

# Phase 2 Geo-Environmental Investigation & Assessment

For

Spout Farm, Preston

Undertaken on behalf of

**Community Gateway Association** 

Report No 8517G-WML-00-XX RP-G-0001 March 2019

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# **Revision Status / History**

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# WILCONSULTING Civil, Structural and Geotechnical Engineers

# **Executive Summary**

Site Location	The site comprises land off Preston Road, Longridge, Preston. It is centred on approximate Ordnance Survey National Grid Reference 360288E, 436034N with an indicative postcode of PR3 3BD.
Development Proposals	It is understood that the development will comprise the construction of 34no low rise residential structures with associated access roads and external areas of hardstanding for parking together with private gardens.
Ground Conditions	Ground conditions encountered during the intrusive investigation generally comprise a surface layer of topsoil and mixed cohesive and granular made ground in the north-eastern and eastern sections, these being underlain by cohesive glacial till to a maximum proven depth of 5.00 metres below ground level (mbgl).
	Construction near retained trees and importantly within any RPAs should be undertaken with due regard to guidance provided in BS5837:2012 'Trees in relation to design, demolition and construction – recommendations'.
Site Preparation	Topsoil stripped from the area of redevelopment should be stockpiled and protected from inclement weather, where considered suitable for future use in garden and landscaped areas following confirmatory laboratory testing. However, due to thickness of topsoil encountered, it is envisaged that there will be a surplus to be removed from site and consideration should be given to its commercial value or re-use on other sites.
	Cohesive glacial till beneath the site may prove sensitive to moisture change and may become softened if exposed, particularly during wet weather conditions. Where possible, the site strip should therefore be undertaken in stages and only as phased construction determines.
	Where this is not possible and there is a requirement to expose the glacial till for any appreciable time, surfaces should be excavated to fall to facilitate surface water run-off and covered with a suitably granular protective layer which will also facilitate site plant movement.
	It is anticipated that new structures at the site can be supported on traditional shallow spread foundations constructed within the natural glacial till at depths of no less than 1.00m below existing ground level. Such foundations should be designed on a net allowable bearing pressure not exceeding 100kN/m <sup>2</sup> .
Foundations and Floor Slabs	Assessment as to the soil heave or shrinkage potential should be undertaken in accordance with Appendix 4.2-A of NHBC Standards 2010, Foundations, Chapter 4.2, Building Near Trees in consideration of a medium volume change classification for the clay with foundations designed to appropriate depths where such effects are envisaged.
	Given the relatively shallow nature of the made ground and topsoil it is anticipated that new floor slabs may be constructed as ground bearing on natural glacial deposits, subject to confirmation of finished levels. Alternatively, it may be a preference for floor slabs to be suspended in the form of a beam and block construction.
Excavations and Groundwater	Excavations at the site will be feasible using conventional hydraulic plant. All excavations at the site requiring man entry and deeper than 1.20m will need adequate lateral support, or will need to be battering back to a safe angle to ensure their stability.
	Significant groundwater inflows are not anticipated during excavations with conventional 'sump and pump' dewatering measures being adequate to keep excavations dry.
Pavements	In consideration of the recorded ground conditions it is recommended that new road pavement design should be based on a California Bearing Ratio (CBR) value of no more than 2.5% in made ground and cohesive glacial deposits.
Concrete Classification	The typical design sulphate (DS) class and "Aggressive Chemical Environment for Concrete" (ACEC) class for the site are DS-1 and AC-1 respectively.
Soakaways	In consideration of the site being underlain by relatively impermeable cohesive glacial till at shallow depth, soakaways are not considered to be a feasible drainage option for the site.

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Ground Gas	The initial results give a maximum Qhg value of <0.002l/hr and indicate the site to classify as Characteristic Situation (CS) $1 -$ Very Low Gas Risk', with no specific ground gas protection measures required.
Contamination Assessment	Risks to Human HealthAnalysis results indicate that made ground beneath the site contains only slightly elevated and localised concentrations of PAH compounds above their respective SL's. These probably relate to the presence of ash within the made ground matrix.Following site development, where surfaced with buildings and hardstanding, there will be no mechanism for a direct contact pollution linkage with any unidentified contaminants. 
	As the relatively impermeable glacial till will also inhibit significant lateral migration of any contaminant, the risk to controlled waters is therefore assessed as very low with no specific environmental remediation required.
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. However, 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 not envisaged
Waste Soils	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 un-contaminated and could be classified as 'Non-Hazardous' or even 'Hazardous' for disposal purposes. 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 Community Gateway Association to undertake a Phase 2 Geo-environmental Investigation and Assessment of a site at Spout Farm in the Longridge area of Preston.

#### Proposed Development

- 1.2 It is understood that the development will comprise the construction of 34no low rise residential structures with associated access roads and external areas of hardstanding for parking together with private gardens.
- 1.3 The proposed development plan by PGB Architectural Services Ltd, referenced 2856-014 Revision B, dated March 2016, 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 The Phase 1 Desk Study has been undertaken and is presented in the following WML Consulting report:
  - Phase 1 Desk Study and Preliminary Geo-environmental Assessment, Reference 8517/G/01, dated January 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 Phase 1 desk study are briefly summarised in the following sections. However, the two reports are not exclusive and should be read in conjunction.
- 1.8 The ground investigation comprised the formation of window sample probeholes, undertaken with reference to BS5930:2015 Code of Practice for Ground Investigation and BS10175:2011 together with A1:2013, "Investigation of Potentially Contaminated Sites Code of Practice" except where superseded by EN ISO 22475-1 "Geotechnical Investigation and Assessment Sampling by Drilling and Excavation and Groundwater Measurements".
- 1.9 Geotechnical soil testing has been undertaken in general accordance with guidelines provided in BS1377:1990 Parts 1-9, "Method of Test for Soils for Civil Engineering Purposes". Samples for chemical



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

# 2.0 SITE LOCATION AND DESCRIPTION

#### Site Location

- 2.1 The site comprises land off Preston Road, Longridge, Preston. It is centred on approximate Ordnance Survey National Grid Reference 360288E, 436034N with an indicative postcode of PR3 3BD.
- 2.2 The site is bounded to the north by Alston Reservoir No. 2, to the east by undeveloped grassland surrounding a nature reserve and pond, to the south by Spout Farm Nursery and to the west by Preston Road with residential properties beyond.

#### **Site Description**

- 2.3 The site is predominantly undeveloped and surfaced with managed grass and low lying vegetation.
- 2.4 The northern, southern and western site boundaries comprise linear strips of mature deciduous trees with further sporadic semi-mature deciduous trees forming the eastern site boundary.
- 2.5 An area of semi-mature to mature trees and shrubs is located in the southern central section of the site.
- 2.6 Several small stockpiles of wood (felled trees), woodchip and asphalt scrapings are located in the northeastern section of the site.
- 2.7 A line of mature conifers extends roughly north-east to south-west across the eastern part of the site and separates the larger undeveloped section of the site from the smaller eastern area.
- 2.8 At the time of the investigation in February 2019, the eastern area was locally surfaced with gravel and used for the storage of a number of forestry machines and equipment.
- 2.9 Several fuel bowsers and waste oil storage drums were noted in the south-eastern corner. However, no visual or olfactory evidence of spills or leakages were evident.
- 2.10 Two metal barn structures, with concrete floor slabs, and several smaller metal storage (wood) sheds are located in the south-western corner of the yard, immediately adjacent to the conifers.
- 2.11 Several small stockpiles of wood chip, granular soils and logs were also located in the south-eastern section of the site close to the eastern site boundary.
- 2.12 The field pond within the central section of the site on the historical plans was not visible at the time of the site inspection in December 2018. However, localised marsh type grasses were noted in this area denoting the area of the field pond which is likely to be evident during prolonged or heavy rainfall.
- 2.13 Access to the site is from the track to Spout Farm on the southern site boundary.

#### Topography

- 2.14 No topographic survey had been undertaken at the time of the Phase 1 study.
- 2.15 However, during the investigation in February 2019, the site was noted to be generally level with more localised grassy undulations.



# 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 BGS plans indicate that the site is 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 Carboniferous Warley Wise Grit, which comprise predominantly sandstone with siltstone beds and subordinate seams of coal.
- 3.3 In consideration of the underlying geology, risks of subsidence from coal mining can be discounted. The BGS indicate that difficult ground conditions due to underground mining of vein minerals beneath the site are 'unlikely or localised and are at a level where they need not be considered'.

#### Radon

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

#### **Environmental Setting**

- 3.5 The glacial till is classified as a 'Secondary Aquifer Undifferentiated' (formerly unproductive). The bedrock underlying the site is classified as a 'Secondary (A) Aquifer'.
- 3.6 The site is not within an Environment Agency (EA) Source Protection Zone (SPZ). There are also no active groundwater abstraction licences within 500m of the site.
- 3.7 The nearest surface water feature is Alston Reservoir No.2, 89m north with a pond in the adjacent nature reservoir (former Alston Reservoir No 3) some 50m east. A south-westerly flowing unnamed watercourse is also located some 134m south-west.
- 3.8 There are no active, non-operational or historic landfills recorded within 500m of the site.
- 3.9 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.
- 3.10 There are no designated environmentally sensitive sites within 1km of the study site. However, it is understood that a nature reserve is located immediately east at the site of the former Alston No 3 Reservoir.

#### Site History

- 3.11 The earliest maps dated 1847 indicate the site to comprise undeveloped agricultural land with several field boundaries immediately east of Preston Road, which extended roughly north to south along the western site boundary. The site has remained unchanged although a pond has been shown in the central northern section since 2012.
- 3.12 The surrounding area originally comprised undeveloped rural / agricultural land with occasional small field ponds, woodland and localised residential structures. By 1892 Alston Reservoir No 3 had been constructed to the east of the site, with earthworks forming the reservoir walls along the south-eastern site boundary. By 1910 the second, larger reservoir had been constructed some 50m north of the site with associated Straining Chambers 10m north-east. Alston No 1 reservoir had been constructed immediately east of No 3 reservoir by 1932. The reservoir immediately east of the site was no longer shown on the map of 2010 and by 2014 a large pond was located, some 50m south-east of the site in its place. Anecdotal information indicates that this may form part of a relatively new nature reserve.

# 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 possibly groundwater and the possible installation of ground gas monitoring standpipe with subsequent monitoring for hazardous ground gas concentrations and flow where 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 provide samples for chemical analysis.
- 5.3 A general coverage of the site was considered appropriate although the investigation locations were also chosen so as not to impact on the presence of suspected services beneath the site and access to the existing storage area in the south-eastern section.
- 5.4 Gas monitoring standpipes were installed in selected probeholes for the measurement of ground gas and groundwater levels.
- 5.5 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**

- 5.6 Ground investigation work was undertaken by LOT Geotechnics Ltd between the 4<sup>th</sup> and 6<sup>th</sup> February 2019. This comprised the formation of 18no window sample probeholes to a maximum depth of 5.00 metres below ground level (mbgl).
- 5.7 The exploratory hole records are presented in Appendix 02 of this report whilst the exploratory hole locations are shown on drawing 8517G-SK01 in Appendix 01.

#### Monitoring Standpipe

5.8 Monitoring wells for groundwater and ground gas measurements were installed in 6no probeholes as indicated on the logs presented in Appendix 02.

#### **Geotechnical and Chemical Testing**

- 5.9 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.
- 5.10 Geotechnical soils testing was undertaken on selected samples for the following:
  - Natural Moisture Content.
  - Liquid and Plastic Limit.
- 5.11 Chemical analysis was undertaken on selected soil samples for the following contaminants of concern:
  - Total Arsenic, Boron, Cadmium, Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc.
  - Total Cyanide, Phenols, Sulphur, Sulphate.
  - Speciated USEPA Polyaromatic Hydrocarbons (PAH).
  - Asbestos Screen and Identification.
  - 2:1 water/soil sulphate extract, pH.



- 5.12 Leachate analyses was also undertaken on selected samples of shallow made ground due to the proximity of the reservoirs and adjacent nature reserve, 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).
  - 2:1 water/soil sulphate extract, pH.
  - Water hardness.
- 5.13 The results of the chemical analysis are presented in Appendix 04.

# Gas and Groundwater Monitoring

5.14 Gas and groundwater monitoring has been carried out on two occasion, to date, on 20<sup>th</sup> and 26<sup>th</sup> February 2019. The monitoring results are presented in Appendix 05.

### 6.0 **GROUND CONDITIONS**

#### Stratigraphy

6.1 Ground conditions encountered during the intrusive investigation generally comprise a surface layer of topsoil and mixed cohesive and granular made ground in the north-eastern and eastern sections, these being underlain by cohesive glacial till to a maximum proven depth of 5.00 metres below ground level (mbgl).

#### Topsoil

- 6.2 Topsoil was encountered across the majority of the site (namely WS01 to WS12) from ground level to depths of between 0.30m and 0.55mbgl.
- 6.3 The topsoil was surfaced with turf and generally comprised dark brown, slightly silty, sandy clay with rootlets.

#### Made Ground

- 6.4 Made ground was only encountered within WS13 to WS18 located in the north-eastern and eastern sections of the site, from ground level to depths of between 0.20m and 0.45mbgl and forming the compacted granular compound of the existing storage area.
- 6.5 The made ground generally comprised brownish grey, variably sandy gravel with a low to medium cobble content with the exception of WS13, where the surface was noted to be reworked natural soils comprising brownish grey, slightly sandy, gravelly clay.
- 6.6 Gravel sized particles included brick, sandstone, concrete, asphalt and locally wood. Cobble sized fragments included brick, concrete and asphalt.

#### **Glacial Till**

- 6.7 Within all of the exploratory holes, glacial till was encountered beneath the topsoil or made ground at depths of between 0.20m and 0.55mbgl and extending to a maximum proven depth of 5.00mbgl.
- 6.8 The till generally comprised firm to stiff, brown and occasionally grey mottled, slightly sandy, slightly gravelly clay. Gravel sized particles include sandstone and siltstone.
- 6.9 Within WS12 in the central section of the site, a soft, light grey, slightly gravelly, sandy clay was encountered at the base of the topsoil, extending from 0.40m to 1.00mbgl.
- 6.10 SPT 'N' values within the cohesive glacial till ranged between 9 and 21, indicating a generally firm and locally stiff consistency.
- 6.11 Natural moisture contents of between 15% and 24% were recorded within the glacial till. Liquid Limits from 30% to 46% together with corresponding Plasticity Indices between 15% and 23% indicate clay of low but generally intermediate plasticity and low to medium volume change potential.

#### 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 during the formation of WS08 and WS17 in the central and south-eastern sections of the site at depths of 0.50m and 0.20mbgl respectively. This was observed to within the topsoil and made ground above the relatively impermeable cohesive till.
- 6.14 A groundwater seepage was also encountered during the formation of WS07 in the central part of the site, presumably within a more granular horizon in the glacial till at a depth of 2.50mbgl.
- 6.15 During the initial monitoring visit, groundwater was encountered at a depth of 0.60mbgl within WS01 with the remaining standpipes waterlogged due to a period of heavy rainfall. During the second monitoring visit groundwater was recorded at depths of between 0.58m and 2.40mbgl. However, this is likely to be due to infiltration of surface water and water perched within the saturated topsoil and therefore not representative of the true phreatic groundwater levels across the site.
- 6.16 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

6.17 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 Construction near retained trees and importantly within any RPAs should be undertaken with due regard to guidance provided in BS5837:2012 'Trees in relation to design, demolition and construction recommendations'.
- 7.2 Topsoil stripped from the area of redevelopment should be stockpiled and protected from inclement weather, where considered suitable for future use in garden and landscaped areas following confirmatory laboratory testing. However, due to thickness of topsoil encountered, it is envisaged that there will be a surplus to be removed from site and consideration should be given to its commercial value or re-use on other sites.
- 7.3 Cohesive glacial till beneath the site may prove sensitive to moisture change and may become softened if exposed, particularly during wet weather conditions. Where possible, the site strip should therefore be undertaken in stages and only as phased construction determines.
- 7.4 Where this is not possible and there is a requirement to expose the glacial till for any appreciable time, surfaces should be excavated to fall to facilitate surface water run-off and covered with a suitably granular protective layer which will also facilitate site plant movement.
- 7.5 As the site is relatively flat, no significant earthworks are envisaged.

#### Foundations

- 7.6 Made ground and any soft or loose natural deposits should be considered unsuitable for the direct support of structural loads as their generally incompetent nature could result in unacceptable total and differential settlements.
- 7.7 It is anticipated that new structures at the site can be supported on traditional shallow spread foundations constructed within the natural glacial till at depths of no less than 1.00m below existing ground level. Such foundations should be designed on a net allowable bearing pressure not exceeding 100kN/m<sup>2</sup>.
- 7.8 All formations will need to be carefully inspected to confirm the anticipated soil strength. Any soft/loose or otherwise incompetent soils so encountered should be excavated and replaced with foundation concrete.
- 7.9 Where spread foundations and floor slabs bearing on clay soils are to be constructed in close proximity to existing trees, identification of the tree species will be required to determine its water demand as provided in Appendix 4.2-A of NHBC Standards 2010, Foundations, Chapter 4.2, Building Near Trees. Assessment as to the soil heave or shrinkage potential should then be undertaken in consideration of a medium volume change classification for the clay with foundations designed to appropriate depths where such effects are envisaged.

#### Floor Slabs

7.10 Given the relatively shallow nature of the made ground and topsoil it is anticipated that new floor slabs may be constructed as ground bearing on natural glacial deposits, subject to confirmation of finished levels. Alternatively, it may be a preference for floor slabs to be suspended in the form of a beam and block construction.

#### Excavations and Groundwater

- 7.11 Excavations at the site will be feasible using conventional hydraulic plant. All excavations at the site requiring man entry and deeper than 1.20m will need adequate lateral support, or will need to be battering back to a safe angle to ensure their stability.
- 7.12 Significant groundwater inflows are not anticipated during excavations with conventional 'sump and pump' dewatering measures being adequate to keep excavations dry.
- 7.13 Due to the relatively impermeable nature of the cohesive glacial till, excavations should be protected from the ingress of surface water run-off during times of heavy and/or prolonged rainfall.

#### Pavement Design

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

#### **Concrete Design**

- 7.16 Design/mix of buried concrete should be undertaken in accordance with the "Aggressive Chemical Environment for Concrete" (ACEC) classification, of BRE Special Digest 1:2005 (Concrete in Aggressive Ground). With reference to the site history, it is deemed appropriate to classify the site as "Brownfield", with respect to BRE Special Digest.
- 7.17 Excluding results in the upper 0.30mbgl, the values of 2:1 water/soil extract for sulphate for soils do not exceed 10mg/l. Values of pH range from 7.3 to 8.5 indicating near neutral to slightly alkaline conditions.
- 7.18 On the basis of these results, the typical design sulphate (DS) class and "Aggressive Chemical Environment for Concrete" (ACEC) class for the site are DS-1 and AC-1 respectively.

#### Drainage and Soakaways

7.19 In consideration of the site being underlain by relatively impermeable cohesive glacial till at shallow depth, 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 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 Furthermore, no visual or olfactory evidence of significant ground contamination has been recorded from the intrusive investigations.
- 8.3 Notwithstanding this, 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 and controlled waters 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 assessment at this stage.
- 8.12 Due to measured Soil Organic Content (SOM) results for the topsoil and made ground being generally above 2.5%, it has been considered appropriate to adopt SL's relevant for 2.5% SOM in accordance with CEIH/LQM. Where SOM concentrations are below 2.5% the SL's assuming a 1% SOM have been used.
- 8.13 The tables of relevant SL's protective of human health are provided in Appendix 06.

#### **Controlled Waters**

- 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 (soft to moderately soft), 2000.
- 8.15 A table of relevant assessment criteria protective of controlled waters is provided in Appendix 06.

#### **Soil Test Results**

8.16 5no samples of topsoil and 3no samples of made ground were analysed for a suite of Contaminants of Concern (CoC). The majority of the concentrations measured were below the relevant SL's with the following exceptions.

Contaminant	Number of Exceedances	SL mg/kg (2.5% SOM)	Recorded Concentrations (mg/kg)	Samples	
Benzo[a]anthracene	1	11	31	WS16 – 0.10m	
Chrysene	1	22	34	WS16 – 0.10m	
Benzo[b]fluoranthene	1	2.6	30	WS16 – 0.10m	
Benzo[a]pyrene	1	3.3	28	WS16 – 0.10m	
Dibenz[a,h]anthracene	2	0.28	0.82 - 7.7	WS16 – 0.10m WS17 – 0.20m	

8.17 No asbestos fibres were detected in any of the samples analysed.

#### Leachate Test Results

- 8.18 3no soil samples (WS07, WS13 and WS18) were submitted for the analysis of leachable concentrations of metals, semi-metals and PAH compounds.
- 8.19 All of the results were below the generic criteria when compared to the EQS for freshwater, and the more stringent UKDWS, with no exceptions.



# Conclusions

### **Risks to Human Health**

- 8.20 Analysis results indicate that made ground beneath the site contains only slightly elevated and localised concentrations of PAH compounds above their respective SL's. These probably relate to the presence of ash within the made ground matrix.
- 8.21 Following site development, where surfaced with buildings and hardstanding, there will be no mechanism for a direct contact pollution linkage with any unidentified contaminants. Therefore, the risk to end-users and to the general public will be negligible in such areas.
- 8.22 However, where made ground is exposed at the surface in garden areas, it should be capped with a clean soil cover comprising 450mm of sub-soil and 150mm of topsoil to break any exposure pathway to future site users. Alternatively, it may be more practical to remove the made ground where it is relatively thin and to place it with a nominal 150mm thickness of topsoil directly on the underlying natural soil.
- 8.23 Furthermore, existing topsoil at the site can be re-used in proposed garden areas although further analysis may need to be undertaken following the site strip operation to confirm this.

#### **Risks to Controlled Waters**

- 8.24 All of the leachate test results were below the relevant UKDWS and EQS.
- 8.25 The site is not within an EA Source Protection Zone (SPZ) and there are no ground / surface water abstractions recorded within influencing distance.
- 8.26 As the relatively impermeable glacial till will also inhibit significant lateral migration of any contaminant, the risk to controlled waters is therefore assessed as 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.

	Туре А	Туре В	Туре С	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

# Table 3 - Building Types

The proposed development is indicated to comprise the construction of Type A buildings, the definition of which is provided in BS8485:2015 as:

 Private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building. Some small rooms present.

#### Ground Gas Conceptual Model

- 9.6 The site is not within an area recorded as being affected by naturally occurring radon gas and the presence of ground gas resulting from shallow unrecorded mine workings is considered unlikely.
- 9.7 There are no current or historic landfills within influencing distance of the site.
- 9.8 Nearby in-filled small ponds are unlikely to present a significant source of ground gas with intervening relatively impermeable glacial till inhibiting any significant lateral migration of off-site ground gas towards the site.



- 9.9 No appreciable thickness of made ground from historical in-filling or naturally occurring organic / degradable soils have been encountered beneath the site.
- 9.10 In consideration of the above, the preliminary risk to the development from ground gas has been assessed as low. However, it has been considered prudent to undertake monitoring, primarily for methane and carbon dioxide, with associated flow rates, on 2no occasion to date, on 20<sup>th</sup> and 26<sup>th</sup> February 2019.

# **Results and Recommendations**

- 9.11 The results to date indicate a methane concentrations range from below detection limits to 0.1% by volume in air (v/v) with carbon dioxide concentrations ranging from below detectable limits of 0.1% to 0.2% v/v.
- 9.12 Peak ground gas flows range from below detectable limits of 0.1l/hr to 3.8l/hr, but were all generally below 1l/hr.
- 9.13 The initial results give a maximum Qhg value of <0.002l/hr and indicate the site to classify as Characteristic Situation (CS) 1 Very Low Gas Risk', with no specific ground gas protection measures required.
- 9.14 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 Waste arisings comprising uncontaminated natural soil would be suitable, subject to confirmatory analysis, for re-use as sub-soil within any planned garden or landscaped areas.
- 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 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.
- 10.6 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. However, 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 not envisaged.



# **APPENDIX 01**

Drawings





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 Job N	<sup>10.</sup> 85	17G	Drawing No.	SK-0	<b>1</b> P1	



# **APPENDIX 02**

**Exploratory Hole Records** 

			Project Title: Spout Farm						W	$\overline{S}$	01		
WMLco	ONSULT	ING	Project	Numbe	er: 8517G	i	Client: Community Gat Association	y Gateway Sheet 1 Of 1					
			GL (mA	AOD):			N Coord: 0		E Coord: 0				
Date: 04/02/20	19		Method	od: Window Sample			Driller: LOT Geotechnie	cs Ltd	Logged	d By: TP	B		
Depth (m)	Туре	Test Result	t	Level Legend Depth (m)			Description				Wa	ater Sta	andpipe
0.10	D	N=12 N=17 N=13 N=14 N=17				0.30	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including (GLACIAL TILL)	rn, slightly si wn and occ ndy, slightly ilar to subro sandstone i 5.00 m	Ity, sand	dy CLAY Ily grey y CLAY , fine to stone.			
KEY D - Disturbed S	Sample			REM No Gr	IARKS oundwat	er Encounte	ered	Water Strik	es Strike	Level	Minutes	Casing	Sealed
B - Bulk Samp U - Undisturbe W - Water Sar	le d nple											- 20119	
S - Standard F C - Cone Pene	enetration	on Test Test											
N - Penetration	n Test 'N ar Vane	l' Value kPa						Daily Log C	Df Depth	s	Chisell	ing	
<ul> <li>✓ - Groundwa</li> <li>✓ - Groundwa</li> </ul>	ater Stril ater Lev	ke el <b>A</b>	GS	Scale:	Scale: 1:40				Casing	Water	From	То	Hours

		Project	Title: S	pout Fa	rm	WS02							
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	6	Client: Community Gat Association	eway	Sheet '	1 Of 1			
			GL (m/	(mAOD):			N Coord: 0		E Coor	d: 0			
Date: 04/02/20	19		Method	od: Window Sample			Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	t	Level	Legend	Depth (m)	Description				W	ater Sta	Indpipe
1.00	J	N=12 N=17 N=13 N=14				0.35 1.00 2.00 3.00 4.00 5.00 6.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including s (GLACIAL TILL)	n, slightly si vn and occ ndy, slightly ilar to subro sandstone a 4.00 m	Ity, sand casional gravell ounded, and silt	ly CLAY lly grey y CLAY fine to stone.			
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		REM No Gr	L ARKS oundwat	L	ı ered	Water Strik	Strike	Level S	Minutes Chisel	Casing	Sealed		
- Groundwa	ater Stril ater Lev	ke el <b>A</b>	GS	Scale:	Scale: 1:40				Casing	Water	From	То	Hours

Pr			Project	Title: S	pout Fa	rm			W	$\overline{S}$	03	)	
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	3	Client: Community Gat Association	eway	Sheet '	1 Of 1			
			GL (m/	AOD):			N Coord: 0		E Coord: 0				
Date: 04/02/20	19		Method	d: Wind	ow Sam	ple	Driller: LOT Geotechnie	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Resul	t	Level Legend Depth (m)		Depth (m)	Description	I			W	ater Sta	Indpipe
0.20	E	N=12 N=19 N=13 N=15				0.40 1.00 2.00 3.00 4.00 5.00 6.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including (GLACIAL TILL) End Of Borehole At	n, slightly si wn and occ ndy, slightly ilar to subro sandstone 4.00 m	Ity, sand	ly CLAY Ily grey y CLAY , fine to stone.			
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			REM No Gr	ARKS	ter Encounte	ered	Water Strik	Strike	Level S Water	Minutes	Casing Ing To	Sealed	
	ater Lev	el A	GS	Scale:	Scale: 1:40								

			Project	Title: S	pout Fai	rm	WS04						
WMLco	ONSULT	NG	Project	Numbe	r: 8517G	3	Client: Community Gat Association	teway Sheet 1 Of 1					
			GL (mA	AOD):			N Coord: 0		E Coor	d: 0			
Date: 04/02/2019			Method: Window Sample				Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	:	Level	Legend	Depth (m)	Description				Wa	ater Sta	Indpipe
1.00	D	N=12 N=19 N=14 N=16 N=21				0.45 1.00 2.00 3.00 4.00 5.00 6.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including s (GLACIAL TILL)	n, slightly si vn and occ ndy, slightly ilar to subro sandstone i 5.00 m	Ity, sand	ly CLAY lly grey y CLAY fine to stone.			
KEY D - Disturbed	L Sample	<u> </u>		REM No Gr	L ARKS oundwat	ter Encounte	red	Water Strik	es Strike		Minutes	Casing	Sealed
B - Bulk Samp U - Undisturbe W - Water Sar	le d mple										.viiriules		
S - Standard F C - Cone Pene	enetrati etration	on Test Test											
N - Penetration	n Test 'N ar Vane	I' Value kPa						Daily Log C	) Df Depth	s	Chisell	ing	
<ul> <li>✓ - Groundwa</li> <li>✓ - Groundwa</li> </ul>	ater Strik ater Lev	ce el	GS	Socie	1.40			Date	Casing	Water	From	То	Hours
		Scale:	1:40										

			Project	Title: S	pout Fai	m	WS05						
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	i	Client: Community Gat Association	teway Sheet 1 Of 1					
			GL (m/	AOD):			N Coord: 0		E Coord: 0				
Date: 04/02/2019			Method	d: Wind	ow Sam	ole	Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	t	Level Legend Depth (m) Description					Wa	ater Sta	andpipe		
1.10	J	N=15 N=18 N=14 N=16				0.40 1.00 2.00 3.00 4.00 5.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including s (GLACIAL TILL)	n, slightly si vn and occ ndy, slightly ilar to subro sandstone a 4.00 m	Ity, sand casional gravell ounded, and silt	ly CLAY lly grey y CLAY fine to stone.			
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 V - Groundwater Strike			REM No Gr	L ARKS oundwat	er Encounte	ı ered	Water Strik	Strike	Level S Water	Minutes Chisell From	Casing Ing To	Sealed	
▼ - Groundwater Level				Scale:	1:40								

			Project	Title: S	pout Fa	rm	WS06							
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	3	Client: Community Gat Association	eway	Sheet '	1 Of 1				
			GL (m/	AOD):			N Coord: 0		E Coord: 0					
Date: 04/02/20	19		Method: Window Sample				Driller: LOT Geotechnie	cs Ltd	Loggeo	l By: TP	В			
Depth (m)	Туре	Test Result	t	Level	Legend	Depth (m)	Description				Wa	ater Sta	andpipe	
0.30	E	N=13 N=19 N=15 N=15		Level Legend Depth (r		0.55 1.00 2.00 3.00 4.00 5.00 6.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including (GLACIAL TILL) End Of Borehole At	wn, slightly silty, sandy CLAY own and occasionally grey andy, slightly gravelly CLAY. gular to subrounded, fine to g sandstone and siltstone.						
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			REM No Gr	ARKS	ter Encounte	ered	Water Strik	Strike	Level S Water	Minutes	Casing ing To	Sealed		
			Scale:	1:40										

			Project	Title: S	pout Fai	WS07							
WML	ONSULT	ING	Project	Numbe	r: 8517G	;	Client: Community Gat Association	eway	Sheet 1 Of 1				
			GL (m/	OD):			N Coord: 0	E Coord: 0					
Date: 05/02/20	19		Method	d: Wind	ow Sam	ple	Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	t	Level	/el Legend	Depth (m)	Description				W	ater Sta	Indpipe
0.20	E	N=15 N=21 N=17 N=17				0.30 1.00 2.00 3.00 4.00 5.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including s (GLACIAL TILL) End Of Borehole At	n, slightly si vn and occ ndy, slightly ilar to subro sandstone a 4.00 m	Ity, sand	ly CLAY lly grey y CLAY fine to stone.			
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration Test C - Cone Penetration Test C - Cone Penetration Test N - Penetration Test 'N' Value V - Hand Shear Vane kPa ✓ - Groundwater Strike ✓ - Groundwater Level			REM Scale:	ARKS 1:40			Water Strik	es Strike 2.5 Df Depth Casing	Level S Water	Minutes Chisel From	Casing ing To	Sealed	

			Project	Title: S	pout Fai	WS08							
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	ì	Client: Community Gat Association	teway Sheet 1 Of 1					
			GL (mA	AOD):			N Coord: 0		E Coord: 0				
Date: 05/02/2019			Method	I: Wind	ow Sam	ple	Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result		Level Legend Depth (m) Description				Wa	ater Sta	ndpipe			
0.50	EJ	N=19 N=18 N=15 N=13				0.55 1.00 2.00 3.00 4.00 6.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sat Gravel is subangu coarse, including s (GLACIAL TILL) End Of Borehole At	n, slightly si vn and occ ndy, slightly lar to subro sandstone a 4.00 m	lty, sand	ly CLAY ily grey y CLAY fine to stone.			
KEY				RFM	ARKS			Water Strik	<b>es</b>				
D - Disturbed S B - Bulk Samp	Sample							Date	Strike	Level	Minutes	Casing	Sealed
U - Undisturbe	ed mole							07/02/2019	0.5				
S - Standard F	Penetrati	ion Test											
N - Penetration	n Test 'N	i est N' Value									<u></u>		
$\nabla$ - Hand Shea	ar Vane ater Stril	кРа ке 🗖						Daily Log C	of Depth	S	Chisel	ing T.	
<ul> <li>✓ - Groundwater Strike</li> <li>✓ - Groundwater Level</li> </ul>			GS	Scale:	1:40			Casing	vvaler				

			Project	Title: S	pout Fai	m	WS09						
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	ì	Client: Community Gat Association	teway Sheet 1 Of 1					
			GL (m/	AOD):			N Coord: 0		E Coord: 0				
Date: 05/02/2019			Method	1: Wind	ow Sam	ple	Driller: LOT Geotechnie	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	t	Level	Legend	Depth (m)	Description				Wa	ater Sta	ndpipe
1.00	J	N=15 N=17 N=13 N=20				0.40 1.00 2.00 3.00 4.00 5.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including (GLACIAL TILL) End Of Borehole At	n, slightly si wn and occ ndy, slightly ilar to subro sandstone 4.00 m	Ity, sand casional gravell ounded, and silt	ly CLAY lly grey y CLAY fine to stone.		***************************************	
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			REM No Gr	L ARKS oundwat	er Encounte	I	Water Strik	Strike	Level S Water	Minutes Chisell From	Casing ing To	Sealed	
AGS				Scale:	1:40								
			Project Title: Spout Farm					WS10					
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WMLco	ONSULT	ING	Project	Numbe	er: 8517G	i	Client: Community Gat Association	eway	Sheet ?	1 Of 1			
			GL (m/	AOD):			N Coord: 0		E Coor	d: 0			
Date: 05/02/20	19		Method	1: Wind	ow Sam	ble	Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	B		
Depth (m)	Туре	Test Result	t	Level	Legend	Depth (m)	Description				Wa	ater Sta	andpipe
0.20	D	N=18 N=14 N=11 N=10 N=9				0.30 1.00 2.00 3.00 4.00 5.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including s (GLACIAL TILL)	n, slightly si vn and occ ndy, slightly ilar to subre sandstone a 5.00 m	lty, sanc casional gravell ounded, and silt	ly CLAY Ily grey y CLAY , fine to stone.			
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				REM No Gr	ARKS oundwat	er Encounte	ered	Water Strik Date Daily Log C Date	es Strike Df Depth Casing	Level S Water	Minutes Chisel From	Casing ing To	Sealed

		Project Title: Spout Farm						W	'S'	11		
	IG	Project	Numbe	r: 8517G	ì	Client: Community Gat Association	eway	Sheet '	1 Of 1			
		GL (mA	AOD):			N Coord: 0		E Coor	d: 0			
Date: 05/02/2019		Method	I: Wind	ow Sam	ple	Driller: LOT Geotechnie	cs Ltd	Loggeo	l By: TP	В		
Depth (m) Type	Test Result		Level	Legend	Depth (m)	Description				W	ater Sta	andpipe
0.80 D	N=20 N=19 N=15				0.35 1.00 2.00 3.00 4.00 5.00	Turf over dark brow with rootlets. (TOPSOIL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including (GLACIAL TILL) End Of Borehole At	n, slightly si wn and occ ndy, slightly ilar to subro sandstone 4.00 m	Ity, sand	ly CLAY lly grey y CLAY fine to stone.			
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed W - Water Sample S - Standard Penetration C - Cone Penetration To N - Penetration Test 'N' V - Hand Shear Vane ki C - Groundwater Strike C - Groundwater Level	REMARKS No Groundwater Encountered Date Date Date Date Date				Water Strik	es Strike Df Depth Casing	Level S Water	Minutes Chise From	S Casing	Sealed		

			Project	Title: S	pout Fa	rm		WS12					
WML	ONSULT	ING	Project	Numbe	r: 8517G	3	Client: Community Gat Association	eway	Sheet <sup>2</sup>	1 Of 1			
			GL (m/	AOD):			N Coord: 0		E Coor	d: 0			
Date: 05/02/20	19	-	Method	l: Wind	ow Sam	ple	Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	:	Level	Legend	Depth (m)	Description				W	ater Sta	Indpipe
0.80	D	N=11 N=11 N=17 N=12				0.40 1.00 2.00 3.00 4.00 5.00 6.00	Turf over dark brow with rootlets. (TOPSOIL) Soft, light grey, slig Gravel is subround sandstone. (GLACIAL TILL) Firm to stiff, brow mottled, slightly sal Gravel is subangu coarse, including s (GLACIAL TILL) End Of Borehole At	n, slightly si ghtly gravell ed, fine to c vn and occ ndy, slightly lar to subre sandstone a 4.00 m	Ity, sand y, sand oarse, ir casional gravell ounded, and silt	ly CLAY y CLAY ncluding lly grey y CLAY fine to stone.			
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 Date Date Daily Daily Date					es Strike Df Depth Casing	Level S Water	Minutes Chisel From	Casing Casing Ing To	Sealed
												1	

	Project Title: Spout Farm							13	3		
	Project Nur	mber: 85	17G		Client: Community Gat Association	eway	Sheet <sup>2</sup>	1 Of 1			
	GL (mAOD)	):			N Coord: 0		E Coor	d: 0			
Date: 06/02/2019	Method: W	Vindow S	ample		Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	В		
Depth (m) Type Test Result	t Lev	vel Lege	nd Depth	n (m)	Description				Wa	ater Sta	indpipe
0.10 E N=16 1.10 J N=16 N=14 N=11 N=14 N=13			0.20 1.00 2.00 3.00 4.00 6.00		Brownish grey, slig with a low cobb subangular, fine t concrete, sandstor subangular, includ (MADE GROUND) Firm to stiff, brow mottled, slightly san Gravel is subangu coarse, including s (GLACIAL TILL)	htly sandy, le content o coarse, i ne and woo ing brick. vn and occ ndy, slightly lar to subre sandstone a 4.00 m	gravell Grav includin d. Cobb casional gravell ounded and silt	y CLAY els are g brick bles are lly grey y CLAY , fine to stone.			
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	GS sc	REMARKS       Water Strikes         No Groundwater Encountered       Date         Strike       Leve         Daily Log Of Depths         Date       Casing Wate         Scale: 1:40       Date					Level S Water	Minutes Chisell From	Casing ing To	Sealed	

	Project Title	Project Title: Spout Farm						'S'	14	I	
	Project Nun	mber	: 8517G	i	Client: Community Gate Association	eway	Sheet 1	I Of 1			
	GL (mAOD)	):			N Coord: 0		E Coor	d: 0			
Date: 06/02/2019	Method: W	Vindo	ow Samp	ble	Driller: LOT Geotechnic	s Ltd	Loggeo	l By: TP	В		
Depth (m) Type Test Resul	t Lev	vel I	Legend	Depth (m)	Description				Wa	ater Sta	Indpipe
0.20 E		***************************************		0.25 0.50 1.00 2.00 3.00 4.00 5.00	Dark brownish grey, fine to coarse G concrete, sandsto cobble content. C including concrete (MADE GROUND) Firm, brownish gre gravelly CLAY. Gra coarse, including s (GLACIAL TILL) Firm to stiff, brow mottled, slightly sar Gravel is subangul coarse, including s (GLACIAL TILL)	slightly sar RAVEL in ne and as Cobbles ar e. ey, slightly avel is sub- andstone. m and occ dy, slightly lar to subro sandstone a	ndy, sub cluding phalt. I re suba sandy, angular, gravelly bunded, and silts	angular y brick Medium ingular slightly fine to y CLAY fine to stone.			
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	GS Sc.	EMA o Gro	ARKS oundwat	er Encounte	ered	Water Strik Date Daily Log C Date	es Strike Df Depth Casing	Level S Water	Minutes Chisell From	Casing ing To	Sealed

WMLCONSULTING			Project	Title: S	pout Fa	rm			W	'S'	15		
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	3	Client: Community Gat Association	eway	Sheet '	1 Of 1			
			GL (m/	AOD):			N Coord: 0		E Coor	d: 0			
Date: 06/02/20	19		Method	1: Wind	ow Sam	ple	Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	t	Level	Legend	Depth (m)	Description				Wa	ater Sta	Indpipe
1.20	J	N=14 N=19 N=16 N=9				0.30 0.50 1.00 2.00 3.00 4.00 5.00	Brownish grey, sa coarse GRAVEL in concrete and asp Cobbles are sub including brick a (MADE GROUND) Firm, brownish gra gravelly CLAY. Gr. coarse, including s (GLACIAL TILL) Firm to stiff, brow mottled, slightly sat Gravel is subangu coarse, including s (GLACIAL TILL)	andy, suba ncluding sa halt. Low c angular, fi nd concre ey, slightly avel is sub- sandstone. vn and occ ndy, slightly lar to subro sandstone a 4.00 m	ngular, indstone cobble of ine to te. sandy, angular casional gravelly ounded, and silt	fine tc e, brick content coarse slightly , fine tc Ily grey y CLAY , fine tc stone.			
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				REM No Gr	L ARKS oundwat	ter Encounte	Levred	Water Strik	Strike	Level S Water	Minutes Chisell From	Casing ing To	Sealed
	- Groundwater Strike												

Pro				Project Title: Spout Farm						'S'	16		
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	ì	Client: Community Gat Association	eway	Sheet ?	I Of 1			
			GL (m/	AOD):			N Coord: 0		E Coor	d: 0			
Date: 06/02/20	19		Method	l: Wind	ow Sam	ple	Driller: LOT Geotechnic	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	t	Level	Legend	Depth (m)	Description				Wa	ater Sta	Indpipe
0.10	E	N=15 N=19 N=19 N=19				0.20 0.50 1.00 2.00 3.00 4.00 5.00	Dark brownish grey coarse GRAVEL i sandstone and asj Cobbles are subar (MADE GROUND) Firm, brownish grey (GLACIAL TILL) Stiff, brown and c slightly sandy, sligh subangular to sub including sandsto (GLACIAL TILL)	4.00 m	y y y y y y y y y y y y y y y y y y y	r, fine to oncrete content sphalt. mottled Gravel is coarse			
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				REM No Gri	ARKS oundwat 1:40	er Encounte	ered	Water Strik	es Strike Df Depth Casing	Level S Water	Minutes Chisell From	Casing ing To	Sealed

			Project	Title: S	pout Fa	rm		W	'S'	17	,		
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	3	Client: Community Gat Association	eway	Sheet '	1 Of 1			
			GL (m/	AOD):			N Coord: 0		E Coor	d: 0			
Date: 05/02/20	19		Method	d: Wind	ow Sam	ple	Driller: LOT Geotechnie	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	t	Level	Legend	Depth (m)	Description				W	ater Sta	andpipe
0.20	E					0.45 0.70 1.00 2.00 3.00 4.00 5.00	Brownish grey, slig to coarse GRAVEL and concrete. (MADE GROUND) Firm, brown and o slightly sandy, sligh subangular to sul including sandsto (GLACIAL TILL) End Of Borehole At	htly sandy, s including s occasionally try gravelly brounded, ine and silt 0.70 m	subangu andstor y grey i CLAY. C fine to tstone.	ular, fine ne, brick mottled Gravel is coarse			
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			REMARKS Hole terminated at 0.70mbg due to water in pit.			ı ogl	Water Strik	Strike 0.2	Level	Minutes	Casing	Sealed	
<ul> <li>✓ - Groundwa</li> <li>✓ - Groundwa</li> </ul>	<ul> <li>✓ - Hand Shear Vane kPa</li> <li>✓ - Groundwater Strike</li> <li>✓ - Groundwater Level</li> </ul>			Date Casing Water From						From	То	Hours	
				Scale:	1:40								

			Project	Title: S	pout Fai	m			W	'S'	18	)	
WMLco	ONSULT	ING	Project	Numbe	r: 8517G	i	Client: Community Gat Association	eway	Sheet <sup>2</sup>	1 Of 1			
			GL (m/	AOD):			N Coord: 0		E Coor	d: 0			
Date: 05/02/20	19		Method	I: Wind	ow Sam	ble	Driller: LOT Geotechnie	cs Ltd	Loggeo	l By: TP	В		
Depth (m)	Туре	Test Result	t	Level	Legend	Depth (m)	Description				Wa	ater Sta	Indpipe
0.10	D	N=14 N=18 N=15 N=17				0.25 0.45 1.00 2.00 3.00 4.00 5.00	Dark brownish grey fine to coarse GR sandstone and as (MADE GROUND) Firm, grey, slightl CLAY. Gravel is s including sandstor (GLACIAL TILL) Firm to stiff, brow mottled, slightly sa Gravel is subangu coarse, including (GLACIAL TILL) End Of Borehole At	4.00 m	Iightly g fine to casional gravell ounded, and silt	angular poncrete gravelly coarse lly grey y CLAY , fine to stone.			
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			REMARKS No Groundwater Encountered					Strike	Level	Minutes	Casing	Sealed	
• Groundwa	Groundwater Level     Groundwater Level				1:40			Date Casing Water				To	Hours



#### **APPENDIX 03**

**Geotechnical Testing Results** 



## LABORATORY REPORT



4043

#### Contract Number: PSL19/1185

Report Date: 26 February 2019

Client's Reference: 8517G

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

#### For the attention of: Sam Seddon

Contract Title:Spout FarmDate Received:20/2/2019Date Commenced:20/2/2019Date Completed:26/2/2019

#### Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

10 R Gunson

(Director)

A Watkins (Director) R Berriman (Quality Manager)

S Royle (Laboratory Manager) S Eyre (Senior Technician) L Knight (Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe, Doncaster DN4 0AR tel: +44 (0)844 815 6641 fax: +44 (0)844 815 6642 e-mail: rgunson@prosoils.co.uk awatkins@prosoils.co.uk Page 1 of

## SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
WS01		D	1.20		Brown sandy CLAY.
WS04		D	1.00		Brown sandy CLAY.
WS10		D	1.00		Brown sandy CLAY.
WS11		D	0.80		Brown sandy CLAY.
WS12		D	0.80		Brown very sandy CLAY.
WS18		D	0.90		Brown sandy CLAY.

			<b>Contract No:</b>
$( \diamond \langle )$		Spout Form	PSL19/1185
		Spout Farm	Client Ref:
4043	Professional Solls Laboratory		8517G

## SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole	Sample	Sample	Тор	Base	Moisture Content	Linear Shrinkage	Particle Density	Liquid Limit	Plastic Limit	Plasticity Index	Passing .425mm	Remarks
Number	Number	Туре	Depth	Depth	%	%	Mg/m <sup>3</sup>	%	%	%	%	
			m	m	Clause 3.2	Clause 6.5	Clause 8.2	Clause 4.3/4	Clause 5.3	Clause 5.4		
WS01		D	1.20		19			40	20	20	100	Intermediate plasticity CI.
WS04		D	1.00		17			38	19	19	100	Intermediate plasticity CI.
WS10		D	1.00		15			37	18	19	100	Intermediate plasticity CI.
WS11		D	0.80		24			45	23	22	100	Intermediate plasticity CI.
WS12		D	0.80		19			30	15	15	100	Low plasticity CL.
WS18		D	0.90		20			46	23	23	100	Intermediate plasticity CI.

**SYMBOLS :** NP : Non Plastic

\*: Liquid Limit and Plastic Limit Wet Sieved.

<b>A</b>			Contract No:
		Shout Form	PSL19/1185
		Spout Farm	Client Ref:
4043	Professional Soils Laboratory		8517G





#### **APPENDIX 04**

**Chemical Analytical Results** 



Chemistry to deliver results Chemtest Ltd. Depot Road Newmarket CB8 0AL Tel: 01638 606070 Email: info@chemtest.com

2

Report No.:	19-04826-1		
Initial Date of Issue:	19-Feb-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	8517G Spout Farm		
Quotation No.:		Date Received:	08-Feb-2019
Order No.:	8517G	Date Instructed:	08-Feb-2019
No. of Samples:	17		
Turnaround (Wkdays):	5	Results Due:	14-Feb-2019
Date Approved:	18-Feb-2019		
Approved By:			
Ulipe Mary			
Details:	Glynn Harvey, Laboratory Manager		

# Chemtest The right chemistry to deliver results Project: 8517G Spout Farm

**Results - Leachate** 

Client: WML Consulting Ltd		Chei	mtest Jo	ob No.:	19-04826	19-04826	19-04826
Quotation No.:	(	Chemte	st Sam	ple ID.:	771012	771017	771023
Order No.: 8517G		Clie	nt Samp	le Ref.:	E	E	E
		Sa	ample Lo	ocation:	WS07	WS13	WS18
			Sampl	e Type:	SOIL	SOIL	SOIL
			Top Dep	oth (m):	0.20	0.10	0.10
			Date Sa	ampled:	05-Feb-2019	06-Feb-2019	06-Feb-2019
Determinand	Accred.	SOP	Units	LOD			
рН	U	1010		N/A	8.0	8.1	8.4
Sulphur	N	1220	mg/l	1.0	< 1.0	4.7	< 1.0
Sulphate	U	1220	mg/l	1.0	1.2	14	2.7
Hardness	U	1415	mg/l	15	19	25	17
Arsenic (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Boron (Dissolved)	U	1450	µg/l	20	< 20	< 20	< 20
Cadmium (Dissolved)	U	1450	µg/l	0.080	< 0.080	< 0.080	< 0.080
Copper (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Mercury (Dissolved)	U	1450	µg/l	0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Lead (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Vanadium (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Zinc (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0
Chromium (Hexavalent)	U	1490	µg/l	20	< 20	< 20	< 20
Naphthalene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Chrysene	Ν	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1700	µg/l	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1700	µg/l	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
Dibenz(a,h)Anthracene	U	1700	µg/l	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
Total Of 16 PAH's	Ν	1700	µg/l	2.0	< 2.0	< 2.0	< 2.0
Total Phenols	U	1920	mg/l	0.030	< 0.030	< 0.030	< 0.030

# Chemtest The right chemistry to deliver results Project: 8517G Spout Farm

### Results - Soil

Client: WML Consulting Ltd		Che	mtest J	ob No.:	19-04826	19-04826	19-04826	19-04826	19-04826	19-04826	19-04826	19-04826	19-04826
Quotation No.:	(	Chemte	est Sam	ple ID.:	771007	771008	771009	771010	771011	771013	771014	771015	771016
Order No.: 8517G		Clie	nt Samp	le Ref.:	E	J	E	J	E	E	J	J	E
		Sa	ample Lo	ocation:	WS01	WS02	WS03	WS05	WS06	WS08	WS08	WS09	WS10
			Sampl	е Туре:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top De	oth (m):	0.10	1.00	0.20	1.10	0.30	0.50	1.30	1.00	0.20
			Date Sa	ampled:	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	05-Feb-2019	05-Feb-2019	05-Feb-2019	05-Feb-2019
			Asbest	os Lab:	DURHAM		DURHAM		DURHAM	DURHAM			DURHAM
Determinand	Accred.	SOP	Units	LOD									
АСМ Туре	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
ACM Detection Stage	U	2192		N/A	-		-		-	-			-
Moisture	Ν	2030	%	0.020	19	17	15	14	21	20	14	18	24
рН	U	2010		N/A	6.5	7.5	6.0	8.0	6.0	7.3	7.9	7.4	6.1
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.44		< 0.40		< 0.40	< 0.40			0.45
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total Sulphur	U	2175	%	0.010	0.039	0.011	0.031	0.017	0.032	0.023	0.020	0.013	0.057
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50		< 0.50		< 0.50	< 0.50			< 0.50
Sulphate (Total)	U	2430	mg/kg	100	680		450		470	320			860
Arsenic	U	2450	mg/kg	1.0	6.4		4.8		6.1	3.5			8.0
Cadmium	U	2450	mg/kg	0.10	0.10		0.12		0.12	< 0.10			0.19
Copper	U	2450	mg/kg	0.50	17		17		21	170			23
Mercury	U	2450	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Nickel	U	2450	mg/kg	0.50	23		22		22	15			22
Lead	U	2450	mg/kg	0.50	25		24		29	33			38
Selenium	U	2450	mg/kg	0.20	0.39		0.34		0.36	0.25			0.40
Vanadium	U	2450	mg/kg	5.0	28		25		25	22			28
Zinc	U	2450	mg/kg	0.50	36		34		41	19			47
Chromium (Hexavalent)	Ν	2490	mg/kg	0.50	< 0.50		< 0.50		< 0.50	< 0.50			< 0.50
Organic Matter	U	2625	%	0.40	4.0		2.9		2.8	2.1			4.8
Naphthalene	U	2700	mg/kg	0.10	< 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			< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 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			< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Fluoranthene	U	2700	mg/kg	0.10	0.17		< 0.10		0.10	< 0.10			0.10
Pyrene	U	2700	mg/kg	0.10	0.30		0.16		0.19	< 0.10			0.12
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10			< 0.10



### <u>Results - Soil</u>

Client: WML Consulting Ltd		Che	mtest Jo	ob No.:	19-04826	19-04826	19-04826	19-04826	19-04826	19-04826	19-04826	19-04826	19-04826
Quotation No.:	(	Chemte	est Sam	ple ID.:	771007	771008	771009	771010	771011	771013	771014	771015	771016
Order No.: 8517G		Clie	nt Samp	le Ref.:	E	J	E	J	E	E	J	J	E
		Sa	ample Lo	ocation:	WS01	WS02	WS03	WS05	WS06	WS08	WS08	WS09	WS10
			Sample	e Type:	SOIL								
			Top Dep	oth (m):	0.10	1.00	0.20	1.10	0.30	0.50	1.30	1.00	0.20
			Date Sa	ampled:	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	04-Feb-2019	05-Feb-2019	05-Feb-2019	05-Feb-2019	05-Feb-2019
			Asbest	os Lab:	DURHAM		DURHAM		DURHAM	DURHAM			DURHAM
Determinand	Accred.	SOP	Units	LOD									
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0		< 2.0		< 2.0	< 2.0			< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30		< 0.30		< 0.30	< 0.30			< 0.30

# Chemtest The right chemistry to deliver results Project: 8517G Spout Farm

### Results - Soil

Client: WML Consulting Ltd		Che	mtest J	ob No.:	19-04826	19-04826	19-04826	19-04826	19-04826
Quotation No.:		Chemtest Sample ID.:			771018	771019	771020	771021	771022
Order No.: 8517G		Clie	nt Samp	le Ref.:	J	E	J	E	E
		Sa	ample Lo	ocation:	WS13	WS14	WS15	WS16	WS17
			Sampl	e Type:	SOIL	SOIL	SOIL	SOIL	SOIL
			Top De	pth (m):	1.10	0.20	1.20	0.10	0.20
			Date Sa	ampled:	06-Feb-2019	06-Feb-2019	06-Feb-2019	06-Feb-2019	06-Feb-2019
			Asbest	tos Lab:		DURHAM		DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD					
АСМ Туре	U	2192		N/A		-		-	-
Asbestos Identification	U	2192	%	0.001		No Asbestos Detected		No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A		-		-	-
Moisture	N	2030	%	0.020	14	6.9	17	10	9.7
рН	U	2010		N/A	8.2	9.9	8.5	8.6	10.6
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40		< 0.40		< 0.40	0.51
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	0.088	< 0.010	< 0.010	0.28
Total Sulphur	U	2175	%	0.010	0.016	0.31	< 0.010	0.13	0.054
Cyanide (Total)	U	2300	mg/kg	0.50		< 0.50		< 0.50	< 0.50
Sulphate (Total)	U	2430	mg/kg	100		2500		1300	1500
Arsenic	U	2450	mg/kg	1.0		9.3		14	14
Cadmium	U	2450	mg/kg	0.10		0.18		0.55	0.21
Copper	U	2450	mg/kg	0.50		11		20	7.9
Mercury	U	2450	mg/kg	0.10		< 0.10		0.12	< 0.10
Nickel	U	2450	mg/kg	0.50		20		16	12
Lead	U	2450	mg/kg	0.50		32		42	20
Selenium	U	2450	mg/kg	0.20		< 0.20		0.37	< 0.20
Vanadium	U	2450	mg/kg	5.0		16		26	22
Zinc	U	2450	mg/kg	0.50		84		140	44
Chromium (Hexavalent)	N	2490	mg/kg	0.50		< 0.50		< 0.50	< 0.50
Organic Matter	U	2625	%	0.40		5.2		7.6	0.66
Naphthalene	U	2700	mg/kg	0.10		0.27		0.74	0.10
Acenaphthylene	U	2700	mg/kg	0.10		0.12		1.2	0.13
Acenaphthene	U	2700	mg/kg	0.10		< 0.10		5.5	0.83
Fluorene	U	2700	mg/kg	0.10		0.11		6.9	0.92
Phenanthrene	U	2700	mg/kg	0.10		0.71		42	3.8
Anthracene	U	2700	mg/kg	0.10		0.17		17	0.92
Fluoranthene	U	2700	mg/kg	0.10		1.4		63	4.1
Pyrene	U	2700	mg/kg	0.10		1.5		62	3.8
Benzo[a]anthracene	U	2700	mg/kg	0.10		1.0		31	2.0
Chrysene	U	2700	mg/kg	0.10		1.2		34	1.6
Benzo[b]fluoranthene	U	2700	mg/kg	0.10		0.87		30	1.9
Benzo[k]fluoranthene	U	2700	mg/kg	0.10		0.42		14	0.77
Benzo[a]pyrene	U	2700	mg/kg	0.10		1.1		28	1.6
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10		0.85		17	2.0
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10		0.14		7.7	0.82
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10		0.77		19	1.8



### Results - Soil

Client: WML Consulting Ltd		Che	mtest J	ob No.:	19-04826	19-04826	19-04826	19-04826	19-04826
Quotation No.:	(	Chemte	est Sam	ple ID.:	771018	771019	771020	771021	771022
Order No.: 8517G		Client Sample Ref .:		J	E	J	E	E	
		Sa	ample Lo	ocation:	WS13	WS14	WS15	WS16	WS17
			Sampl	е Туре:	SOIL	SOIL	SOIL	SOIL	SOIL
			Top De	oth (m):	1.10	0.20	1.20	0.10	0.20
			Date Sa	ampled:	06-Feb-2019	06-Feb-2019	06-Feb-2019	06-Feb-2019	06-Feb-2019
			Asbest	os Lab:		DURHAM		DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD					
Total Of 16 PAH's	U	2700	mg/kg	2.0		11		380	27
Total Phenols	U	2920	mg/kg	0.30		< 0.30		< 0.30	< 0.30



#### **Test Methods**

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	рН	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; Dibenz[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	Allkaline 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; Dibenz[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 TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge



#### **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 N Project N Client:-	ame:- o:- ent:-	Spout Farm 8517G Community Gas Data Gi	Gateway FM436		Date:- Start Tin End Time Ground ( Weather	ne:- 2:- Condition Conditio	s:- ns:- rator:-	20/02/2019 10:30 11:30 Wet Drizzle		Atmosph Start:- End:- Trend:-	<b>heric Pressure</b> 1004mb 1004mb Rising	2	
	Peak	Steady		Cl	14	C	02		Peak	Peak		Watar	
ID	Flow l/hr	Flow I/hr	DP	Peak	GSV I/hr	Peak	GSV I/hr	Min O2 %	H2S ppm	CO ppm	Hexane %	Water Level mbgl	mbgl
WS01	<0.1	<0.1	0	0.0	0.0000	0.4	0.0004	20.4	0	0	0.000	0.60	3.80
WS04	-	-	-	-	-	-	-	-	-	-	-	-	-
WS08	-	-	-	-	-	-	-	-	-	-	-	-	-
WS10	-	-	-	-	-	-	-	-	-	-	-	-	-
WS13	-	-	-	-	-	-	-	-	-	-	-	-	-
WS16	-	-	-	-	-	-	-	-	-	-	-	-	-

Additional Comments

WS04, WS08, WS10, WS13 & WS16 flooded. All holes bailed out.

#### Gas & Groundwater Monitoring Record Sheet



Project N Project N Client:- Instrume	ame:- lo:- ent:-	Spout Farm 8517G Community Gas Data Gf	Gateway =M436		Date:- Start Tim End Time Ground C Weather	ne:- 2:- Condition Condition Oper	s:- ns:- ator:-	26/02/2019 11:30 12:30 Dry Sunny P Hobson	Atmospheric Press Start:- End:- Trend:-			e 1025mb 1025mb Rising	
Hole ID	Peak Flow I/hr	Steady Flow I/hr	DP	Cł Peak	i4 GSV I/hr	C Peak	02 GSV l/hr	Min O2 %	Peak H2S ppm	Peak CO ppm	Hexane %	Water Level mbgl	Base of Hole mbgl
WS01	0.2	0	0	0.0	0.0000	0.0	0.0000	20.4	0	0	0.000	2.40	3.80
WS04	0.3	0.1	0	0.1	0.0003	0.2	0.0006	20.5	0	0	0.000	1.88	3.45
WS08	0.3	0	1	0.0	0.0000	0.2	0.0006	20.3	0	0	0.000	1.86	2.60
WS10	0.8	0.5	3	0.0	0.0000	0.1	0.0008	20.6	0	0	0.000	0.58	3.00
WS13	3.8	1.9	10	0.0	0.0000	0.4	0.0152	20.0	0	0	0.000	2.40	3.00
WS16	2.3	0	0	0.0	0.0000	0.1	0.0023	20.5	0	0	0.000	0.70	3.20

Additional Comments

TEST DATE AN	D CONDITIONS
Date	17/08/18
Atmospheric Pressure	e 1001 mB
Ambient Temperatur	e 21.7 °C
Environics Serial No.	5089

GFM436 Final Inspection & Calibration Check Certificate

Customer	WML Consulting Ltd
Certificate Number	120377
Order Number	320675

Serial Number	12969
Software Version	G436-00.0027/0010

GAS DATA LTD	
Unit 4, Fairfield Court	
Seven Stars Estate	
Wheler Rd	
Coventry	
CV3 4LJ	
Tel 02476303311	Fax 02476307711

<b>Recalibration DUE Date</b>	
17/08/19	

Instrument Checks						
Keyboard	*					
Pump Flow In	500	Accept > 200 cc/min	Pump Flow @ -200mB	300	Accept > 200 cc/min	
Clock Set / Running		4	Labels Fitted		*	

			Gas Checks		Market States	The state of the second	
	CH 4		<i>CO</i> <sub>2</sub>		0,		
Sensor	Instrument Gas True Gas		Instrument Gas	True Gas	Instrument Gas	True Car	
	Readings %	Value %	Readings %	Value %	Readings %	Value %	
	60 60	60	40	10	20.9		
	Accept ±3.0	00	Accept ±3.0	40	Accept ±0.5	20.9	
	5	-	5	-1.91.141	6	- 6	
	Accept ±0.3	3	Accept ±0.3	5	Accept ±0.3		
Zero Reading 100% N2	0	0	0		0		
	Accept ±0.0	0	Accept ±0.0	0	Accept ±0.1	0	

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



#### 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.
   Flow - Gas flow measured in litres per hour
   <0.1 - Where flows are less than 0.1l/hr are recorded</li>
   Co<sub>2</sub> - Carbon Dioxide
- O<sub>2</sub> Oxygen
- H<sub>2</sub>S Hydrogen Sulphide
- CO Carbon Monoxide

- Pressure differential measured in millibars
- Percentage

PD

%

l/hr

 $CH_4$ 

GSV

- ppm Parts Per Million
  - Litres per hour
  - Methane
- mbgl Metres below ground level
  - Gas Screening Value

		2. 1 1 1 1 2 1		Cross Ga	s Effects				
Applie	Applied Gas (ppm) Instrument Readings (ppm)						1 de la		
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	co	Toxic 3:	нех		
H2S	1500	150	00		0	0			
со	1000	80	)	1	000	0	1		
Hexane	2.0%	0			0	1.9	9		
				Pressure	Checks				
			Atmo	spheric Pre	ssure [AP] (m	B)	NW N		
	Current	Atmospheric	Atmospheric Pressure (mB)		Instrument Atmospheric I		Pressure Rea	ding (mB)	
		AP Open Ports			1001		Accept ±2,0		
	AP Port (In	+800 mB		mB	800		Accept ±5.0		
	Arrorein	ternarj	+1200mb		1200		Accept:	t5.0	
	1266321			Flow	Checks	Terahow in			
1	Boi	rehole Flow				Diffe	rential Press	ıre	
Applied	Reading (l/h)	Instrum	nent Readin	g (l/h)	Applied Pr	ressure (Pa)	Instrum	nent Reading (Pa)	
	-30	-30.1	Accep	t ±3.0	-	545	-552	Accept ±50	
	-3	-3	Accep	t±1.0		22	-22	Accept ±6.0	
0 3 30		0 Accept 3 Accept	t ±0.0	0 16	0	0 Ad 16 Ad	Accept ±0.5		
			pt ±0.5		16		Accept ±3.0		
		30	Accep	t ±3.0	3	384	384	Accept ±50	
	60	60	Accep	t±6.0	1	185	1181	Accept ±130	
	90	<sup>′</sup> 90.5	Accep	t ±9.0	2	333	>>>>>	Accept ±250	

Temperature Checks					
Calibration Temperature					
Applied Temperature <sup>0</sup> C	emperature Reading *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:	Date Tested:
Jack Rutland	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.

Gas Data Ltd is certified to BS EN ISO9001:2015. Certificate NQA 8374. Valid until 22/03/2019



#### **APPENDIX 06**

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 (CaCO3 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 50-100 100-150 150-200 200-250	2 10 10 20 20	50
Copper	Copper µg/l		0.5 0.5 3 8 12	2000
Cyanide (Free)	µq/l	-	1	-
Cyanide		-	-	50
Iron	µq/l	-	1000	200
Lead	µg/l	0-50 50-150 150-250 >250	4 10 20 20	10
Mercurv	ua/l	-	1	1
Nickel µg/l		0-50 50-100 100-150 150-250 >250	$\begin{array}{c cccc} 0-50 & 8 \\ 50-100 & 20 \\ 100-150 & 20 \\ 150-250 & 40 \\ >250 & 40 \end{array}$	
Selenium	ua/l	-	-	10
Sulphate (SO4)	mq/l	-	400	250
Zinc	µg/l	0-50 50-150 150-250 >250	8 15 50 50	5000
рН	-	-	6-9	-

#### Table 2: Organic Tier 1 Water Environment Screening Criteria

Contaminant	Units	UK DWS	₩НΟ
<ul> <li>PAHs - The sum of</li> <li>Benzo(b)fluoranthene,</li> <li>Benzo(ghi)perylene,</li> <li>Benzo(k)fluoranthene,</li> <li>indeno(1,2,3- c,d)pyrene)</li> </ul>	µg/l	0.1	-
Phenol (total)	µg/l	0.5	-
МТВЕ	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 1% SOM for Hydrocarbons

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

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

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## 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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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 <sup>f</sup>
1,2,4-Trichlorobenzene	6.4
Hexachlorobenzene	3.3 (0.5) <sup>vap</sup>
Total Petroleum Hydrocarbons (TPH)	
Aliphatic C5-6	78
Aliphatic C6-8	230
Aliphatic C8-10	65
Aliphatic C10-12	330(118) <sup>vap</sup>
Aliphatic C12-16	2,400(59) <sup>sol</sup>
Aliphatic C16-35	92,000(21) <sup>f, sol</sup>
Aliphatic C35 - 44	92,000(21) <sup>f,sol</sup>
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 <sup>f</sup>
Aromatic C21-35	1,500 <sup>f</sup>
Aromatic C35 - 44	1,500 <sup>f</sup>

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