

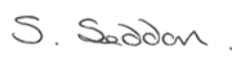
Phase 2 Geoenvironmental Investigation & Assessment

For

Oakwood Lodge, Wythenshawe

Undertaken on behalf of

Garden City Design and Build Ltd

Report Title:	Oakwood Lodge, Wythenshawe Geoenvironmental Investigation and Assessment
Report Reference:	8928G-WML-00-XX RP-G-0002
Client:	Garden City Design and Build Ltd
Issue Date:	11th November 2019
Revised:	18th December 2019
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Revision Status / History

Rev	Date	Issue / Purpose/ Comment	Prepared	Checked	Authorised
-	11/11/2019	Final	TPB	SCS	PGD
A	18/12/2019	Updated Ground Gas Risk Assessment		-	SCS

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Executive Summary

Site Location	The site is located at Longley Lane, Wythenshawe and is centred on approximate Ordnance Survey National Grid Reference 383410E, 389477N.
Development Proposals	Construction of 20no semi-detached residential properties with areas of hardstanding for access and car parking, soft landscaping and private gardens.
Ground Conditions	Made ground was encountered to depths of between 0.30m and 1.80mbgl, underlain by glaciofluvial sheet deposits to depths of between 3.40m and 3.80mbgl. These were underlain by glacial till to a maximum proven depth of 5.00mbgl. Standing groundwater has been recorded at depths of between 1.82m and 2.80mbgl.
Site Preparation and Earthworks	Following demolition, all existing foundations and other buried structures should be removed to facilitate construction of new foundations and drainage. It is noted that a ground obstruction was encountered at a depth of 0.50mbgl at the location of WS08 and it cannot be discounted, without further ground investigation, that other such obstructions may be present beneath other areas of the site. Construction near retained trees and importantly within any RPAs should be undertaken with due regard to guidance provided in BS5837:2012 'Trees in relation to design, demolition and construction – recommendations'.
Foundations and Floor Slabs	New structures should be supported on traditional shallow spread foundations constructed within the natural granular deposits at a minimum depth of 0.75m below proposed ground level. Under such circumstances, foundations may be designed to a net allowable bearing pressure of 100kN/m². New floor slabs will be suspended in the form of a beam and block construction, although ground bearing floor slabs could be adopted where constructed directly on natural glaciofluvial deposits.
Excavations and Groundwater	Perched groundwater inflows should be anticipated within excavations below depths of 1.80mbgl. Conventional 'sump and pump' dewatering measures will be adequate to keep excavations dry provided that groundwater exclusion measures such as interlocking sheet piles are adopted to prevent excessive ingress of water. Such support measures will also reduce the risk of 'running sand' conditions leading to loss of ground beneath any nearby adjacent structures or infrastructure.
Pavements	The design of new road pavements should be based on a CBR of no more than 2.5% in made ground and 5% within unsaturated natural granular glacial deposits.
Concrete Classification	The typical design sulphate (DS) class and "Aggressive Chemical Environment for Concrete" (ACEC) class for the site are DS-1 and AC-1 respectively.
Soakaways	The site is underlain by granular soils which may prove sufficiently permeable for the consideration of soakaway drainage. Large-scale infiltration testing will be required at drainage design stage to confirm the suitability of soakaway drainage.
Ground Gas	The site classifies as CS1 – Very Low gas risk with no specific ground gas protection required.
Contamination Assessment	Chemical analysis has confirmed that the site does not contain any significant sources of ground contamination and confirms to a large extent that the risk to human health from ground contamination is low. However, in view of the restricted nature of the ground investigation, it is recommended that further investigation and assessment is undertaken within proposed garden areas once the existing Oakwood Lodge building is demolished. In advance of this, it would be prudent to allow for removing any made ground from garden areas to expose clean natural soil or alternatively to provide a 600mm thick clean capping layer to break any potential exposure pathway. The risk to controlled waters from contamination arising from the site is considered low with no environmental remediation considered necessary.

Potable Water Supplies	The requirement for specific materials and measures to protect the water supply from ground contamination is not envisaged.
Waste Soils	Concrete and asphalt surfacing together with excavated foundations and other below ground concrete structures will be suitable for re-use as engineering fill, subject to appropriate sorting and crushing to a suitable grading. Excavated natural soils will be suitable for re-use as clean capping in garden areas, subject to confirmatory chemical analysis. Where soils are surplus to requirements, it is likely that the majority of made ground would be classified as Non-Hazardous with natural deposits classified as Inert for landfill disposal. Limited analysis of asphalt surfacing has indicated that it is unlikely to contain coal tar in hazardous concentrations. However, further analysis should be undertaken to fully categorise the asphalt materials should they be disposed to landfill.

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1.0 INTRODUCTION

Appointment

- 1.1 WML Consulting has been commissioned by Garden City Design and Build Ltd to undertake a Phase 2 Geoenvironmental Investigation and Assessment of a site referred to as Oakwood Lodge, Wythenshawe.

Proposed Development

- 1.2 It is understood that the project comprises the construction of 20no semi-detached residential properties with areas of hardstanding for access and car parking, soft landscaping and private gardens.
- 1.3 A proposed development plan by Arcus Consulting LLP referenced 5415-00-05-A, dated May 2019 is presented in Appendix 01.

Objective

- 1.4 The objective of the ground investigation and assessment was to provide geotechnical recommendations for construction design purposes together with a geo-environmental risk assessment in terms of possible ground contamination.
- 1.5 To achieve the objective, the following tasks were undertaken:
- Review the existing desk study report for the site and design a Phase 2 Ground Investigation in accordance with the Environment Agency (2004) Model Procedures for the Management of Land Contamination, CLR11.
 - Characterise the ground conditions in terms of geology, soil geotechnical parameters and ground contamination from information provided by the ground investigation.
 - Provide recommendations regarding suitable foundations, floor slabs and new pavement construction, together with any other geotechnical considerations that could affect possible future development.
 - Determine a ground conceptual model for the site so as to undertake an appropriate Phase 2 ground contamination Generic Quantitative Risk Assessment (GQRA).

Scope

- 1.6 A Phase 1 Desk Study for the site area has been undertaken by WML and is presented in the following report:
- Phase 1 Desk Study and Preliminary Geoenvironmental Assessment Report, Reference 8928G-WML-00-XX-RP-G-0001, dated August 2019.
- 1.7 This report includes the findings of a Phase 2 Ground Investigation designed on conclusions and recommendations provided in the desk study report. For ease of reference, the findings of the desk study are summarised in the following sections. However, the two reports are not exclusive and should be read in conjunction.
- 1.8 The ground investigation comprised the formation of window sample probeholes undertaken with reference to BS5930:2015 Code of Practice for Ground Investigation and BS10175:2011 together with A1:2013, "Investigation of Potentially Contaminated Sites - Code of Practice" except where superseded by EN ISO 22475-1 "Geotechnical Investigation and Assessment – Sampling by Drilling and Excavation and Groundwater Measurements".
- 1.9 Geotechnical soil testing has been undertaken in general accordance with guidelines provided in BS1377:1990 – Parts 1-9, "Method of Test for Soils for Civil Engineering Purposes". Samples for

chemical analysis were obtained and handled generally in accordance with the current guidelines (BS10175: 2011 and A1:2013).

- 1.10 The ground investigation has also been undertaken with reference to BS8576:2013, Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs).

2.0 SITE LOCATION AND DESCRIPTION

Site Location

- 2.1 The site comprises the former Oakwood Lodge day care centre, Longley Lane, Wythenshawe and is centred on approximate Ordnance Survey National Grid Reference 383410E, 389477N with an indicative postcode of M22 4LA.
- 2.2 The proposed development site is bounded to the north-east by playing fields, to the east and south by residential properties and to the south-west by a nursery.

Site Description

- 2.3 At the time of the site investigation in October 2019, the site was unoccupied and predominantly fenced-off from the general public.
- 2.4 The majority of the site was occupied by a single-storey, brick structure surrounded by localised areas of unmaintained soft landscaping together with asphalt hardstanding formerly used for access and parking.
- 2.5 A series of asphalt pedestrian footpaths extended to the west and north of the structure.
- 2.6 The south-eastern section of the site comprised further areas of asphalt road and parking, interspersed with soft landscaping.
- 2.7 The only vehicular access into the site is from the shared access road with the adjacent nursery, off Longley Lane to the south-west.
- 2.8 A metal security fence and mature hedges run around the northern, eastern and western site boundaries with a number of semi-mature trees located on the northern site boundary.
- 2.9 A mature oak tree was located in the south-eastern part of the site with two further mature oak trees located within the grounds of the neighbouring nursery, immediately to the south-west of the site.
- 2.10 The site is generally level and commensurate with the surrounding topography, ranging from approximately 35.85m Above Ordnance Datum (AOD) in the north to 35.10m AOD in the south-east.

3.0 SUMMARY OF ENVIRONMENTAL AND HISTORICAL SETTING

3.1 The following paragraphs summarise the most relevant findings of the Phase 1 desk study report.

Geology

- 3.2 The site is indicated to be underlain by Devensian Glaciofluvial Sheet Deposits which mainly comprise sands and gravels.
- 3.3 The superficial deposits are indicated to be underlain by strata of the Triassic Wilmslow Sandstone Formation.
- 3.4 In consideration of the underlying geology, risks of subsidence from coal mining can be discounted. In addition the Coal Authority interactive website indicates that the site is not located within a designated 'Development High Risk Area'.

Radon

- 3.5 The property is not in a radon affected area as defined by the BGS/Public Health England as less than 1% of properties are above the action level of exposure. Therefore, no radon protection measures are necessary for new structures as described in publication BR211 by the Building Research Establishment.

Environmental Setting

- 3.6 The superficial deposits underlying the site are classified as a 'Secondary (A) Aquifer'. The underlying bedrock is classified as a 'Principal Aquifer'.
- 3.7 The site is not within an Environment Agency (EA) Source Protection Zone (SPZ) and there are no groundwater abstraction licences within 500m of the site.
- 3.8 The nearest surface water feature is a drain some 143m south-east of the site at Didsbury Golf Course.
- 3.9 A historic landfill located approximately 120m south accepted unknown waste types for an unknown period of time.
- 3.10 A petrol filling station is located on Longley Lane 165m west of the site.
- 3.11 There are no records of sites which have been determined as Contaminated Land under Section 78R of the Environmental Protection Act 1990 within 500m of the study site.

Site History

- 3.12 The earliest maps dated 1876 indicate the site to have been undeveloped and in rural / agricultural use with a track extending along the eastern site boundary. A tree-lined field boundary also extended roughly north-west to south-east across the central section of the site.
- 3.13 By 1956 the nursery had been constructed immediately to the south-west of the site and by 1989 the site itself had been developed as Oakwood Lodge, roughly in its current configuration.

4.0 PRELIMINARY CONTAMINATION RISK ASSESSMENT

- 4.1 Based on the above findings, the Phase 1 desk study report concluded that potential pollution linkages were on the whole considered unlikely with associated preliminary risks being assessed generally as very low to low.
- 4.2 However, the report recommended that assumptions in the conceptual model be verified by providing information on the physical and chemical ground conditions through site investigations.
- 4.3 The investigations were to comprise sampling and chemical analysis of the near surface soil and the installation of ground gas monitoring standpipe with subsequent monitoring for hazardous ground gas concentrations and flow, primarily due to the historical landfill recorded some 120m to the south.
- 4.4 In addition, investigations were to be undertaken to establish geotechnical parameters for the design of foundations, floor slabs and pavement construction.

5.0 SITE INVESTIGATION

Rationale

- 5.1 Intrusive investigations were undertaken primarily to provide geotechnical parameters for structural design purposes but also to verify the preliminary site conceptual model and confirm the anticipated low environmental risk.
- 5.2 Window sample probeholes were undertaken to provide information on near surface deposits and to obtain samples for chemical analysis.
- 5.3 This method of investigation was chosen due to the restrictive nature of the site with a centrally located structure and small courtyards. Due to the small diameter of the probing equipment, the depth of penetration achieved is dependent on favourable ground conditions. As such, ground penetration may be restricted in circumstances where the ground is particularly strong or contains relatively large obstructions such as cobbles and/or boulders.
- 5.4 2no cored holes were also undertaken along the line of the access road in order to determine road construction thickness.
- 5.5 A general coverage of the site was considered appropriate although the investigation locations were limited due to the existing structures and known / anticipated services.
- 5.6 Monitoring standpipes were installed in selected probeholes for the measurement of ground gas and groundwater levels.

Intrusive Works

- 5.7 Ground investigation work was undertaken by LOT Geotechnics Ltd on 18th September 2019. This comprised the formation of 10no window sample probeholes and 2no road cores to a maximum depth of 5.00 metres below ground level (mbgl).
- 5.8 The exploratory hole records are presented in Appendix 02 of this report whilst the exploratory hole locations are shown on drawing 8928G-SK01 in Appendix 01.

Monitoring Standpipes

- 5.9 Monitoring wells for groundwater and ground gas measurement were installed in 5no probeholes as indicated on the logs presented in Appendix 02.

Geotechnical and Chemical Testing

- 5.10 In-situ geotechnical testing was undertaken at regular intervals during the formation of the probeholes in the form of Standard Penetration Tests (SPTs). The results for this testing are presented on the descriptive logs in Appendix 02.
- 5.11 Chemical analysis was undertaken on selected soil samples for the following contaminants of concern:
- Total Arsenic, Boron, Cadmium, Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc.
 - Total Cyanide, Phenols, Sulphur, Sulphate.
 - Speciated USEPA Polyaromatic Hydrocarbons (PAH).
 - Asbestos Screen and Identification.
 - 2:1 water/soil sulphate extract, pH.
- 5.12 The results of the chemical analysis are presented in Appendix 03.

Gas and Groundwater Monitoring

- 5.13 Gas and groundwater monitoring has been carried out on six occasions between 30th September and 4th December 2019. The monitoring results are presented in Appendix 04.

6.0 GROUND CONDITIONS

Stratigraphy

- 6.1 Ground conditions encountered during the intrusive investigation comprised made ground to depths of between 0.30m and 1.80mbgl, this being underlain by glaciofluvial sheet deposits to depths of between 3.40m and 3.80mbgl. These were underlain by glacial till to a maximum proven depth of 5.00mbgl.

Made Ground

General

- 6.2 Made ground was encountered within all exploratory holes from ground level to depths of between 0.30m and 1.80mbgl.
- 6.3 This generally comprised dark brown, slightly silty, slightly gravelly sand to depths of between 0.30m and 1.80mbgl. Gravel sized fragments include brick, sandstone and locally concrete and metal.
- 6.4 Within WS03, WS04 and WS05 in the southern section of the site a surface horizon of asphalt (WS03 & WS04) or concrete hardstanding (WS05) was encountered to a depth of 0.10mbgl. This was underlain by light brownish grey, slightly sandy gravel sub-base of limestone to depths of between 0.25m and 0.37mbgl and in turn by dark to orange brown and locally green grey, variably clayey and silty, slightly gravelly sand to depths of between 0.50m and 0.70mbgl. Gravel sized fragments included brick, sandstone and locally wood.
- 6.5 Within WS08 and WS08A, located within a courtyard in the centre of the existing structure, the made ground comprised a thin surface horizon of imported topsoil underlain by brownish grey, slightly gravelly, clayey sand to depths of 0.50m, where a concrete obstruction was encountered and the holes terminated.

Asphalt Access Road Construction

- 6.6 Cored holes CS01 and CS02 were formed within the existing access road to the south of the main development area. The cores indicated the road construction to comprise 30mm (CS01) and 40mm (CS02) of surface course over approximately 50mm of binder course.
- 6.7 The above road construction was underlain by a granular sub-base comprising light brownish grey, slightly sandy gravel of limestone, to a depth of around 0.30mbgl.
- 6.8 Photographs of the core are presented on the exploratory hole logs in Appendix 02.

Glaciofluvial Sheet Deposits

- 6.9 Within all of the exploratory holes, soils considered to represent glaciofluvial sheet deposits were encountered at depths of between 0.30m and 1.80mbgl. These extended to depths of between 3.40m and 3.80mbgl.
- 6.10 The glaciofluvial sheet deposits generally comprised loose to medium dense, orange brown, variably gravelly sand.
- 6.11 SPT 'N' values within the sand ranged between 5 and 31 with an average of 16 indicating a locally loose but generally medium dense state of compaction. The lower SPT 'N' values were associated with groundwater strikes encountered during exploratory hole formation.

Glacial Till

- 6.12 The glaciofluvial sheet deposits were underlain by glacial till which extended to a maximum proven depth of 5.00mbgl.
- 6.13 This comprised stiff, brown silty clay.
- 6.14 SPT 'N' values within the till ranged between 13 and in excess of 50 with an average of 26 indicating a generally stiff and locally very stiff consistency.

Visual/Olfactory Evidence of Contamination

- 6.15 No visual and/or olfactory evidence of significant ground contamination was identified within the exploratory holes during the investigation.

Groundwater

- 6.16 Groundwater seepages were encountered during the formation of the majority of exploratory holes at depths of between 2.50m and 3.60mbgl.
- 6.17 During the monitoring visits, standing water was recorded within all of the standpipes at depths of between 1.82m and 2.80mbgl.
- 6.18 It should be appreciated that the groundwater monitoring described above has been undertaken during a very short period of time. Significant variations in the long term groundwater regime may occur at other times, particularly with prolonged, extreme weather conditions, and that no account can be taken of such in this report.

General

- 6.19 It should also be appreciated that ground conditions may vary between and away from the exploratory hole positions, and that no account can be taken in this report of such variations.

7.0 GEOTECHNICAL APPRAISAL

Site Preparation and Earthworks

- 7.1 It is assumed that no demolition will proceed until an asbestos survey has been undertaken with and Asbestos Containing Material (ACM) so encountered being removed by an appropriately licensed specialist.
- 7.2 Following demolition, all existing foundations and other buried structures should be removed to facilitate construction of new foundations and drainage. It is noted that a ground obstruction was encountered at a depth of 0.50mbgl at the location of WS08 and it cannot be discounted without further ground investigation that other such obstructions may be present beneath other areas of the site.
- 7.3 It is assumed that demolition of the building and the removal of any trees and other vegetation will be undertaken in consultation with an ecological specialist.
- 7.4 Construction near retained trees and importantly within any RPAs should be undertaken with due regard to guidance provided in BS5837:2012 'Trees in relation to design, demolition and construction – recommendations'.
- 7.5 All existing asphalt/concrete hardstanding and below ground foundations removed as part of the clearance work, subject to appropriate screening, crushing and confirmatory testing, will be suitable for re-use as bulk fill beneath hard cover areas if required.

Foundations

- 7.6 Any localised areas of made ground and soft natural strata should be considered unsuitable for the direct support of structural loads as their generally incompetent nature could result in unacceptable total and differential settlements.
- 7.7 New structures should therefore be supported on traditional shallow spread foundations constructed within the natural granular deposits at a minimum depth of 0.75m below proposed ground level. Under such circumstances, foundations may be designed to a net allowable bearing pressure of 100kN/m².
- 7.8 Foundation formation levels should be thoroughly inspected with any soft, loose, or otherwise deleterious material encountered being removed and replaced with foundation concrete.
- 7.9 Foundation construction will need to take account of any remaining services and, where they are in close proximity, may need to be taken down to beneath the lowest level of the service trench so that their structural integrity is maintained.

Floor Slabs

- 7.10 It is anticipated that new floor slabs will be suspended in the form of a beam and block construction, although ground bearing floor slabs could be adopted where constructed directly on natural glaciofluvial deposits.

Excavations and Groundwater

- 7.11 Excavations at the site will be feasible using conventional hydraulic plant. All excavations at the site requiring man-entry will need adequate lateral support, or will need to be battering back to a safe angle to ensure their stability.
- 7.12 Perched groundwater inflows should be anticipated within excavations below depths of 1.80mbgl. Conventional 'sump and pump' dewatering measures will be adequate to keep excavations dry

provided that groundwater exclusion measures such as interlocking sheet piles are adopted to prevent excessive ingress of water.

- 7.13 Such support measures will also reduce the risk of 'running sand' conditions leading to loss of ground beneath any nearby adjacent structures or infrastructure.

Pavement Design

- 7.14 In consideration of the ground conditions, it is recommended that new road pavement design should be based on a California Bearing Ratio (CBR) value of no more than 2.5% in made ground and 5% within unsaturated natural granular glacial deposits.
- 7.15 The CBR would need to be reviewed and confirmed by site inspection and possibly suitable in-situ testing at formation levels following any earthwork operations and prior to pavement construction.

Concrete Design

- 7.16 Design/mix of buried concrete should be undertaken in accordance with the "Aggressive Chemical Environment for Concrete" (ACEC) classification, of BRE Special Digest 1:2005 (Concrete in Aggressive Ground). With reference to the site history, it is deemed appropriate to classify the site as "Brownfield", with respect to BRE Special Digest.
- 7.17 Values of 2:1 water/soil extract for sulphate for soils at anticipated foundation depths range from less than 10 to 30mg/l. Values of pH range from 7.2 to 8.5 indicating near neutral to slightly alkaline conditions.
- 7.18 On the basis of these results, the typical design sulphate (DS) class and "Aggressive Chemical Environment for Concrete" (ACEC) class for the site are DS-1 and AC-1 respectively.

Drainage and Soakaways

- 7.19 The site is underlain by granular soils which may prove sufficiently permeable for the consideration of soakaway drainage.
- 7.20 Large-scale infiltration testing will therefore be required at drainage design stage to confirm the suitability of soakaway drainage.

8.0 GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA)

General

- 8.1 A review of the desk study information has concluded that pollution linkages were generally considered unlikely with associated very low to low preliminary risk.
- 8.2 Furthermore, no visual and/or olfactory evidence of significant ground contamination has been identified within the exploratory holes during the investigation.
- 8.3 However, it has been considered prudent to adopt a precautionary principal and undertake chemical analysis of sub-surface soils to establish in more detail the human health risk status of the site.

Human Health

- 8.4 Selected samples have been analysed for a general suite of contaminants of concern and compared against Screening Levels (SL's) for human health to determine the significance of the measured concentrations in relation to the site conceptual model. Thus, a Generic Quantitative Risk Assessment has been undertaken in line with guidelines provided in CLR11, Model Procedures for the Management of Land Contamination, 2004.GQRA).
- 8.5 The criteria for a limited number of contaminants have been derived by DEFRA in their document entitled SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, April 2014.
- 8.6 Within the document, Category 4 Screening Levels (C4SL's) are described as being more pragmatic than previous screening criteria and represent concentrations in soil that present an 'acceptable' level of risk within the context of Part 2A.
- 8.7 The National Planning Policy Framework states that 'after development, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990'. Therefore by inference, the C4SL's are appropriate for use in the planning context.
- 8.8 Although the SP1010 document states that C4SL only apply for a 'sandy loam soil with 6% soil organic matter', it is generally accepted that assessment criteria for metals are not sensitive to changes in soil organic content (SOM). The C4SL's have therefore been adopted as assessment criteria in this report for the listed metals within the SP1010.
- 8.9 Subsequent to SP1010, LQM/CIEH have published a document entitled 'The LQM/CIEH S4ULs for Human Health Risk Assessment' 2015. In brief, the document provides updated assessment criteria which have been derived in accordance with UK legislation, national as well as EA policy and using a modified version of the CLEA software and available guidance. The new screening criteria, or Suitable 4 Use Levels (S4ULs), are intended to provide a complete and updated replacement to the previous LQM/CIEH GAC of 2009. As such they are considered appropriate for use in this assessment for other contaminants not covered by C4SL's and/or for organic contaminants assuming a worst-case Soil Organic Matter (SOM) of 1% as an initial conservative assessment.
- 8.10 For each contaminant, S4UL's and C4SL's have been calculated for six land use scenarios, namely:
- Residential with homegrown produce.
 - Residential without homegrown produce.
 - Allotments.
 - Commercial.
 - Public Open Space near residential housing.
 - Public Parks (remote from residential housing).

- 8.11 In light of the proposed development, the SL's for a "Residential with homegrown produce" end-use are considered appropriate for a conservative assessment at this stage.
- 8.12 A table of relevant SL's protective of human health for 1% SOM are provided in Appendix 05.

Soil Test Results

- 8.13 7no samples of made ground were analysed for a suite of contaminants of concern. The majority of the concentrations measured were below the stringent SL's for "Residential with homegrown produce" end-use with the following exception.

Contaminant	Number of Samples Exceeding SL	SL (mg/kg)	Recorded Concentrations (mg/kg)	Sample
Lead	1	200	612	WS01 – 0.30m

- 8.14 2no samples of asphalt from WS03 and WS04 was analysed to determine the concentration of benzo(a)pyrene (BaP). Where the concentration exceeds 50mg/kg, this may indicate that the asphalt is likely to contain coal tar at sufficient concentrations as to deem it hazardous waste.
- 8.15 The analysis recorded a BaP concentration of less than 4.0mg/kg, therefore suggesting that the asphalt does not contain coal tar at hazardous concentrations for disposal purposes.
- 8.16 No asbestos was detected in any of the samples analysed.

Discussion and Conclusions

Human Health

- 8.17 Chemical analysis has confirmed that the site does not contain any significant sources of ground contamination, with only one sample recording an elevated concentration of lead above its respective SL. It is noted that the sample was of made ground which was recorded as containing rare metal and may therefore suggest that the contamination is very isolated in nature.
- 8.18 The chemical analysis therefore confirms to a large extent that the risk to human health from ground contamination is low.
- 8.19 Following site development, where surfaced with buildings and hardstanding, there will be no mechanism for a direct contact pollution linkage with any unidentified contaminants. Therefore, the risk to end-users and to the general public will be negligible in such areas.
- 8.20 However, in view of the restricted nature of the ground investigation, it is recommended that further investigation and assessment is undertaken within proposed garden areas once the existing Oakwood Lodge building is demolished.
- 8.21 In advance of this, it would be prudent to allow for removing any made ground from garden areas to expose clean natural soil or alternatively to provide a 600mm thick clean capping layer to break any potential exposure pathway.

Controlled Waters

- 8.22 No significant groundwater has been observed in the standpipes with this being perched in the granular glaciofluvial deposits considered to represent the 'Secondary (A) Aquifer'. In terms of sensitivity, the groundwater within the superficial aquifer is considered to be of limited resource value and utilisation.

- 8.23 In addition, the underlying cohesive glacial till and its relatively low transmissivity rates would limit migration of any localised contamination from the site. Therefore risks to the underlying 'Principal Aquifer' are also considered low and can be discounted.
- 8.24 Furthermore, no visual and/or olfactory evidence of significant contamination was detected in the soil or recorded within the chemical analyses results.
- 8.25 There are no surface water courses within close proximity to the site.
- 8.26 Therefore, the risk to controlled waters from contamination arising from the site is considered low with no environmental remediation considered necessary.

9.0 GROUND GAS RISK ASSESSMENT

Methodology

- 9.1 Current guidance for the assessment of risk associated with the presence of hazardous ground gases (principally methane and carbon dioxide) is provided in two key documents, namely:
- Code of practice for the Characterisation and remediation from Ground Gas in Affected Developments, British Standard Institution (BS 8485: 2015 & A1:2019); and
 - Assessing Risks posed by Hazardous Ground Gases to Buildings, CIRIA (C665, 2007).
- 9.2 The assessment presented herein is primarily based on the BS8485 document.
- 9.3 Hazardous ground gas qualitative risk assessment is based on a conceptual model similar to that used for soil and groundwater contamination sources (i.e., source-pathway-receptor pollutant linkages). A semi-quantitative estimate of risk can be assessed based on knowledge of the conceptual model and a measure of hazardous gas concentration and gas flow at the site within monitoring standpipes.
- 9.4 Based on the measured flow rates and hazardous gas concentrations, individual "hazardous gas flow rates" (Qhg) can be derived for each monitoring point, from which the "site characteristic hazardous gas flow rate" (Qhgs), and then the "Characteristic Situation" (CS) can be determined.
- 9.5 BS8485 provides guidance on the level of gas protection requirements based upon the characteristic situation and the proposed development based on building type as outlined in Table 3.

Table 3 - Building Types

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ Public, possible multiple	Commercial / Public	Commercial / Industrial
Control (Change of use)	None	Some but not all	Full	Full
Room Sizes	Small	Small/ medium	Small to Large	Large Industrial/ Retail Park

- 9.6 The proposed development therefore is indicated to comprise the construction of Type A buildings which include:-
- *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.*

Ground Gas Conceptual Model

- 9.7 The property is not in a radon affected area as defined by the BGS/Public Health England as less than 1% of properties are above the action level of exposure. Therefore, no radon protection measures are necessary for new structures as described in publication BR211 by the Building Research Establishment.
- 9.8 In consideration of the underlying geology, risks of shallow abandoned mine workings which could contain hazardous gases can be discounted.

- 9.9 No appreciable thickness of made ground or other soil with significant organic content has been encountered beneath the site.
- 9.10 A historic landfill recorded approximately 120m to the south accepted unknown waste types for an unknown period of time and could therefore be considered a plausible source of ground gas although the likelihood of continued generation of landfill gas in significant volumes is low.
- 9.11 However, as the granular nature of the glaciofluvial soils could provide a pathway for lateral migration, it has been considered prudent to undertake ground gas monitoring, primarily for methane and carbon dioxide, with associated flow rates, on 6no occasions between 30th September and 4th December 2019.

Results and Recommendations

- 9.12 The results indicate concentrations of peak and steady state methane below detection limits of 0.1% by volume in air (v/v). Peak and steady state carbon dioxide concentrations generally ranging from 0.6 to 3.2% but locally up to 7.1% in WS5.
- 9.13 Carbon dioxide concentrations did exceed the 5% threshold within WS5 only. However, in consideration of these limited exceedances and conceptual site model, they are not considered to be characteristics of the sites ground gas regime.
- 9.14 No detectable ground gas flows have been recorded during the monitoring visit.
- 9.15 Therefore, the results give a maximum individual Q_{hg} value of 0.007l/hr and indicate the site to classify as Characteristic Situation (CS) 1 – Very Low Gas Risk' with no specific ground gas protection required.
- 9.16 Although the carbon dioxide concentration in WS5 exceeds 5%, it is not considered typical for the site as a whole and does not merit an increase of the characteristic gas situation to CS2.

10.0 OTHER POTENTIAL DEVELOPMENT CONSIDERATIONS

Excavated Soils

- 10.1 Groundworks undertaken during the development will produce excavated soil which will require appropriate site management. Principally, and in line with the sustainable development agenda, any soils arising from site excavations should firstly be considered for re-use where possible by incorporation into the development.
- 10.2 Concrete and asphalt surfacing together with excavated foundations and other below ground concrete structures will be suitable for re-use as engineering fill, subject to appropriate sorting and crushing to a suitable grading.
- 10.3 Excavated natural soils will be suitable for re-use as clean capping in garden areas, subject to confirmatory chemical analysis.
- 10.4 Where soils are surplus to requirements, they will need to be removed from site through appropriate waste management.
- 10.5 It should be noted that the chemical analysis results for disposal classification are assessed against different assessment criteria to those relating to contamination risk assessment. Soils that are deemed suitable for use in terms of risk to human health and the environment may not necessary be uncontaminated and could be classified as 'Non-Hazardous' or even Hazardous' for disposal purposes.
- 10.6 For guidance and based on the current information, it is likely that the majority of made ground would be classified as Non-Hazardous with natural deposits classified as Inert for landfill disposal.
- 10.7 Limited analysis of asphalt surfacing has indicated that it is unlikely to contain coal tar in hazardous concentrations. However, further analysis should be undertaken to fully categorise the asphalt materials should they be disposed to landfill.
- 10.8 It will be the responsibility of the waste producer to undertake testing and classification of any waste soils for disposal to an appropriately licenced landfill in accordance with current guidelines and Duty of Care requirements.

Imported Fill

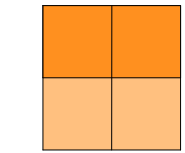
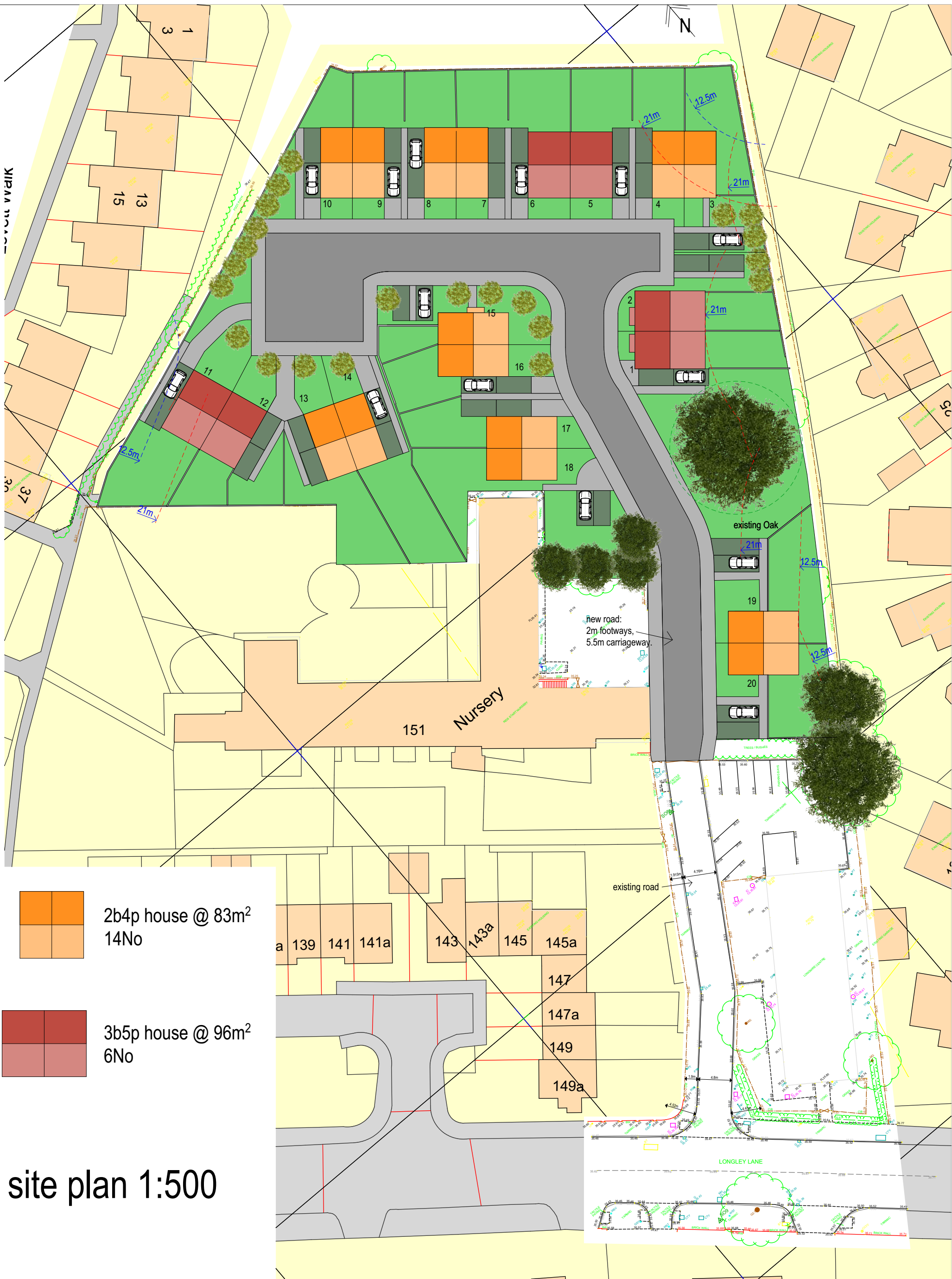
- 10.9 Imported fill will be subject to specific quality requirements and should be accompanied by appropriate certification to confirm its suitability. Allowance should also be made for testing imported fill materials prior to placement to ensure suitability.

Water Supply Pipes

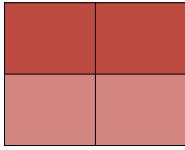
- 10.10 The relevant water supply provider will need to be consulted with regards the selection of suitable water supply pipe materials for the development. In light of the ground conditions encountered, the requirement for specific materials and measures to protect the water supply from ground contamination is not envisaged.

APPENDIX 01

Drawings



2b4p house @ 83m²
14No



3b5p house @ 96m²
6No

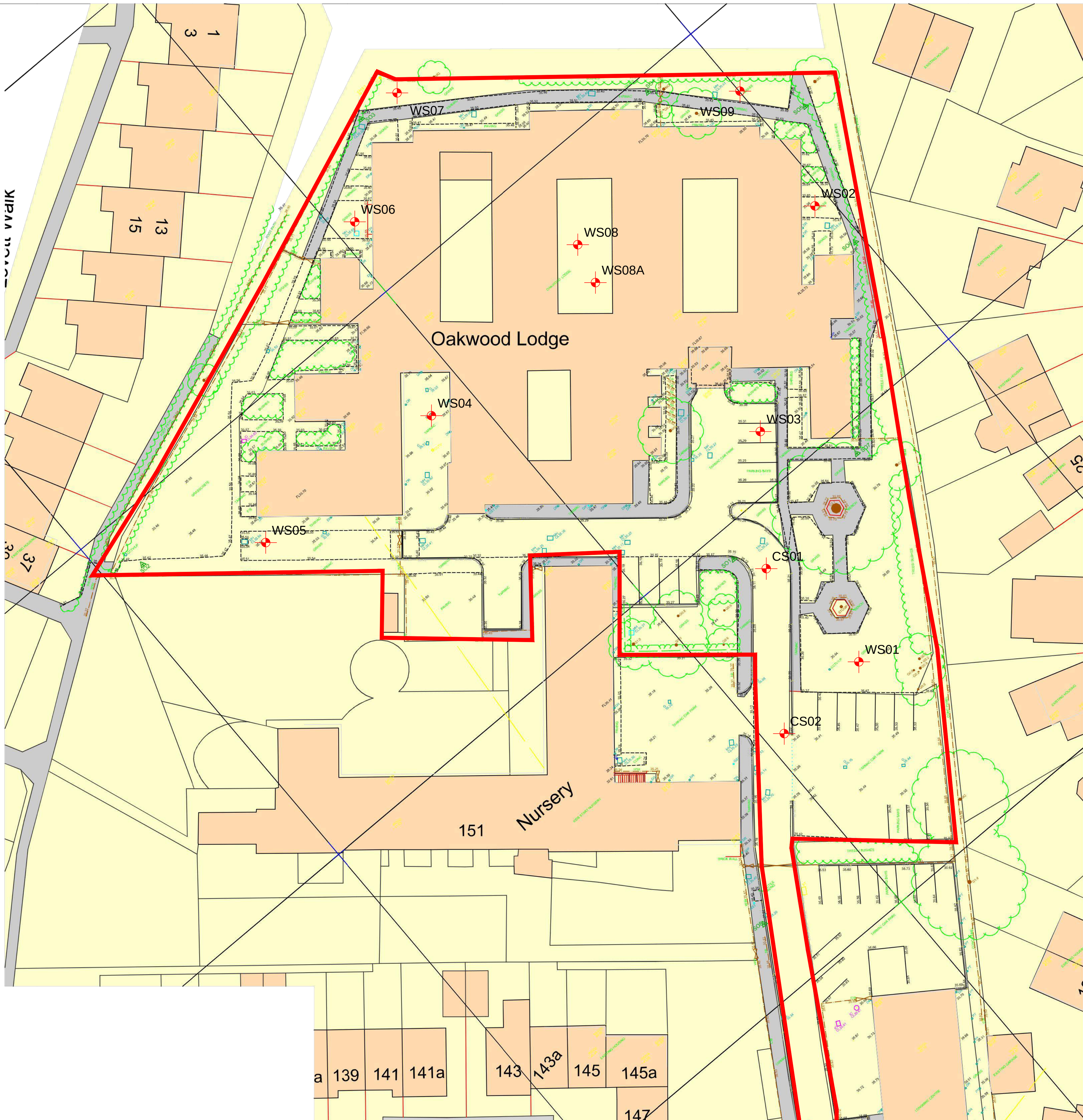
site plan 1:500

Rev. A 14 05 19 existing access shown
Client WCHG
Project Oakwood Lodge

Title outline proposals option 4
Scale 1:500 Date 02 05 19 Stage
Job No 5415 Drawing No 00-05 Rev. A Drawn GS

Arcus Consulting LLP
Manchester 0161 905 3222 Liverpool 0151 708 1080
Newcastle 0191 272 5781 London 020 8742 2512
Wakefield 0192 466 9000 www.arcus.uk.com
This document is copyright of Arcus Consulting LLP. Do not scale this drawing.
Only use figured dimensions. All dimensions to be checked on site prior to construction.





APPENDIX 02

Exploratory Hole Records

	Project Title: Oakwood Lodge		CS01
	Project Number: 8928G	Client: Garden City Design & Build Ltd	
	GL (mAOD):	N Coord: 0	E Coord: 0
Date: 18/09/2019	Method: Window Sample	Logged By: TPB	Scale: 1:5



Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water
					0.08	Dark grey, medium to coarse, angular, bituminous bound gravel of granite - HRA (SURFACE COURSE)	
						Dark grey, fine to coarse, angular, bituminous bound gravel of granite - DBM (BINDER COURSE)	
						Light brownish grey, slightly sandy, subangular, medium to coarse GRAVEL of limestone. (SUBBASE)	
					0.30	End Of Trial Pit At 0.30 m	
KEY D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 						REMARKS No Groundwater Encountered HRA - Hot Rolled Asphalt, DBM - Dense Bituminous Macadam.	

WML CONSULTING	Project Title: Oakwood Lodge		CS02
	Project Number: 8928G	Client: Garden City Design & Build Ltd	
	GL (mAOD):	N Coord: 0	E Coord: 0
Date: 18/09/2019	Method: Window Sample	Logged By: TPB	Scale: 1:5



Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water
					0.09	Dark grey, medium to coarse, angular, bituminous bound gravel of granite - HRA (SURFACE COURSE) 0.02 ...Surface Course debonded from Binder Course Dark grey, fine to coarse, angular, bituminous bound gravel of granite - DBM (BINDER COURSE) Light brownish grey, slightly sandy, subangular, medium to coarse GRAVEL of limestone. (SUBBASE)	
					0.30	End Of Trial Pit At 0.30 m	
KEY D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa ▽ - Groundwater Strike ▼ - Groundwater Level						REMARKS No Groundwater Encountered HRA - Hot Rolled Asphalt, DBM - Dense Bituminous Macadam.	

		Project Title: Oakwood Lodge				WS01	
		Project Number: 8928G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 18/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.30	E					Turf over dark brown, slightly silty, slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse, including sandstone, brick and rare metal. (MADE GROUND)		
1.50	J	N=17			1.00	Medium dense, orange brown, slightly gravelly, fine to medium SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)		
		N=20			2.00			
		N=5			2.20			
					3.00	Loose to medium dense, brownish grey, gravelly, fine to coarse SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)	▼	
		N=13			3.50			
					4.00	Firm to stiff, brown, silty CLAY. (GLACIAL TILL)		
		N=26			5.00			
						End Of Borehole At 5.00 m		
					6.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa - Groundwater Strike - Groundwater Level 	REMARKS Hole collapsing to 3.50mbgl. Scale: 1:40	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="6">Water Strikes</th> </tr> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> <tr> <td>19/09/2019</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="3">Daily Log Of Depths</th> <th colspan="3">Chiselling</th> </tr> <tr> <th>Date</th> <th>Casing</th> <th>Water</th> <th>From</th> <th>To</th> <th>Hours</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>	Water Strikes						Date	Strike	Level	Minutes	Casing	Sealed	19/09/2019	3																	Daily Log Of Depths			Chiselling			Date	Casing	Water	From	To	Hours												
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19/09/2019	3																																																							
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Date	Casing	Water	From	To	Hours																																																			

		Project Title: Oakwood Lodge				WS02	
		Project Number: 8928G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 19/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.10	E				0.30	Turf over dark brown, slightly silty, slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse, including sandstone and brick. (MADE GROUND) Orange brown, slightly silty, slightly gravelly, fine to medium SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS) Loose to medium dense, orange brown, gravelly, fine to coarse SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)		
		N=25			0.60			
		N=20			1.00			
		N=9			2.00			
					3.00			
					3.65			
3.90	J	N=19			4.00	Stiff, brown, silty CLAY. (GLACIAL TILL)		
						End Of Borehole At 4.00 m		
					5.00			
					6.00			

KEY

D - Disturbed Sample
 B - Bulk Sample
 U - Undisturbed
 W - Water Sample
 S - Standard Penetration Test
 C - Cone Penetration Test
 N - Penetration Test 'N' Value
 V - Hand Shear Vane kPa
 - Groundwater Strike
 - Groundwater Level

REMARKS

Hole collapsing to 3.00mbgl.

Scale: 1:40

Water Strikes

Date	Strike	Level	Minutes	Casing	Sealed
19/09/2019	2.8				

Daily Log Of Depths **Chiselling**

Date	Casing	Water	From	To	Hours

		Project Title: Oakwood Lodge				WS03	
		Project Number: 8928G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 18/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.05	J				0.10	Asphalt. (MADE GROUND)		
0.50	E				0.37	Light brownish grey, slightly sandy, subangular, medium to coarse GRAVEL of limestone. (MADE GROUND)		
		N=24			0.70	Dark brown, slightly silty, slightly gravelly, fine to medium SAND. Gravel is subrounded, fine to coarse, including sandstone and brick. (MADE GROUND)		
		N=13			1.00	Medium dense, brownish grey, gravelly, fine to coarse SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)		
		N=10			2.00			
		N=21			3.00			
4.00	J				3.80			
		pp 50/230mm			4.00	Stiff, brown, silty CLAY. (GLACIAL TILL)		
					5.00	End Of Borehole At 5.00 m		
					6.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level		REMARKS Hole collapsing to 4.00mbgl. 	Water Strikes <table border="1"> <thead> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> </thead> <tbody> <tr> <td>19/09/2019</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Date	Strike	Level	Minutes	Casing	Sealed	19/09/2019	3																											
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Date	Casing	Water	From	To	Hours																																	

Scale: 1:40

		Project Title: Oakwood Lodge				WS04	
		Project Number: 8928G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 18/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.03	J				0.09	Asphalt. (MADE GROUND)		
0.40	E				0.27			
					0.60	Light brownish grey, slightly sandy, subangular, medium to coarse GRAVEL of limestone. (MADE GROUND)		
		N=22			1.00			
					1.10	Orange brown and green grey mottled, slightly gravelly, clayey, fine to medium SAND. Gravel is angular to subrounded, fine to coarse, including sandstone, brick and wood. (MADE GROUND)		
		N=18			2.00	Orange brown, slightly gravelly, fine to medium SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)		
					3.00			
		N=8			3.70			
					4.00	Stiff, brown, silty CLAY. (GLACIAL TILL)		
		N=23			5.00			
		N=19				End Of Borehole At 5.00 m		
					6.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa - Groundwater Strike - Groundwater Level		REMARKS Hole collapsing to 3.00mbgl. Scale: 1:40		Water Strikes																									
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19/09/2019	2.5																												
Daily Log Of Depths						Chiselling																							
Date	Casing	Water	From	To	Hours																								

		Project Title: Oakwood Lodge				WS05	
		Project Number: 8928G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 18/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.30	E				0.10	Concrete Paving. (MADE GROUND)		
					0.25			
2.00	J	N=10			0.50	Grey, sandy, subangular, fine to coarse GRAVEL including limestone. (MADE GROUND)		
					1.00			
		N=17			1.60	Dark brown, slightly gravelly, clayey SAND. Gravel is subangular, fine to coarse, including sandstone and brick. (MADE GROUND)		
					2.00			
		N=8			3.00	Medium dense, orange brown, slightly silty, slightly gravelly, fine to medium SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)		
					3.50			
N=31			4.00	Stiff, brown, silty CLAY. (GLACIAL TILL)				
			5.00					
		N=20						
					6.00	End Of Borehole At 5.00 m		

KEY

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REMARKS

Hole collapsing to 3.00mbgl.

Scale: 1:40

Water Strikes

Date	Strike	Level	Minutes	Casing	Sealed
19/09/2019	3.3				

Daily Log Of Depths

Date	Casing	Water	From	To	Hours

		Project Title: Oakwood Lodge				WS06	
		Project Number: 8928G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 18/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.20	E					Turf over dark brown, slightly silty, gravelly SAND. Gravel is subangular to subrounded, fine to coarse, including sandstone and brick. (MADE GROUND)		
		N=31			1.00	Medium dense, brownish grey, variably gravelly, fine to coarse SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)		
		N=18			2.00			
		N=13			3.00			
		N=26			3.60			
					4.00	Stiff, brown, silty CLAY. (GLACIAL TILL)		
		N=17			5.00	End Of Borehole At 5.00 m		
					6.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level		REMARKS Hole collapsing to 3.00mbgl. 	Water Strikes <table border="1"> <thead> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> </thead> <tbody> <tr> <td>19/09/2019</td> <td>3.6</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Date	Strike	Level	Minutes	Casing	Sealed	19/09/2019	3.6																												
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Scale: 1:40

		Project Title: Oakwood Lodge				WS07	
		Project Number: 8928G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 19/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.10	E				0.30	Turf over dark brown, slightly silty, slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse, including sandstone and brick.		
					0.70	(MADE GROUND)		
		N=23			1.00	Orange brown, slightly silty, slightly gravelly, fine to medium SAND. Gravel is subrounded, fine to coarse, including sandstone.		
					1.50	(GLACIOFLUVIAL SHEET DEPOSITS)		
		N=27			2.00	Dark brown, slightly silty, slightly gravelly, organic SAND.		
					2.50	(GLACIOFLUVIAL SHEET DEPOSITS)		
		N=7			3.00	Loose to medium dense, orange brown, gravelly, fine to coarse SAND. Gravel is subrounded, fine to coarse, including sandstone.		
					3.50	(GLACIOFLUVIAL SHEET DEPOSITS)		
3.80	J				4.00	Stiff, brown, silty CLAY.		
		N=48				(GLACIAL TILL)		
						End Of Borehole At 4.00 m		
					5.00			
					6.00			

KEY

D - Disturbed Sample
 B - Bulk Sample
 U - Undisturbed
 W - Water Sample
 S - Standard Penetration Test
 C - Cone Penetration Test
 N - Penetration Test 'N' Value
 V - Hand Shear Vane kPa
 - Groundwater Strike
 - Groundwater Level

REMARKS

Hole collapsing to 3.00mbgl.

Scale: 1:40

Water Strikes

Date	Strike	Level	Minutes	Casing	Sealed
19/09/2019	3.2				

Daily Log Of Depths

Date	Casing	Water	From	To	Hours

			Project Title: Oakwood Lodge				WS08																										
			Project Number: 8928G		Client: Garden City Design & Build Ltd					Sheet 1 Of 1																							
			GL (mAOD):		N Coord: 0		E Coord: 0																										
Date: 19/09/2019			Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB																										
Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe																									
0.30	E				0.50	Turf over dark brown, slightly silty, slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse, including sandstone. (MADE GROUND)																											
					1.00	Brownish grey, slightly gravelly, clayey SAND. Gravel is subangular, fine to coarse, including limestone and brick. (MADE GROUND)																											
					2.00	End Of Borehole At 0.50 m																											
					3.00																												
					4.00																												
					5.00																												
					6.00																												
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level			REMARKS No Groundwater Encountered Concrete obstruction at 0.50mbgl. 			Water Strikes <table border="1"> <thead> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>				Date	Strike	Level	Minutes	Casing	Sealed																		
Date	Strike	Level	Minutes	Casing	Sealed																												
			Scale: 1:40			Daily Log Of Depths Chiselling <table border="1"> <thead> <tr> <th>Date</th> <th>Casing</th> <th>Water</th> <th>From</th> <th>To</th> <th>Hours</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>				Date	Casing	Water	From	To	Hours																		
Date	Casing	Water	From	To	Hours																												

			Project Title: Oakwood Lodge				WS08A	
			Project Number: 8928G		Client: Garden City Design & Build Ltd			
			GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 19/09/2019			Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
					0.50	Turf over dark brown, slightly silty, slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse, including sandstone. (MADE GROUND)		
					1.00	Brownish grey, slightly gravelly, clayey SAND. Gravel is subangular, fine to coarse, including limestone and brick. (MADE GROUND)		
					2.00	End Of Borehole At 0.50 m		
					3.00			
					4.00			
					5.00			
					6.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa - Groundwater Strike - Groundwater Level	REMARKS No Groundwater Encountered Concrete obstruction at 0.50mbgl. 	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="6">Water Strikes</th> </tr> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="3">Daily Log Of Depths</th> <th colspan="3">Chiselling</th> </tr> <tr> <th>Date</th> <th>Casing</th> <th>Water</th> <th>From</th> <th>To</th> <th>Hours</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>	Water Strikes						Date	Strike	Level	Minutes	Casing	Sealed																			Daily Log Of Depths			Chiselling			Date	Casing	Water	From	To	Hours												
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Date	Strike	Level	Minutes	Casing	Sealed																																																			
Daily Log Of Depths			Chiselling																																																					
Date	Casing	Water	From	To	Hours																																																			

Scale: 1:40

		Project Title: Oakwood Lodge				WS09	
		Project Number: 8928G		Client: Garden City Design & Build Ltd			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 19/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.20	E				0.30	Turf over dark brown, slightly silty, slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse, including sandstone. (MADE GROUND)		
		N=10			1.00	Medium dense, brown, slightly silty, slightly gravelly, fine to medium SAND. Gravel is subrounded, fine to coarse, including sandstone, brick and concrete. (MADE GROUND)		
		N=11			1.80			
2.20	J				2.00	Loose to medium dense, orange brown, gravelly, fine to coarse SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)		
		N=7			3.00			
		N=18			3.40			
		N=28			4.00	Stiff, brown, silty CLAY. (GLACIAL TILL)		
					5.00	End Of Borehole At 5.00 m		
					6.00			

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa - Groundwater Strike - Groundwater Level 		REMARKS Hole collapsing to 3.00mbgl. Scale: 1:40		Water Strikes																									
				<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Date</th> <th>Strike</th> <th>Level</th> <th>Minutes</th> <th>Casing</th> <th>Sealed</th> </tr> <tr> <td>19/09/2019</td> <td>3.2</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>						Date	Strike	Level	Minutes	Casing	Sealed	19/09/2019	3.2												
Date	Strike	Level	Minutes	Casing	Sealed																								
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Date	Casing	Water	From	To	Hours																								

APPENDIX 03

Chemical Analytical Results

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 19/08832
Issue Number: 1

Date: 04 October, 2019

Client: WML Construction
No 8 Oak Green
Earl Road
Stanley Green Business Park
Cheadle Hulme
Cheshire
SK8 6QL

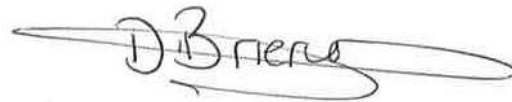
Project Manager: Sam Seddon
Project Name: Oakwood Lodge
Project Ref: 8928G
Order No: 8928G
Date Samples Received: 20/09/19
Date Instructions Received: 23/09/19
Date Analysis Completed: 04/10/19

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 19/08832

Client Project Name: Oakwood Lodge

Client Project Ref: 8928G

Lab Sample ID	19/08832/1	19/08832/2	19/08832/3	19/08832/4	19/08832/5	19/08832/6	19/08832/7	Units	Limit of Detection	Method ref
Client Sample No	1	2	3	4	5	6	7			
Client Sample ID	WS01	WS01	WS02	WS02	WS03	WS03	WS04			
Depth to Top	0.30	1.50	0.10	3.90	0.05	0.50	4.00			
Depth To Bottom										
Date Sampled	18-Sep-19	18-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19			
Sample Type	Soil	Soil	Soil	Soil	Solid - Road Core / Tarmac	Soil	Soil			
Sample Matrix Code	4AE	4	4AE	3	7	4A	6			
% Stones >10mm _A	3.3	<0.1	<0.1	<0.1	-	4.3	<0.1	% w/w	0.1	A-T-044
pH _D ^{M#}	7.33	7.67	7.23	7.62	-	8.06	7.91	pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01	<0.01	0.03	-	<0.01	0.03	g/l	0.01	A-T-026s
Sulphate (acid soluble) _D ^{M#}	470	-	270	-	-	<200	-	mg/kg	200	A-T-028s
Sulphur (total) _D	345	<50	180	844	-	82	405	mg/kg	50	A-T-024s
Cyanide (total) _A ^{M#}	11	-	<1	-	-	<1	-	mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	-	<0.2	-	-	<0.2	-	mg/kg	0.2	A-T-050s
Organic matter _D ^{M#}	3.9	-	3.3	-	-	0.8	-	% w/w	0.1	A-T-032 OM
Arsenic _D ^{M#}	8	-	7	-	-	<1	-	mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	-	<1.0	-	-	<1.0	-	mg/kg	1	A-T-027s
Cadmium _D ^{M#}	<0.5	-	<0.5	-	-	<0.5	-	mg/kg	0.5	A-T-024s
Copper _D ^{M#}	26	-	24	-	-	2	-	mg/kg	1	A-T-024s
Chromium (hexavalent) _D	<1	-	<1	-	-	<1	-	mg/kg	1	A-T-040s
Lead _D ^{M#}	612	-	53	-	-	5	-	mg/kg	1	A-T-024s
Mercury _D	<0.17	-	<0.17	-	-	<0.17	-	mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	14	-	13	-	-	5	-	mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	-	<1	-	-	<1	-	mg/kg	1	A-T-024s
Vanadium _D ^{M#}	21	-	22	-	-	11	-	mg/kg	1	A-T-024s
Zinc _D ^{M#}	159	-	51	-	-	11	-	mg/kg	5	A-T-024s
Benzo(a)pyrene _D	-	-	-	-	<4.0	-	-	mg/kg	4	A-T-019 TAR

Envirolab Job Number: 19/08832

Client Project Name: Oakwood Lodge

Client Project Ref: 8928G

Lab Sample ID	19/08832/1	19/08832/2	19/08832/3	19/08832/4	19/08832/5	19/08832/6	19/08832/7	Units	Limit of Detection	Method ref
Client Sample No	1	2	3	4	5	6	7			
Client Sample ID	WS01	WS01	WS02	WS02	WS03	WS03	WS04			
Depth to Top	0.30	1.50	0.10	3.90	0.05	0.50	4.00			
Depth To Bottom										
Date Sampled	18-Sep-19	18-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19			
Sample Type	Soil	Soil	Soil	Soil	Solid - Road Core / Tarmac	Soil	Soil			
Sample Matrix Code	4AE	4	4AE	3	7	4A	6			
Asbestos in Soil (inc. matrix)										
Asbestos in soil _p [#]	NAD	-	NAD	-	-	NAD	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	-	N/A	-	-	N/A	-			A-T-045

Envirolab Job Number: 19/08832

Client Project Name: Oakwood Lodge

Client Project Ref: 8928G

Lab Sample ID	19/08832/1	19/08832/2	19/08832/3	19/08832/4	19/08832/5	19/08832/6	19/08832/7	Units	Limit of Detection	Method ref
Client Sample No	1	2	3	4	5	6	7			
Client Sample ID	WS01	WS01	WS02	WS02	WS03	WS03	WS04			
Depth to Top	0.30	1.50	0.10	3.90	0.05	0.50	4.00			
Depth To Bottom										
Date Sampled	18-Sep-19	18-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19			
Sample Type	Soil	Soil	Soil	Soil	Solid - Road Core / Tarmac	Soil	Soil			
Sample Matrix Code	4AE	4	4AE	3	7	4A	6			
PAH-16MS										
Acenaphthene _A ^{M#}	0.10	-	0.01	-	-	<0.01	-	mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	0.01	-	<0.01	-	-	<0.01	-	mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	0.13	-	0.04	-	-	<0.02	-	mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.57	-	0.16	-	-	<0.04	-	mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.61	-	0.16	-	-	<0.04	-	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.83	-	0.22	-	-	<0.05	-	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	0.30	-	0.07	-	-	<0.05	-	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	0.29	-	<0.07	-	-	<0.07	-	mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	0.66	-	0.19	-	-	<0.06	-	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	0.09	-	<0.04	-	-	<0.04	-	mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	1.04	-	0.26	-	-	<0.08	-	mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	0.08	-	0.01	-	-	<0.01	-	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.35	-	0.08	-	-	<0.03	-	mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	0.13	-	<0.03	-	-	<0.03	-	mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	0.67	-	0.16	-	-	<0.03	-	mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	0.96	-	0.28	-	-	<0.07	-	mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	6.82	-	1.64	-	-	<0.08	-	mg/kg	0.01	A-T-019s

Envirolab Job Number: 19/08832

Client Project Name: Oakwood Lodge

Client Project Ref: 8928G

Lab Sample ID	19/08832/8	19/08832/9	19/08832/11	19/08832/12	19/08832/13	19/08832/14	19/08832/15	Units	Limit of Detection	Method ref
Client Sample No	8	9	11	12	13	14	15			
Client Sample ID	WS04	WS04	WS05	WS06	WS07	WS07	WS08			
Depth to Top	0.03	0.40	2.00	0.20	0.10	3.80	0.30			
Depth To Bottom										
Date Sampled	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19			
Sample Type	Solid - Road Core / Tarmac	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	7	4A	1A	4ABE	4AE	5	6A			
% Stones >10mm _A	-	12.7	19.7	15.1	2.9	<0.1	2.8	% w/w	0.1	A-T-044
pH _D ^{M#}	-	8.05	7.89	7.60	7.53	7.86	8.45	pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	-	0.07	<0.01	<0.01	<0.01	0.03	<0.01	g/l	0.01	A-T-026s
Sulphate (acid soluble) _D ^{M#}	-	290	-	<200	320	-	230	mg/kg	200	A-T-028s
Sulphur (total) _D	-	263	<50	135	232	608	112	mg/kg	50	A-T-024s
Cyanide (total) _A ^{M#}	-	<1	-	<1	<1	-	<1	mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	-	<0.2	-	<0.2	<0.2	-	<0.2	mg/kg	0.2	A-T-050s
Organic matter _D ^{M#}	-	1.0	-	2.1	5.0	-	0.9	% w/w	0.1	A-T-032 OM
Arsenic _D ^{M#}	-	3	-	4	8	-	2	mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	-	<1.0	-	<1.0	<1.0	-	<1.0	mg/kg	1	A-T-027s
Cadmium _D ^{M#}	-	<0.5	-	<0.5	0.7	-	<0.5	mg/kg	0.5	A-T-024s
Copper _D ^{M#}	-	7	-	14	35	-	8	mg/kg	1	A-T-024s
Chromium (hexavalent) _D	-	<1	-	<1	<1	-	<1	mg/kg	1	A-T-040s
Lead _D ^{M#}	-	17	-	37	81	-	22	mg/kg	1	A-T-024s
Mercury _D	-	<0.17	-	<0.17	<0.17	-	<0.17	mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	-	10	-	10	16	-	10	mg/kg	1	A-T-024s
Selenium _D ^{M#}	-	<1	-	<1	<1	-	<1	mg/kg	1	A-T-024s
Vanadium _D ^{M#}	-	16	-	14	24	-	14	mg/kg	1	A-T-024s
Zinc _D ^{M#}	-	40	-	46	101	-	27	mg/kg	5	A-T-024s
Benzo(a)pyrene _D	<4.0	-	-	-	-	-	-	mg/kg	4	A-T-019 TAR

Envirolab Job Number: 19/08832

Client Project Name: Oakwood Lodge

Client Project Ref: 8928G

Lab Sample ID	19/08832/8	19/08832/9	19/08832/11	19/08832/12	19/08832/13	19/08832/14	19/08832/15	Units	Limit of Detection	Method ref
Client Sample No	8	9	11	12	13	14	15			
Client Sample ID	WS04	WS04	WS05	WS06	WS07	WS07	WS08			
Depth to Top	0.03	0.40	2.00	0.20	0.10	3.80	0.30			
Depth To Bottom										
Date Sampled	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19			
Sample Type	Solid - Road Core / Tarmac	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	7	4A	1A	4ABE	4AE	5	6A			
Asbestos in Soil (inc. matrix)										
Asbestos in soil _p [#]	-	NAD	-	NAD	NAD	-	NAD			A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	-	N/A	-	N/A	N/A	-	N/A			A-T-045

Envirolab Job Number: 19/08832

Client Project Name: Oakwood Lodge

Client Project Ref: 8928G

Lab Sample ID	19/08832/8	19/08832/9	19/08832/11	19/08832/12	19/08832/13	19/08832/14	19/08832/15	Units	Limit of Detection	Method ref
Client Sample No	8	9	11	12	13	14	15			
Client Sample ID	WS04	WS04	WS05	WS06	WS07	WS07	WS08			
Depth to Top	0.03	0.40	2.00	0.20	0.10	3.80	0.30			
Depth To Bottom										
Date Sampled	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19	19-Sep-19			
Sample Type	Solid - Road Core / Tarmac	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	7	4A	1A	4ABE	4AE	5	6A			
PAH-16MS										
Acenaphthene _A ^{M#}	-	<0.01	-	0.04	0.02	-	<0.01	mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	-	<0.01	-	<0.01	<0.01	-	<0.01	mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	-	<0.02	-	0.07	0.04	-	<0.02	mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	-	<0.04	-	0.20	0.28	-	0.08	mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	-	<0.04	-	0.19	0.29	-	0.09	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	-	<0.05	-	0.26	0.38	-	0.12	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	-	<0.05	-	0.09	0.15	-	0.07	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	-	<0.07	-	0.10	0.14	-	<0.07	mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	-	<0.06	-	0.23	0.31	-	0.09	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	-	<0.04	-	<0.04	<0.04	-	<0.04	mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	-	<0.08	-	0.41	0.43	-	0.14	mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	-	<0.01	-	0.03	0.01	-	<0.01	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	-	<0.03	-	0.10	0.17	-	0.07	mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	-	<0.03	-	<0.03	<0.03	-	<0.03	mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	-	<0.03	-	0.31	0.19	-	0.05	mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	-	<0.07	-	0.38	0.43	-	0.14	mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	-	<0.08	-	2.41	2.84	-	0.85	mg/kg	0.01	A-T-019s

Envirolab Job Number: 19/08832

Client Project Name: Oakwood Lodge

Client Project Ref: 8928G

Lab Sample ID	19/08832/17							Units	Limit of Detection	Method ref
Client Sample No	17									
Client Sample ID	WS09									
Depth to Top	2.32									
Depth To Bottom										
Date Sampled	19-Sep-19									
Sample Type	Soil									
Sample Matrix Code	6A									
% Stones >10mm _A	20.5							% w/w	0.1	A-T-044
pH _D ^{M#}	8.39							pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01							g/l	0.01	A-T-026s
Sulphur (total) _D	<50							mg/kg	50	A-T-024s

REPORT NOTES

General

This report shall not be reproduced, except in full, without written approval from Envirolab.

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	WML Construction , No 8 Oak Green, Earl Road, Stanley Green Business Park, Cheadle Hulme, Cheshire, SK8 6QL	Project No:	19/08832
Project:	Oakwood Lodge	Date Received:	23/09/2019 (am)
Clients Project No:	8928G	Cool Box Temperatures (°C):	17.3

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

APPENDIX 04

Gas Monitoring Results

Gas & Groundwater Monitoring Record Sheet



Project Name:- Oakwood Lodge
Project No:- 8928G
Client:- Garden City Design & Build

Date:- 30/09/2019
Start Time:- 07:45
End Time:- 08:30
Ground Conditions:- Wet
Weather Conditions:- Drizzle

Atmospheric Pressure
Start:- 1004mb
End:- 1004mb
Trend:- Rising

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4			CO2			Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak %	Steady %	Qhg l/hr	Peak %	Steady %	Qhg l/hr						
WS2	<0.1	<0.1	0	-0.1	-0.1	-0.0001	3.2	3.2	0.0032	16.9	0	0	0.000	2.45	2.70
WS3	<0.1	<0.1	0	0.0	-0.1	-0.0001	1.0	1.0	0.0010	18.9	0	0	0.000	2.10	2.43
WS5	<0.1	<0.1	0	0.0	-0.1	-0.0001	7.1	7.1	0.0071	11.2	0	0	0.000	2.60	3.00
WS7	<0.1	<0.1	0	0.0	-0.1	-0.0001	2.1	2.1	0.0021	18.2	0	0	0.000	2.78	3.00
WS9	<0.1	<0.1	0	-0.1	-0.1	-0.0001	2.9	2.9	0.0029	16.6	0	0	0.000	2.25	2.70

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Oakwood Lodge
Project No:- 8928G
Client:- Garden City Design & Build

Date:- 08/10/2019
Start Time:- 11:10
End Time:- 11:50
Ground Conditions:- Wet
Weather Conditions:- Sunny

Atmospheric Pressure
Start:- 997mb
End:- 996mb
Trend:- Sunny

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4			CO2			Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak %	Steady %	Qhg l/hr	Peak %	Steady %	Qhg l/hr						
WS2	<0.1	<0.1	0	0.0	-0.2	-0.0002	2.4	2.4	0.0024	17.9	0	0	0.000	2.27	2.70
WS3	<0.1	<0.1	0	0.0	-0.2	-0.0002	0.9	0.9	0.0009	18.7	0	0	0.000	2.00	2.40
WS5	<0.1	<0.1	0	0.0	-0.2	-0.0002	7.1	7.1	0.0071	10.9	0	0	0.000	2.45	3.00
WS7	<0.1	<0.1	0	0.0	-0.2	-0.0002	0.6	0.6	0.0006	19.6	0	0	0.000	2.65	3.00
WS9	<0.1	<0.1	0	0.0	-0.2	-0.0002	2.9	2.9	0.0029	16.2	0	0	0.000	2.00	2.63

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Oakwood Lodge
Project No:- 8928G
Client:- Garden City Design & Build

Date:- 21/10/2019
Start Time:- 12:45
End Time:- 13:15
Ground Conditions:- Dry
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 1019mb
End:- 1017mb
Trend:- Rising

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4			CO2			Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak %	Steady %	Qhg l/hr	Peak %	Steady %	Qhg l/hr						
WS2	<0.1	<0.1	0	0.0	-0.1	-0.0001	1.8	1.8	0.0018	17.9	0	0	0.000	2.39	2.70
WS3	<0.1	<0.1	0	0.0	-0.1	-0.0001	0.8	0.8	0.0008	19.0	0	0	0.000	2.12	2.73
WS5	<0.1	<0.1	0	0.0	-0.1	-0.0001	7.0	7.0	0.0070	11.4	0	0	0.000	2.47	3.00
WS7	<0.1	<0.1	0	0.0	-0.1	-0.0001	1.7	1.7	0.0017	18.1	0	0	0.000	2.72	3.00
WS9	<0.1	<0.1	0	0.0	-0.1	-0.0001	3.1	3.1	0.0031	16.6	0	0	0.000	2.25	2.70

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Oakwood Lodge
Project No:- 8928G
Client:- Garden City Design & Build

Date:- 04/11/2019
Start Time:- 12:25
End Time:- 13:05
Ground Conditions:- Dry
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 978mb
End:- 978mb
Trend:- Steady

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4			CO2			Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak %	Steady %	Qhg l/hr	Peak %	Steady %	Qhg l/hr						
WS2	<0.1	<0.1	0	0.0	-0.1	-0.0001	0.8	0.8	0.0008	18.9	0	0	0.000	2.00	2.70
WS3	<0.1	<0.1	0	0.0	-0.1	-0.0001	1.8	1.8	0.0018	18.0	0	0	0.000	2.25	2.73
WS5	<0.1	<0.1	0	0.0	-0.1	-0.0001	5.4	5.3	0.0053	12.2	0	0	0.000	2.46	3.00
WS7	<0.1	<0.1	0	0.0	-0.1	-0.0001	1.8	1.8	0.0018	17.9	0	0	0.000	2.66	3.00
WS9	<0.1	<0.1	0	0.0	-0.1	-0.0001	2.8	2.8	0.0028	16.3	0	0	0.000	2.00	2.60

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Oakwood Lodge
Project No:- 8928G
Client:- Garden City Design & Build

Date:- 15/11/2019
Start Time:- 11:30
End Time:- 12:30
Ground Conditions:- Damp
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 1005mb
End:- 1005mb
Trend:- Steady

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4			CO2			Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak %	Steady %	Qhg l/hr	Peak %	Steady %	Qhg l/hr						
WS2	<0.1	<0.1	0	0.0	0.0	0.0000	0.6	0.6	0.0006	19.3	0	0	0.000	1.90	2.40
WS3	<0.1	<0.1	0	0.0	0.0	0.0000	1.9	1.9	0.0019	17.5	0	0	0.000	2.10	2.70
WS5	<0.1	<0.1	0	0.0	0.0	0.0000	5.2	5.2	0.0052	12.3	0	0	0.000	2.25	3.00
WS7	<0.1	<0.1	0	0.0	0.0	0.0000	2.0	2.0	0.0020	17.5	0	0	0.000	2.45	3.00
WS9	<0.1	<0.1	0	0.0	0.0	0.0000	1.6	1.6	0.0016	18.1	0	0	0.0	1.82	2.67

Additional Comments

Gas & Groundwater Monitoring Record Sheet



Project Name:- Oakwood Lodge
Project No:- 8928G
Client:- Garden City Design & Build

Date:- 04/12/2019
Start Time:- 10:30
End Time:- 11:30
Ground Conditions:- Frozen
Weather Conditions:- Dry

Atmospheric Pressure
Start:- 1014mb
End:- 1013mb
Trend:- Steady

Instrument:- Gas Data GFM436

Operator:- P Hobson

Hole ID	Peak Flow l/hr	Steady Flow l/hr	DP	CH4			CO2			Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
				Peak %	Steady %	Qhg l/hr	Peak %	Steady %	Qhg l/hr						
WS2	<0.1	<0.1	0	0.0	0.0	0.0000	1.9	1.9	0.0019	17.4	0	0	0.000	2.30	2.75
WS3	<0.1	<0.1	0	0.0	0.0	0.0000	0.5	0.5	0.0005	19.3	0	0	0.000	2.06	2.36
WS5	<0.1	<0.1	0	0.0	0.0	0.0000	5.9	5.9	0.0059	11.3	0	0	0.000	2.50	3.00
WS7	<0.1	<0.1	0	0.0	0.0	0.0000	1.9	1.9	0.0019	17.9	0	0	0.000	2.80	3.00
WS9	<0.1	<0.1	0	0.0	0.0	0.0000	3.2	3.2	0.0032	16.2	0	0	0.0	2.10	2.70

Additional Comments

GAS MONITORING METHODOLOGY

1. The following are recorded upon arrival or at each location as the monitoring progresses:-
 - Operator name;
 - Instrumentation name i.e. Gas Data - GFM436;
 - Atmospheric pressure;
 - Time of commencement of the monitoring visit;
 - Ground conditions e.g. wet, dry waterlogged etc.;
 - General weather conditions, as the prevailing conditions may affect the results; and
 - Condition of the monitoring point e.g. damaged, covered etc.
2. The background oxygen concentration in the vicinity of the monitoring point is recorded to ensure that the instrument is zeroed.
3. Where appropriate, both the flow and pressure differential are recorded at each monitoring point prior to obtaining the gas concentrations.
4. Concentrations of light hydrocarbon gas, comprising methane (%v/v), carbon dioxide (%v/v), oxygen (%v/v), hydrogen sulphide (ppm), carbon monoxide (ppm) and hexane % are monitored continuously over a 90 seconds period. The highest concentrations of methane, carbon dioxide, carbon monoxide and hydrogen sulphide and the lowest concentration of oxygen are then recorded.
5. If/where concentrations stabilise after 90 seconds, the steady-state concentrations are recorded. If concentrations are still varying, monitoring is continued until steady-state conditions are attained and concentrations then recorded. The accuracy for light hydrocarbon gases is :-
 - Methane - +/-0.2% at 5%.
 - Carbon dioxide - +/-0.1% at 10%.
6. Depth to water level and base of installation are recorded as the movement of groundwater can affect gas migration and migration pathways to monitoring points.
7. The above steps are to be repeated at each monitoring point.
8. The following are then recorded upon completion of the monitoring process:-
 - Atmospheric pressure;
 - Time of completion of the monitoring visit.

Key For Gas Monitoring Records

BH/WS	- Readings taken from gas valve within borehole or window sample probehole.	PD	- Pressure differential measured in millibars
Flow	- Gas flow measured in litres per hour	%	- Percentage
<0.1	- Where flows are less than 0.1/hr are recorded	ppm	- Parts Per Million
CO ₂	- Carbon Dioxide	l/hr	- Litres per hour
O ₂	- Oxygen	CH ₄	- Methane
H ₂ S	- Hydrogen Sulphide	mbgl	- Metres below ground level
CO	- Carbon Monoxide	GSV	- Gas Screening Value

TEST DATE AND CONDITIONS			
Date	14/08/19		
Atmospheric Pressure	993	mB	
Ambient Temperature	21.9	°C	
EnviroNics Serial No.	5089		

**GFM436 Final Inspection & Calibration
Check Certificate**

GAS DATA LTD

Unit 4, Fairfield Court

Seven Stars Estate

Wheler Rd

Coventry

CV3 4LJ

Tel 02476303311

Fax 02476307711



Customer	WML Consulting Ltd
Certificate Number	121220
Order Number	323564

Serial Number	12969
Software Version	G436-00.0027/0010

Recalibration DUE Date
14/08/20

Instrument Checks			
Keyboard	✓		Display Contrast
Pump Flow In	500	Accept > 200 cc/min	Pump Flow @ -200mB
Clock Set / Running	✓		Labels Fitted

Gas Checks						
Sensor	CH ₄		CO ₂		O ₂	
	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %
	Readings %		Readings %		Readings %	
	60	60	40	40	20.9	20.9
	Accept ±3.0		Accept ±3.0		Accept ±0.5	
Zero Reading 100% N2	5	5	5	5	6	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N2	0	0	0	0	0	0
	Accept ±0.0		Accept ±0.0		Accept ±0.1	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings (ppm)			
Gas Type	Range (ppm)		Zero Reading		Instrument Gas Reading	
H2S	5000	1500	0	Accept ±0.0	1500	Accept ±5.0
CO	2000	1000	0	Accept ±0.0	1000	Accept ±5.0
Hexane	2.0%	2.0%	0	Accept ±0.0	1.99	Accept ±10.0

Cross Gas Effects								
Applied Gas (ppm)		Instrument Readings (ppm)						
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:	HEX	
H2S	1500	1500		0		0		
CO	1000	40		1000		0		
Hexane	2.0%	0		0		1.99		

Pressure Checks			
Atmospheric Pressure [AP] (mB)			
Current Atmospheric Pressure (mB)		Instrument Atmospheric Pressure Reading (mB)	
AP Open Ports		993	Accept ± 2.0
AP Port (Internal)	+800 mB	800	Accept ± 5.0
	+1200mh	1200	Accept ± 5.0

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading (l/h)	Instrument Reading (l/h)		Applied Pressure (Pa)	Instrument Reading (Pa)	
-30	-30.3	Accept ± 3.0	-556	-570	Accept ± 50
-3	-3	Accept ± 1.0	-23	-22	Accept ± 6.0
0	0	Accept ± 0.0	0	0	Accept ± 0.5
3	3	Accept ± 0.5	17	17	Accept ± 3.0
30	30	Accept ± 3.0	385	384	Accept ± 50
60	60	Accept ± 6.0	1192	1193	Accept ± 130
90	90.4	Accept ± 9.0	2362	>>>>	Accept ± 250

Temperature Checks		
Calibration Temperature	Instrument Temperature Reading °C	
Applied Temperature °C		
-10	-10	Accept ± 2.0
0	0	Accept ± 1.0
30	30	Accept ± 1.0
60	60	Accept ± 1.0
100	100	Accept ± 1.0

Technician:
<i>Jack Rutland</i>

Date Tested:
15/08/19

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated. The results displayed on the instrument at each stage are recorded above.

APPENDIX 05

Site Specific Acceptance Criteria

Site Specific Assessment Criteria for Residential (with homegrown produce) assuming a 1% SOM for Hydrocarbons

Contaminant	Assessment Criteria for Residential (mg/kg)
Metals	
Arsenic	37
Boron	290
Cadmium	26
Chromium III	910
Chromium VI	6
Copper	2,400
Lead*	200
Mercury	1.2
Nickel	130
Selenium	250
Vanadium	410
Zinc	3,700
Non – Metals	
Phenol	120
Polyaromatic Hydrocarbons (PAH)	
Benz[a]anthracene	7.2
Benzo[a]pyrene	2.2
Benzo[b]fluoranthene	2.6
Benzo[ghi]perylene	320
Benzo[k]fluoranthene	77
Chrysene	15
Dibenz[ah]anthracene	0.24
Fluoranthene	280
Indeno[123-cd]pyrene	27
Naphthalene	2.3
Pyrene	620

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* Where not included in the S4UL's criteria for a limited number of contaminants, namely lead, have been derived by DEFRA in their document entitled SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, April 2014.

Contaminant	Criteria for Residential End Use (mg/kg)
Volatile Organic Compounds (VOCs)	
Benzene	0.087
Ethylbenzene	47
Toluene	130
Xylene	56
1,2-Dichloroethane	0.0071
1,1,1-Trichloroethane	8.8
Tetrachloroethane	1.6
Tetrachloroethene (PCE)	0.18
Tetrachloromethane	0.026
Trichloroethene (TCE)	0.016
Trichloromethane	0.91
Vinyl Chloride	0.00064
Semi-Volatile Organic Compounds (SVOCs)	
1,2-Dichlorobenzene	23
1,4-Dichlorobenzene	61 ^f
1,2,4-Trichlorobenzene	2.6
Hexachlorobenzene	1.8 (0.2) ^{vap}
Total Petroleum Hydrocarbons (TPH)	
Aliphatic C5-6	42
Aliphatic C6-8	100
Aliphatic C8-10	27
Aliphatic C10-12	130(48) ^{vap}
Aliphatic C12-16	1,100(24) ^{sol}
Aliphatic C16-35	65,000(8.48) ^{f, sol}
Aliphatic C35 - 44	65,000(8.84) ^{f, sol}
Aromatic C5 – 7 (benzene)	70
Aromatic C7 – 8 (toluene)	130
Aromatic C8-10	34
Aromatic C10-12	74
Aromatic C12-16	140
Aromatic C16-21	260 ^f
Aromatic C21-35	1,100 ^f
Aromatic C35 - 44	1,100 ^f

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