	<0.63	<1.60
CS3	<3.5	Amber 2	<1.60	<3.10
CS4	<15	Red	>1.60	>3.10
CS5	<70			
CS6	>70			

Thresholds for GSV

A summary of the monitoring results is provided below, which utilises the highest steady state concentration and highest flow rate at each location in order to adopt a worst-case scenario for the risk assessment.

BH	Flow (l/h)	CH_4 (%)	CO_2 (%)	VOC (ppm)	CH_4 GSV (l/hr)	CO_2 GSV (l/hr)	Characteristic Situation	NHBC Classification
BH1	<0.1	<0.1	2.4	0.635	<0.01	<0.01	**CS1**	**Green**

Summary of Monitoring Results

On-site monitoring has shown emissions of methane in air of up to <0.1% and carbon dioxide in air of up to 2.4% recorded during the monitoring visits. The maximum borehole flow rate was 0.1 l/h.

As such the maximum Gas Screening Value for methane is <0.01 l/h and the maximum Gas Screening Value for carbon dioxide at site is also <0.01 l/h. As such the worst-case value for the site would be 0.01 litres of gas per hour.

As such the Gas Screening Value for methane is less than 0.01 l/h and the Gas Screening Value for carbon dioxide at site is (also) less than 0.01 l/h. According to CIRIA (2007b) the worst-case monitoring results from each location during this preliminary assessment would be classified as Characteristic Situation 1 and unlikely to be considered a significant risk.

5.7.5 Landscape Planting/Ecological Features

The concentrations of the phytotoxic substances Total Copper and Total Nickel encountered in the samples obtained were generally below the landscape planting generic assessment levels and therefore are not considered to be a significant risk to plant growth on-site.

However, the concentration of the phytotoxic substance Total Zinc encountered in one of the samples obtained exceeded the landscape planting generic assessment levels:

Substance	Sample Location/s	Concentration/s	Guideline Value	Comments
Total Zinc	BH1	780mg/kg	300mg/kg	Although the Made Ground would be considered as a potential risk to landscape planting (should there be any), the presence of hard standing beneath the BH1 location would negate any risk across the majority of the site. Where present on-site, it is recommended that remediation be undertaken in areas of landscape planting on-site.

5.7.6 Buildings and Construction Materials

Concrete Cast In-Situ

The concentrations of Total Sulphate encountered did not exceed the BRE guidance level of 2400mg/kg. From the water soluble sulphate concentrations BRE Special Digest 1 : 2005, Tables C1 and C2 would classify the samples submitted as up to Class DS-1. This should be taken into account should any concrete structures be installed within the soils represented by these samples.

Potable Water Supply Pipes

If at any point in the future, it be intended to install new water supply pipes within the Made Ground then consideration to the pipe materials used and/or the trench construction in accordance with UKWIR (2010) and the WATER UK HBF guide. Based upon the concentrations of TPH returned by the samples of Made Ground and the analysis undertaken, the use of standard PE pipe materials at the site may be unsuitable and barrier pipe should be used on-site.

5.7.7 Soil Disposal

The samples were analysed using the 'Catwastesoil' assessment tool, which concluded that the majority of the samples were generally not hazardous in nature, with the exception of the sample from BH1:

Sample	Strata	Hazardous Waste	Hazardous Property
BH1 – 0.25m	Made Ground	Hazardous	HP10 – Reprotoxic HP14 - Ecotoxic
TP1 – 0.50m	Made Ground	Not Hazardous	-
TP2 – 0.25m	Made Ground	Not Hazardous	-
TP3 – 0.50m	Made Ground	Not Hazardous	-
TP4 – 0.25m	Made Ground	Not Hazardous	-

5.8 Revised Site Conceptual Model and Conclusions

The findings of the Phase 2 site investigation have demonstrated that in the context of a proposed residential use of the site with private gardens, the contaminant of concern with respect to end-user protection was elevated Lead encountered across the site.

A potential risk to other receptors including potable water supply pipe may exist as detailed in this report.

A Phase 2 Site Investigation has identified the following Source/Pathway/receptor linkages present on-site or potentially present.

Potential Contaminants / Source	Pathway	Receptor	Site specific settings	Risk Classification: Based on Phase II Investigation	Action Required
LEAD	Inhalation, ingestion and dermal contact.	Human Health Residents	Residential use with gardens	Low/Medium	Further action required – Soil Remediation required
LEAD	Inhalation, ingestion and dermal contact	Human Health Workers	Workers and the general public should follow regulation on health and safety during development (HSE, 1991).	Low	Further action required – Soil Remediation required
NO SOURCES	Through high permeability strata, fissures and shafts, and by Inhalation by humans	Human Health Inhalation of Gases	Elevated ground gas not encountered	None	No further action

NO SOURCES	Negligible groundwater flow	Shallow groundwater Surface Water contamination via groundwater flow	Unproductive Strata underlying the site.	None	No further action
NO SOURCES	Negligible groundwater flow	Deep groundwater	Unproductive Strata underlying the site.	None	No further action
TPH	Chemical attack, gas accumulation in buildings	Building structures/services	Potential for small amount of Made Ground	Low/Medium	Barrier pipe recommended for potable water pipes.
ZINC	Uptake (root and stomata), ingestion, inhalation and dermal absorption by animal)	Ecological features (i.e. Flora and Fauna)	There are no significant sensitive land uses within 250m of the site. However, there are areas of soft landscaping proposed on-site.	Low	No further action

Phase 2 Conceptual Site Model

5.9 Viable Risks Requiring Action

- There is a risk to end-users of the site from elevated Lead encountered across the site. Remediation should be undertaken on-site to negate these risks.
- There is a risk to the workforce on-site from elevated Lead encountered across the site. Normal PPE and following health and safety regulations would negate this risk.
- There is a risk to water pipe on-site from the concentrations of TPH encountered. WATER UK HBF guide recommendations barrier pipe which would negate this risk.

5.10 Remedial Options Proposed

A number of potential remedial options are presented to sever the pollutant linkages with respect to soil contamination present and include:

Option 1: Further Chemical Testing and Human Health Risk Assessment

Impacted soils were identified across the site. It is considered unlikely that the extent of remediation required on the site could be minimised if further investigation of the site was undertaken.

Option 2: Adoption of Cover System in Soft Landscaped Areas

The BRE "Cover Systems For Land Regeneration, Thickness Design of Cover Systems for Contaminated Land, BRE, March 2004", allows for the design of cover systems to impacted soils where the concentration of determinants within the ground does not exceed any of the respective SSV, SGV's or GAC's by more than six times. In such a situation a maximum cover thickness of 600mm is given. However, the concentration of determinants within the certified clean soil/topsoil, which comprises the cover system, determines the overall thickness of the system and can reduce the required thickness markedly below 600mm. Where the concentration of determinants within the ground does exceed any of the respective SSV, SGV's or GAC's by more than six then an engineered capping system is recommended.

The concentrations of elevated determinants outlined in Section 5.8 identified concentrations that were more than six times their guideline value. Therefore, a simple cover system would not be suitable. Consideration should also be given to other, or combinations of remedial options such as source removal, provision of greater thickness of cover, or provision of an engineered cover system (Option 6).

Option 3: Excavation of Impacted Soil

It could be proposed to excavate and stockpile the impacted material on the site in preparation for classification and subsequent disposal off-site to a suitable licenced facility. The initial excavations should be centred on the trial-holes with impacted soil and then extended in all directions, so that the impacted soils can be 'chased' out. Once excavation has been completed validation would be required to prove all impacted soil has been removed. Validation would involve taking a representative number of samples from the sides and base of any excavation and then sent off for appropriate chemical analysis. The stockpiled soils must be placed on an impermeable liner with raised edges. During periods of rainfall, the stockpile must be covered over to minimise leaching and run-off into the underlying soils. Covering of the stockpile may be required to prevent fumes impacting receptors off-site. The remedial works must be inspected and independently validated by a suitable person. On completion of the development, a Validation and Closure Report must be supplied to both the Local Authority and the NHBC detailing the remediation works undertaken on the site. Any voids resulting from the removal of impacted soil must be backfilled with a suitable certified clean granular soil. The developer/groundworker must be made aware of the potential for sources not identified in the Phase 2 site investigation to be found within the site both during demolition and the excavation of trenches for services and foundations.

Option 4: Excavation of All Made Ground and Topsoil

Made Ground was encountered across the site a maximum depth in excess of 0.95m bgl. This could be excavated for disposal at an appropriate waste management facility after further categorisation as explained for Option 3.

Option 5: Hard Landscape Entire Site

Hard landscaping the entire site could eliminate exposure to contaminated soils through:

I. Direct soil and dust ingestion
II. Consumption of home-grown produce
III. Dermal contact
IV. Inhalation of dust (indoor and outdoor)

Option 6: Engineering Capping System

If an engineering capping system was required, it should comprise geotextile and/or mesh underlying a 200mm thick layer of gap graded crushed concrete (5-75mm) or the like with geotextile underlying 400mm thickness of clean certified Topsoil.

5.11 Recommended Option

In respect to soil contamination, it is anticipated that the protection of the end-user may be achieved by the following:

- **Areas of proposed hardstanding (e.g. building footprint, roadways etc.)**

In areas of permanent hardstanding such as the building footprint and roadways etc., the development itself would adequately break exposure pathways to human health and therefore further remedial measures may not be required in these areas.

- **Sensitive end use areas (garden areas, patio's etc.)**

In areas of sensitive end use such as gardens, patio's, soft-landscaping etc. soils should be removed from the site to mitigate the risks to end users and break exposure pathways. It would be recommended that the soils be excavated down to at least 600mm and replaced with a geotextile and/or mesh underlying a 200mm thick layer of gap graded crushed concrete (5-75mm) or the like with geotextile underlying 400mm thickness of clean certified Topsoil.

Barrier pipe should be used on-site.

5.12 Discovery Strategy

The discovery strategy sets out the actions that must be taken if contamination is encountered during the course of a development.

A significant observation includes any observation of contamination. Examples of the types of observations that would be considered significant are set out in the following table.

Evidence	Description
Visual	• Fuel or oil like substances mixed in with or smeared on the soil or floating on perched, groundwater or surface waters. • Waste materials (refuse, barrels, industrial wastes, ash, tar, etc.) buried at specific location or across the site. • Marked variation in colour. For example red, orange, yellow, green, light or dark blue, etc. may indicate contamination from a variety of contaminants. • Soils including large amounts of ash and clinker where such contamination of soils wasn't expected.
Odours	• Fuel, oil and chemical type odours • Unusual odours such as sweet odours or fishy odours
Wellbeing	• Light headedness and/or nausea when in excavations, at the working face of an excavation, when visual or olfactory evidence of contamination exists, etc. • Burning of nasal passages, throat, lungs or skin • Blistering or reddening of skin due to contact with soil

Potential Indicators of Contamination

Note: The examples provided in this table are not exhaustive.

The following table sets out the actions that must be taken if significant or suspected land, water or air contamination is observed by site staff, contractors or visitors.

Person Observing Contamination	To Be Reported To:	Action To Be Taken
Site visitor	Must report observations to the site manager	None
Contractor	Must report observations to the site manager	Stop work and where possible and safe make area safe and secure area before reporting to site manager
On-site manager	Must report observations to their direct manager, the appointed Environmental Consultant, the Planning Authority and Contaminated Land Officer at the Local Council	Stop work and where possible and safe make area safe and secure area before reporting to others
Environmental Consultant	Must report observations to the site manager, the Planning Authority and Contaminated Land Officer at the Local Council	Advise that work stops and where possible that the area is made safe before reporting to others

Actions after observation

The following table identifies other organisations that may need to be contacted in an emergency or where pollution of controlled waters or nuisance is occurring.

Occurrence	Description	Contact
Risk to the public	If at any point residents, the public or others may be at risk as a result of contamination found during the course of investigation, remediation or development works	• Contact the emergency services if there is a risk to life • Contaminated Land Officer/Planning Authority • Health & Safety Executive
Nuisance to residents / the public	If a nuisance has been or is likely to be caused to nearby residents, the public and others – for example odours, dust, noise, vibration, etc.	• Pollution Control Team at the Local Council (and other Councils where necessary)
Pollution of controlled waters	If any surface, culverted or groundwater has been polluted – for example slurry, contaminated soil/water or a chemical spillage entering a river or canal.	• Environment Agency • Planning Authority and Contaminated Land Officer at the Local Council
Pollution of adjoining land	If land outside the boundary of the development site is polluted from site activities – for example slurry, contaminated soil/water or a chemical spillage	• The owner of the land • Planning Authority and Contaminated Land Officer at the Local Council

Actions after observation

Any materials brought onto the site (soils and / or clay) should be validated either at source or once laid at site. Given the nature of the ground conditions, appropriate health and safety practices should be adhered to in order to protect site workers. Any waste material leaving site for off-site disposal (soil and / or water) should be handled in accordance with the current Waste Management and Duty of Care Regulations.

The above conclusions have been drawn on the results of the tests carried out on the soil samples analysed and address remediation issues for the protection of the end-user only. It is recommended that any remedial measures suggested in this report should be subject to formal approval by local Environmental Health and/or Planning Departments and approval should be obtained prior to any works being undertaken. The comments made in this report do not address any third party liability.

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APPENDIX A

Borehole Logs

Site Analytical Services Ltd.

Site	Borehole Number
64 HAMILTON TERRACE, LONDON, NW8 9UJ	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	100mm cased to 0.00m		REGENCY GROVE LIMITED	2134496
	Location TQ264826	**Dates** 24/11/2021	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.15) 0.15	MADE GROUND: Grass over dark brown sandy topsoil		
0.25	D1						MADE GROUND: Dark brown, silty sandy clay containing brick and concrete fragments		
0.50	D2					(0.80)			
0.75	D3								
1.00	D4					0.95	Stiff, brown orange silty sandy CLAY		
1.00	V1 99								
1.50	D5								
1.50	V2 127					(1.45)			
2.00	D6								
2.00	V3 133								
						2.40	Stiff, dark brown orange silty sandy CLAY		
2.50	D7								
2.50	V4 140+								
3.00	D8								
3.00	V5 140+								
3.50	D9								
3.50	V6 140+					(2.60)			
4.00	D10								
4.00	V7 140+								
4.50	D11								
4.50	V8 140+								
5.00	D12					5.00	Complete at 5.00m		
5.00	V9 140+								

Remarks
Groundwater was not encountered durng boring/excavation
V= Vane Test - Results in kPa
D= Disturbed Sample
Excavating from 0.00m to 1.00m for 1 hour.

Scale (approx)	Logged By
1:50	EW

Figure No. 2134496.BH1

Site Analytical Services Ltd.

Site	Borehole Number
64 HAMILTON TERRACE, LONDON, NW8 9UJ	BH1

Installation Type
Single Installation

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 100 mm

Client
REGENCY GROVE LIMITED

Job Number
2134496

Location
TQ264826

Ground Level (mOD)

Engineer

Sheet
1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				1.00	Bentonite Seal
				5.00	Slotted Standpipe

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks
Lockable cover set in cement

Site Analytical Services Ltd.

Site 64 HAMILTON TERRACE, LONDON, NW8 9UJ			**Trial Pit Number** TP1
Excavation Method HAND EXCAVATION	**Dimensions** 0.30m(W) x 0.30m(L) x 1.00m(D)	**Ground Level (mOD)**	**Client** REGENCY GROVE LIMITED	**Job Number** 2134496
	Location TQ264826	**Dates** 24/11/2021	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.15) 0.15	MADE GROUND: Grass over dark brown sandy topsoil		
0.25	D1				(0.65)	MADE GROUND: Dark brown, silty sandy clay containing brick and other man-made fragments		
0.50	D2							
0.75	D3				0.80 (0.20) 1.00	Brown orange silty sandy CLAY		
1.00	D4					Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater was not encountered durng boring/excavation

Scale (approx)	Logged By	Figure No.
1:50	EW	2134496.TP1

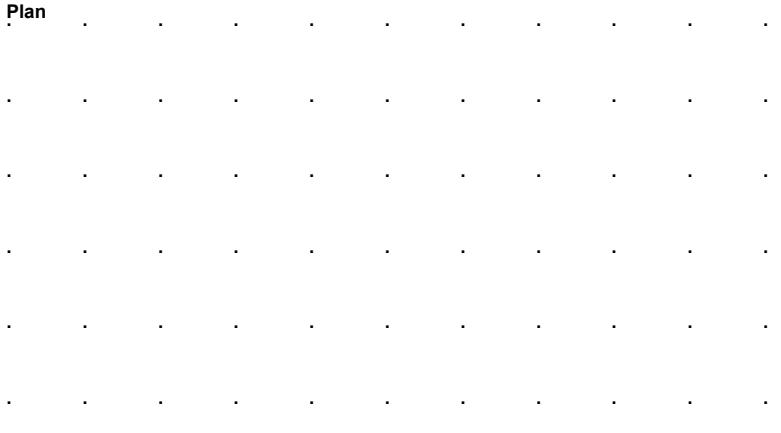
Site Analytical Services Ltd.

Site	Trial Pit Number
64 HAMILTON TERRACE, LONDON, NW8 9UJ	TP2

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		REGENCY GROVE LIMITED	2134496
	Location TQ264826	**Dates** 24/11/2021	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.10	MADE GROUND: Grass over dark brown sandy topsoil		
0.25	D1				(0.72)	MADE GROUND: Dark brown, silty sandy clay containing brick and other man-made fragments		
0.50	D2				0.82			
0.75	D3				(0.18)	Brown orange silty sandy CLAY		
1.00	D4				1.00	Complete at 1.00m		

Plan



Remarks

D= Disturbed Sample
Groundwater was not encountered durng boring/excavation

Scale (approx)	Logged By	Figure No.
1:50	EW	2134496.TP2

Site Analytical Services Ltd.

Site 64 HAMILTON TERRACE, LONDON, NW8 9UJ			**Trial Pit Number** TP3
Excavation Method HAND EXCAVATION	**Dimensions** 0.30m(W) x 0.30m(L) x 1.00m(D)	**Ground Level (mOD)**	**Client** REGENCY GROVE LIMITED	**Job Number** 2134496
	Location TQ264826	**Dates** 24/11/2021	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.10	MADE GROUND: Grass over dark brown sandy topsoil		
0.25	D1				(0.75)	MADE GROUND: Dark brown, silty sandy clay containing brick and other man-made fragments		
0.50	D2				0.85			
0.75	D3				(0.15)	Brown orange silty sandy CLAY		
1.00	D4				1.00	Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater was not encountered durng boring/excavation

Scale (approx)	Logged By	Figure No.
1:50	EW	2134496.TP3

Site Analytical Services Ltd.

Site	Trial Pit Number
64 HAMILTON TERRACE, LONDON, NW8 9UJ	TP4

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
HAND EXCAVATION	0.30m(W) x 0.30m(L) x 1.00m(D)		REGENCY GROVE LIMITED	2134496
	Location TQ264826	**Dates** 24/11/2021	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.15) 0.15	MADE GROUND: Grass over dark brown sandy topsoil		
0.25	D1				(0.65)	MADE GROUND: Dark brown, silty sandy clay containing brick and other man-made fragments		
0.50	D2							
0.75	D3				0.80 (0.20) 1.00	Brown orange silty sandy CLAY		
1.00	D4					Complete at 1.00m		

Plan

Remarks

D= Disturbed Sample
Groundwater was not encountered durng boring/excavation

Scale (approx)	Logged By	Figure No.
1:50	EW	2134496.TP4

APPENDIX B

Laboratory Test & Gas Monitoring Data

GAS MONITORING (VISIT 1/4)

DATE: **01/12/21**

Weather Conditions:	Ground Conditions:	Temperature (°C):
Cloudy with Sunny Spells	Dry	+9.0

Barometric Pressure (mbar):	Barometric Pressure Trend (24hr):	Ambient O2:
994		20.5%

Monitoring Point Location	Flow	Atmospheric Pressure (mbar)	Methane %	Carbon Dioxide %	Oxygen %	VOC (ppm)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (bgl)	Depth to Base of well (bgl)
BH1	<0.1	994	<0.1	1.7	18.1	0.574	<0.1	<0.1	Dry	4.91

Table 1

GAS MONITORING (VISIT 2/4)

DATE: **07/12/21**

Weather Conditions:	Ground Conditions:	Temperature (°C):
Raining	Wet	8.0

Barometric Pressure (mbar):	Barometric Pressure Trend (24hr):	Ambient O2:
989		20.4%

Monitoring Point Location	Flow	Atmospheric Pressure (mbar)	Methane %	Carbon Dioxide %	Oxygen %	VOC (ppm)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (bgl)	Depth to Base of well (bgl)
BH1	<0.1	989	<0.1	1.9	17.4	0.635	<0.1	<0.1	Dry	4.91

Table 1a

GAS MONITORING (VISIT 3/4)

DATE: **14/12/21**

Weather Conditions:	Ground Conditions:	Temperature (°C):
Cloudy	Dry	13.0

Barometric Pressure (mbar):	Barometric Pressure Trend (24hr):	Ambient O2:
1024		21.4%

Monitoring Point Location	Flow	Atmospheric Pressure (mbar)	Methane %	Carbon Dioxide %	Oxygen %	VOC (ppm)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (bgl)	Depth to Base of well (bgl)
BH1	<0.1	1024	<0.1	2.3	17.0	0.461	<0.1	<0.1	Dry	4.91

Table 1b

GAS MONITORING (VISIT 4/4)

DATE: **21/12/21**

Weather Conditions:	Ground Conditions:	Temperature (°C):
Cloudy	Dry	6.0

Barometric Pressure (mbar):	Barometric Pressure Trend (24hr):	Ambient O2:
1022		21.4%

Monitoring Point Location	Flow	Atmospheric Pressure (mbar)	Methane %	Carbon Dioxide %	Oxygen %	VOC (ppm)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Depth to water (bgl)	Depth to Base of well (bgl)
BH1	<0.1	1022	<0.1	2.4	16.5	0.350	<0.1	<0.1	Dry	4.91

Table 1c

Steve Barrett
Site Analytical Services Ltd
Units 14 -15
River Road Business Park
33 River Road
Barking
Essex
IG11 0EA

t: 0208 5948134
f: 0208 5948072
e: SAS -

i2 Analytical Ltd.
7 Woodshots Meadow,
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Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 21-25519

Project / Site name:	64 Hamilton Terrace London NW8 9UJ	**Samples received on:**	26/11/2021
Your job number:	21 34496	**Samples instructed on/ Analysis started on:**	26/11/2021
Your order number:	9527	**Analysis completed by:**	06/12/2021
Report Issue Number:	1	**Report issued on:**	06/12/2021
Samples Analysed:	5 soil samples		

Signed: A. Czerwińska

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
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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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 21-25519
Project / Site name: 64 Hamilton Terrace London NW8 9UJ
Your Order No: 9527

Lab Sample Number				2096808	2096809	2096810	2096811	2096812
Sample Reference				BH1	TP1	TP2	TP3	TP4
Sample Number				D1	D2	D1	D3	D1
Depth (m)				0.25	0.50	0.25	0.50	0.25
Date Sampled				24/11/2021	24/11/2021	24/11/2021	24/11/2021	24/11/2021
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	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	20	15	16	19	19
Total mass of sample received	kg	0.001	NONE	0.60	0.60	0.60	0.60	0.60
Whole Sample Crushed		N/A	NONE	Crushed	Crushed	Crushed	Crushed	Crushed
Asbestos in Soil Screen	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	KSZ	KSZ	KSZ	KSZ	KSZ
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.5	6.7	6.5	7.0	6.8
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Complex Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	1300	610	730	950	1100
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.017	0.015	0.024	0.054	0.055
Sulphide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Organic Matter (automated)	%	0.1	MCERTS	6.9	4.7	5.0	5.5	6.4
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.93	0.20	0.34	0.40	0.62
Anthracene	mg/kg	0.05	MCERTS	0.22	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	2.4	0.76	1.4	1.6	2.3
Pyrene	mg/kg	0.05	MCERTS	2.2	0.72	1.3	1.5	2.2
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.5	0.55	0.87	1.2	1.7
Chrysene	mg/kg	0.05	MCERTS	1.1	0.37	0.88	0.82	1.1
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.9	0.68	1.4	1.3	1.8
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.65	0.20	0.37	0.63	0.93
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1.6	0.50	1.1	1.2	1.6
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.90	0.33	0.66	0.68	0.99
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.27	< 0.05	< 0.05	0.21	0.29
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.0	0.29	0.62	0.75	1.1
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	14.7	4.60	8.92	10.2	14.6

Analytical Report Number: 21-25519
Project / Site name: 64 Hamilton Terrace London NW8 9UJ
Your Order No: 9527

Lab Sample Number				2096808	2096809	2096810	2096811	2096812
Sample Reference				BH1	TP1	TP2	TP3	TP4
Sample Number				D1	D2	D1	D3	D1
Depth (m)				0.25	0.50	0.25	0.50	0.25
Date Sampled				24/11/2021	24/11/2021	24/11/2021	24/11/2021	24/11/2021
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	23	25	25	21	24
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.4	1.7	1.7	1.4	1.5
Boron (total)	mg/kg	1	MCERTS	9.6	11	11	12	14
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	36	35	36	34	37
Copper (aqua regia extractable)	mg/kg	1	MCERTS	82	110	100	71	71
Lead (aqua regia extractable)	mg/kg	1	MCERTS	5200	430	640	410	500
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1.2	1.3	1.4	1.1	1.2
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	23	30	28	25	27
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	63	76	75	70	72
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	780	140	190	160	200
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6 $_{HS\_1D\_AL}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 $_{HS\_1D\_AL}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 $_{HS\_1D\_AL}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12 $_{EH\_CU\_1D\_AL}$	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 $_{EH\_CU\_1D\_AL}$	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 $_{EH\_CU\_1D\_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AL}$	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7 $_{HS\_1D\_AR}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 $_{HS\_1D\_AR}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 $_{HS\_1D\_AR}$	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12 $_{EH\_CU\_1D\_AR}$	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 $_{EH\_CU\_1D\_AR}$	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35 $_{EH\_CU\_1D\_AR}$	mg/kg	10	MCERTS	25	< 10	26	21	29
TPH-CWG - Aromatic (EC5 - EC35) $_{EH\_CU+HS\_1D\_AR}$	mg/kg	10	MCERTS	35	< 10	34	28	38
TPH Total C5 - C35 $_{EH\_CU+HS\_1D\_TOTAL}$	mg/kg	10	NONE	35	< 10	34	28	38

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

Analytical Report Number : 21-25519
Project / Site name: 64 Hamilton Terrace London NW8 9UJ

* 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 *
2096808	BH1	D1	0.25	Brown loam with vegetation and gravel
2096809	TP1	D2	0.5	Brown loam with vegetation and gravel
2096810	TP2	D1	0.25	Brown loam with vegetation and gravel
2096811	TP3	D3	0.5	Brown loam with vegetation and gravel
2096812	TP4	D1	0.25	Brown loam with vegetation and gravel

Analytical Report Number : 21-25519
Project / Site name: 64 Hamilton Terrace London NW8 9UJ

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

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
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.	L038-PL	D	MCERTS
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
Complex Cyanide in soil	Determination of complex cyanide by calculation.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-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
Free cyanide in soil	Determination of free 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
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	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
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
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-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.	L038-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
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
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
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS

Analytical Report Number : 21-25519
Project / Site name: 64 Hamilton Terrace London NW8 9UJ

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPH7 Ali Aro Sum	Determination of dichloromethane/hexane extractable hydrocarbons in soil by GC-MS, speciation by interpretation.	In-house method	L064-PL	D	NONE
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Crush Whole Sample	Either: Client specific preparation instructions - sample(s) crushed whole prior to analysis; OR Sample unsuitable for standard preparation and therefore crushed whole prior to analysis.	In house method, applicable to dry samples only.	L019-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.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

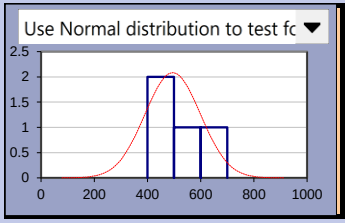
APPENDIX C

Statistical Analysis

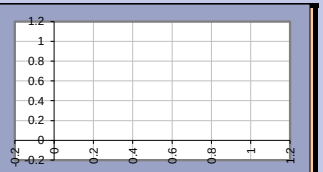
Test Results

Client/client ref: Regency Grove Site ref: 64 Hamilton Terrace
Project ref: 21/34496 Data description: Heavy Metal
Date: 06-Dec-2021
User details: Radhika Patel

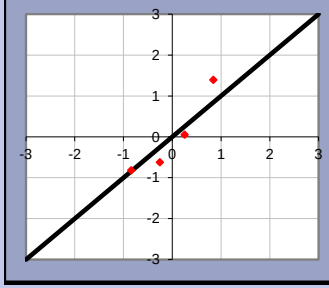
Dataset:	Pb
Sample mean, $\bar{x}$	495
Sample standard deviation, s	104.08
Sample size, n	4
Critical concentration, Cc	200



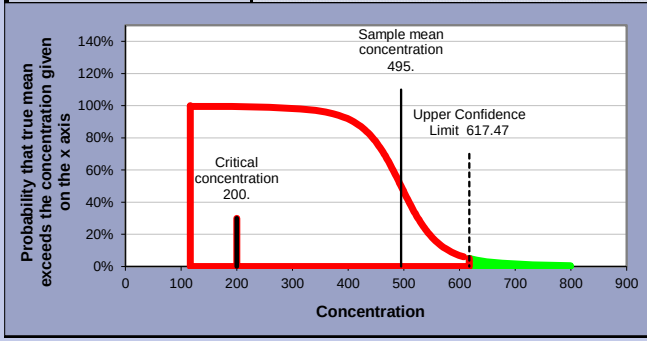
Outliers & non-detects	
Outliers present?	NO
Significance level	5%
Outliers removed?	1
Non-detects	0



Normality test	
Significance level:	5%
Normal distribution	
Use:	Auto: One-sample t-tes



Test scenario:	Planning: is true mean lower than critical concentration (μ < Cc)?
Null hypothesis:	The true mean concentration is equal to or greater than the critical concentration: μ ≥ Cc
Alternative hypothesis:	The true mean concentration is less than the critical concentration: μ < Cc



Evidence against Null hypothesis:	1%
Base decision on:	evidence level
Evidence level required:	95%
Balance of probability?	N/A
Reject Null Hypothesis?	No
μ ≥ Cc	

Back to data | Back to summary | Go to outlier test | Go to normality test