

Phase 2 Geo-Environmental Investigation & Assessment

For

The Boundary Medical Centre, Hulme

Undertaken on behalf of

Mossclare St Vincent's Housing Group

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Executive Summary

Site Location	The site comprises land to the rear of the existing Cornbrook Medical Centre on Booth Street West, Manchester. It is centred on approximate Ordnance Survey National Grid Reference 384211E, 396704N with an indicative postcode of M15 6PR.
Development Proposals	It is understood that the development will comprise minor remodelling of the ground floor internal layout and the construction of a single-storey office extension to the rear elevation in the location of the existing car park.
Ground Conditions	Ground conditions encountered during the intrusive investigation comprise made ground to depths of between 1.30m and 3.30mbgl, being locally underlain by glaciofluvial sheet deposits to depths of between 2.90m and 3.30mbgl, in turn underlain by glacial till to a maximum proven depth of 4.70mbgl.
Site Preparation	The historical plans indicate the existing structure to have been built between 1995 and 2002, it cannot be fully ruled out that asbestos could be present. Therefore, although considered unlikely, refurbishment and localised demolition should not proceed until an appropriate asbestos survey of the existing building has been undertaken and any Asbestos Containing Materials (ACM) removed by an appropriately licensed contractor. Buried concrete/brick obstructions associated with former site use are envisaged although these are unlikely to be significant. Where encountered, these will need to be broken out to suitable depths below formation levels where they are to impinge on the proposed building. It is also anticipated that existing services crossing the site, including electricity and drainage, would need to be moved / diverted to allow for development of the site.
Foundations and Floor Slabs	The proposed structure would need to be supported by piled foundations with piles being taken down into competent glacial till, anticipated at depths of between 2.90m and 3.30mbgl. The choice of pile type would be largely dependent on the need to balance optimum construction methods against environmental issues such as noise and vibration effects. Consultation with a reputable piling contractor will be required in this respect. In consideration of the thickness of un-compacted made ground, new floor slabs would need to be suspended.
Excavations and Groundwater	Excavations at the site will be feasible using conventional hydraulic plant. Perched groundwater inflows should be anticipated at depths of around 3.00mbgl during excavations within granular deposits. Conventional 'sump and pump' dewatering measures will probably be adequate to keep excavations dry although it cannot be discounted that groundwater exclusion measures such as interlocking sheet piles may be required to prevent excessive ingress of water into excavations.
Pavements	New road pavement design should be based on a California Bearing Ratio (CBR) value of no more than 2.5% in made ground.
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	In consideration of the thickness of made ground, soakaways would not be considered suitable at the site.
Ground Gas	The site to classify as Characteristic Situation (CS) 1 – Very Low Gas Risk', with no specific gas protection measures required.
Contamination Assessment	In consideration of the chemical test results, it is concluded that the site does not contain any significant and/or widespread contamination sources. The risk to human health from ground contamination is therefore considered very low with no specific environmental remediation required.
Potable Water Supplies	The utilities supplier will need to be consulted with regards the selection of suitable water supply pipe materials for the development. The requirement for specific materials and measures to protect the water supply from ground contamination is unlikely but cannot be

	discounted at this stage.
Waste Soils	For preliminary guidance based on the current information, it is likely that made ground would be classified as 'Non-hazardous' with natural soils classified as 'Inert' for landfill disposal. 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.

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1.0 INTRODUCTION

Appointment

- 1.1 WML Consulting has been commissioned by Mosscafe St Vincent's Housing Group to undertake a Phase 2 Geo-environmental Investigation and Assessment of a site located at the Cornbrook (Boundary) Medical Centre, Booth Street West, Manchester, M15 6PR.

Proposed Development

- 1.2 It is understood that the development will comprise minor remodelling of the ground floor internal layout and the construction of a single-storey office extension to the rear elevation in the location of the existing car park.
- 1.3 The proposed development plan 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 has been undertaken and is presented in the following WML Consulting report:
- Phase 1 Desk Study and Preliminary Geoenvironmental Assessment, Reference 8651G-WML-00-XX RP-G-0001, dated February 2019.
- 1.7 This report includes the findings of a ground investigation designed on conclusions and recommendations provided in the Phase 1 Report. For ease of reference, the findings of the desk study are summarised in the following sections. The two reports however 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 land to the rear of the existing Cornbrook Medical Centre on Booth Street West, Manchester. It is centred on approximate Ordnance Survey National Grid Reference 384211E, 396704N with an indicative postcode of M15 6PR.
- 2.2 The proposed development site is bounded to the north by the existing medical centre, to the east and south by a residential apartment block on Higher Cambridge Street and Boundary Lane, and to the west by car parking associated with the neighbouring residential properties.

Site Description

- 2.3 The proposed development site comprises a relatively level area of car parking, with very localised landscaping, to the rear of the existing structure.
- 2.4 The rear elevation of the existing structure, which forms the northern boundary of the development area, is of single-storey brick construction.
- 2.5 The southern and eastern site boundaries are formed by residential apartment structures with the western site boundary secured with a metal security fence.
- 2.6 Access into the development area is from Boundary Lane to the west via a gate from the neighbouring car park.

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 British Geological Survey (BGS) plans indicates the site to be underlain by Devensian Glaciofluvial Sheet Deposits underlain by sandstone strata of the Triassic Chester Pebble Beds.

3.3 In consideration of the underlying geology, risks of subsidence from coal mining can be discounted.

Radon

3.4 The property is not in a radon affected area as defined by the BGS/Public Health England where 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

3.5 The Glacial Sheet Deposits beneath the site are classified as a 'Secondary (A) Aquifer'. The underlying Chester Pebble Beds are classified as a 'Principal Aquifer'.

3.6 The site is located within an Environment Agency (EA) Zone 3 'Total Catchment' SPZ. There are 4no groundwater abstractions at Manchester Metropolitan University for heat pump and general use between 358m north and 460m west of the site. Corn Brook, an underground river, runs roughly east to west some 106m south-east of the site.

3.7 There are no active or historic landfills recorded within 500m of the site.

3.8 The Groundsure report indicates that the risk of flooding from rivers and the sea (RoFRaS) is currently designated as 'medium' with the site indicated to be located within an EA Zone 3 Floodplain.

Site History

3.9 The earliest maps dated 1848 indicate the site and surrounding area to have comprised predominantly residential terraced housing with Carver Street extending roughly north-west to south-east across the central section of the site. An area of undeveloped land was located to the south of the site, with Corn Brook running roughly north-east to south-west some 100m south.

3.10 By 1893, the surrounding area had undergone further, predominantly residential development with localised industrial activities including breweries 125m south-east, 200m east and a warehouse 200m north.

3.11 By 1949, the south-eastern corner of the site had been cleared, along with a number of structures in the immediate surrounding area.

3.12 By 1978, the remaining structures at the site had been cleared and was in use as car parking with localised landscaping associated with Cooper House to the south. By this time the surrounding area had undergone extensive redevelopment including residential structures to the west, the University of Manchester to the east and a school to the south.

3.13 By 2002, the site had been redeveloped with the current structure located in the north and a car park in the southern section.

4.0 PRELIMINARY CONTAMINATION RISK ASSESSMENT

- 4.1 Based on the above findings, the Phase 1 desk study report concluded that pollution linkages were either not envisaged or considered unlikely with the overall preliminary contamination risk assessed 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 appropriate 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 confirmatory monitoring for hazardous ground gas concentrations and flow if considered necessary.
- 4.4 In addition, appropriate 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 A hand excavated trial pit (HP1) was undertaken to examine the foundations to the existing structure in the area of the proposed new extension.
- 5.4 A general coverage of the redevelopment area was considered appropriate although the investigation locations were also chosen so as not to impact on the presence of known/suspected services beneath the site.
- 5.5 Monitoring standpipes were installed in selected probeholes for the measurement of ground gas and groundwater levels.
- 5.6 Chemical analysis of a general suite of contaminants was undertaken on selected samples of soil. This was to confirm the anticipated low contamination risk and to establish the chemical suitability of soils for possible re-use within the development.

Intrusive Works

- 5.7 Ground investigation work was undertaken by LOT Geotechnics Ltd on the 18th March 2019. This comprised the formation of 3no window sample probeholes to a maximum depth of 4.70 metres below ground level (mbgl) and 1no hand excavated trial pit to 1.00mbgl.
- 5.8 The exploratory hole records are presented in Appendix 02 of this report whilst the exploratory hole locations are shown on Drawing 8651G-SK01 in Appendix 01.

Monitoring Standpipe

- 5.9 Monitoring wells for groundwater and ground gas measurements were installed in 2no probeholes as indicated on the logs presented in Appendix 03.

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 03.
- 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).
 - Total Petroleum Hydrocarbons - CWG Aliphatic/Aromatic Split (TPH).
 - Asbestos Screen and Identification.
 - 2:1 water/soil sulphate extract, pH.
- 5.12 The results of the chemical analysis are presented in Appendix 04.

Gas and Groundwater Monitoring

- 5.13 Confirmatory gas and groundwater monitoring has been carried out on 1no occasion, on 9th April 2019. The monitoring results are presented in Appendix 05.

6.0 GROUND CONDITIONS

Stratigraphy

- 6.1 Ground conditions encountered during the intrusive investigation comprise made ground to depths of between 1.30m and 3.30mbgl, being locally underlain by glaciofluvial sheet deposits to depths of between 2.90m and 3.30mbgl, in turn underlain by glacial till to a maximum proven depth of 4.70mbgl.

Made Ground

- 6.2 Made ground was encountered within all exploratory holes from ground level to depths of between 1.30m and 3.30mbgl with the greatest thickness being encountered in WS1 in the western section of the site. This is considered to represent infilled basements associated with the former residential housing.
- 6.3 The made ground generally comprised a surface horizon of brick or concrete paving on sand bedding underlain by pinkish brown to brownish grey, gravelly sand and sandy gravel to depths of between 0.80m and 1.40mbgl. Gravel sized fragments included sandstone, brick and more locally plastic and metal.
- 6.4 Within WS1 and WS2 this was in turn underlain by brown and grey, slightly gravelly, sandy clay with pockets of clayey sand to depths of 3.30m and 1.30mbgl respectively. Gravel sized fragments include sandstone, brick and more locally metal.
- 6.5 Within WS3 this was in underlain by brownish grey, slightly sandy gravel and cobbles of brick to a depth of 2.30mbgl.
- 6.6 SPT 'N' values within the made ground range between 1 and 17.

Glaciofluvial Sheet Deposits

- 6.7 Within WS2 and WS3, in the central and northern parts of the site, the made ground was underlain by strata considered to represent glaciofluvial sheet deposits to depths of between 2.90m and 3.30mbgl.
- 6.8 These deposits generally comprised orange brown, slightly clayey, gravelly, fine to coarse sand.
- 6.9 SPT 'N' values within the granular glaciofluvial sheet deposits range between 7 and 17 and indicated a generally loose to medium dense state of compaction.

Glacial Till

- 6.10 Within all of the exploratory holes glacial till was encountered underlying the made ground (WS1) and glaciofluvial sheet deposits (WS2 and WS3) at depths of between 2.90m and 3.30mbgl, extending to a maximum proven depth of 4.70mbgl.
- 6.11 These deposits generally comprised firm to stiff, brownish grey, slightly silty, slightly sandy, slightly gravelly clay. Gravel comprises sandstone, siltstone and mudstone.
- 6.12 SPT 'N' values within the cohesive glacial till range between 13 and in excess of 50 and indicated an initially firm, becoming stiff to very stiff consistency.

Existing Foundations

- 6.13 The findings of the hand excavated trial pit, formed to expose the structural foundation is summarised in the following table.

Foundation Pit	Depth (m)	Foundations				Bearing Stratum
		Type	Thickness (m)	Projection from side of wall (m)	Depth to base (mbgl)	
HP1	1.00	Stepped Brick onto concrete ground beam.	0.55	0.05	0.75	Made ground

6.14 Photographs of the foundation pits are presented in Appendix 02.

Visual/Olfactory Evidence of Contamination

6.15 A slight hydrocarbon aroma was observed within the made ground in WS1 between depths of 2.90m and 3.10mbgl. A sample of which has been submitted for hydrocarbon analyses and is discussed further within Section 8.0.

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

Groundwater

6.17 Groundwater seepages were encountered during the formation of all exploratory holes, at depths of between 2.90m and 3.00mbgl, within made ground in WS1 and glaciofluvial sheet deposits in WS2 and WS3.

6.18 During the monitoring visit, groundwater was recorded at a depth of 2.85mbgl in WS2, however WS1 was noted to be dry.

6.19 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

6.20 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 In consideration of the location of the proposed new extension localised demolition may be required to accommodate the new extension structure.
- 7.2 The historical plans indicate the existing structure to have been built between 1995 and 2002, it cannot be fully ruled out that asbestos could be present. Therefore, although considered unlikely, refurbishment and localised demolition should not proceed until an appropriate asbestos survey of the existing building has been undertaken and any Asbestos Containing Materials (ACM) removed by an appropriately licensed contractor.
- 7.3 Buried concrete/brick obstructions associated with former site use are envisaged although these are unlikely to be significant. Where encountered, these will need to be broken out to suitable depths below formation levels where they are to impinge on the proposed building.
- 7.4 Such materials removed as part of the clearance work, subject to appropriate screening and crushing, will be suitable for re-use as bulk fill beneath hard cover areas.
- 7.5 As the site is relatively flat, no significant earthworks to provide level development platforms are envisaged.
- 7.6 However, it should be noted that surplus materials will be generated from excavations for foundations and drainage, which are likely to require removal from site.
- 7.7 It is also anticipated that existing services crossing the site, including electricity and drainage, would need to be moved / diverted to allow for development of the site.

Foundations

- 7.8 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.
- 7.9 Therefore, in consideration of the depth of such materials extending to depths in excess of 3.00mbgl, and the anticipated piled nature of the existing structure the use of traditional shallow spread and mass concrete trench fill foundations is not considered a viable foundation solution.
- 7.10 It is also anticipated that ground improvement by vibro-treatment is not likely to be considered a suitable option due to the due to the proximity of the existing structure.
- 7.11 Subsequently, the proposed structure would need to be supported by piled foundations with piles being taken down into competent glacial till, anticipated at depths of between 2.90m and 3.30mbgl. The choice of pile type would be largely dependent on the need to balance optimum construction methods against environmental issues such as noise and vibration effects. Consultation with a reputable piling contractor will be required in this respect.
- 7.12 During excavation works, care should be taken to avoid damage / undermining of existing structural foundations, with the provision of adequate support measures where considered appropriate. Foundations should also be designed and constructed so that they do not interact and overstress or be overstressed by existing foundations.
- 7.13 In this respect, further investigations should be undertaken to fully delineate the existing foundations if / where proposed new structures are within influencing distance of such.

- 7.14 Foundation construction will need to take account of any remaining and/or new services. It is anticipated that due to the high volume of services beneath the proposed extension structure, these would need to be relocated.

Floor Slabs

- 7.15 In consideration of the thickness of un-compacted made ground, new floor slabs would need to be suspended.

Excavations and Groundwater

- 7.16 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.
- 7.17 Perched groundwater inflows should be anticipated at depths of around 3.00mbgl during excavations within granular deposits. Conventional 'sump and pump' dewatering measures will probably be adequate to keep excavations dry although it cannot be discounted that groundwater exclusion measures such as interlocking sheet piles may be required to prevent excessive ingress of water into excavations.
- 7.18 Such support and groundwater exclusion measures will also prevent 'running sand' conditions leading to loss of ground beneath nearby adjacent structures or infrastructure.

Pavement Design

- 7.19 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.
- 7.20 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

- 7.21 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.
- 7.22 Values of 2:1 water/soil extract for sulphate for soils at foundation depth do not exceed 81mg/l. Values of pH range from 8.7 to 9.4 indicating alkaline conditions.
- 7.23 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

- 7.24 In consideration of the thickness of made ground, soakaways would not be considered suitable at the site.

8.0 GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA)

General

- 8.1 A review of the desk study information has concluded that the potential for a significant pollution linkage to be present at the site is low with corresponding low risk to human health and the environment.
- 8.2 No visual or olfactory evidence of significant ground contamination has been recorded from the intrusive investigations.
- 8.3 However, it has been considered prudent to adopt a precautionary principal and undertake chemical analysis of the 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 "Commercial" end-use are considered appropriate for a conservative assessment at this stage.
- 8.12 A table of relevant SL's are provided in Appendix 06.

Soil Test Results

- 8.13 4no soil samples were analysed for a suite of Contaminants of Concern (CoC). The majority of the concentrations measured were below the stringent SL's for "Commercial" end-use with no exceptions.
- 8.14 A sample submitted for TPH analysis, associated with the hydrocarbon odour and staining in WS3 at 3.00mbgl, recorded all concentrations both below the relevant SL's and also the Laboratory's lowest order of detection.
- 8.15 No asbestos fibres were detected in any of the samples analysed.

Discussion and Conclusions

- 8.16 In consideration of the chemical test results, it is concluded that the site does not contain any significant and/or widespread contamination sources. The risk to human health from ground contamination is therefore considered very low with no specific environmental remediation required.

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 is indicated to comprise the construction of **Type B** buildings, the definition of which is provided in BS8485:2015.

Ground Gas Conceptual Model

- 9.7 The site is not located in an area where radon protection measures are required.
- 9.8 There are no current or historic landfills within influencing distance of the site.
- 9.9 Made ground from historical in-filling has been encountered to a depth of 3.30mbgl beneath the western part of the site. However, no degradable or organic materials were noted within the made ground during the intrusive investigations.
- 9.10 The presence of ground gas resulting from shallow unrecorded mine workings can be discounted.
- 9.11 In consideration of the above, the risk from ground gas arising from and migrating to/from the site is assessed as very low. However, it has been considered prudent to undertake a single confirmatory monitoring visit, primarily for methane and carbon dioxide, with associated flow rates on 9th April 2019.

Results and Recommendations

- 9.12 The results to date indicate that methane and carbon dioxide concentrations do not exceed 0.10% by volume in air (v/v). No detectable ground gas flows have been recorded during the monitoring visit.
- 9.13 The results give a maximum Q_{hg} value of <0.0001l/hr and indicate the site to classify as Characteristic Situation (CS) 1 – Very Low Gas Risk', with no specific gas protection measures required.
- 9.14 This will need to be confirmed with the local authority Environmental Health / Building Control Officer prior to any building design being finalised.

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 However, it is anticipated that due to the nature of the proposed modifications all waste soils would need to be removed from site. Therefore where soils are surplus to requirements, they will need to be removed from site through appropriate waste management.
- 10.3 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.
- 10.4 For preliminary guidance based on the current information, it is likely that made ground would be classified as 'Non-hazardous' with natural soils classified as 'Inert' for landfill disposal.
- 10.5 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

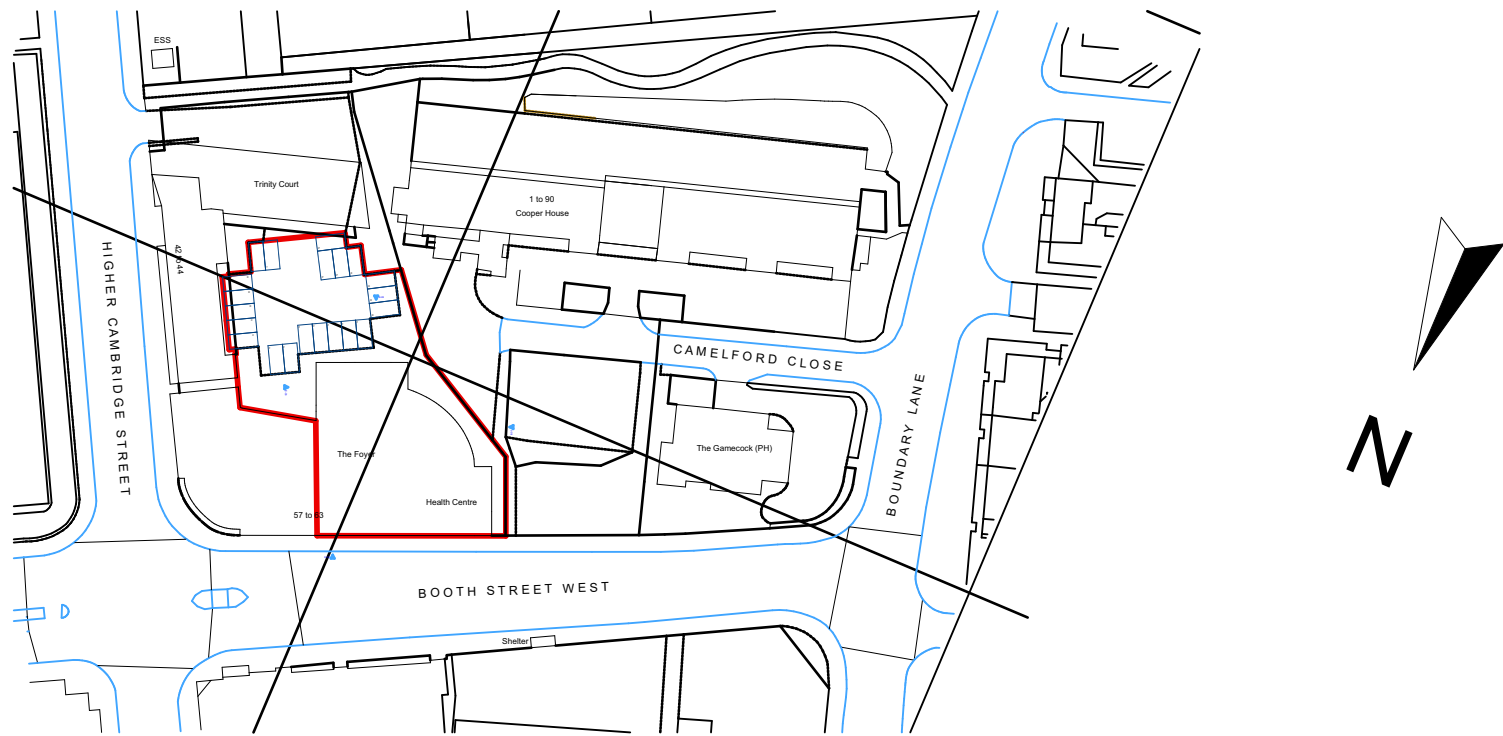
- 10.6 Imported fill will be subject to specific quality requirements and should be accompanied by appropriate certification to confirm its suitability. Allowance should also be made for testing imported fill materials prior to placement to ensure suitability.

Water Supply Pipes

- 10.7 The utilities supplier 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 at anticipated water pipe depths, the requirement for specific materials and measures to protect the water supply from ground contamination is unlikely but cannot be discounted at this stage.

APPENDIX 01

Drawings



-1.
.

Site Location Plan
1:1250



-1.
.

Existing Site Plan
1:500



Arcus Consulting LLP
Wakefield 0192 466 9000
Liverpool 0151 708 1080
www.arcus.uk.com
Manchester 0161 905 3222
Newcastle 0191 272 5781
Cambridge 0122 325 7706
info@arcus.uk.com

Client

Mosscaire St Vincents Housing

Project

The Foyer, Manchester

Title

Scale Date Stage

Job No Drawing No Rev

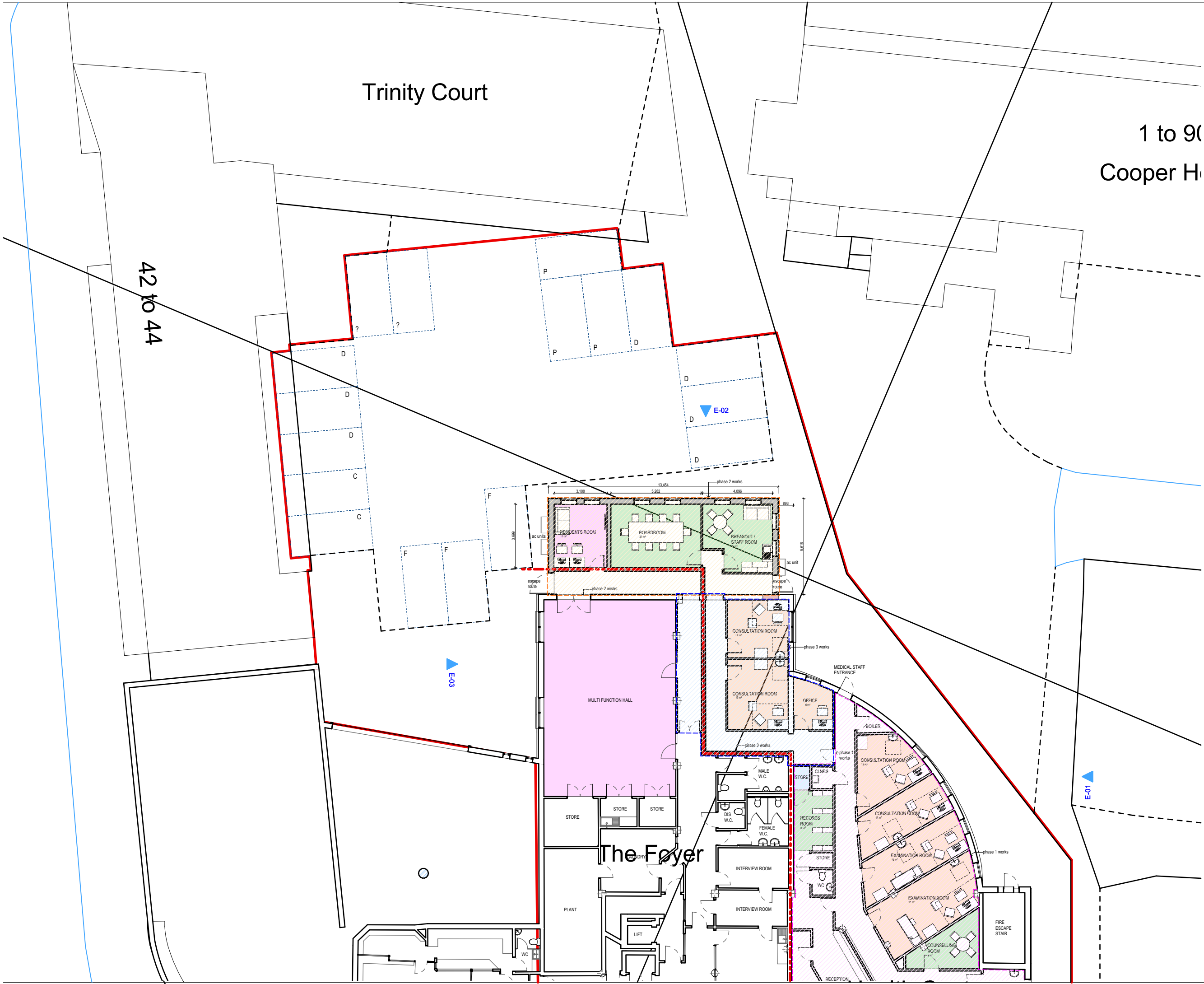
Drawn Approved

This drawing is the copyright of Arcus. Contractors must check all dimensions on site. Do not scale the drawings. Only figured dimensions are to be worked to.

Trinity Court

1 to 90
Cooper H

42 to 44



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Liverpool 0151 708 1080
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Manchester 0161 905 3222
Newcastle 0191 272 5781

Cambridge 0122 325 7706
info@arcus.uk.com

Client

Mossclare St Vincents Housing

Project

The Foyer, Manchester

Title

Proposed Car Park

Scale 1:200 @ A3 Date 08/08/18 Stage FE

Job No 4725 Drawing No 006 Rev

Drawn KT Approved

This drawing is the copyright of Arcus. Contractors must check all dimensions on site. Do not scale the drawings. Only figured dimensions are to be worked to.

GENERAL NOTES

1. DO NOT SCALE FROM THIS DRAWING WORK TO FIGURED DIMENSIONS ONLY.
2. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS ALLOWED WITHOUT PRIOR PERMISSION IN WRITING.
3. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL ARCHITECTS, ENGINEERS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
4. THE CONTRACTOR SHALL INCORPORATE ALL THE REQUIREMENTS OF THE PRE-TENDER STAGE HEALTH & SAFETY PLAN.

KEY

- SITE BOUNDARY
- WS01
WINDOW SAMPLE
PROBEHOLES
- TP01
HAND EXCAVATED
FOUNDATION PIT
- EXISTING BUILDING



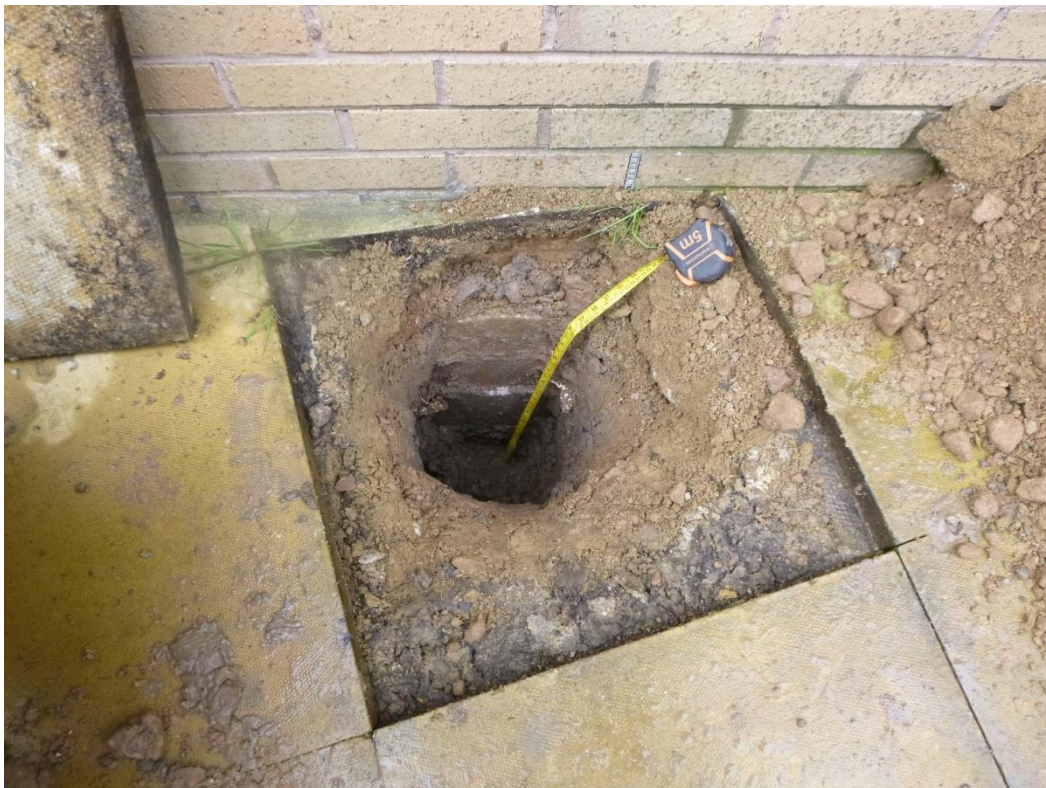
P1	FIRST PRELIMINARY ISSUE.	APR'19	SCS	PGD
Rev.	Amendment	Date	By	Chkd
Project BOUNDARY MEDICAL CENTRE				
Client ARCUS CONSULTING				
Title EXPLORATORY HOLE LOCATION PLAN				
Drawn SCS	Checked PGD	Date 01-04-19	Scale 1:200@A2	
WML CONSULTING Chartered Civil and Structural Engineers		No.8 Oak Green Earl Road Stanley Green Business Park Cheadle Hulme Cheshire SK9 6QL Tel 0161 482 0600 Fax 0161 486 9210 e-mail info@wmlconsulting.com www.wmlconsulting.com		
Job No. 8651G		Drawing No. SK-01-		

APPENDIX 02

Site Photographs



Photograph 1
Location of HP1 to southern elevation.



Photograph 2
HP1



**Photograph 3
HP1.**

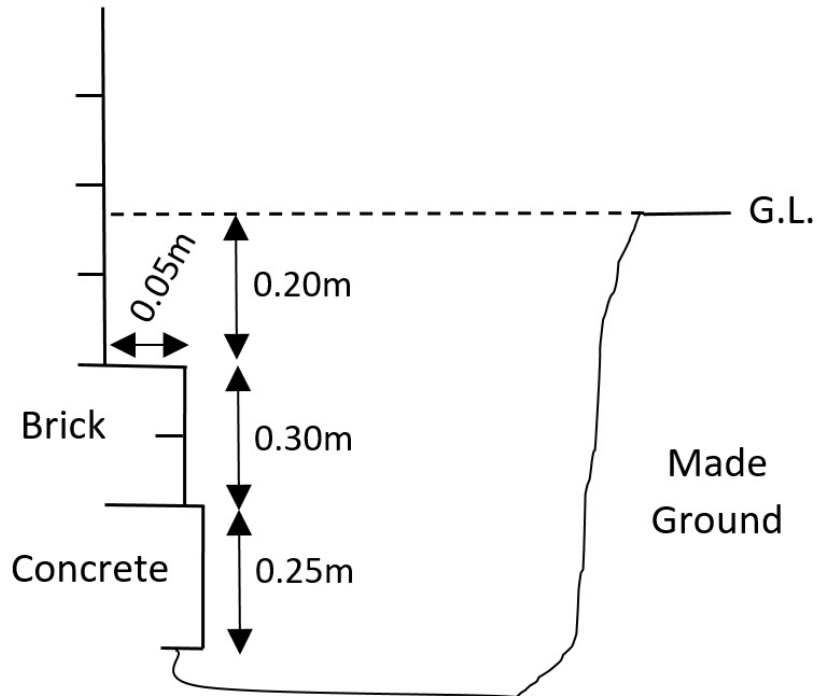


**Photograph 4
Standpipe cover at the surface of WS1 after completion.**

APPENDIX 03

Exploratory Hole Records

WML CONSULTING	Project Title: The Boundary Medical Centre		HP1
	Project Number: 8651G	Client: Arcus Consulting LLP	
	GL (mAOD):	N Coord: 0	E Coord: 0
Date: 18/03/2019	Method: Hand Dug	Logged By: TPB	Scale: 1:20



Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water
0.35	E					Concrete paving slab. (MADE GROUND)	
					0.75	Brown, gravelly SAND. Gravel is subangular, fine to coarse including sandstone and brick. (MADE GROUND)	
					1.00	Very soft to soft, slightly gravelly, sandy CLAY. Gravel subangular, fine to coarse, including brick and sandstone. (MADE GROUND)	
						End Of Trial Pit At 1.00 m	
KEY D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 						REMARKS No Groundwater Encountered Concrete footing encountered extending to 0.75mbgl.	

		Project Title: The Boundary Medical Centre				WS1	
		Project Number: 8651G		Client: Arcus Consulting LLP			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 18/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.50	E	N=1			0.15	Concrete paving slab. (MADE GROUND)	▼	
					0.40			
		1.00		1.40	Pinkish brown, gravelly, fine to coarse SAND. Gravel is subangular, fine to coarse, including sandstone. (MADE GROUND)			
		2.00		2.00		Brownish grey, fine to coarse SAND and subangular to subrounded, fine to coarse GRAVEL including sandstone, brick, metal and plastic. (MADE GROUND)		
3.00	J + V	N=7		3.00	Brown and grey, slightly gravelly, sandy CLAY with pockets of clayey SAND. Gravel is subangular to subrounded, fine to coarse, including sandstone and brick. (MADE GROUND)			
3.60	J			3.30		2.90 - 3.10 Slight hydrocarbon aroma.		
		N=29		4.00	Firm to stiff, brownish grey, slightly silty, slightly sandy, slightly gravelly CLAY. Gravel is subangular, fine to medium, including sandstone, siltstone and mudstone. (GLACIAL TILL)			
		pp 50/265mm		4.70		End Of Borehole At 4.70 m		
				5.00				
				6.00				
				7.00				
				8.00				

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 refused at 4.70mbgl. Scale: 1:50	<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>19/03/2019</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	19/03/2019	3																	Daily Log Of Depths			Chiselling			Date	Casing	Water	From	To	Hours												
Water Strikes																																																								
Date	Strike	Level	Minutes	Casing	Sealed																																																			
19/03/2019	3																																																							
Daily Log Of Depths			Chiselling																																																					
Date	Casing	Water	From	To	Hours																																																			

		Project Title: The Boundary Medical Centre				WS2	
		Project Number: 8651G		Client: Arcus Consulting LLP			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 18/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe	
0.30	E	N=11			0.20	Brick paving. (MADE GROUND)			
							Yellow brown, fine to coarse SAND. (MADE GROUND)		
						1.00	Brownish grey, fine to coarse SAND and subangular, fine to coarse, including sandstone, brick and plastic. (MADE GROUND)		
1.60	J	N=17			1.30				
					2.00	Brownish grey, slightly gravelly, sandy CLAY. Gravel is subangular, fine to coarse, including sandstone, brick and metal. (MADE GROUND)			
		N=29			2.90				
					3.00	Orange brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)			
		N=12			4.00	Firm to stiff, brownish grey, slightly silty, slightly sandy, slightly gravelly CLAY. Gravel is subangular, fine to medium, including sandstone, siltstone and mudstone. (GLACIAL TILL)			
		N=57			4.50				
					5.00	End Of Borehole At 4.50 m			
					6.00				
					7.00				
					8.00				

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 refused at 4.50mbgl.

Scale: 1:50

Water Strikes

Date	Strike	Level	Minutes	Casing	Sealed
19/03/2019	2.9				

Daily Log Of Depths

Date	Casing	Water	From	To	Hours

		Project Title: The Boundary Medical Centre				WS3	
		Project Number: 8651G		Client: Arcus Consulting LLP			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 18/03/2019		Method: Window Sample		Driller: LOT Geotechnics Ltd		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.40	E				0.20	Brick paving. (MADE GROUND)		
		N=17			0.80	Yellow brown, fine to coarse SAND. (MADE GROUND)		
					1.00	Pinkish brown, gravelly, fine to coarse SAND. Gravel is subangular, fine to coarse, including sandstone. (MADE GROUND)		
		N=14			2.00	Brownish grey, slightly sandy, subangular to subrounded, fine to coarse GRAVEL and COBBLES including brick. (MADE GROUND)		
2.60	J				2.30	Orange brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is subrounded, fine to coarse, including sandstone. (GLACIOFLUVIAL SHEET DEPOSITS)	▼	
		N=7			3.00			
					3.30			
		N=13			4.00	Firm, brownish grey, slightly silty, slightly sandy, slightly gravelly CLAY. Gravel is subangular, fine to medium, including sandstone, siltstone and mudstone. (GLACIAL TILL)		
						End Of Borehole At 4.00 m		
					5.00			
					6.00			
					7.00			
					8.00			

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 3.20mbgl. Scale: 1:50		<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>19/03/2019</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	19/03/2019	3																	Daily Log Of Depths			Chiselling			Date	Casing	Water	From	To	Hours												
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19/03/2019	3																																																														
Daily Log Of Depths			Chiselling																																																												
Date	Casing	Water	From	To	Hours																																																										

APPENDIX 04

Chemical Analytical Results



2183

Final Report

Report No.: 19-09839-1

Initial Date of Issue: 28-Mar-2019

Client WML Consulting Ltd

Client Address: No. 8 Oak Green
Stanley Green Business Park
Earl Rd
Cheadle
SK8 6QL

Contact(s): Sam Seddon

Project 8651G The Boundary Medical Centre

Quotation No.:		Date Received:	20-Mar-2019
Order No.:	8651G	Date Instructed:	20-Mar-2019
No. of Samples:	8		
Turnaround (Wkdays):	7	Results Due:	28-Mar-2019
Date Approved:	28-Mar-2019		

Approved By:



Details: Martin Dyer, Laboratory Manager

Results - Soil

Client: WML Consulting Ltd	Chemtest Job No.:				19-09839	19-09839	19-09839	19-09839	19-09839	19-09839	19-09839	19-09839
Quotation No.:	Chemtest Sample ID.:				796817	796818	796819	796820	796821	796822	796823	796824
Order No.: 8651G	Client Sample Ref.:				E	JV	J	E	J	E	J	E
	Client Sample ID.:				1	2	3	4	5	6	7	8
	Sample Location:				WS1	WS1	WS1	WS2	WS2	WS3	WS3	HP1
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	3.0	3.6	0.3	1.6	0.4	2.6	0.35
	Date Sampled:				18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019
	Asbestos Lab:				COVENTRY			COVENTRY		COVENTRY		COVENTRY
Determinand	Accred.	SOP	Units	LOD								
ACM Type	U	2192		N/A	-			-		-		-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected			No Asbestos Detected		No Asbestos Detected		No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-			-		-		-
Moisture	N	2030	%	0.020	9.0	39	14	14	6.4	6.4	8.6	17
pH	U	2010		N/A	9.8		8.9	11.5	9.4	9.3	8.7	9.0
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40			0.54		< 0.40		< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.16		0.033	0.48	0.081	< 0.010	< 0.010	0.050
Total Sulphur	U	2175	%	0.010	0.024		0.12	0.14	< 0.010	0.014	< 0.010	0.048
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50			< 0.50		< 0.50		< 0.50
Sulphate (Total)	U	2430	mg/kg	100	770			4100		210		770
Arsenic	U	2450	mg/kg	1.0	31			13		17		12
Cadmium	U	2450	mg/kg	0.10	< 0.10			0.18		0.12		0.20
Copper	U	2450	mg/kg	0.50	17			9.2		4.2		30
Mercury	U	2450	mg/kg	0.10	0.23			0.12		< 0.10		0.28
Nickel	U	2450	mg/kg	0.50	10			15		4.9		15
Lead	U	2450	mg/kg	0.50	72			22		8.4		130
Selenium	U	2450	mg/kg	0.20	< 0.20			< 0.20		< 0.20		< 0.20
Vanadium	U	2450	mg/kg	5.0	12			18		6.7		21
Zinc	U	2450	mg/kg	0.50	51			26		6.3		47
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50			< 0.50		< 0.50		< 0.50
Organic Matter	U	2625	%	0.40	0.59			1.0		< 0.40		4.7
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0		< 1.0						
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0		< 1.0						
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0		< 1.0						
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0		< 1.0						
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0		< 1.0						
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0		< 1.0						
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0		< 1.0						
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0						
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0		< 5.0						
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0		< 1.0						
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0		< 1.0						
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0		< 1.0						
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0		< 1.0						
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0		< 1.0						
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0		< 1.0						

Results - Soil

Client: WML Consulting Ltd	Chemtest Job No.:				19-09839	19-09839	19-09839	19-09839	19-09839	19-09839	19-09839	19-09839
Quotation No.:	Chemtest Sample ID.:				796817	796818	796819	796820	796821	796822	796823	796824
Order No.: 8651G	Client Sample Ref.:				E	JV	J	E	J	E	J	E
	Client Sample ID.:				1	2	3	4	5	6	7	8
	Sample Location:				WS1	WS1	WS1	WS2	WS2	WS3	WS3	HP1
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	3.0	3.6	0.3	1.6	0.4	2.6	0.35
	Date Sampled:				18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019	18-Mar-2019
	Asbestos Lab:				COVENTRY			COVENTRY		COVENTRY		COVENTRY
Determinand	Accred.	SOP	Units	LOD								
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0		< 1.0						
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0						
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0		< 5.0						
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0		< 10						
Naphthalene	U	2700	mg/kg	0.10	< 0.10			< 0.10		< 0.10		< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10			< 0.10		< 0.10		< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10			< 0.10		< 0.10		< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10			< 0.10		< 0.10		< 0.10
Phenanthrene	U	2700	mg/kg	0.10	0.69			0.25		0.21		0.57
Anthracene	U	2700	mg/kg	0.10	0.11			< 0.10		< 0.10		0.14
Fluoranthene	U	2700	mg/kg	0.10	0.59			0.13		0.12		0.63
Pyrene	U	2700	mg/kg	0.10	0.64			0.20		0.14		0.76
Benzo[a]anthracene	U	2700	mg/kg	0.10	0.33			< 0.10		< 0.10		0.27
Chrysene	U	2700	mg/kg	0.10	0.42			< 0.10		< 0.10		0.36
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	0.18			< 0.10		< 0.10		0.29
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10			< 0.10		< 0.10		0.19
Benzo[a]pyrene	U	2700	mg/kg	0.10	0.16			< 0.10		< 0.10		0.35
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	0.40			< 0.10		< 0.10		0.23
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	0.15			< 0.10		< 0.10		0.13
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	0.46			< 0.10		< 0.10		0.29
Total Of 16 PAH's	U	2700	mg/kg	2.0	4.1			< 2.0		< 2.0		4.2
Total Phenols	U	2920	mg/kg	0.30	< 0.30			< 0.30		< 0.30		< 0.30

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

- U UKAS accredited
- M MCERTS and UKAS accredited
- N Unaccredited
- S This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
- SN This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
- T This analysis has been subcontracted to an unaccredited laboratory
- I/S Insufficient Sample
- U/S Unsuitable Sample
- N/E not evaluated
- < "less than"
- > "greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

APPENDIX 05

Gas Monitoring Results

Gas & Groundwater Monitoring Record Sheet



Project Name:- Boundary Medical Centre
Project No:- 8651G
Client:- MSV Housing Group

Date:- 09/04/2019
Start Time:- 10:00
End Time:- 10:30
Ground Conditions:- Dry
Weather Conditions:- Overcast

Atmospheric Pressure
Start:- 1013mb
End:- 1012mb
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	GSV l/hr	Peak	GSV l/hr						
WS1	<0.1	<0.1	0	0.0	0.0000	0.1	0.0001	20.2	0	0	0.000	Dry	2.80
WS2	<0.1	<0.1	0	0.0	0.0000	0.0	0.0000	20.5	0	0	0.000	2.85	3.30

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	17/08/18		
Atmospheric Pressure	1001	mB	
Ambient Temperature	21.7	°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	120377
Order Number	320675

Serial Number	12969
Software Version	G436-00.0027/0010

Recalibration DUE Date
17/08/19

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	
	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	80		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		1001	Accept ± 2.0
AP Port (Internal)	+800 mB	800	Accept ± 5.0
	+1200 mB	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	-30.1	Accept ± 3.0	-545	-552	Accept ± 50
-3	-3	Accept ± 1.0	-22	-22	Accept ± 6.0
0	0	Accept ± 0.0	0	0	Accept ± 0.5
3	3	Accept ± 0.5	16	16	Accept ± 3.0
30	30	Accept ± 3.0	384	384	Accept ± 50
60	60	Accept ± 6.0	1185	1181	Accept ± 130
90	90.5	Accept ± 9.0	2333	>>>>	Accept ± 250

Temperature Checks		
Calibration Temperature	Instrument Temperature Reading $^{\circ}\text{C}$	
Applied Temperature $^{\circ}\text{C}$		
-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:
Jack Rutland

Date Tested:
20/08/18

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 06

Site Specific Acceptance Criteria

Screening Levels for "Commercial" end use assuming a 1% SOM for Hydrocarbons.

Contaminant	Screening Levels for Commercial End Use (mg/kg)
Metals	
Arsenic	640
Boron	240,000
Cadmium	190
Chromium III	8,600
Chromium VI	33
Copper	68,000
Lead*	2330
Mercury	58
Nickel	980
Selenium	12,000
Vanadium	9,000
Zinc	730,000
Non Metals	
Phenol	440
Polyaromatic Hydrocarbons (PAHs)	
Benz[a]anthracene	170
Benzo[a]pyrene	35
Benzo[b]fluoranthene	44
Benzo[ghi]perylene	3,900
Benzo[k]fluoranthene	1,200
Chrysene	350
Dibenz[ah]anthracene	3.5
Fluoranthene	23,000
Indeno[123-cd]pyrene	500
Naphthalene	190
Pyrene	54,000

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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	Screening Levels for Commercial End Use (mg/kg)
Volatile Organic Compounds	
Benzene	27
Ethylbenzene	5,700
Toluene	56,000
M - Xylene	6,200
O - Xylene	6,600
P - Xylene	5,900
Total Petroleum Hydrocarbons	
Aliphatic C5-6	3,200
Aliphatic C6-8	7,800
Aliphatic C8-10	2,000
Aliphatic C10-12	9,700
Aliphatic C12-16	59,000
Aliphatic C16-35	1,600,000
Aliphatic C35 - 44	1,600,000
Aromatic C5 - 7	26,000
Aromatic C7 - 8	56,000
Aromatic C8-10	3,500
Aromatic C10-12	16,000
Aromatic C12-16	36,000
Aromatic C16-21	28,000
Aromatic C21-35	28,000
Aromatic C35 - 44	28,000

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