

Phase 2 Geo-Environmental Investigation & Assessment

For

Dob Brook Close, Failsworth

Undertaken on behalf of

The Guinness Partnership

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Executive Summary

Site Location	The site comprises land located off Dob Brook Close, Failsworth, Manchester. It is centred on approximate Ordnance Survey National Grid Reference 388340E, 400675N with an indicative postcode of M40 1DB.
Development Proposals	It is understood that the currently proposed development will comprise 30no residential apartment units within 3no low rise structures, together with external hardstanding for access and parking. The development will also include shared landscaped garden areas.
Ground Conditions	Ground conditions encountered during the intrusive investigation comprise made ground to depths of between 1.30m and 3.80mbgl, this being underlain by Glacial Till which has been proven to a maximum depth of 5.00mbgl.
Site Preparation and Earthworks	Prior to any site earthworks commencing, infestations of Japanese Knotweed (JKW) will need to be treated / eradicated by the specialist contractor. The removal of trees and other vegetation may need to be undertaken in consultation with an ecological specialist. Due to the previously undeveloped nature of the site, significant ground obstructions in the form of existing foundations, floor slabs and other buried obstructions are not anticipated, but cannot be fully discounted. As the site is bounded to the south by the Rochdale Canal, any groundworks will need to ensure that the integrity of the canal is not compromised and will need to be undertaken in accordance with the Canal Trusts 'Code of Practice'. A detailed structural dilapidation survey of the existing boundary wall will be required, in consultation with a party wall surveyor, prior to any works commencing. The CCTV survey undertaken by GUN in September 2019, did not encounter any evidence for a culvert extending beneath the site from Dob Brook Close in the north-west. It is anticipated that, once the vegetation has died down and/or has been cleared, further inspection should be undertaken to ascertain whether any manholes are visible on site, with further survey work being undertaken to accurately delineate the culvert, should this be the case.
Foundations and Floor Slabs	Foundations will need to be taken down to competent glacial till where a net allowable bearing pressure of 100kN/m² would be achieved. However, the till will be encountered, in most cases, at depths of between 2.00m and 4.50mbgl, becoming deeper from the south-west to the north-east of the site. Foundation depths for each apartment block may therefore vary considerably with the deeper foundation excavations needing to be adequately supported and dewatered to maintain stability. Therefore, in consideration of the issues outlined above it is anticipated that a piled foundation solution will be the most suitable option for all structures at the site. Pile type, selection and design should to be undertaken in conjunction with a reputable, specialist piling contractor, ideally with experience of the local ground conditions. Once the proposed layout has been confirmed, it is recommended that further plot specific ground investigations comprising cable percussive boreholes, are undertaken to provide geotechnical parameters for deeper soils for appropriate pile design. In consideration of the thickness of made ground, new floor slabs will need to be suspended and probably of beam and block construction.
Excavations and Groundwater	Perched groundwater inflows should be anticipated within excavations. Conventional 'sump and pump' dewatering measures may not be adequate to keep excavations dry and it cannot be discounted that groundwater exclusion measures such as interlocking sheet piles may be required 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	New road pavement design should be based on a California Bearing Ratio (CBR) value of no more than 2.5%.

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. However, further testing of sulphate and pH levels in deeper soils will be required should a piled foundation option be considered.
Soakaways	In consideration of the site being underlain by made ground and relatively impermeable glacial till, soakaways are not considered to be a feasible drainage option for the site
Ground Gas	The site classifies as Characteristic Situation (CS) 1 – Very Low Gas Risk'. However, as carbon dioxide concentrations exceed 5%, the site may need to be classified as Characteristic Situation (CS) 2 – 'Low Gas Risk' in accordance with BS8485:2015. Therefore, at this stage it cannot be discounted that new structures may need to incorporate ground gas protection measures to provide a score of 3.5 in accordance with Table 4 of BS8485:2015. This would typically comprise: • Passive sub-floor dispersal (minimum 100mm clear void); • Sub-slab ventilation at minimum 1500mm²/m centres to at least opposite sides of the structure; • Lapped, taped and sealed gas resistant membrane to reasonable levels of workmanship in line with current good practice. • Membrane to be sealed around all penetrations and to damp proof course. This will need to be confirmed on completion of the ground gas monitoring and risk assessment in due course and should also be confirmed with the local authority Environmental Health / Building Control Officer prior to any building design being finalised.
Contamination Assessment	The test results indicate that made ground beneath the site contains levels of certain contaminants that are slightly elevated above their respective SL's. These relate in the main to very slightly elevated and localised concentrations of lead and mercury within a single sample of made ground (TP1 0.40mbgl) and several slightly elevated PAH compounds. These are considered to be most likely due to the presence of ash and clinker within the made ground matrix. Proposed shared landscaped areas should be capped by clean sub-soil and topsoil thus removing the pollution linkage. This will normally comprise a 600mm clean cover where underlain by made ground. The likelihood of encountering unrecorded contamination in other areas of the site cannot be wholly discounted. Very localised slightly elevated leachable concentrations of lead and copper were recorded within a single sample of made ground when compared to the stringent drinking water standards and EQS vales respectively. Taking into consideration that the site is not within an EA Source Protection Zone and there are no groundwater / surface water abstractions recorded within influencing distance, the slightly elevated concentrations are not considered to pose a significant risk to controlled waters. In view of this and the likelihood for the Rochdale Canal to be lined with impermeable puddle clay, recorded leachable concentrations of contaminants beneath the site are not considered to pose a significant risk to groundwater or to the canal with no specific environmental remedial measures necessary. Notwithstanding this, provisions should be put in place through appropriate management of surface water run-off, to ensure that no silt or sediment enters the canal during construction.
Potable Water Supplies	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.
Waste Soils	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.

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 The Guinness Partnership to undertake a Phase 2 Geo-environmental Investigation and Assessment of a site referred to as Dob Brook Close, Failsworth.

Proposed Development

- 1.2 It is understood that the currently proposed development will comprise 30no residential apartment units within 3no low rise structures, together with external hardstanding for access and parking. The development will also include shared landscaped garden areas.
- 1.3 A drawing indicating the proposed layout by Bowker Sadler Architecture, referenced 18-079-0009 Rev A, 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 has been undertaken by WML and is presented in the following report:
- Phase 1 Desk Study and Preliminary Geoenvironmental Assessment Report, Reference 8948G-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 Phase 1 desk study. 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 and machine excavated trial holes 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 located off Dob Brook Close, Failsworth, Manchester. It is centred on approximate Ordnance Survey National Grid Reference 388340E, 400675N with an indicative postcode of M40 1DB.
- 2.2 The proposed development site is bounded to the north and east by residential properties on Dob Brook Close, to the south by the Rochdale Canal and to the west by a scrap yard and car showroom.

Site Description

- 2.3 At the time of the investigation on 11th September 2019, the site was undeveloped and fenced-off from the general public.
- 2.4 The north-western, western and southern area of the site was surfaced with overgrown grass and low-lying vegetation.
- 2.5 The central and south-eastern area was surface with dense semi-mature and mature trees of varying species. Further mature trees were located sporadically within the northern and western sections of the site.
- 2.6 Historically the western and south-western section of the site included large stands of Japanese Knotweed. It is understood that these have been treated by a Japanese Knotweed specialist and evidence of dead stems and the base of large stands were visible in this section of the site. However, locally small volumes of re-growth were noted during the site inspection in August 2019.
- 2.7 An area of localised fly tipping, located in the north-western corner of the site, mainly comprised plastic, broken windscreen glass, vegetation and metal sheeting. No obvious signs of Asbestos Containing Material (ACM) was evident within the fly-tipped material.
- 2.8 The brick wall which forms the western boundary with the scrap yard included a metal door which historically provided access between the adjacent site into a former structure within the site boundary (demolished in 1980).
- 2.9 The site reduces in elevation from approximately 89.00m Above Ordnance Datum (AOD) in the west to around 88.50mAOD in the north-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 and Mining

3.2 The site is indicated to be underlain by Devensian Glacial Till comprising mainly clay but possibly with interbedded sand and gravel horizons. The superficial deposits are indicated to be underlain by strata of the Permian Collyhurst Sandstone which is recorded to comprise mainly red sandstone.

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 Health Protection Agency 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

3.5 The superficial deposits underlying the site are classified as a 'Secondary (Undifferentiated) Aquifer'. The underlying bedrock is classified as a 'Principal Aquifer'.

3.6 The site is not within an Environment Agency Source Protection Zone (SPZ) and there are no groundwater abstraction licences within 1km.

3.7 The nearest surface water feature is the Rochdale Canal which forms the southern site boundary.

3.8 The nearest historic landfill is located over 250m to the north off Mill Lane. A vehicle scrap yard is located at the south-western site boundary.

3.9 There are 3no petrol filling stations located within 250m of the site, the closest being 105m west which is obsolete.

3.10 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

3.11 The earliest complete maps dated 1848 indicate the site to have been predominantly undeveloped and in rural / agricultural use. A watercourse, presumably Dob Brook, extended north-west to south-east across the central section of the site, before being culverted to the south-east. By 1892 Dob Brook had been either been culverted or diverted.

3.12 The site then remained unchanged until 1906 when it formed the south-western section of a larger football ground. With the exception of a small structure in the south-western corner of the site between 1931 and 1980 the site has never been further developed.

3.13 The area immediately surrounding the site historically comprised undeveloped rural/agricultural land before being developed for mixed industrial, commercial and residential uses. The closest historical industrial development in the wider surrounding area included a cotton mill, brewery and later a vehicle scrap yard which is still in use.

4.0 PRELIMINARY CONTAMINATION RISK ASSESSMENT

- 4.1 The Phase 1 desk study report concluded that potential pollution linkages are 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 of hazardous ground gas concentrations and flow.

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 A general coverage of the site was considered appropriate although investigations could not be undertaken in the area demarcated as being affected by Japanese Knotweed on drawing 8948G-SK01 in Appendix 01, and within localised stands of knotweed within the densely overgrown areas.
- 5.3 It should also be noted that investigation locations were chosen where possible to align with the development layout at the time and that the layout was changed since the site investigation was undertaken as a result of planning consultation with the Canals and River Trust.
- 5.4 Window sample probeholes were undertaken to provide information on near surface deposits and to facilitate installation of standpipes.
- 5.5 This method of investigation was chosen due to the densely overgrown nature of the site and restricted access. 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.
- 5.6 Also, due to the restricted nature of the site, machine excavated trial pits were undertaken, using a tracked mini-digger, to provide information on near surface deposits and to obtain samples for chemical analysis. The size of the machine was limited due to the gate size and requirement associated with the Japanese Knotweed.
- 5.7 TP1, TP4 and WS1 were also located within potential areas of the suspected infilled/ culverted Dob Brook.
- 5.8 Monitoring standpipes were installed in selected probeholes for the measurement of gas and groundwater levels.

Intrusive Works

- 5.9 Ground investigation work was undertaken by LOT Geotechnics Ltd on 11th September 2019. This comprised the formation of 6no window sample probeholes to a maximum depth of 5.00 metres below ground level (mbgl).
- 5.10 WML also oversaw the formation of 4no machine excavated trial pits on 11th September 2019 to a maximum depth of 2.70mbgl.
- 5.11 The exploratory hole records are presented in Appendix 02 of this report whilst the exploratory hole locations are shown on Drawing 8948G-SK01 in Appendix 01.

Monitoring Standpipes

- 5.12 Monitoring wells for groundwater were installed in 3no probeholes as indicated on the logs presented in Appendix 02.

Geotechnical and Chemical Testing

- 5.13 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.
- 5.14 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.
- 5.15 In order to assess the potential risk to controlled waters, selected samples of soils were submitted for leachate preparation and analyses of the following suite of contaminants:
- Total arsenic, boron, cadmium, chromium VI, copper, lead, mercury, nickel, selenium, vanadium, zinc.
 - Speciated (16) hydrocarbons (PAH).
 - Total phenols, sulphur, sulphate.
 - Sulphate extract, pH.
 - Water hardness (CaCO₃).
- 5.16 The results of the chemical analysis are presented in Appendix 03.

Gas and Groundwater Monitoring

- 5.17 Gas and groundwater monitoring has been carried out on three occasions to date between 17th September and 21st October 2019. The monitoring results are presented in Appendix 04.

6.0 GROUND CONDITIONS

Stratigraphy

- 6.1 Ground conditions encountered during the intrusive investigation comprise made ground to depths of between 1.30m and 3.80mbgl, this being underlain by Glacial Till which has been proven to a maximum depth of 5.00mbgl.

Made Ground

- 6.2 Made ground was encountered within all exploratory holes from ground level to depths of between 1.30m and 3.80mbgl.
- 6.3 The upper horizon of made ground generally comprised brown and grey, interbedded clay, sand and gravel with a low to medium cobble content, to depths of between 0.90m and 1.90mbgl. Gravel sized fragments included brick, sandstone, concrete, slate, ash and locally coal, clinker, metal, wood and ceramic. Cobble sized fragments included sandstone, brick and concrete.
- 6.4 Within the majority of exploratory holes a lower horizon of made ground comprising dark grey to black, locally slightly silty, sandy gravel extended to depths of between 1.30m and 3.80mbgl. Gravel sized fragments included predominantly ash and clinker but also locally wood, brick and slate.
- 6.5 Within WS1, a basal layer of made ground comprised dark brown, slightly clayey, silty sand with occasional organic flecks from 2.30m to 3.00mbgl. Also, within WS5, a horizon of dark brown, organic, peaty clay was encountered between 2.40m and 2.90mbgl.
- 6.6 Deposits considered to represent possible recent deposits was encountered within WS4 between depths of 2.30m and 3.00mbgl. This comprised soft grey slightly silty, sandy clay with some decayed roots.
- 6.7 SPT 'N' values within the made ground ranged between 3 and 21, but generally between 3 and 8, indicating it to be soft and/or loosely compacted.

Glacial Till

- 6.8 Within the all of the exploratory holes, glacial till was encountered beneath the made ground at depths of between 1.30m and 3.80mbgl.
- 6.9 The till generally comprised brown and grey mottled, slightly sandy, slightly gravelly, silty clay.
- 6.10 The upper horizons were generally described as being soft to firm, increasing in strength with increasing depth, generally to a stiff consistency.
- 6.11 SPT 'N' values within the glacial till ranged between 6 and 47 with an average of 18 indicating a locally soft but generally firm to stiff consistency.

Visual/Olfactory Evidence of Contamination

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

Groundwater

- 6.13 Groundwater seepages were encountered within the majority of exploratory holes at depths of between 1.00m and 2.40mbgl and mainly within the granular horizons of made ground.

- 6.14 During the initial monitoring visits, standing water was recorded at depths of between 1.25m and 2.80mbgl. This is considered to represent water perched within the made ground with true phreatic groundwater levels anticipated to be in excess of 5.00mbgl.
- 6.15 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

- 6.16 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 Prior to any site earthworks commencing, infestations of Japanese Knotweed (JKW) will need to be treated / eradicated by the specialist contractor. This will likely comprise excavating and removing the JKW and the associated rhizome infested soil to a licenced landfill. However, infestations are also known to exist immediately west of the site within the vehicle scarp yard. Therefore, the JKW specialist should be consulted with regards to the prevention of spread and regrowth beneath the party wall. It is understood that this is to be managed through the use of root barriers.
- 7.2 A report on the effective treatment and eradication of JKW should be sought from the specialist treatment contractor on completion.
- 7.3 The removal of trees and other vegetation may need to be undertaken in consultation with an ecological specialist.
- 7.4 Due to the previously undeveloped nature of the site, significant ground obstructions in the form of existing foundations, floor slabs and other buried obstructions are not anticipated. However, in consideration of the infilled nature of the site, it cannot be wholly discounted that localised obstructions may be encountered and will need to be broken out to suitable depths below formation levels where they are to impinge on the proposed redevelopment.
- 7.5 Site enabling works will need to take account of the integrity of neighbouring statutory utilities.
- 7.6 As the site is bounded to the south by the Rochdale Canal, any groundworks will need to ensure that the integrity of the canal is not compromised and will need to be undertaken in accordance with the Canal Trusts 'Code of Practice'.
- 7.7 Site enabling works and particularly the removal of JKW infested soil, will also need to take account of the integrity of the existing party wall to the western boundary of the site. A detailed structural dilapidation survey of the wall may therefore be required, in consultation with a party wall surveyor, prior to any works commencing.
- 7.8 The CCTV survey undertaken by GUN in September 2019, did not encounter any evidence for a culvert extending beneath the site from Dob Brook Close in the north-west. However, it was noted that due to the site being overgrown, it could not be determined if any manhole covers were located within the site boundary. Therefore, although considered unlikely, it cannot be fully discounted that Dob Brook may be culverted beneath the site.
- 7.9 It is anticipated that, once the vegetation has died down and/or has been cleared, further inspection should be undertaken to ascertain whether any manholes are visible on site, with further survey work being undertaken to accurately delineate the culvert, should this be the case.

Foundations

- 7.10 Made ground and any soft organic clays should be considered unsuitable for the direct support of structural loads as these could result in unacceptable total and differential settlements on loading.
- 7.11 Foundations will therefore need to be taken down to competent glacial till where a net allowable bearing pressure of 100kN/m² would be achieved. However, the till will be encountered, in most cases, at depths of between 2.00m and 4.50mbgl, becoming deeper from the south-west to the north-east of the site. Foundation depths for each apartment block may therefore vary considerable with the deeper foundation excavations needing to be adequately supported and dewatered to maintain stability.
- 7.12 Also, such excavations will generate significant waste soil which would probably need to be disposed to landfill.

- 7.13 This, together with the anticipated depth of excavation in most areas will likely render the use of deep mass concrete spread foundations impractical and uneconomical.
- 7.14 Therefore, in consideration of the issues outlined above it is anticipated that a piled foundation solution will be the most suitable option for all structures at the site.
- 7.15 Piles will need to be taken down through the made ground and any soft soils and into the underlying competent glacial till. Pile design should assume no side support (skin friction) for the pile sections surrounded by made ground or soft soils.
- 7.16 Pile type, selection and design should to be undertaken in conjunction with a reputable, specialist piling contractor, ideally with experience of the local ground conditions.
- 7.17 For preliminary considerations, a pre-cast driven concrete pile would minimise waste soil arisings but potential noise and vibration effects may render this option unsuitable. Therefore, a bored pile solution is likely to be the most appropriate solution for the site.
- 7.18 Once the proposed layout has been confirmed, it is recommended that further plot specific ground investigations are undertaken in order to inform detailed foundation design. This will include the formation of cable percussive boreholes to provide geotechnical parameters for deeper soils for appropriate pile design.

Floor Slabs

- 7.19 In consideration of the thickness of made ground, new floor slabs will need to be suspended and probably of beam and block construction.

Excavations and Groundwater

- 7.20 Excavations at the site will be feasible using conventional hydraulic plant. All excavations at the site and specifically requiring man-entry, will need adequate lateral support, or will need to be battering back to a safe angle to ensure their stability.
- 7.21 Perched groundwater inflows should be anticipated within excavations. Conventional 'sump and pump' dewatering measures may not be adequate to keep excavations dry and it cannot be discounted that groundwater exclusion measures such as interlocking sheet piles may be required to prevent excessive ingress of water.
- 7.22 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

- 7.23 In consideration of the near surface ground conditions being of made ground, it is recommended that new road pavement design should be based on a California Bearing Ratio (CBR) value of no more than 2.5%.
- 7.24 The CBR will 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.
- 7.25 In any event, all formations should be proof-rolled with any soft, loose or otherwise unsuitable material being removed and replaced with compacted granular fill.

Concrete Design

- 7.26 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.

- 7.27 Values of 2:1 water/soil extract for sulphate range between 10mg/l and 58mg/l. Values of pH at range from 7.2 to 7.4 indicating near neutral conditions.
- 7.28 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.
- 7.29 However, further testing of sulphate and pH levels in deeper soils will be required should a piled foundation option be considered.

Drainage and Soakaways

- 7.30 In consideration of the site being underlain by made ground and relatively impermeable glacial till, soakaways are not considered to be a feasible drainage option for the site.

8.0 GENERIC QUANTITATIVE RISK ASSESSMENT (GQRA)

General

- 8.1 A review of the desk study information has concluded that significant pollution linkages were unlikely with the overall preliminary risk on the whole being assessed as to low
- 8.2 Further to this, no visual and/or olfactory evidence of significant ground contamination was identified within the exploratory holes during the investigation.
- 8.3 However, due to the presence of made ground, it has been considered prudent to adopt a precautionary principal and undertake chemical analysis of the near-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 both 1% and 2.5% SOM are provided in Appendix 05.

Controlled Water

- 8.13 Due to the proximity of the Rochdale Canal, it has been considered prudent to establish the leachability potential of contaminants within the made ground soils.
- 8.14 Generic criteria for the assessment of potential groundwater contamination have been derived from very conservative guidelines protective of drinking water and environmental quality, namely:
- UK Drinking Water Standards (DWS) as defined by The Water Supply (Water Quality) Regulations, 2016;
 - UK Environmental Quality Standards (EQS) for Freshwater, based on a Hardness of 50mg/l to 100mg/l (Soft in accordance with United Utilities information for the area), 2000.
- 8.15 A table of relevant assessment criteria protective of controlled waters is provided in Appendix 05.

Soil Test Results

- 8.16 8no samples of made ground were analysed for a suite of Contaminants of Concern (CoC). The Organic Matter Content for the samples generally range from 2.5% to 7.6% with a single samples at 1.7%. It has therefore been considered appropriate to adopt screening levels (SL's) relating to a 2.5% SOM in the generic assessment.
- 8.17 The majority of the concentrations measured are below the relevant SL's for "Residential with homegrown produce" end-use assuming a 2.5% SOM with the following exceptions.

Contaminant	Number of Exceedances	SL (mg/kg)	Recorded Concentrations (mg/kg)	Samples
Mercury	1	1.2	2.1	TP1 – 0.40m
Lead	1	200	270	TP1 – 0.40m
Benzo[a]anthracene	1	11	15	TP2 – 0.65m
Benzo[a]pyrene	4	2.7	4.2 – 13	TP1 – 0.40m TP2 – 0.30m TP2 – 0.65m TP4 – 0.30m
Dibenzo[a,h]anthracene	6	0.28	0.64 – 2.3	WS1 – 0.40m TP1 – 0.40m TP2 – 0.30m TP2 – 0.65m TP3 – 0.20m TP4 – 0.30m
Benzo[b]fluoranthene	4	3.3	4.2 – 12	TP1 – 0.40m TP2 – 0.30m TP2 – 0.65m TP4 – 0.30m

- 8.18 No asbestos was detected in any of the soil samples analysed.

Leachate Test Results

- 8.19 4no soil samples, namely TP1, TP2, TP3 and TP4, were submitted for the analysis of leachable concentrations of metals, semi-metals and PAH compounds.
- 8.20 The majority of the results were below the generic criteria when compared to the EQS for freshwater, and the more stringent UKDWS, with the following minor exceedances.

Contaminant	Ref Value ug/l		Exceedances ug/l		Samples
	EQS	UKDWS	EQS	UKDWS	
Copper	3	2000	3.3 & 5.3	-	TP2 – 1.70m TP4 – 1.70m
Lead	10	10	17	17	TP4 – 1.70m

Discussion and Conclusions

Risks to Human Health

- 8.21 The test results indicate that made ground beneath the site contains levels of certain contaminants that are slightly elevated above their respective SL's. These relate in the main to very slightly elevated and localised concentrations of lead and mercury within a single sample of made ground (TP1 0.40mbgl) and several slightly elevated PAH compounds. These are considered to be most likely due to the presence of ash and clinker within the made ground matrix.
- 8.22 As the site is currently covered with vegetation and secured from public access, the current risk to human health from direct contact with these contaminants is considered low.
- 8.23 Following site development, there will be no mechanism for a direct contact pollution linkage with contaminated soil where surfaced with buildings and hardstanding. However, a direct contact pollution linkage is plausible in proposed shared landscaped areas and it is recommended that these should be capped by clean sub-soil and topsoil thus removing the pollution linkage. This will normally comprise a 600mm clean cover where underlain by made ground.
- 8.24 In consideration of the above, it is anticipated that a remediation strategy will be required to bring the site to a condition suitable for the intended use by removing unacceptable risks to human health. The strategy will need to be submitted to the Local Planning Authority for their approval prior to any development commencing.
- 8.25 The likelihood of encountering unrecorded contamination in other areas of the site cannot be wholly discounted.

Risks to Controlled Waters

- 8.26 Slightly elevated leachable concentrations of lead were recorded within a single sample of made ground when compared to the stringent drinking water standards. In addition, when the results were compared against the EQS values for surface water, slight exceedances of copper were recorded in 2no samples of made ground.
- 8.27 Taking into consideration that the site is not within an EA Source Protection Zone and there are no groundwater / surface water abstractions recorded within influencing distance, the slightly elevated concentrations are not considered to pose a significant risk to controlled waters.

- 8.28 Furthermore, the site will include a positive drainage system which will intercept a significant volume of surface water runoff, thus greatly reducing the potential for contaminants to leach and become mobile.
- 8.29 In view of this and the likelihood for the Rochdale Canal to be lined with impermeable puddle clay, recorded leachable concentrations of contaminants beneath the site are not considered to pose a significant risk to groundwater or to the canal with no specific environmental remedial measures necessary.
- 8.30 Notwithstanding this, provisions should be put in place through appropriate management of surface water run-off, to ensure that no silt or sediment enters the canal during construction.

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 B buildings which include:
- *Private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout the ground floor.*

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 beneath the site up to 3.80m in thickness. This was not found to contain any significant volumes of organic materials which could be considered a significant source of ground gas. However, a relatively thin horizon of peaty clay was encountered

within WS5 between 2.40m and 2.90mbgl. Notwithstanding this, due to the age of infilling, the potential for the made ground to generate ground gas in significant volumes is considered low.

- 9.10 With the exception of localised recent deposits (WS4 2.30m to 3.00mbgl) which included some decayed roots, no evidence a significant thickness of natural organic material was encountered in the exploratory holes within the area of the infilled brook.
- 9.11 The presence of ground gas resulting from shallow unrecorded mine workings can be discounted.
- 9.12 In consideration of the above, the preliminary risk to the development from ground gas has been assessed low. However, it has been considered prudent to undertake ground gas monitoring, primarily for methane and carbon dioxide, with associated flow rates, on 3no occasions to date between 17th September and 21st October 2019.

Results and Recommendations

- 9.13 The results indicate concentrations of peak and steady methane below detection limits with peak and steady carbon dioxide concentrations generally ranging from 0.1% to 8.1% by volume in air.
- 9.14 No detectable ground gas flows have been recorded during the initial monitoring visits.
- 9.15 The results give a maximum composite Q_{hg} value of 0.0081l/hr and indicate the site to classify as Characteristic Situation (CS) 1 – 'Very Low Gas Risk'. However, as carbon dioxide concentrations exceed 5%, the site may need to be classified as Characteristic Situation (CS) 2 – 'Low Gas Risk' in accordance with BS8485:2015.
- 9.16 Therefore, at this stage it cannot be discounted that new structures may need to incorporate ground gas protection measures to provide a score of 3.5 in accordance with Table 4 of BS8485:2015. This would typically comprise:
- Passive sub-floor dispersal (minimum 100mm clear void);
 - Sub-slab ventilation at minimum 1500mm²/m centres to at least opposite sides of the structure;
 - Lapped, taped and sealed gas resistant membrane to reasonable levels of workmanship in line with current good practice.
 - Membrane to be sealed around all penetrations and to damp proof course.
- 9.17 This will need to be confirmed on completion of the ground gas monitoring and risk assessment in due course and should also 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, due to the restricted nature of the site and the inhomogeneous nature of the underlying made ground, sorting and segregation of excavated soils to render them suitable for re-use is not considered feasible.
- 10.3 Where soils are surplus to requirements, they will need to be removed from site through appropriate waste management.
- 10.4 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.
- 10.5 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.
- 10.6 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

- 10.7 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

- 10.8 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.

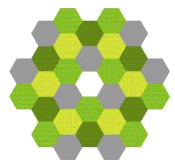
APPENDIX 01

Drawings

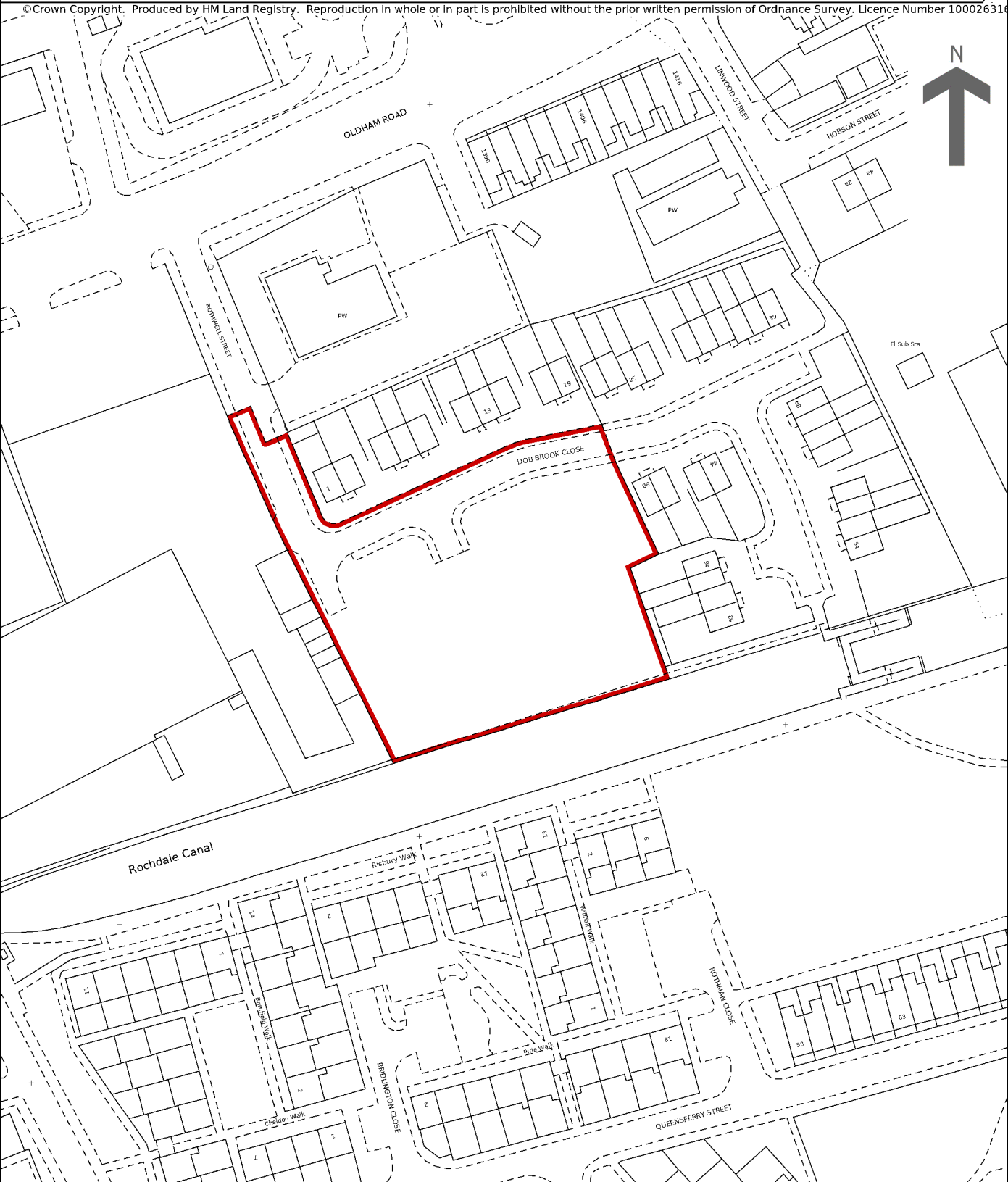
HM Land Registry

Current title plan

Title number **GM575031**
Ordnance Survey map reference **SD8800NW**
Scale **1:1250**
Administrative area **Greater Manchester :**
Manchester



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■ DRAWING TO BE READ IN CONJUNCTION WITH THE HEALTH AND SAFETY PLAN AND ALL RELEVANT RISK ASSESSMENTS

Schedule of Accommodation

Apartment Type	Gross Internal Floor Area (GIA)
2 N° Type 1 - 1B2P Apartments (Ground Floor)	50.8 m²
2 N° Type 2 - 1B2P Apartment (First Floor)	54.5 m²
2 N° Type 3 - 1B2P Apartments (Ground Floor)	50.8 m²
2 N° Type 4 - 1B2P Apartments (First Floor)	54.5 m²
2 N° Type 5 - 1B2P Apartments (Ground Floor)	50.8 m²
2 N° Type 6 - 1B2P Apartments (First Floor)	54.5 m²
8 N° Type 7 - 2B3P Apartments (Ground Floor)	61.0 m²
8 N° Type 8 - 2B4P Duplex Apartments (First Floor / Second Floor)	87.7 m²
1 N° Type 9 - 1B2P Apartment (Ground Floor)	50.8 m²
1 N° Type 10 - 1B2P Apartment (First Floor)	54.5 m²
Total:	30 N° Apartments 100% Parking
14 N° 1B2P Apartments	
8 N° 2B3P Apartments	
8 N° 2B4P Apartments	



Proposed Site Plan
1 : 200

A 30.09.19 ADS Apartment Gross Internal Floor Areas added MD

REV. DATE DRN. CHKD.

PROJECT
Dob Brook Close

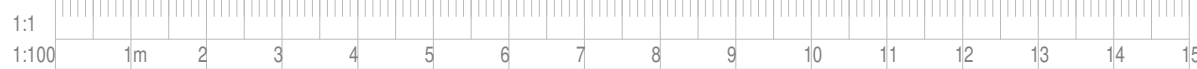
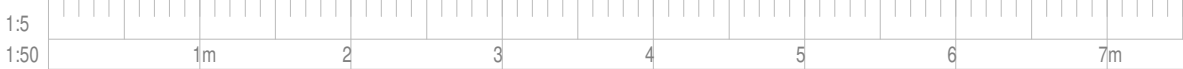
CLIENT
The Guinness Partnership

DRAWING
Proposed Site Plan

SCALE As indicated	SHEET SIZE @ A1	DRAWN ADS	CHECKED MD	DATE 13/09/2019
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BOWKER SADLER ARCHITECTURE
A: Hatherlow House, Hatherlow, Romiley, Stockport SK6 3DY
T: 0161 406 7333
E: office@bowker-sadler.co.uk
W: www.bowker-sadler.co.uk

JOB No 18-079	DRAWING No 0009	REVISION A
STATUS FEASIBILITY		





Station	Easting	Northing	Level
1	388361.508	400715.560	88.568
2	388307.208	400695.132	88.311

GENERAL NOTES

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

KEY

- SITE BOUNDARY
- ⊕ WS1 WINDOW SAMPLE PROBEHOLES
- ⊞ TP1 WINDOW SAMPLE PROBEHOLES
- ▨ AREA OF KNOWN JAPANESE KNOTWEED

P1	FIRST PRELIMINARY ISSUE	AUG '19	SCS	PGD
Rev.	Amendment	Date	By	Chkd

Project	DOB BROOK CLOSE
Client	THE GUINNESS PARTNERSHIP
Title	EXPLORATORY HOLE LOCATION PLAN

Drawn	Checked	Date	Scale
SCS	PGD	2210-19	1:200

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
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Job No.	8949G	Drawing No.	SK-01
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APPENDIX 02

Exploratory Hole Records

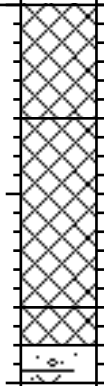
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	Project Number: 8948G	Client: Guinness Partnership	
	GL (mAOD):	N Coord: 0	E Coord: 0
Date: 11/09/2019	Method: Tracked Excavator	Logged By: TPB	Scale: 1:40



Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water
0.10	E				0.15	Dark brown, slightly silty SAND with roots. (MADE GROUND)	
0.40	E				1.00	Brownish grey, slightly clayey, gravelly SAND. Gravel is angular to subangular, fine to coarse, including brick, sandstone, slate and concrete. Medium cobble content. Cobbles are subangular, including brick and concrete. (MADE GROUND)	
1.90	E				1.70		
					2.00	Dark grey, slightly silty, slightly sandy, angular to subangular, fine to coarse GRAVEL including ash and clinker. (MADE GROUND)	
2.60	J				2.50		
					2.70	Firm, brown and grey mottled, slightly sandy, slightly gravelly, silty CLAY. Gravel is subangular to subrounded, fine to coarse, including sandstone. (GLACIAL TILL)	
					3.00	End Of Trial Pit At 2.70 m	
KEY D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 						REMARKS	

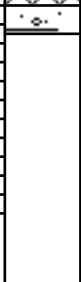
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	Project Number: 8948G	Client: Guinness Partnership	
	GL (mAOD):	N Coord: 0	E Coord: 0
Date: 11/09/2019	Method: Tracked Excavator	Logged By: TPB	Scale: 1:40



Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water
0.30	E					Dark brown, slightly silty, slightly gravelly SAND with roots. Gravel subangular, fine to coarse, including brick, sandstone and ash. (MADE GROUND)	
0.65	E				0.60		
					1.00	Brownish grey, slightly clayey, sandy, angular to subangular, fine to coarse GRAVEL including brick, sandstone, slate, concrete, ash and wood. Medium cobble content. Cobbles are subangular, including sandstone, brick and concrete. (MADE GROUND)	
1.70	E				1.60		
1.90	J				1.80	Dark grey, slightly silty, sandy, angular to subangular, fine to coarse GRAVEL including ash and clinker. (MADE GROUND)	
2.00	D				2.00	Firm, brown and grey mottled, slightly sandy, slightly gravelly, silty CLAY. Gravel is subangular to subrounded, fine to coarse, including sandstone. (GLACIAL TILL)	
						End Of Trial Pit At 2.00 m	
					3.00		
KEY D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa  - Groundwater Strike  - Groundwater Level 						REMARKS No Groundwater Encountered	

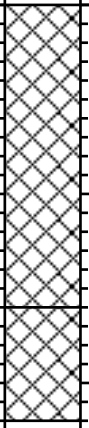
	Project Title: Dob Brook Close		TP3
	Project Number: 8948G	Client: Guinness Partnership	
	GL (mAOD):	N Coord: 0	E Coord: 0
Date: 11/09/2019	Method: Tracked Excavator	Logged By: TPB	Scale: 1:40



Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	
0.20	E					Turf over brownish grey, slightly clayey, gravelly SAND. Gravel is angular to subangular, fine to coarse, including brick, sandstone, wood and concrete. Low cobble content. Cobbles are subangular, including brick and concrete. (MADE GROUND)		
1.00	E				1.00			
					1.80	Dark grey, slightly silty, sandy, angular to subangular, fine to coarse GRAVEL including ash, clinker, brick, wood and slate. (MADE GROUND)		
					2.00			
2.60	J				2.50	Firm, brown and grey mottled, slightly sandy, slightly gravelly, silty CLAY. Gravel is subangular to subrounded, fine to coarse, including sandstone. (GLACIAL TILL) End Of Trial Pit At 2.65 m		
					2.65			
					3.00			
KEY						REMARKS		
D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa								
 - Groundwater Strike  - Groundwater Level								
								

	Project Title: Dob Brook Close		TP4
	Project Number: 8948G	Client: Guinness Partnership	
	GL (mAOD):	N Coord: 0	E Coord: 0
Date: 11/09/2019	Method: Tracked Excavator	Logged By: TPB	Scale: 1:40



Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water
0.30	E				1.00	Turf over brownish grey, slightly clayey, sandy, angular to subangular, fine to coarse GRAVEL including brick, sandstone, slate, concrete, wood, metal and ash. Medium cobble content. Cobbles are subangular, including brick and concrete. (MADE GROUND)	
1.70	E				1.60		
					2.00	Dark grey, slightly silty, slightly sandy, angular to subangular, fine to coarse GRAVEL including ash, clinker and brick. (MADE GROUND)	
					2.20		
					2.40	Firm, brown and grey mottled, slightly sandy, slightly gravelly, silty CLAY. Gravel is subangular to subrounded, fine to coarse, including sandstone. (GLACIAL TILL) End Of Trial Pit At 2.40 m	
				3.00			
KEY					REMARKS		
D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa							
 - Groundwater Strike  - Groundwater Level							

		Project Title: Dob Brook Close				WS1	
		Project Number: 8948G		Client: Guinness Partnership			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 11/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe	
0.40	E					Dark brown, slightly clayey, gravelly SAND with rootlets. Gravel is angular to subangular, fine to coarse, including brick, concrete, ash, clinker and coal. Low cobble content. Cobbles are subangular, including brick. (MADE GROUND)			
1.40	D	N=21			1.00				
					1.20		Brown, slightly gravelly, sandy CLAY. Gravel subangular, fine to coarse, including brick, ash and sandstone. (MADE GROUND)		
		N=3			1.90				
					2.00		Dark grey, slightly silty, sandy, angular to subangular, fine to coarse GRAVEL including ash and clinker. (MADE GROUND)		
					2.30				
		N=15			3.00	Dark brown, slightly clayey, silty SAND with occasional organic flecks (MADE GROUND)			
					4.00	Stiff, brown and grey mottled, slightly sandy, slightly gravelly, silty CLAY. Gravel is subangular to subrounded, fine to coarse, including sandstone and siltstone. (GLACIAL TILL)			
		N=15			5.00				
		N=32				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 Scale: 1:40		Water Strikes					
				Date	Strike	Level	Minutes	Casing	Sealed
				12/09/2019	1				
Daily Log Of Depths						Chiselling			
Date	Casing	Water	From	To	Hours				

		Project Title: Dob Brook Close				WS2	
		Project Number: 8948G		Client: Guinness Partnership			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 11/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: TPB	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
0.40	E				0.30	Turf over brown and grey, slightly sandy, subangular, fine to coarse GRAVEL including sandstone and brick. (MADE GROUND)		
		N=5			0.70			
					1.00	Brownish grey, slightly clayey, gravelly SAND with occasional organic flecks. Gravel is subangular, fine to coarse, including brick, ash, wood, sandstone, ceramic. (MADE GROUND)		
1.70	D				1.70			
		N=10			2.00	Brown, slightly gravelly, sandy CLAY. Gravel is subangular, fine to coarse, including brick and sandstone. (MADE GROUND)		
					2.00			
		N=18			3.00			
					3.00			
		N=32			4.00			
					4.00			
		N=26			4.60			
					4.60	End Of Borehole At 4.60 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 No Groundwater Encountered Sampler refused at 4.60mbgl. 	<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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		Project Title: Dob Brook Close				WS6	
		Project Number: 8948G		Client: Guinness Partnership			
		GL (mAOD):		N Coord: 0		E Coord: 0	
Date: 11/09/2019		Method: Window Sample		Driller: LOT Geotechnics		Logged By: KE	

Depth (m)	Type	Test Result	Level	Legend	Depth (m)	Description	Water	Standpipe
					0.15	Black clayey organic sand with many roots. (MADE GROUND)		
		N=5			1.00	Black clayey sandy fine to coarse gravel with medium cobble content. Gravel is concrete clinker and brick. Cobbles are brick. (MADE GROUND)		
					1.50			
		N=3			1.80	Soft brown sandy clay. (MADE GROUND)		
					2.00	Black ash and clinker. (MADE GROUND)	▼	
					2.40			
		N=12			3.00	Soft to firm locally very soft brown mottled grey sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded sandstone and mudstone and quartz. (GLACIAL TILL)		
					3.60			
		N=13			4.00			
					4.40			
		N=10			5.00	Firm brown slightly sandy slightly gravelly CLAY. (GLACIAL TILL)		
					5.40			
					5.80			
					6.00	End Of Borehole At 5.00 m		

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 	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>13/09/2019</td> <td>1.9</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	13/09/2019	1.9																											
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Scale: 1:40

APPENDIX 03

Chemical Analytical Results



2183

Final Report

Report No.:	19-30759-1		
Initial Date of Issue:	19-Sep-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	8948G Dob Brook Close		
Quotation No.:		Date Received:	13-Sep-2019
Order No.:	8948G	Date Instructed:	13-Sep-2019
No. of Samples:	15		
Turnaround (Wkdays):	5	Results Due:	19-Sep-2019
Date Approved:	19-Sep-2019		
Approved By:			
Details:	Amy Parekh-Pross, Technical Projects Manager		

Project: 8948G Dob Brook Close

Client: WML Consulting Ltd	Chemtest Job No.:					19-30759	19-30759	19-30759	19-30759
Quotation No.:	Chemtest Sample ID.:					887992	887996	887999	888003
Order No.: 8948G	Client Sample Ref.:					E	E	E	E
	Client Sample ID.:					4	8	11	15
	Sample Location:					TP1	TP2	TP3	TP4
	Sample Type:					SOIL	SOIL	SOIL	SOIL
	Top Depth (m):					1.9	1.7	1	1.7
	Date Sampled (\$):					11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019
Determinand	Accred.	SOP	Type	Units	LOD				
pH	U	1010			N/A	8.3	8.2	8.2	8.1
Sulphur	N	1220		mg/l	1.0	21	10	13	23
Sulphate	U	1220		mg/l	1.0	62	31	39	68
Hardness	U	1415		mg/l	15	160	59	78	96
Arsenic (Dissolved)	U	1450		µg/l	1.0	4.0	5.4	3.3	4.5
Boron (Dissolved)	U	1450		µg/l	20	130	63	73	86
Cadmium (Dissolved)	U	1450		µg/l	0.080	0.093	< 0.080	< 0.080	0.13
Copper (Dissolved)	U	1450		µg/l	1.0	< 1.0	3.3	2.0	5.3
Mercury (Dissolved)	U	1450		µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1450		µg/l	1.0	1.5	< 1.0	< 1.0	< 1.0
Lead (Dissolved)	U	1450		µg/l	1.0	1.6	4.7	< 1.0	17
Selenium (Dissolved)	U	1450		µg/l	1.0	1.8	3.7	< 1.0	2.7
Vanadium (Dissolved)	U	1450		µg/l	1.0	1.2	2.1	1.4	3.1
Zinc (Dissolved)	U	1450		µg/l	1.0	7.6	2.5	1.4	12
Chromium (Hexavalent)	U	1490		µg/l	20	< 20	< 20	< 20	< 20
Naphthalene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1700		µg/l	0.10	< 0.10	4.4	< 0.10	< 0.10
Pyrene	U	1700		µg/l	0.10	< 0.10	4.2	< 0.10	< 0.10
Benzo[a]anthracene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	N	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1700		µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	1700		µg/l	2.0	< 2.0	8.6	< 2.0	< 2.0
Total Phenols	U	1920		mg/l	0.030	< 0.030	< 0.030	< 0.030	< 0.030

Results - Soil

Project: 8948G Dob Brook Close

Client: WML Consulting Ltd	Chemtest Job No.:				19-30759	19-30759	19-30759	19-30759	19-30759	19-30759	19-30759	19-30759	19-30759
Quotation No.:	Chemtest Sample ID.:				887989	887990	887991	887993	887994	887995	887997	887998	888000
Order No.: 8948G	Client Sample Ref.:				E	E	E	J	E	E	J	E	J
	Client Sample ID.:				1	2	3	5	6	7	9	10	12
	Sample Location:				WS1	TP1	TP1	TP1	TP2	TP2	TP2	TP3	TP3
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.4	0.1	0.4	2.6	0.3	0.65	1.9	0.2	2.6
	Date Sampled (\$):				11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019
	Asbestos Lab:				COVENTRY	COVENTRY	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	No Asbestos Detected		No Asbestos Detected	
ACM Detection Stage	U	2192		N/A	-	-	-		-	-		-	
Moisture	N	2030	%	0.020	19	27	14	20	17	22	18	18	20
pH	U	2010		N/A	8.1	7.4	8.2	7.2	8.0	8.2	7.4	8.2	7.4
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.77	< 0.40	0.42		0.50	< 0.40		< 0.40	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.063	< 0.010	< 0.010	0.031	< 0.010	0.025	0.058	< 0.010	0.010
Total Sulphur	U	2175	%	0.010	0.092	0.086	0.070	0.050	0.094	0.11	0.031	0.041	0.035
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50		< 0.50	< 0.50		< 0.50	
Sulphate (Total)	U	2430	mg/kg	100	1400	1200	800		1200	2300		620	
Arsenic	U	2450	mg/kg	1.0	27	18	16		18	12		15	
Cadmium	U	2450	mg/kg	0.10	0.50	0.34	0.31		0.32	0.32		0.45	
Copper	U	2450	mg/kg	0.50	80	34	55		42	45		36	
Mercury	U	2450	mg/kg	0.10	0.77	0.35	2.1		0.24	0.97		0.25	
Nickel	U	2450	mg/kg	0.50	34	18	31		19	24		27	
Lead	U	2450	mg/kg	0.50	180	91	270		93	150		140	
Selenium	U	2450	mg/kg	0.20	0.48	0.60	0.32		0.66	0.50		0.31	
Vanadium	U	2450	mg/kg	5.0	38	29	38		28	28		34	
Zinc	U	2450	mg/kg	0.50	170	78	120		64	92		66	
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50		< 0.50	< 0.50		< 0.50	
Organic Matter	U	2625	%	0.40	5.5	13	5.3		7.6	2.5		3.3	
Naphthalene	U	2700	mg/kg	0.10	0.59	< 0.10	1.1		0.97	4.9		0.84	
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	0.38		0.19	0.63		0.13	
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	2.0		0.50	5.1		0.98	
Fluorene	U	2700	mg/kg	0.10	0.37	< 0.10	1.9		0.61	5.0		0.70	
Phenanthrene	U	2700	mg/kg	0.10	2.6	< 0.10	13		4.7	29		3.6	
Anthracene	U	2700	mg/kg	0.10	0.66	< 0.10	3.6		1.2	9.3		1.4	
Fluoranthene	U	2700	mg/kg	0.10	4.1	1.1	14		6.9	31		6.5	
Pyrene	U	2700	mg/kg	0.10	4.6	1.2	15		7.6	32		6.6	
Benzo[a]anthracene	U	2700	mg/kg	0.10	3.3	2.3	6.3		4.9	15		2.9	
Chrysene	U	2700	mg/kg	0.10	3.3	1.7	5.8		3.8	13		2.6	
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	2.4	< 0.10	5.3		4.2	12		3.3	
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	1.4	< 0.10	2.9		2.2	6.1		1.5	
Benzo[a]pyrene	U	2700	mg/kg	0.10	2.3	< 0.10	5.6		4.2	13		2.6	
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	1.4	< 0.10	3.3		2.6	7.3		1.5	
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	0.64	< 0.10	1.1		0.89	2.3		0.72	

Results - Soil

Project: 8948G Dob Brook Close

Client: WML Consulting Ltd	Chemtest Job No.:					19-30759	19-30759	19-30759	19-30759	19-30759	19-30759	19-30759	19-30759	19-30759
Quotation No.:	Chemtest Sample ID.:					887989	887990	887991	887993	887994	887995	887997	887998	888000
Order No.: 8948G	Client Sample Ref.:					E	E	E	J	E	E	J	E	J
	Client Sample ID.:					1	2	3	5	6	7	9	10	12
	Sample Location:					WS1	TP1	TP1	TP1	TP2	TP2	TP2	TP3	TP3
	Sample Type:					SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):					0.4	0.1	0.4	2.6	0.3	0.65	1.9	0.2	2.6
	Date Sampled (\$):					11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019
	Asbestos Lab:					COVENTRY	COVENTRY	COVENTRY		COVENTRY	COVENTRY		COVENTRY	
Determinand	Accred.	SOP	Units	LOD										
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	1.4	< 0.10	3.0			3.3	6.5		1.6	
Total Of 16 PAH's	U	2700	mg/kg	2.0	29	6.3	84			49	190		38	
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30			< 0.30	< 0.30		< 0.30	

Project: 8948G Dob Brook Close

Client: WML Consulting Ltd	Chemtest Job No.:				19-30759	19-30759
Quotation No.:	Chemtest Sample ID.:				888001	888002
Order No.: 8948G	Client Sample Ref.:				E	E
	Client Sample ID.:				13	14
	Sample Location:				WS2	TP4
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.4	0.3
	Date Sampled (\$):				11-Sep-2019	11-Sep-2019
	Asbestos Lab:				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
ACM Detection Stage	U	2192		N/A	-	-
Moisture	N	2030	%	0.020	16	16
pH	U	2010		N/A	8.2	8.2
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	1.5	1.9
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.12	0.015
Total Sulphur	U	2175	%	0.010	0.11	0.064
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50
Sulphate (Total)	U	2430	mg/kg	100	3700	680
Arsenic	U	2450	mg/kg	1.0	13	24
Cadmium	U	2450	mg/kg	0.10	0.32	0.38
Copper	U	2450	mg/kg	0.50	30	51
Mercury	U	2450	mg/kg	0.10	< 0.10	0.40
Nickel	U	2450	mg/kg	0.50	39	25
Lead	U	2450	mg/kg	0.50	51	150
Selenium	U	2450	mg/kg	0.20	0.22	< 0.20
Vanadium	U	2450	mg/kg	5.0	35	31
Zinc	U	2450	mg/kg	0.50	72	110
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	1.7	6.2
Naphthalene	U	2700	mg/kg	0.10	0.67	0.93
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	0.45
Acenaphthene	U	2700	mg/kg	0.10	0.19	1.7
Fluorene	U	2700	mg/kg	0.10	0.14	1.9
Phenanthrene	U	2700	mg/kg	0.10	0.68	15
Anthracene	U	2700	mg/kg	0.10	0.16	4.1
Fluoranthene	U	2700	mg/kg	0.10	0.99	18
Pyrene	U	2700	mg/kg	0.10	1.1	18
Benzo[a]anthracene	U	2700	mg/kg	0.10	0.30	7.7
Chrysene	U	2700	mg/kg	0.10	0.36	6.9
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	0.43	6.2
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	0.30	3.4
Benzo[a]pyrene	U	2700	mg/kg	0.10	0.53	6.6
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	3.9
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	1.2

Project: 8948G Dob Brook Close

Client: WML Consulting Ltd	Chemtest Job No.:				19-30759	19-30759
Quotation No.:	Chemtest Sample ID.:				888001	888002
Order No.: 8948G	Client Sample Ref.:				E	E
	Client Sample ID.:				13	14
	Sample Location:				WS2	TP4
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.4	0.3
	Date Sampled (\$):				11-Sep-2019	11-Sep-2019
	Asbestos Lab:				COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD		
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	3.7
Total Of 16 PAH's	U	2700	mg/kg	2.0	5.9	100
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1490	Hexavalent Chromium in Waters	Chromium [VI]	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
1700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters 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)
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
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.
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)

SOP	Title	Parameters included	Method summary
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and Trimethylphenols Note: 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"
- \$ This information has been supplied by the client and can affect the integrity of test data.

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 04

Gas Monitoring Results

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	300	Accept > 200 cc/min
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% N ₂	5	5	5	5	6	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N ₂	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	
H ₂ S	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:
Jack Rutland

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

The GAC's for the assessment of potential groundwater contamination have been derived from very conservative guidelines protective of drinking water and environmental quality, namely:

- UK Drinking Water Standards (DWS) as defined by The Water Supply (Water Quality) Regulations, 2016;
- UK Environmental Quality Standards (EQS) for Freshwater, based on a Hardness of 0-100mg/l (soft), 2000;
- Petroleum Products in Drinking-water, Background document for development of WHO Guidelines for Drinking-water Quality, 2011.

Table 1: Inorganic Tier 1 Water Environment Screening Criteria

Contaminant	Units	Hardness Banding (CaCO ₃ mg/l)	EQS /WFD (Freshwater)	UK DWS
Arsenic	µg/l	-	50	10
Ammonia	mg/l	-	0.2	0.5
Boron	µg/l	-	2000	1000
Cadmium	µg/l	-	5	5
Chromium	µg/l	0-50	2	50
		50-100	10	
		100-150	10	
		150-200	20	
		200-250	20	
Copper	µg/l	0-10	0.5	2000
		10-50	0.5	
		50-200	3	
		200-250	8	
		>250	12	
Cyanide (Free)	µg/l	-	1	-
Cyanide	-	-	-	50
Iron	µg/l	-	1000	200
Lead	µg/l	0-50	4	10
		50-150	10	
		150-250	20	
		>250	20	
Mercury	µg/l	-	1	1
Nickel	µg/l	0-50	8	20
		50-100	20	
		100-150	20	
		150-250	40	
		>250	40	
Selenium	µg/l	-	-	10
Sulphate (SO ₄)	mg/l	-	400	250
Zinc	µg/l	0-50	8	5000
		50-150	15	
		150-250	50	
		>250	50	
pH	-	-	6-9	-

Table 2: Organic Tier 1 Water Environment Screening Criteria

Contaminant	Units	UK DWS	WHO
PAHs - The sum of • Benzo(b)fluoranthene, • Benzo(ghi)perylene, • Benzo(k)fluoranthene, • indeno(1,2,3-c,d)pyrene)	µg/l	0.1	-
Phenol (total)	µg/l	0.5	-
MTBE	µg/l	-	15
Aliphatic C5-C6	µg/l	-	15,000
Aliphatic C6-C8	µg/l	-	15,000
Aliphatic C8-C10	µg/l	-	300
Aliphatic C10-C12	µg/l	-	300
Aliphatic C12-C16	µg/l	-	300
Aliphatic C16-21	µg/l	-	(300) *
Aliphatic C21-35	µg/l	-	(300)*
Aromatic C6-C7	µg/l	1 (benzene)	10 (benzene)
Aromatic C7-C8	µg/l	-	700 (toluene)
Aromatic C8-C10	µg/l	-	300 (ethylbenzene)
Aromatic C10-12	µg/l	-	100
Aromatic C12-C16	µg/l	-	100
Aromatic C16-C21	µg/l	-	90
Aromatic C21-C35	µg/l	-	90

Site Specific Assessment Criteria for Residential (with homegrown produce) assuming a 2.5% 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	200
Polyaromatic Hydrocarbons (PAH)	
Benz[a]anthracene	11
Benzo[a]pyrene	2.7
Benzo[b]fluoranthene	3.3
Benzo[ghi]perylene	340
Benzo[k]fluoranthene	93
Chrysene	22
Dibenz[ah]anthracene	0.28
Fluoranthene	560
Indeno[123-cd]pyrene	26
Naphthalene	5.6
Pyrene	1,200

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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	0.17
Ethylbenzene	110
Toluene	290
Xylene	130
1,2-Dichloroethane	0.011
1,1,1-Trichloroethane	18
Tetrachloroethane	3.4
Tetrachloroethene (PCE)	0.39
Tetrachloromethane	0.056
Trichloroethene (TCE)	0.034
Trichloromethane	1.7
Vinyl Chloride	0.00087
Semi-Volatile Organic Compounds (SVOCs)	
1,2-Dichlorobenzene	55
1,4-Dichlorobenzene	150 ^f
1,2,4-Trichlorobenzene	6.4
Hexachlorobenzene	3.3 (0.5) ^{vap}
Total Petroleum Hydrocarbons (TPH)	
Aliphatic C5-6	78
Aliphatic C6-8	230
Aliphatic C8-10	65
Aliphatic C10-12	330(118) ^{vap}
Aliphatic C12-16	2,400(59) ^{sol}
Aliphatic C16-35	92,000(21) ^{f, sol}
Aliphatic C35 - 44	92,000(21) ^{f, sol}
Aromatic C5 – 7 (benzene)	140
Aromatic C7 – 8 (toluene)	290
Aromatic C8-10	83
Aromatic C10-12	180
Aromatic C12-16	330
Aromatic C16-21	540 ^f
Aromatic C21-35	1,500 ^f
Aromatic C35 - 44	1,500 ^f

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