Land at Tollgate Road, Colney Heath

Phase 2 Ground Investigation Report (GIR)

On behalf of Vistry Group

Vistry Group

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Registered Office: Buckingham Court Kingsmead Business Park, London Road, High Wycombe, Buckinghamshire, HP11 1JU
Office Address: 50/60 Station Road, Cambridge, CB1 2JH
T: +44 (0)1223 882 000 E: Cambridge.uk@stantec.com

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	Name	Position	Signature	Date
Prepared by:	Matt Green	Senior Geoenvironmental Engineer	[redacted]	21/06/22
Reviewed by:	Lawrence Truslove	Principal Geotechnical Engineer		23/06/22
Approved by:	Oliver Belson	Associate		24/06/22
For and on behalf of Stantec UK Limited				

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Executive Summary

This Ground Investigation Report presents an evaluation of geotechnical and geoenvironmental information, together with suggested characteristic values of geotechnical parameters for use in the design of the geotechnical elements for the proposed residential development of Land at Tollgate Road, Colney Heath.

SITE LOCATION The Site comprises farmland covering a stable yard and two fields located on the southern edge of Colney Heath, Hertfordshire.

GROUND CONDITIONS The ground conditions on Site, as revealed by the ground investigation, comprise topsoil, overlying granular deposits of the Kesgrave Catchment Subgroup underlain by the Lowestoft Formation, with chalk bedrock expected to be present at depth. Made ground was locally encountered in the stable yard area of the site. These findings are in general agreement with the published geological information, recent exploratory hole records and known history of the Site. The ground conditions encountered are summarised in the following table.

Summary of Existing Ground Conditions:

Stratum	Base of Stratum (m bgl)	Thickness range (m)	Typical Description
Topsoil	0.15 to 0.40 (from surface in all locations except WS1 &WS2)	0.15 to 0.40	Grey slightly gravelly clayey fine to medium SAND
Made Ground	0.50 to 0.70 (present in WS1, WS2 and SA02 only)	0.30 to 0.70	Encountered in SA02 as re-worked topsoil with plastic inclusions. Encountered from surface in in WS1 & WS2 as grey sandy GRAVEL
Kesgrave Catchment Subgroup	1.50 to 4.70[a]	1.25 to 3.10	Cohesive: Variable firm orangish brown or greyish brown slightly to very gravelly slightly sandy to very sandy CLAY
	0.85 to 9.30[a]	0.50 to 8.95	Granular: Medium dense orangish brown slightly clayey gravelly SAND or slightly clayey sandy GRAVEL
Lowestoft Formation	2.10 to 7.80 [a]	0.30 to 2.90	Cohesive: Firm grey clay with sand sized chalk fragments
	4.60 to 10.00 [a]	>0.6 to >4.3	Granular: Medium dense to dense grey fine SAND
Chalk	-	-	Not encountered.
Notes: [a] Stratum not fully penetrated in all exploratory holes			

No visual or olfactory evidence of soil contamination was recorded in any of the exploratory holes during the ground investigation.

GEOTECHNICAL CONSIDERATIONS The principal geotechnical considerations will be the shrinkability, strength and compressibility of the soils.

SPREAD FOUNDATIONS Generally, the ground conditions at the study site appear suitable for the adoption of conventional trench fill or strip footings. For the granular soils present near surface a provisional presumed bearing resistance of 78kPa can be assumed for foundation up to 1.0m wide. The cohesive soils present on site are medium volume change potential soils requiring minimum foundation depths of 0.9m below final ground level and a provisional presumed bearing resistance of approximately 85kPa can be assume for a foundation not exceeding 1m width. Due allowance should be made in the design of foundations for the present hedgerows on site, whether they are to remain or be removed, and any future trees and hedgerows planted as part of the development.

FLOOR SLABS Made Ground was not encountered on the study site (except around the stable yard) and only the areas where the hedges are present are likely to be subject to tree influence and therefore (if seasonal desiccation is absent) in theory over the majority of the site ground bearing floor slabs could be employed based on the current NHBC Standards. For house plots within the zone of influence of hedgerows or trees a precast form of suspended ground floor slab is likely to be required with a minimum subfloor void in accordance with NHBC Standards to allow for potential heave of desiccated soils.

PAVEMENT DESIGN For preliminary design purposes a CBR of 20% can be assumed for granular deposits, together with a CBR of 2% for cohesive deposits.

BURIED CONCRETE Testing did not record any elevated levels of total sulphur and sulphates in the near surface soils and significant earthworks are not proposed at the site and therefore the likelihood of oxidisation of sulphides to sulphate is low. Therefore, near surface strata can be assigned a Design Sulphate DS-1 and ACEC Classes of AC-1s where the groundwater can be considered static mobile in the Kesgrave Catchment Subgroup.

GEOENVIRONMENTAL CONSIDERATIONS. No visual or olfactory evidence of contamination was recorded on site during the ground investigation.

Testing of soil samples recovered from the site recorded elevated concentrations of PAHs and petroleum hydrocarbons across the site. In three samples (two of made ground recovered from the stable yard, and one of topsoil) concentrations of PAHs exceeded the assessment criteria for a residential end use. It is recommended that made ground present within the stable yard area is removed from areas of proposed future landscaping (including gardens). Additional sampling should be undertaken in the area surrounding TP05 to further investigate the elevated PAH concentrations recorded in that location.

A single sample recovered from topsoil in TP02 recorded asbestos the presence of asbestos containing cement. This appears to be an isolated fragment trafficked onto site, but further asbestos screening should be undertaken on the topsoil present on site to confirm that this is or otherwise.

Ground gas concentrations recorded post fieldwork monitoring were found to be generally low and no specific gas protection measures are considered necessary.

The summary contains an overview of the key findings and conclusions. However, no reliance should be placed on any part of the summary until the whole of the report has been read.

1 Introduction

1.1 Brief and Purpose of Work

1.1.1 Stantec UK Limited (Stantec) has been commissioned by Vistry Group (the Client) to design and undertake a Ground Investigation to inform the development of the site known as Land at Tollgate Road, Colney Heath.

1.1.2 The study site was subject of a Phase 1 Desk Study, prepared by Stantec (Stantec, 2022). The pertinent findings of the desk study are summarised within this report where required. For further details reference should be made to the desk study.

1.1.3 The ground investigation undertaken is a combined geotechnical and geoenvironmental investigation that was scoped to provide general coverage across the site. The purpose of this study is to support a planning application for the proposed development of the site and to inform foundation and main infrastructure design.

1.1.4 This report does not purport to be a "Geotechnical Design Report" as defined in Clause 2.8 of Eurocode 7 (Geotechnical Design BS EN 1997-1:2004). Some of the data contained herein and used to support any geotechnical assessment presented in this report may be historical or for other reasons not fully compliant with the requirements of that code.

1.2 Proposed Development

1.2.1 It is proposed to develop provision for up to 150 new homes, including 35% affordable homes and the creation of pedestrian routes adjacent to the site to provide long-term sustainable connections to key employment areas and Colney Heath local facilities.

1.3 Objectives

Geoenvironmental

1.3.1 The objective of this report is to review the available environmental information and factual data from the Phase 2 ground investigation and its associated geoenvironmental testing, to assess if there are potential contamination hazards associated with ground conditions that might require management (remediation or mitigation). As required by the National Planning Policy Framework (NPPF) this work has been carried out in accordance with "established procedures". The approach follows online guidance called: Land contamination: risk management (LC:RM) (which can be downloaded from https://www.gov.uk/guidance/landcontamination-how-to-manage-the-risks).

Geotechnical

1.3.2 The objective of this report is to review the ground conditions encountered during the ground investigation and to provide recommendations for the design of foundations and main site infrastructure.

1.4 Site Location

1.4.1 The site is located on the southern edge of Colney Heath, Hertfordshire, approximately 5km south-east of St Albans.

1.4.2 The site is approximately centred at Grid Reference 520891, 205504 with the approximate postcode AL4 0NZ. A Site Location Plan is presented as **Figure 1**.

1.5 Limitations

1.5.1 Guidance on the context of this report and any general limitations or constraints on its content and usage are given in the final section of this report.

2 Site Details

2.1 Site Description

2.1.1 The site comprises an irregularly shaped parcel of land occupied by a large horse paddock with stables on the western site boundary and a residential property (No.42 Tollgate Road) on the north-western corner of the site. The site is accessed via a gravel surfaced driveway located to the west of the residential property.

2.1.2 The stable buildings were located just south of the access into the site and comprised a long single storey wooden structure with steel storage containers adjacent. The land immediately surrounding the stables was used for the storage of horse boxes.

2.1.3 In front of the stable building was a small outdoor arena with show jumping apparatus which was covered with shredded rubber surfacing.

2.1.4 The field area closest to the stables had been sub-sectioned using electric fencing to provide smaller paddocks for the horses.

2.1.5 The north-eastern boundary of the site runs along the back of houses fronting onto Tollgate Road.

2.2 Site History

2.2.1 OS map records and Google Earth imagery were reviewed as part of the Phase 1 Desk Study, revealing that the site has been in agricultural usage since at least the late 19th century. The residential properties adjacent to the north of the site date from the early through to the late twentieth century.

2.3 Geology

2.3.1 The 1:50,000 series geological map (BGS, 1978) and BGS GeoIndex (onshore) (BGS, 2021) indicate the following geological sequence underlying the Site:

- Deposits of the Kesgrave Catchment Subgroup, typically comprising sands and gravels outcrop over the central area of the site.
- Deposits of the Lowestoft Formation (Boulder Clay) comprising a chalky till containing sands, gravels, silts and clays outcrop on the northern and north-eastern areas of the site.
- The south-western edge of the site, closest to the River Colne, is mapped as being underlain by Alluvium.
- Beneath the superficial deposits the site is underlain by the Lewes Nodular Chalk Formation and Seaford Chalk Formation. These form part of the White Chalk Sub-Group which typically comprise chalk with flints, with discrete marl seams, nodular chalk and flint seams throughout.

2.3.2 The BGS borehole record viewer (BGS, 2021) includes two nearby borehole records. These are summarised in Table 2.1 below.

Table 2.1 BGS borehole Records Summary

BGS Described Lithology	Depth from (m bgl)	Depth to (m bgl)
Borehole TL20NW14 200m west of the Site		
Made Ground	0.0	0.1
Topsoil	0.1	0.8
Boulder Clay	0.8	5.9
Glacial Gravel	5.9	11.0
Boulder Clay	11.0	13.0
Glacial Gravel	13.0	20.0
Upper Chalk	20.0	>21.0
Borehole TL20NW17 450m south-east of the Site		
Topsoil	0.0	0.2
Glacial Gravel	0.2	5.9
Lake Deposits	5.9	6.5
Boulder Clay	6.5	9.9
Upper Chalk	9.9	>10.2

Made Ground and Landfills

2.3.3 The Phase 1 Desk Study identified the presence of an historical landfill adjacent to the north-western site boundary. Limited information is available, but records suggest the site accepted inert waste. Part of the site is shown to be overlain by sands and gravels of the Kesgrave Catchment Subgroup and therefore a potential pathway exists for ground gases produced in the adjacent landfill to migrate onto site. The inert landfill presents a limited hazard as a source of ground gas owing to the inert nature of materials accepted and therefore the potential risk to future residents at the site is considered to be low.

2.3.4 There is considered to be limited potential for made ground on site and if it is present locally it would be expected to be localised and of limited thickness.

2.4 Engineering Geology and Ground Instability

2.4.1 The Phase 1 Desk Study identified potential sources of ground instability at the site as follows:

- The potential for natural cavities to be present within the Chalk.
- The potential presence of shrinkable clays beneath the site.
- The potential presence of compressible ground associated with soft clays in the Alluvium, and
- The potential presence of running sands associated with shallow groundwater and granular soils.

2.5 Hydrogeological Setting

2.5.1 The superficial Kesgrave sand and gravels and the Alluvium are classed as a Secondary A Aquifers – these are permeable layers capable of supporting water supplies at a local, rather than strategic scale.

2.5.2 The Lowestoft Formation is classed as a Secondary Aquifer – Undifferentiated. 'Undifferentiated' is assigned where it is not possible to attribute either Secondary category A or B to a rock type. In general, these layers have previously been designated as both minor and non-aquifers in different locations due to the variable characteristics of the rock type.

2.5.3 The Chalk bedrock is designated a Principal Aquifer.

2.5.4 Shallow perched groundwater is expected within the Lowestoft Formation and Kesgrave sands and gravels. Groundwater within the chalk is anticipated to be between 10 and 15m bgl.

2.5.5 Groundwater within the Chalk aquifer is identified as flowing towards the southeast. Shallow perched groundwater in the Superficial deposits is considered likely to flow south or south-west towards the River Colne.

2.6 Hydrological Setting

2.6.1 The River Colne runs parallel to the southern/south western site boundary. A secondary drainage ditch is located just south-west of the River Colne and runs parallel to the river.

2.7 Summary of Identified Potential Geoenvironmental Risks

2.7.1 The Phase 1 Desk study did not identify any particular on-site Potential Sources of Contamination (PSCs) from past or current land-use activities other than the general agricultural activities that have taken place.

2.7.2 The historical landfill was identified to the immediate northwest, and this was highlighted as an off-site PSC which may present a hazard to the site and proposed development.

3 Ground Investigation

3.1 Aim of the Investigation

3.1.1 The aim of the recent investigation was to confirm the ground conditions such that informed decisions could be made during the land purchase and subsequent initial designs.

3.1.2 To satisfy the aims of the investigation, the ground investigation comprised:

i) Excavation of ten trial pits using a wheeled excavator to depths of between 2.95 and 3.20m bgl;

ii) Three cable percussion boreholes to depths of 10.0m bgl;

iii) Three window sample boreholes to a depths of between 4.0 and 5.0m bgl;

iv) Soakaway testing undertaken in selected trial pits and;

v) Laboratory testing to determine preliminary geoenvironmental and geotechnical properties of soils encountered.

3.1.3 The scope of the investigation was intended to inform the outline planning application, to confirm the findings of the Phase 1 report and to provide information on the ground conditions to inform design of the foundations, geotechnical elements of the proposed development, drainage strategy and to constitute an exploratory investigation for potential contaminants as outlined in BS 10175 (2011+A2:2017). The site work was carried out in accordance with BS 5930: 2015 and BS EN ISO 14688-1: 2002.

3.1.4 With regard to the investigation for potential contamination of the ground a non-targeted investigation strategy was adopted for the site.

3.2 Fieldwork

3.2.1 The fieldwork for the ground investigation was carried on between 3rd May and 6th May 2022 and the subsequent monitoring was carried out between 25th May and 10th June 2022.

3.2.2 Each exploratory hole location was subject to an initial services scan using a cable avoidance tool and signal generator by a suitably experienced and trained engineer. A hand dug inspection pit was carried out at each of the borehole locations, to provide direct inception for buried services prior to advancement.

3.2.3 The ground conditions recorded in the exploratory hole locations were logged in general accordance with BS EN ISO 14688-1: 2018 and BS 5930:2015+A1:2020 and are presented in **Appendix A**. Their locations are shown on **Figure 2**.

Trial Pitting

3.2.4 Ten machine excavated trial pits (TP1 to TP7 and SA1 to SA3) were excavated using a wheeled back acting excavator to a maximum depth of 3.20mbgl. Hand shear vane testing was undertaken where cohesive soils were encountered. Upon completion the trial pits were backfilled with the arisings using a hydraulic vibrating compactor plate.

3.2.5 Disturbed samples were recovered throughout the trial pit for possible future geotechnical testing and chemical analysis. The chemical analysis samples were recovered in air-tight plastic containers and then stored in refrigerated cool boxes for transport to the analytical laboratory.

Cable Percussion

3.2.6 Three cable percussive boreholes (BH01 to BH03) were drilled using conventional cable percussive methods, utilising 150mm tooling and casing.

3.2.7 Disturbed samples were recovered throughout the boreholes and environmental samples were recovered in air-tight plastic containers and then stored in refrigerated cool boxes for transport to the analytical laboratory.

3.2.8 Standard penetration tests (SPTs) and undisturbed samples were carried out at regular intervals throughout the drilling process, with SPTs undertaken in granular soils, and undisturbed and SPTs alternated within the cohesive soils

3.2.9 Undisturbed samples were collected by driving an open tube (mixture of plastic and thin-walled tubes) over a 450mm distance, with the number of blows taken to drive the same the full depth recorded.

3.2.10 SPTs were carried out using a split spoon sampler and a 63.5kg hammer. The number of blows required to advance the cone over the final 300mm of a 450mm total drive was recorded and is shown as the penetration resistance ("N" value).

3.2.11 Upon completion, 50mm diameter monitoring standpipes with a granular surround were installed within the boreholes and finished with bentonite seal and a flush cover.

Window-less Sampling

3.2.12 Three window-less sampler boreholes (WS1 to WS3) were undertaken. The windowless sampling utilised, a Dando Terrier drilling rig.

3.2.13 Within all locations, SPTs were carried out using a solid cone and a 63.5kg hammer. The number of blows required to advance the cone over the final 300mm of a 450mm total drive was recorded and is shown as the "N" value.

3.2.14 Disturbed samples were recovered from the window samples for possible geotechnical testing and chemical analysis. The chemical samples were recovered in air-tight plastic containers and then stored in refrigerated cool boxes for transport to the analytical laboratory.

3.3 Soakaway Tests

3.3.1 Soakaway infiltration testing was undertaken in three trial pits SA01 to SA03 in general accordance with BRE 365. Following excavation, the pits were installed with monitoring pipes and infilled with washed single sized gravel to facilitate the tests. The tests at SA01 and SA02 failed to sufficiently drain after a 24-hour monitoring period, declared failed and repeat tests were not undertaken. The test undertaken in SA03 recorded adequate drainage within the 24 hour period and two repeat tests were undertaken. These results are discussed in **Section 5.7** below and are presented in **Appendix B.**

3.4 Laboratory Testing

Geotechnical Laboratory Testing

3.4.1 Geotechnical laboratory testing was carried out to verify the soil classification, and to determine the physical properties of the materials encountered.

3.4.2 The geotechnical testing was scheduled by Stantec and was carried out in accordance with BS 1377 by Geolabs Limited. Geolabs hold UKAS accreditation for the geotechnical soil testing undertaken. The results of the geotechnical testing are presented in **Appendix B**.

3.4.3 A summary of the geotechnical testing scheduled is provided in Table 3.1 below.

Table 3.1 Summary of Geotechnical Testing

Test	Number
Atterberg Limit Tests	6
Particle Size Distribution (PSD) – wet sieves (no sedimentation)	8
pH and water soluble sulphate content	6
Triaxial Tests	2

Geoenvironmental Laboratory Testing

3.4.4 Geoenvironmental laboratory testing was carried out on selected soil samples to determine the concentrations of contaminants that were identified during the Phase I report.

3.4.5 The testing was scheduled by Stantec and carried out by Eurofins Chemtest. The geochemical analysis used methods that are accredited by MCERTS where available. The results of the geochemical analysis are presented in **Appendix C**.

3.4.6 A summary of the geoenvironmental testing scheduled is provided in Tables 3.3 below.

Table 3.2 Summary of Geoenvironmental Testing [soil]

Test	Number
Asbestos screen	16
Heavy metals [a]	16
Speciated polycyclic aromatic hydrocarbons (PAH) [b]	16
Speciated Total Petroleum Hydrocarbons [c]	16
Notes: [a] Arsenic, Cadmium, Chromium (III and VI), Copper, Lead, Mercury, Nickel, Selenium, and Zinc; [b] USEPA-16; [c] Speciated aliphatic and aromatic hydrocarbons between C5-C44;	

3.5 Monitoring

3.5.1 Combined groundwater and gas monitoring wells (50mm diameter) were installed in each of the cable percussive boreholes and window-less sample boreholes.

3.5.2 Three ground gas and groundwater level monitoring visits were carried out at nominal fortnightly intervals between 25th May and 10th June 2022. The results of the monitoring visits are presented in **Appendix B**.

4 Ground Conditions Summary

4.1 Stratigraphy

4.1.1 The ground conditions beneath the site, as revealed by the current ground investigation comprise locally either Topsoil, or Made Ground overlying the Kesgrave Catchment Subgroup, with the Lowestoft Formation (Boulder Clay) located at depth. The Lewes Nodular Chalk Formation and Seaford Chalk Formation and the Alluvium were not encountered during the ground investigation. This is because the chalk is present at depth beneath the 10m deep boreholes that were sunk and investigation was not possible on the south-western side of the site where the Alluvium was expected.

4.1.2 The ground conditions encountered are summarised in the following table:

Table 4.1 Summary of Encountered Ground Conditions

Stratum	Base of Stratum (m bgl)	Thickness range (m)	Typical Description
Topsoil	0.15 to 0.40 (from surface in all location except WS1 &WS2)	0.15 to 0.40	Grey slightly gravelly clayey fine to medium SAND
Made Ground	0.50 to 0.70 (present in WS1, WS2 and SA02 only)	0.30 to 0.70	Encountered in SA02 as re-worked topsoil with plastic inclusions. Encountered in WS1 & WS2 as grey sandy GRAVEL surfacing material.
Kesgrave Catchment Subgroup	1.50 to 4.70[a]	1.25 to 3.10	Cohesive: Variable firm orangish brown or greyish brown slightly to very gravelly slightly sandy to very sandy CLAY
	0.85 to 9.30[a]	0.50 to 8.95	Granular: Medium dense orangish brown slightly clayey gravelly SAND or slightly clayey sandy GRAVEL
Lowestoft Formation	2.10 to 7.80 [a]	0.30 to 2.90	Cohesive: Firm grey clay with sand sized chalk fragments
	4.60 to 10.00 [a]	>0.6 to >4.3	Granular: Medium dense to dense grey fine SAND
Chalk	-	-	Not Encountered.
Notes: [a] Stratum not fully penetrated in all exploratory holes			

4.1.3 Comments on the nature and extent of each stratum are presented in the following sections of this report. Where characteristic values of parameters for geotechnical design are suggested in the discussion on ground conditions below, reference should be made to terminology and definitions given in the BS EN 1997-1 and BS EN 1997-2 as appropriate. Characteristic values of geotechnical properties and design values for use in geotechnical design should be reviewed and selected by the Geotechnical Designer taking into consideration the limit states and design methods being used, as well as the site weather and site history (e.g. trafficking by plant) which can impact on the *in situ* properties of the strata.

4.2 Topsoil

4.2.1 **Description**: Topsoil was recorded from ground level in all locations except WS1 and WS2. The topsoil was described as a Grey slightly gravelly clayey fine to medium SAND, with the gravel comprising flint.

4.2.2 **Characteristic Values**: No geotechnical testing, *in situ* or laboratory was carried out on any samples of Topsoil. Given the limited thickness this material should be neglected in any design analysis, hence, no characteristic values are recommended.

4.3 Made Ground

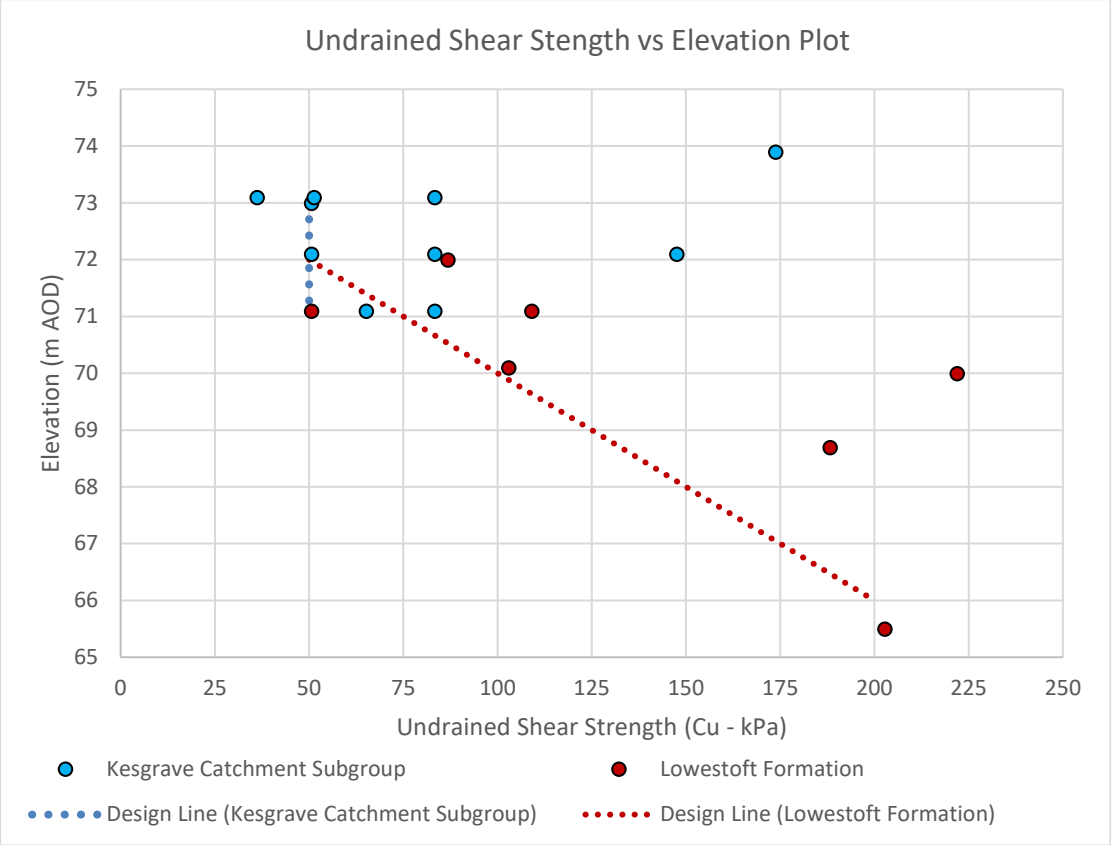
4.3.1 **Description**: The made ground was encountered in WS1 and WS2 located within the stable yard area as grey sandy GRAVEL acting as surfacing material. Re-worked topsoil containing entrained plastic was also recorded in SA02.

4.3.2 **Characteristic Values**: It is considered likely that made ground will be removed from site as part of the site strip, and is not considered to be suitable as a founding material. The granular material present in the yard area can potentially be reused beneath pavements, subject to appropriate grading and geotechnical characterisation.

4.4 Kesgrave Catchment Subgroup

4.4.1 **Description**: The Kesgrave Catchment Subgroup comprised interbedded cohesive and granular layers of variable thickness. The granular layers were typically present above the cohesive layers and were recorded as an orangish brown locally clayey sandy gravel or gravelly sand. The cohesive deposits were found to be variable and were described as firm orangish brown or greyish brown slightly to very gravelly slightly sandy to very sandy CLAY. The granular material was noted to be thicker in the eastern half of the site.

4.4.2 **Shear Strength**: Hand shear vane tests in trial pits were not possible due to gravel content present within this material. Near surface the cohesive deposits were generally described as being of 'firm' based upon a manual field assessment. SPT N_{60} recorded in the cohesive strata ranged between 7 and 32. Using a conversion of the recorded N values multiplied by 5.5, based on the mean recorded soil plasticity (17%) after Stroud (1974), correspond to undrained shear strengths of between 36 and 174 kPa as shown on the figure below. The data suggests there is no particular increase in undrained shear strength with depth.



4.4.3 **Classification:** SPTs carried out within the granular Kesgrave Catchment Subgroup stratum typically recorded N_{60} values of 20 and >50 a medium dense to dense condition. Plasticity testing undertaken on the cohesive material returned modified plasticity index results of between 13 and 26%. Based upon the recorded plasticity indices, the clay would be classified as having a low to intermediate plasticity correlating to a low to medium volume change potential, according to NHBC guidance (NHBC, 2022). To be conservative a medium volume change potential should be assumed.

4.4.4 **Characteristic Values (Cohesive Deposits)**: The cohesive strata may be considered to have an undrained shear strength (C_u) of 50 kPa which is a conservative assessment based on the data available. A bulk unit weight of 19kN/m^3 may be taken for this material based on the material type and consistency and the recommendations of BS 8004 (2015). A CBR of 2% may be assumed for the near surface clay based on the relationship of Black and Lister (1979), where CBR = C_u / 23. From consideration of the correlation with plasticity index (BS 8004, 2015) and the visual description of the material, a characteristic constant volume angle of shearing resistance of 24 degrees is suggested for use in design analysis

4.4.5 **Characteristic Values (Granular Deposits):** Peak and characteristic constant volume angles of shearing resistance of 34 degrees are considered appropriate for use in design analysis. These values have been selected from consideration of the particle angularity, material grading, and values of penetration resistance using the correlations in BS 8004 (2015). A bulk unit weight of 19kN/m^3 may be employed in design based on the material type and the recommendations of BS 8004 (2015).

4.4.6 An assumed CBR value of 20% could be assumed for the granular deposits, based upon the recommendations in TRL Report 1132.

4.5 Lowestoft Formation

4.5.1 **Description**: This deposit was recorded as a grey clay with sand sized chalk fragments, underlain by a grey fine sand.

4.5.2 **Classification**: The moisture content of the cohesive Lowestoft Formation was recorded between 14% and 15% and modified plasticity indices ranged between 18% and 23%, which is indicative of an intermediate plasticity clay. Based upon the recorded plasticity indices, the clay would be classified as having a low to intermediate plasticity correlating to a low to medium volume change potential, according to NHBC guidance (NHBC, 2022). To be conservative a medium volume change potential should be assumed. SPTs carried out within the granular Lowestoft Formation stratum typically recorded N_{60} values of 25 and >50 a medium dense to dense condition.

4.5.3 **Shear Strength**: A field assessment indicated the clay to be firm becoming stiff to very stiff with depth. This was confirmed by SPTs, which recorded initial N_{60} values of 9 to 16 at the top of the stratum and values of 37 near the base of the boreholes. Using a conversion of the recorded N values multiplied by 5.5, based on the mean recorded soil plasticity (20%) after Stroud (1974), correspond to a shear strength range of between 49.5 and 203.5 kPa. Laboratory triaxial analysis upon two samples of the clay reported undrained shear strengths of 103 and 222 kPa.

4.5.4 **Characteristic Values**: For design characteristic undrained shear strength of 50 kPa is considered appropriate at an elevation of 72m AOD increasing linearly to 200 kPa at 66m AOD as shown on the plot above.

4.5.5 From consideration of the correlation with plasticity index (BS 8004, 2015) and the visual description of the material, a characteristic constant volume angle of shearing resistance of 24 degrees is suggested for use in design analysis for the cohesive material. Peak and characteristic constant volume angles of shearing resistance of 34 degrees are considered appropriate for use in design analysis for the granular deposits.

4.5.6 For this material, effective cohesion may be taken to be zero in the design analysis for both facies. The bulk unit weight of the material may be taken to be 19 kN/m^3 based on the material type, undrained shear strength and the recommendations of BS 8004 (2015).

4.6 Groundwater

4.6.1 Groundwater was recorded in the boreholes during the post fieldwork monitoring.

4.6.2 As shown in the table below, monitoring recorded a relatively high groundwater table beneath the site, with groundwater present at approximately 3.0 to 4.0m bgl in the north and east of the site, and at around 0.6 to 2.0 bgl in the south and west of the site.

4.6.3 These results show that groundwater is typically shallower as you approach the River Colne that forms the southwestern site boundary.

4.6.4 It should be noted that the groundwater monitoring was undertaken in early summer only when groundwater levels and will not have picked up seasonal fluctuations that may occur. Groundwater levels are generally at their shallowest in later winter.

4.6.5 A summary of the groundwater levels are presented in

4.6.6

4.6.7

4.6.8 Table 4.2 below.

Table 4.2 Summary of Groundwater Levels

Borehole Reference	Groundwater Level Post Fieldwork Monitoring (range)	
	m bgl	m AOD
BH1	3.11 to 4.11	72.20 to 71.20
BH2	3.94 to 4.42	70.12 to 69.64
BH3	0.59 to 1.70	70.54 to 69.43
WS1	2.16 to 2.41	73.04 to 72.79
WS2	4.58 to >5.00	70.05 to >69.63
WS3	2.46 to 4.50	69.54 to 68.12

4.7 Visual and Olfactory Indicators of Contamination

4.7.1 Visual or olfactory evidence of soil contamination was not recorded in any of the exploratory holes.

5 Preliminary Geotechnical Assessment

5.1 Geotechnical Considerations

5.1.1 This section of the report presents comments on the identified ground conditions and the design and construction of the geotechnical elements of the proposed structures.

5.1.2 It is understood that the site will be developed with the construction of residential properties with associated infrastructure.

5.1.3 This geotechnical assessment should be considered as preliminary and all recommendations should be reviewed at the detailed design stage and once the final development layout and ground levels are fixed.

Characteristic Values of Parameters for Geotechnical Design

5.1.4 Recommended characteristic values of parameters for geotechnical design, as determined from consideration of the results of geotechnical testing and published data and correlations, are discussed in **Section 4** of this report and are summarised below:

Table 5.1 Characteristic Values of Parameters for Geotechnical Design

	Characteristic Values				
Stratum	**Bulk Density (kN/m³)**	**Drained Angle of Friction (°)**	**Drained Cohesion (kPa)**	**Undrained Shear Strength (kPa)**	**CBR (%)**
Kesgrave Catchment Subgroup (Granular)	19	34	0	-	20
Kesgrave Catchment Subgroup (Cohesive)	19	24	0	50	2
Lowestoft Formation (Cohesive)	20	24	0	50 at 72m AOD increasing linearly to 200 at 66m AOD	-
Lowestoft Formation (Granular)	19	34	0	-	-

5.2 Site Preparation

Stability of Excavations

5.2.1 The ground investigation has typically recorded topsoil (locally made ground around the stables) underlain by a variable thickness of granular deposits of the Kesgrave Catchment Subgroup, underlain by cohesive deposits of the Kesgrave Catchment Subgroup and the Lowestoft Formation.

5.2.2 The sidewalls of any shallow excavations into the cohesive or granular deposits may remain freestanding for a limited period of time. However, where vertically sided excavations that are required to stay open for long periods or where deep excavation is required re unlikely to remain stable unless they are supported.

Groundwater Control

5.2.3 The data from the monitoring shows groundwater levels decreasing in depth with distance downslope on the site. Sump pumping should be able to control small seepages of groundwater above the water table in all soils and below the water table in clay soils. In granular soils below the water table pumping and exclusion such as sheet piles is likely to be required to control groundwater.

5.3 Shallow Foundations

5.3.1 The investigation has indicated that a combination of cohesive and granular deposits are likely to be present at typical minimum founding depths across the site. Generally, based on the GI data it is likely that most foundations will be bearing in granular strata with only occasional locations where the granular material is thinnest (for example around TP04 where clay is present from 1.1m bgl) would foundations possibly be in the clay.

5.3.2 Separate recommendations for the design of foundations in cohesive and granular strata are given in the subsections below.

Granular Soils

5.3.3 A minimum foundation depth 0.75m below final ground level will apply for the granular deposits of the Kesgrave Catchment Subgroup.

5.3.4 For preliminary design purposes, based on the characteristic values from Table 5.1, a presumed bearing resistance ($q_{Rv,pres,d}$) of 130 kN/m^2 can be readily assigned to foundations up to 0.6m in width in accordance with section 5.4.4.2 of BS 8004: 2015. This assumes a rough foundation and a partial factor on bearing resistance of 2. Higher bearing resistance values can be achieved with wider foundations, however, because the wider a foundation becomes the deeper it stresses the ground, care should be taken not to overstress the underlying cohesive deposits which could lead to excessive settlements.

5.3.5 The preliminary presumed bearing resistance for the granular deposits of the Kesgrave Catchment Subgroup should limit total settlements of foundations to up to 20mm, however, once the detailed foundation loads and dimensions are known, the total and potential differential foundation settlements (short and long term), both beneath and between individual foundations should be checked and verified for the various design limit states in accordance with the requirements of BS EN 1997-1 (2004a and 2004b). Guidance on minimum foundation width is given in BS 8103 (2011).

Cohesive Soils

5.3.6 In accordance with guidance given in BRE Digest 240 and Chapter 4.2 of NHBC Guidance (NHBC, 2022) the shallow cohesive deposits of the Kesgrave Catchment Subgroup are shrinkable and should be assumed to be of a medium volume change potential, requiring a minimum founding depth of 0.9m bgl. Due allowance should be made in the design of foundations for the hedgerows and occasional trees on the site boundaries, whether they are to remain or be removed, and any future trees and hedgerows planted as part of the development.

5.3.7 For preliminary design purposes, the presumed bearing resistance ($q_{Rv,pres,d}$) of the near surface cohesive strata may be calculated by the expression:

$$q_{Rv,pres,d} = (\pi + 2) \times C_{u,\,k} / \gamma_{Rv,\,SLS}$$ (from BS 8004:2015, eqn. 27).

Where:

$C_{u,\,k}$ is the characteristic undrained shear strength of the soil; and
$\gamma_{Rv,\,SLS}$ is the partial factor on bearing resistance.

5.3.8 Taking an undrained shear strength of 50 kPa and employing a partial factor on bearing resistance of 3, gives a provisional presumed bearing resistance of approximately 85 kPa for a foundation not exceeding 1m width.

5.3.9 The presumed bearing resistance has been selected to prevent overstressing of the cohesive deposits by providing a factor of safety of 3 against general shear failure and it should limit total settlements of foundations to up to 20mm, however, once the detailed foundation loads and dimensions are known, the total and potential differential foundation settlements (short and long term), both beneath and between individual foundations should be checked and verified for the various design limit states in accordance with the requirements of BS EN 1997-1 (2004a and 2004b). Guidance on minimum foundation width is given in BS 8103 (2011).

5.3.10 It is recommended that where foundations cross between granular and cohesive soils, to mitigate any resultant differential settlement, that either foundations are reinforced or the entire foundation is deepened slightly to bear wholly upon the cohesive deposits.

5.3.11 Foundation excavations in all strata should be inspected before concreting and any soft spots or poor ground encountered should be removed and backfilled with concrete. Formations should be protected either by the placement of foundation concrete immediately after inspection or by the placement of a layer of concrete blinding if full concrete placement is not undertaken immediately.

Effects of Trees and Hedgerows

5.3.12 In accordance with NHBC (2022) guidance, the cohesive soils are shrinkable and typically of medium volume change potential. Due allowance should be made in the design of foundations for the present hedgerows on site, whether they are to remain or be removed, and any future trees and hedgerows planted as part of the development.

5.3.13 Any shallow foundations to structures within the area of influence of existing or proposed trees and hedgerows should be designed in accordance with guidelines for foundations given in Chapter 4.2 of the NHBC Standards (NHBC, 2022). In accordance with this guidance, the mature height of any trees retained or to be planted should be taken into consideration, whereas the effect of desiccation from trees or hedges that have been removed will be related to their size when felled.

Natural Cavities

5.3.14 Groundwater levels recorded during the post fieldwork monitoring were seen to be relatively shallow, sitting within the near surface superficial deposits. On this basis and considering the equation for predicting natural cavities in chalk (Edmonds, 2001), it is considered that there is a low subsidence hazard relating to dissolution features being present within chalk beneath the site.

5.3.15 It should however be noted that the glacial processes that historically took place on-site may have resulted in uneven erosion of the chalk surface resulting in a highly variable thickness of unconsolidated glacial material being present beneath the site. Foundation trenches should therefore be inspected for the presence of anomalous soft or loose material.

5.4 Pavement Design

5.4.1 Road pavements will either be founded on in-situ natural cohesive strata, natural granular strata or granular fill. For these materials the following preliminary design CBR and Estimated Long Term Surface Modulus values are recommended.

Table 5.3 Estimated Values of CBR and Long Term Surface Modulus

Stratum	CBR (%)	Subgrade Surface Modulus (MPa)
Natural Cohesive Deposits	2	27.4
Natural Granular Deposits & Granular Fill	20	111.9

5.4.2 These are based on the recommendations of Design Manual for Roads and Bridges Pavement Design CD 225 document, equation 2.4, where E = 17.6 x $CBR^{0.64}$ and the characteristic values of CBR given in Section 4.

5.4.3 Pavements carried on a suitable depth of capping/sub-base should prove adequate at the site provided the exposed deposits are compacted by a heavy smooth wheeled roller and any soft or degradable materials removed and replaced with compacted granular fill. All formations will likely deteriorate rapidly in inclement weather conditions and appropriate construction practice should be adopted with all formations exposed only for the minimum time period.

5.5 Aggressiveness of the Ground

5.5.1 The measured pH values and concentrations of total sulphur, total sulphate and water soluble sulphate measured on six samples recovered as part of the ground investigation are summarised on Table 5.4 below

Table 5.4 Summary of Sulphate and pH Concentrations

Geological Stratum	pH Value	Water Soluble Sulphate (mg/l)
Kesgrave Catchment Subgroup (granular)	6.0	29
Kesgrave Catchment Subgroup (cohesive)	7.8, 7.7	<10, 14
Lowestoft Formation (cohesive)	7.7, 8.0, 8.0	85, 96, 131

5.5.2 The deposits of the Kesgrave Catchment Subgroup and Lowestoft Formation do not typically contain elevated levels of sulphates and they may be assigned a Design Sulphate Class DS-1 and an ACEC Class of AC-1 (groundwater considered to be mobile), as defined by BRE (2017) and BS 8500:2015+A2:2019.

5.5.3 The recommendations of BRE (2017) and BS 8500:2015+A2:2019 should be followed in the design of mixes for buried concrete for the classifications given.

5.6 Infiltration Drainage

5.6.1 The site is underlain by near surface granular strata of the Kesgrave Catchment Subgroup and deeper strata granular strata in the Lowestoft Formation. The deeper strata are generally below the groundwater table and are therefore unsuitable for infiltration drainage. The near surface strata are generally above the groundwater level on the higher northern and eastern parts of the site and in these areas are a potential target for infiltration drainage. However, the ground investigation data indicates that the site is marginal with respect to soakaway suitability. This is because two of the three soakaway test locations (SA1 and SA2) did not provide suitable infiltration rates due to poor infiltration associated with high fines contents in the granular soils. The thickness of the granular soil was highly variable across the site with the deposit bottoming out at depths as shallow as 1.1m (SA02), 1.15m (TP07), 1.6m (BH01) and 1.55m (WS02). Furthermore, it is expected that groundwater levels will be higher than those recorded during the dry late spring period of 2022.

5.6.2 It is possible that further delineation of the areas of deeper near surface granular soils could result in plots in discrete areas potentially being viable for soakaways. If soakaways are locally used in the near surface Kesgrave Catchment Subgroup granular materials then for preliminary design an infiltration rate of $1.0x10^{-6}$ m/s can be assumed.

6 Environmental Data Review

6.1 Introduction/Approach

6.1.1 The Phase I report identified the adjacent off-site landfill as a potential source of contamination, and window sample boreholes were positioned along the boundary with this potential off site source to investigate the potential for ground gas generation within the landfill area to be impacting the site. No other particular potential sources of contamination have been identified and further ground investigation locations were selected to provide general coverage. The receptors identified included human health (current and future site users, neighbours, and construction workers) and controlled waters (surface water and groundwater).

6.1.2 The purpose of carrying out the Generic Quantitative Risk Assessment is to place the results of the laboratory testing and the noted elevations of potential contaminants into context in regard to potential risks to human health and controlled waters receptors.

6.2 Assessment Criteria

6.2.1 The Stantec rationale for the selection of Generic Assessment Criteria (GAC) has been used for this assessment and is presented in **Appendix B**.

6.2.2 Where appropriate the assessment criteria for a residential end use with provision for plant uptake via homegrown produce has been applied as this is the proposed future use of the site. The assessment criteria are also considered to be suitably sensitive to conclude whether further assessment or remediation would be required in order to secure planning permission for development, i.e. that the concentrations of contaminants present are/are not considered likely to cause significant harm to human health.

6.2.3 Where the criterion for a parameter is dependent on soil organic matter (SOM) content, a value of 2.5% has been used which is considered to be a representative value for the dataset.

6.2.4 A summary table presenting the geochemical testing results is presented in **Appendix E.**

6.3 Review of Soil Chemical Testing Results

Metals

6.3.1 Metal concentrations recorded were generally low and are considered to be representative of background concentrations. None of the metals concentrations recorded within the soil samples analysed were at or in excess of their respective adopted GACs for significant risk to human health.

Petroleum Hydrocarbons

6.3.2 Petroleum hydrocarbon concentration in most hydrocarbon bands were recorded below the laboratory limit of detection. The exception is elevated concentrations of C21-C35 hydrocarbons. Both aliphatic and aromatic compounds are recorded for these hydrocarbon bands.

6.3.3 None of the concentrations recorded within the soil samples analysed were at or in excess of their respective adopted GACs for significant risk to human health in a residential setting. The ‘Hazard Index’, exceeds 1 in a sample of made ground recovered from WS1 at 0.3m depth. When the Hazard Index is above 1, it is possible that the cumulative effects of hydrocarbon concentrations may present a risk to end users.

Polycyclic Aromatic Hydrocarbons

6.3.4 Recorded concentrations of polycyclic aromatic hydrocarbons (PAHs) were elevated above the laboratory method detection limit in the majority of samples recovered from the site. Concentrations of benzo(b)fluoranthene, benzo(a)pyrene, and dibenzo(a,h)anthracene exceeded the assessment criteria in a sample of topsoil recovered from TP05 and samples of made ground recovered from WS1 and WS2. In addition the assessment criteria for benzo(a)anthracene was exceeded in the sample of made ground recovered from WS2.

6.3.5 Double-ratio analysis has been undertaken on the PAH concentrations using the tool published by LQM, the outputs of which are presented in **Appendix E.** These plots show that the PAHs present are likely 'urban background' concentrations resulting from the combustion of grass, wood and coal. Furthermore, the exploratory hole records and available historical topographical information do not indicate that the site has been subject to significant level changes or infilling. It is therefore considered likely that ash from agricultural burning has over time become entrained within the near surface soils.

6.3.6 Sixteen samples were screened for the presence of asbestos, none was detected in 15 of the samples screened. Asbestos was however detected in a sample of topsoil recovered from TP02 at 0.1m bgl. Asbestos quantification analysis undertaken on this sample advised that the sample contained 0.52% asbestos by weight. The laboratory advised that the sample contained a fragment of asbestos containing cement weighing 6.1g was present, with the total sample weight being 295.25g. The laboratory then assumed the fragment comprises 25% asbestos in accordance with industry best practice, equating to approximately 0.52% of the total sample comprising asbestos.

6.3.7 Under the Water Supply (Water Fittings) Regulations (DETR, 1999), the Water Supplier has a statutory duty to ensure that the design and material selection for water supply pipes are suitable and their advice and recommendations should be sought with regard to the water supply pipes for the proposed development. It should be noted that the Water Supplier may require additional testing to be carried out. The recorded concentrations of hydrocarbons fall below the assessment criteria of plastic pipework (UKWIR).

6.4 Ground Gas and Vapour Monitoring Results

6.4.1 A summary of the monitoring results are presented in Table 6.1, below

Table 6.1 Summary of Monitoring Results

Location	Flow rate (l/hr)	Maximum Methane Concentration (%v/v)	Maximum Carbon Dioxide Concentration (%v/v)	Highest Potential Gas Screening Value (l/h)	
				Methane	Carbon Dioxide
BH01	>0.1	0	1.8	0	0.0018
BH02	>0.1	0	3.1	0	0.0031
BH03	>0.1	0	3.9	0	0.0039
WS1	>0.1	0	1.9	0	0.0019
WS2	>0.1	0	3.3	0	0.0033
WS3	>0.1	0	2.0	0	0.0020

6.4.2 No concentrations of carbon monoxide or hydrogen sulphide were recorded above the instrument's level of detection 0.1ppm, in the monitoring wells during any of the visits.

7 Tier 2 Contamination Risk Assessment

7.1 Soils

7.1.1 Two samples of made ground recorded recovered from WS1 and WS2 located within the stable yard area recorded elevated concentrations of PAH compounds in excess of the GAC for a residential end use or use as residential public open space. The made ground sample from WS1 also has a petroleum hydrocarbon hazard index of 1.4 indicating that the cumulative effects of hydrocarbon concentrations within this sample are a potential risk to human health. It is therefore recommended that the made ground present within the stable yard area is removed from areas of future soft landscaping.

7.1.2 A sample of topsoil recovered from TP05 also recorded PAH concentration in excess of the GAC for a residential end usage. It is recommended that further samples are taken from the area surrounding this location before the topsoil strip is undertaken in order to delineate the impacted area and determine if this result is indicative of a localised hotspot, or associated with a localised area of PAH contamination.

7.1.3 A topsoil sample from TP02 at 0.1m depth recorded an asbestos concentration of 0.52%. As discussed above there is no evidence that significant quantities of soil have been imported to the site (with the exception of construction material and surfacing present associated with the stable yard), and it is considered that this asbestos containing fragment is likely the result of an isolated fragment being trafficked onto site via agricultural plant, rather than being indicative of widespread contamination. It is however recommended that further samples are recovered from the topsoil to confirm this (or otherwise).

7.2 Ground Gas

7.2.1 The measured concentrations of ground gases typically recorded slightly elevated carbon dioxide concentrations and corresponding slightly depleted oxygen concentrations, with no positive gas flows recorded during monitoring. The results have been classified in general accordance with the procedure for set out within BS 8485 (2015 + A1:2019).

7.2.2 The maximum recorded carbon dioxide and methane concentrations for each visit have been considered together with the peak recorded flow to calculate worst case gas screening values (GSVs). The methane GSV is calculated to be 0.00L/hr together with a GSV of 0.004L/hr for Carbon Dioxide. Based upon the calculated Gas Screening Values, a Characteristic Situation of CS-1 (Very Low Risk) is considered appropriate.

7.2.3 No concentrations of carbon monoxide or hydrogen sulphide were recorded above the instrument's level of detection (0.1ppm) in either of the monitoring wells during any of the visits. As such they are not considered to pose a significant risk to the future users of the development or proposed structures.

7.2.4 Based upon the above, ground gases are not considered to pose a significant risk to the future users of the development or proposed structures and no specific gas protection measures are required.

8 Essential Guidance for Report Readers

8.1.1 This report has been prepared within an agreed timeframe and to an agreed budget that will necessarily apply some constraints on its content and usage. The remarks below are presented to assist the reader in understanding the context of this report and any general limitations or constraints. If there are any specific limitations and constraints, they are described in the report text.

8.1.2 The opinions and recommendations expressed in this report are based on statute, guidance, and best practice current at the time of its publication. Stantec UK does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and the report should be returned to us and reassessed if required for re-use after one year from date of publication. Following delivery of the report, Stantec has no obligation to advise the Client or any other party of such changes or their repercussions.

8.1.3 Some of the conclusions in this report may be based on third party data. No guarantee can be given for the accuracy or completeness of any of the third-party data used. Historical maps and aerial photographs provide a “snapshot” in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times.

8.1.4 The conclusions and recommendations made in this report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be taken into account in any analysis and reporting.

8.1.5 It should be noted that this report is a land condition assessment and does not purport to be an ecological, flood risk or archaeological survey and additional specific surveys may be required.

8.1.6 This report has been written for the sole use of the Client stated at the front of the report in relation to a specific development or scheme. The conclusions and recommendations presented herein are only relevant to the scheme or the phase of project under consideration. This report shall not be relied upon or transferred to any other party without the expressed written authorisation of Stantec. Any such party relies upon the report at its own risk.

8.1.7 The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not taken into account the perceptions of, for example, banks, insurers, other funders, lay people, etc., unless the report has been prepared specifically for that purpose. Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.

8.1.8 Public or legal consultations or enquiries, or consultation with any Regulatory Bodies (such as the Environmental Agency or Local Planning Authorities) have taken place only as part of this work where specifically stated.

9 References

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Site Grid Reference: TL 20910 05489

Stantec

Stantec UK Limited
READING
Caversham Bridge House, Waterman Place, Reading,
Berkshire RG1 8DN
Tel: +44 1189 500 761
www.stantec.com/uk

Client/Project:
Vistry Group

Land at Colney Heath

Title
Site Location Plan

Prepared:	Checked:	Date:	Revision:	Figure
davco	JC	2022.02.24	0	1

Plotted: 24.02.2022 2022.02.24 12:53:29 PM By: Cotton, David
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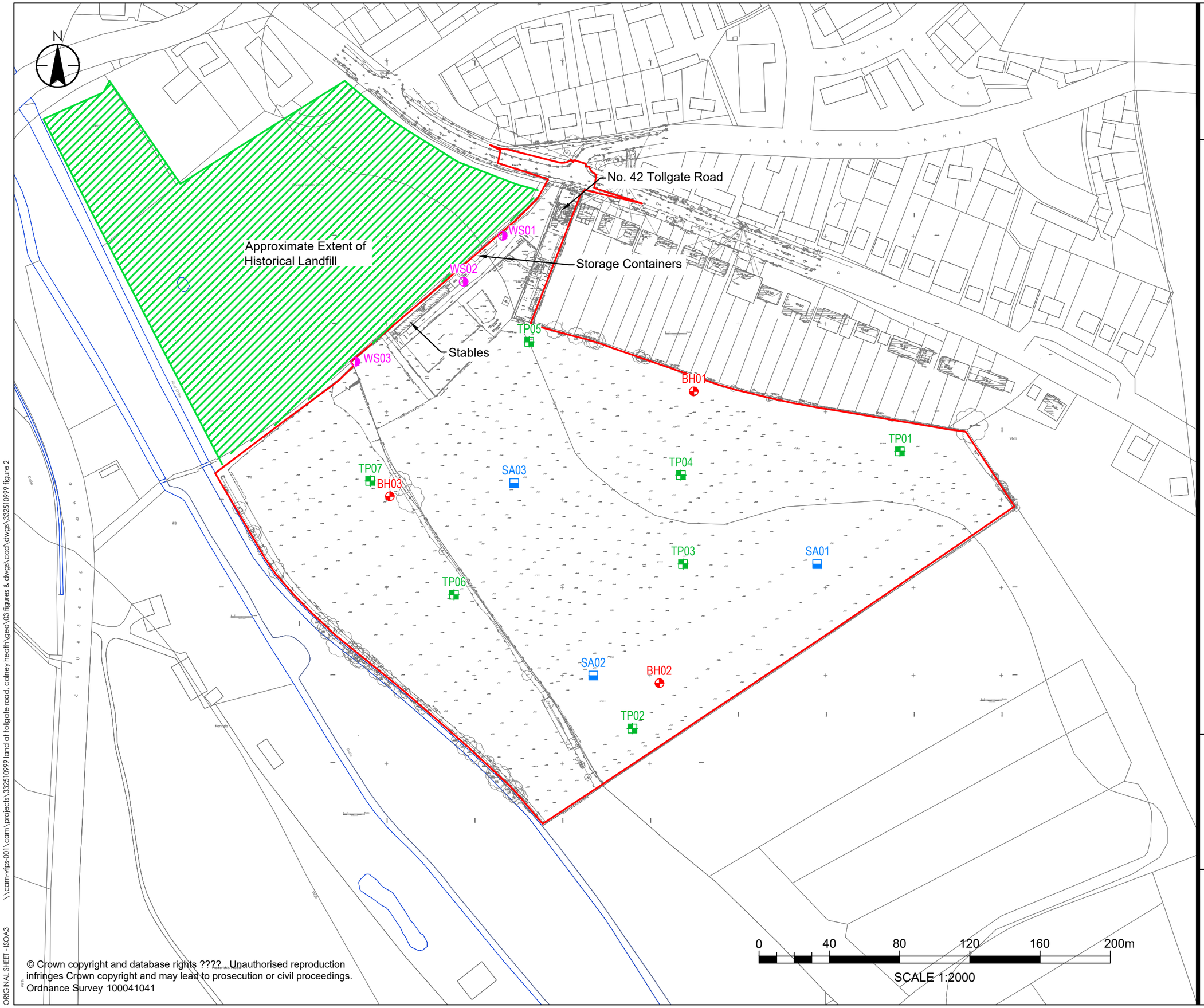

Stantec

Stantec UK Limited
CAMBRIDGE
50/60 Station Road, Cambridge, CB1 2JH
Tel: +44 1223 882 000
www.stantec.com/uk

Key

- Approximate Site Boundary
- Borehole
- Trial Pit
- Window Sample
- Soakaway

Client/Project:
Vistry

Land at Colney Heath

Prepared:	Checked:	Date:
davco	LT	2022.06.27

Title
Site Layout Plan

Revision:	Figure
0	2

Plotted: 27.06.2022 2022.06.27 9:30:36 AM By: Cotton, David
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Appendix A Exploratory Hole Records

Project Name	Project No:		BOREHOLE
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**BH01**
Client	Start Date / End Date		
Vistry Group	**03/05/2022** **03/05/2022**		
Contractor	Ground Level		
A F Howlands	**75.09m OD**		
Method/Plant / Energy Ratio	Coordinates	Logged By: **MRG**	Sheet 1 of 1
Cable Percussion Rig **79 %**	**520925 E** **205562 N**	Checked By: **LT**	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.30) 0.30	74.79	TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
1	1.00	C	54 (6,6/54 for 150mm)			(1.30) 1.60	73.49	Dense orangish brown sandy fine to medium rounded flint GRAVEL [Kesgrave Catchment Subgroup]	
2	2.00	C	N=5					Firm orangish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravels are fine to medium rounded flints [Kesgrave Catchment Subgroup]	
3	3.10	C	N=7			(3.10) 4.70	70.39		
4	4.00	C	N=9						
5	5.10	U1	Ublow=34					Stiff dark grey CLAY with occasional coarse sand sized fragments of white chalk [Lowestoft Formation Boulder Clay]	
6	6.40	S	N=26			(3.10) 7.80	67.29		
7									
8	8.10	S	N=23					Medium dense to dense grey fine SAND [Lowestoft Formation Boulder Clay]	
9	9.50	S	N=32			(2.20) 10.00	65.09		
10								End of Borehole at 10.00m	

General Remarks

1. CAT Scanned prior to excavation. 2. Hand dug starter pit to 1.2m bgl

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration

Project Name	Project No:		BOREHOLE
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**BH02**
Client	Start Date / End Date		
Vistry Group	**03/05/2022** / **04/05/2022**		
Contractor	Ground Level		
A F Howlands	**74.06m OD**		
Method/Plant / Energy Ratio	Coordinates	Logged By: **MRG**	Sheet 1 of 1
Cable Percussion Rig / **79 %**	**520905 E** **205396 N**	Checked By: **LT**	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.35)		TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
						0.35	73.71	Medium dense orangish brown slightly clayey sandy fine to medium rounded flint GRAVEL [Kesgrave Catchment Subgroup]	
1	1.20	C	N=17						
						(2.35)			
2	2.00	C	N=16						
						2.70	71.36	Medium dense orangish brown gravelly fine to coarse SAND. Gravels are fine to medium rounded flints [Kesgrave Catchment Subgroup]	
3	3.00	C	N=19						
4	4.10	C	N=31						
5	5.20	C	N=28			(5.20)			
6									
	6.50	C	N=25						
7									
						7.90	66.16	Medium dense mid brown fine to medium SAND [Kesgrave Catchment Subgroup]	
8	8.10	C	N=16						
						(1.40)			
9									
						9.30	64.76	Stiff dark grey CLAY with occasional coarse sand sized fragments of white chalk [Lowestoft Formation Boulder Clay]	
	9.60	S	N=28			(0.70)			
10						10.00	64.06	End of Borehole at 10.00m	

General Remarks

1. CAT Scanned prior to excavation. 2. Hand dug starter pit to 1.2m bgl

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration

Project Name	Project No:		BOREHOLE
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**BH03**
Client	Start Date / End Date		
Vistry Group	**04/05/2022** / **04/05/2022**		
Contractor	Ground Level		
A F Howlands	**71.13m OD**		
Method/Plant / Energy Ratio	Coordinates	Logged By: **MRG**	Sheet 1 of 1
Cable Percussion Rig / **79 %**	**520752 E** **205502 N**	Checked By: **LT**	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.15) 0.15	70.98	TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
						(0.65) 0.80	70.33	Firm grey slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is fine to medium rounded flint. [Kesgrave Catchment Subgroup]	
1	1.20	C	N=24			(0.50) 1.30	69.83	Mid brown slightly sandy fine to medium rounded flint GRAVEL [Kesgrave Catchment Subgroup]	
2	2.10	C	N=7			(1.50) 2.80	68.33	Firm grey and greyish brown sandy CLAY with occasional fine gravel sized chalk fragments. Sand is fine to coarse. [Kesgrave Catchment Subgroup]	
3	3.10	C	N=12					Firm to stiff grey CLAY with rare to occasioanl fine gravel sized chalk fragments. [Lowestoft Formation Boulder Clay]	
4	4.00	S	N=7			(2.90) 5.70	65.43		
5	5.00	U1	Ublow=18						
6	6.40	S	N=19					Medium dense becoming dense greyish brown slightly gravelly fine to medium SAND. Gravels are fine to medium subrounded flint. [Lowestoft Formation Boulder Clay]	
7									
8	8.10	S	N=27			(4.30) 10.00	61.13		
9									
10	9.70	S	N=41					End of Borehole at 10.00m	

General Remarks

1. CAT Scanned prior to excavation. 2. Hand dug starter pit to 1.2m bgl

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**SA01**
Client	Start Date / End Date		
Vistry Group	**04/05/2022** **04/05/2022**		
Contractor	Ground Level		
A F Howlands	**75.23m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**520995 E** **205463 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.10	ES ES1				(0.30)		TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
						0.30	74.93	*Very gravelly below 0.2m*	
1						(1.20)		Orangish brown slightly clayey very gravelly fine to coarse SAND. Gravels are fine to medium round flints [Kesgrave Catchment Subgroup]	
						1.50	73.73	Firm grey sandy CLAY with localised orangish brown mottling. Sand is fine to medium. [Kesgrave Catchment Subgroup]	
2						(1.50)			
3						3.00	72.23	End of Trial Pit at 3.00m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water
Strike
Standing
Flow

Stability:

Pit Dimensions

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**SA02**
Client	Start Date / End Date		
Vistry Group	**04/05/2022** **04/05/2022**		
Contractor	Ground Level		
A F Howlands	**72.40m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**520868 E** **205400 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.10	ES ES1				(0.30)		TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
						0.30	72.10		
	0.50	ES2				(0.30)		MADE GROUND: Grey slightly gravelly clayey fine to medium SAND with occasional pieces of plastic. Gravels are fine to medium rounded flints. (reworked topsoil)	
						0.60	71.80		
1						(0.50)		Grey slightly gravelly slightly silty fine to medium SAND . Gravels are fine to medium rounded flints. [Kesgrave Catchment Subgroup]	
						1.10	71.30		
						(0.70)		Firm brown sandy CLAY. [Kesgrave Catchment Subgroup] *Clay filled land drain*	
						1.80	70.60		
2						(1.40)		Firm grey slightly sandy silty CLAY [Kesgrave Catchment Subgroup] *band of dark brown fibrous peat with strong organic odour*	
3						3.20	69.20	End of Trial Pit at 3.20m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water
Strike
Standing
Flow

Stability:

Pit Dimensions

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**SA03**
Client	Start Date / End Date		
Vistry Group	**04/05/2022** **04/05/2022**		
Contractor	Ground Level		
A F Howlands	**74.11m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**520823 E** **205509 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.20	ES ES1				(0.25)		TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
						0.25	73.86	Orangish brown slightly clayey very gravelly fine to coarse SAND. Gravels are fine to medium round flints [Kesgrave Catchment Subgroup]	
1									
								Side walls unstable below 1.5m	
						(2.75)			
2									
3						3.00	71.11	End of Trial Pit at 3.00m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water
Strike
Standing
Flow

Stability:

Pit Dimensions

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**TP01**
Client	Start Date / End Date		
Vistry Group	**05/05/2022** **05/05/2022**		
Contractor	Ground Level		
A F Howlands	**75.54m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**521042 E** **205528 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.10	ES ES1				(0.15) 0.15	75.39	TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
	0.30	ES2				(0.40)		Firm greyish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is fine to medium rounded flint. [Kesgrave Catchment Subgroup]	
						0.55	74.99		
1	1.00	B3				(1.65)		Orangish brown clayey gravelly fine to coarse SAND. Gravel is fine to medium rounded flint [Kesgrave Catchment Subgroup]	
2						2.20	73.34		
						(0.80)		Firm brown CLAY [Kesgrave Catchment Subgroup]	
3						3.00	72.54	End of Trial Pit at 3.00m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water

Strike

Standing

Flow

Stability:

Pit Dimensions

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**TP02**
Client	Start Date / End Date		
Vistry Group	**05/05/2022** **05/05/2022**		
Contractor	Ground Level		
A F Howlands	**73.50m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**520890 E** **205370 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.10	ES ES1				(0.20) 0.20	73.30	TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
	0.40	ES ES2						Firm orangish brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium rounded flint [Kesgrave Catchment Subgroup]	
	0.80	D3				(1.30)			
1						1.50	72.00	Firm grey CLAY with frequent sand sized chalk fragments present [Lowestoft Formation Boulder Clay]	
2	2.00	D4				(1.45)		*Cobble of white chalk*	
3						2.95	70.55	End of Trial Pit at 2.95m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water
Strike
Standing
Flow

Stability:

Pit Dimensions

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**TP03**
Client	Start Date / End Date		
Vistry Group	**05/05/2022** **05/05/2022**		
Contractor	Ground Level		
A F Howlands	**75.16m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**520919 E** **205463 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.10	ES ES1				(0.15) 0.15	75.01	TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
	0.50	ES2						Orangish brown gravelly to very gravelly fine to coarse SAND. Gravels are fine to medium rounded flints [Kesgrave Catchment Subgroup]	
1									
	1.50	B3				(2.65)			
2									
						2.80	72.36	Firm grey sandy CLAY. Sand is fine to medium [Kesgrave Catchment Subgroup]	
						(0.20)			
3						3.00	72.16	End of Trial Pit at 3.00m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water
Strike
Standing
Flow

Stability:

Pit Dimensions

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**TP04**
Client	Start Date / End Date		
Vistry Group	**05/05/2022** **05/05/2022**		
Contractor	Ground Level		
A F Howlands	**75.29m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**520918 E** **205514 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.10	ES ES1				(0.20) 0.20	75.09	TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
	0.30	ES ES2				(0.90)		Orangish brown slightly clayey very gravelly fine to coarse SAND. Gravels are fine to medium round flints [Kesgrave Catchment Subgroup]	
1						1.10	74.19		
	1.50	B3				(1.70)		Orangish brown slightly gravelly clayey fine to coarse SAND. Gravels are fine to medium rounded flints [Kesgrave Catchment Subgroup]	
2						2.80	72.49		
						(0.30)		Firm grey sandy CLAY. Sand is fine to medium [Kesgrave Catchment Subgroup]	
3						3.10	72.19	End of Trial Pit at 3.10m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water
Strike
Standing
Flow

Stability:

Pit Dimensions

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**TP05**
Client	Start Date / End Date		
Vistry Group	**05/05/2022** **05/05/2022**		
Contractor	Ground Level		
A F Howlands	**75.02m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**520831 E** **205590 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.20	ES ES1				(0.30)		TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
						0.30	74.72		
	0.60	ES ES2						Orangish brown gravelly to very gravelly fine to coarse SAND. Gravels are fine to medium rounded flints [Kesgrave Catchment Subgroup]	
1	1.00	B3				(1.45)			
						1.75	73.27		
2	2.00	D4						Firm greyish brown slightly sandy to sandy CLAY [Kesgrave Catchment Subgroup]	
						(1.25)			
3						3.00	72.02	End of Trial Pit at 3.00m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water

Strike 2.80 m

Standing 2.80 m

Flow

Stability:

Pit Dimensions

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**TP06**
Client	Start Date / End Date		
Vistry Group	**05/05/2022** **05/05/2022**		
Contractor	Ground Level		
A F Howlands	**71.09m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**520788 E** **205446 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.10	ES ES1				(0.25)		TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
						0.25	70.84		
	0.40	ES2						Grey slightly clayey sandy fine to medium rounded flint GRAVEL. [Kesgrave Catchment Subgroup]	
	0.50	B3				(0.60)			
						0.85	70.24		
1	1.00	D4						Firm grey mottled brown slightly sandy silty CLAY [Kesgrave Catchment Subgroup]	
2						(2.10)			
3						2.95	68.14	End of Trial Pit at 2.95m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water
Strike
Standing
Flow

Stability:

Pit Dimensions

Project Name	Project No:		TRIAL PIT
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**TP7**
Client	Start Date / End Date		
Vistry Group	**05/05/2022** **05/05/2022**		
Contractor	Ground Level		
A F Howlands	**71.10m OD**		
Method/Plant	Coordinates	Logged By: **MRG**	Sheet 1 of 1
JCB 3CX	**520741 E** **205511 N**	Checked By: **LT**	Scale 1:25

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.10	ES ES1				(0.40)		TOPSOIL: Grey slightly gravelly clayey fine to medium SAND. Gravels are fine to medium rounded flints.	
						0.40	70.70		
	0.50	ES ES2				(0.75)		Grey sandy fine to medium rounded flint GRAVEL [Kesgrave Catchment Subgroup] *damp*	
1	1.00	B3		▼		1.15	69.95		
	1.50	D4				(1.80)		Firm slightly gravelly CLAY. Gravels are fine to medium rounded flints. [Kesgrave Catchment Subgroup] *sandy with orangish brown mottling*	
2									
3						2.95	68.15	End of Trial Pit at 2.95m	
4									
5									

General Remarks

1. CAT Scanned Prior to excavation

Water

Strike 1.15 m

Standing

Flow

Stability:

Pit Dimensions

Project Name	Project No:		DYNAMIC SAMPLE
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**WS1**
Client	Start Date / End Date		
Vistry Group	**03/05/2022** **03/05/2022**		
Contractor	Ground Level		
A F Howlands	**75.20m OD**		
Method/Plant / Energy Ratio	Coordinates	Logged By: **LHT**	Sheet 1 of 1
Dando Terrier **70 %**	**520816 E** **205650 N**	Checked By: **LT**	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.30	ES ES1				(0.50)		MADE GROUND: Grass over brown and grey sandy gravel with rootlets.	
						0.50	74.70	Dense brown becoming light brown and brown sandy fine to medium subangular to rounded flint GRAVEL. [Kesgrave Catchment Subgroup]	
1	1.20	S	50 (7,12/50 for 170mm)			(1.35)			
						1.85	73.35	Firm brown silty becoming very silty CLAY. [Kesgrave Catchment Subgroup]	
2	2.00	S	N=8						
3	3.00	S	N=13			(2.15)			
4	4.00	S	N=13			4.00	71.20	End of Window Sample at 4.00m	
5									
6									
7									
8									

General Remarks

1. CAT Scanned prior to excavation. 2. Hand dug starter pit to 1.2m bgl

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %

Project Name	Project No:		DYNAMIC SAMPLE
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**WS2**
Client	Start Date / End Date		
Vistry Group	**04/05/2022** / **04/05/2022**		
Contractor	Ground Level		
A F Howlands	**74.63m OD**		
Method/Plant / Energy Ratio	Coordinates	Logged By: **LHT**	Sheet 1 of 1
Dando Terrier / **70 %**	**520794 E** **205624 N**	Checked By: **LT**	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
	0.20	ES ES1				(0.70)		MADE GROUND: Grass and weeds over brown and grey sandy gravel with rootlets.	
						0.70	73.93		
	0.80	ES2						Firm brown slightly sandy gravelly CLAY. Gravel is subangular to rounded flint. [Kesgrave Catchment Subgroup]	
1						(0.70)			
	1.20	S	N=19						
						1.40	73.23		
						(0.50)		Medium dense light brown sandy fine to medium subangular to rounded flint GRAVEL. [Kesgrave Catchment Subgroup]	
						1.90	72.73		
2	2.00	S	N=13					Firm brown slightly sandy gravelly CLAY. Gravel is subangular to rounded flint. [Kesgrave Catchment Subgroup]	
						(1.55)			
3	3.00	S	N=23						
						3.45	71.18		
				▼				Medium dense brown silty fine to medium SAND. [Kesgrave Catchment Subgroup]	
4						(1.55)			
						5.00	69.63		
5								End of Window Sample at 5.00m	
6									
7									
8									

General Remarks

1. CAT Scanned prior to excavation. 2. Hand dug starter pit to 1.2m bgl

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %
4.50	20	-				

Project Name	Project No:		DYNAMIC SAMPLE
Land of Tollgate Road, Colney Heath	**332510999**	Stantec	**WS3**
Client	Start Date / End Date		
Vistry Group	**05/05/2022** **05/05/2022**		
Contractor	Ground Level		
A F Howlands	**72.62m OD**		
Method/Plant / Energy Ratio	Coordinates	Logged By: **LHT**	Sheet 1 of 1
Dando Terrier **70 %**	**520732 E** **205578 N**	Checked By: **LT**	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.20) 0.20	72.42	Grass and weeds over dark brown very clayey sand TOPSOIL.	
						(1.35)		Brown slightly silty sandy rounded fine to medium occasionally coarse flint GRAVEL/ gravelly SAND. [Kesgrave Catchment Subgroup]	
1	1.20	S	N=17			1.55	71.07		
						(0.40) 1.95	70.67	Stiff light grey and brown CLAY. [Kesgrave Catchment Subgroup]	
2	2.00	S	N=5			(0.35) 2.30	70.32	Loose brown sandy flint GRAVEL. [Kesgrave Catchment Subgroup]	
						(0.80)		Firm grey slightly gravelly to gravelly CLAY. Gravel is fine to medium chalk. [Kesgrave Catchment Subgroup]	
3	3.00	S	N=3	▼		3.10	69.52		
						(0.30) 3.40	69.22	Loose (wet) brown very clayey slightly gravelly SAND. [Kesgrave Catchment Subgroup]	
						(0.30) 3.70	68.92	Firm brown sandy CLAY. [Kesgrave Catchment Subgroup]	
						(0.30) 4.00	68.62	Stiff light grey gravelly CLAY. Gravel is fine to medium chalk. [Lowestoft Formation Boulder Clay]	
4	4.00	S	N=17			(0.60)		Medium dense grey very clayey fine to medum SAND. [Lowestoft Formation Boulder Clay]	
						4.60	68.02	End of Window Sample at 4.60m	
5									
6									
7									
8									

General Remarks

1. CAT Scanned prior to excavation. 2. Hand dug starter pit to 1.2m bgl

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %
3.00	20	-				

Appendix B Factual Report

A F Howland Associates
Geotechnical Engineers

Soakage Test (BRE Digest 365)

Site : Tollgate Road, Colney Heath

Client : Stantec (UK) Ltd

Engineer :

Job Number 22.045

Sheet 1 / 3

Location	Date	Level	Location
SA01	04/05/2022	75.23 mOD	E: 520995 N: 205463

Pit Width (m)	0.50
Pit Depth (m)	3.00
Pit Length (m)	2.20

Soil type at test level	SAND over CLAY
Groundwater	2.95m
Drain discharge depth	Not known
Sidewall stability	Stable
Stone filled or open pit	Stone filled

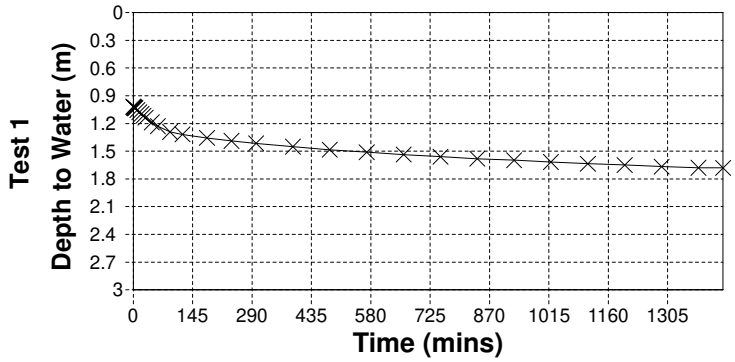
	1
Effective depth (m)	1.98
Volume outflowing between 75% & 25% (m3)*	
Mean surface area through which outflow occurs (m2)	
Time for outflow between 75% & 25% (min)	
SOIL INFILTRATION RATE (ms-1), f	Test Failed

Remarks

1. Soakage test undertaken between 1.0 and 3.0m
2. Datalogger serial no. 10109050
3. Groundwater encountered at 2.95m
4. Test failed due to insufficient drainage over a 24 hour monitoring period

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

Elapsed time (mins)	Depth to Water Test 1
0	1.018
1	1.023
2	1.028
3	1.031
4	1.033
5	1.035
10	1.055
15	1.079
20	1.097
25	1.116
30	1.137
45	1.188
60	1.229
90	1.292
120	1.318
180	1.357
240	1.389
300	1.415
390	1.451
480	1.484
570	1.511
660	1.537
750	1.559
840	1.582
930	1.598
1020	1.617
1110	1.635
1200	1.65
1290	1.667
1380	1.68
1440	1.681



Site : Tollgate Road, Colney Heath

Client : Stantec (UK) Ltd

Engineer :

Job Number 22.045

Sheet 2 / 3

Location	Date	Level	Location
SA02	04/05/2022	72.40 mOD	E: 520868 N: 205400

Pit Width (m)	0.50
Pit Depth (m)	3.00
Pit Length (m)	2.20

Soil type at test level	SAND over CLAY
Groundwater	2.99m
Drain discharge depth	Not known
Sidewall stability	Stable
Stone filled or open pit	Stone filled

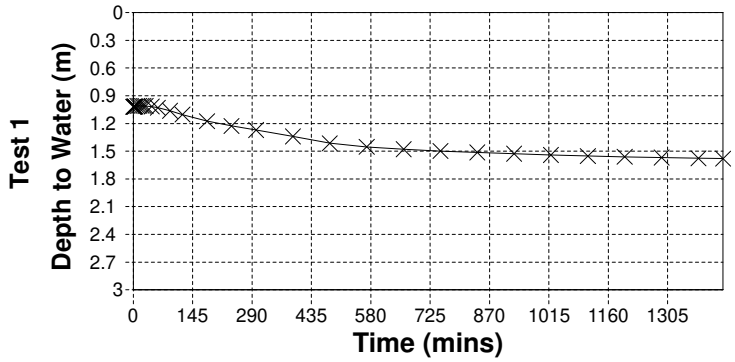
	1
Effective depth (m)	1.98
Volume outflowing between 75% & 25% (m3)*	
Mean surface area through which outflow occurs (m2)	
Time for outflow between 75% & 25% (min)	
SOIL INFILTRATION RATE (ms-1), f	Test Failed

Remarks

1. Soakage test undertaken between 1.0 and 3.0m
2. Datalogger serial no. 10109030
3. Groundwater encountered at 2.99m
4. Test failed due to insufficient drainage over a 24 hour monitoring period

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

Elapsed time (mins)	Depth to Water Test 1
0	1.02
1	1.019
2	1.018
3	1.017
4	1.016
5	1.015
10	1.011
15	1.009
20	1.01
25	1.01
30	1.011
45	1.017
60	1.03
90	1.063
120	1.104
180	1.175
240	1.227
300	1.271
390	1.34
480	1.414
570	1.453
660	1.479
750	1.499
840	1.513
930	1.527
1020	1.541
1110	1.553
1200	1.561
1290	1.569
1380	1.577
1440	1.58



A F Howland Associates
Geotechnical Engineers

Soakage Test (BRE Digest 365)

Site : Tollgate Road, Colney Heath

Client : Stantec (UK) Ltd

Engineer :

Job Number 22.045

Sheet 3 / 3

Location	Date	Level	Location
SA03	04/05/2022	74.11 mOD	E: 520823 N: 205510

Pit Width (m)	0.50
Pit Depth (m)	2.70
Pit Length (m)	2.20

Soil type at test level	SAND with CLAY pockets
Groundwater	2.58m
Drain discharge depth	Not known
Sidewall stability	Unstable
Stone filled or open pit	Stone filled

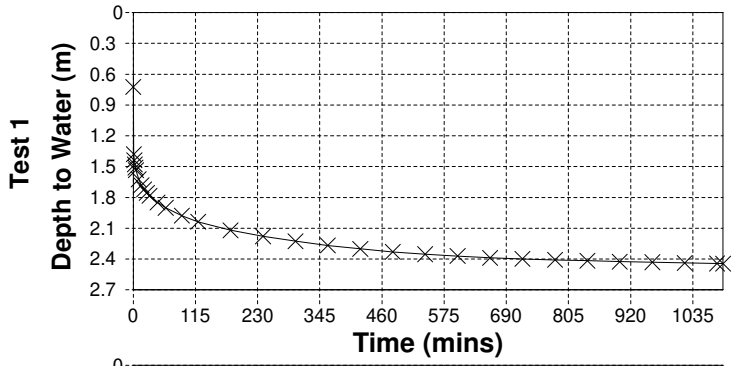
	1	2	3
Effective depth (m)	1.98	1.95	1.90
Volume outflowing between 75% & 25% (m3)*	0.33	0.32	0.31
Mean surface area through which outflow occurs (m2)	6.45	6.37	6.23
Time for outflow between 75% & 25% (min)	273.72	304.74	401.46
SOIL INFILTRATION RATE (ms-1), f	3.08E-6	2.76E-6	2.09E-6

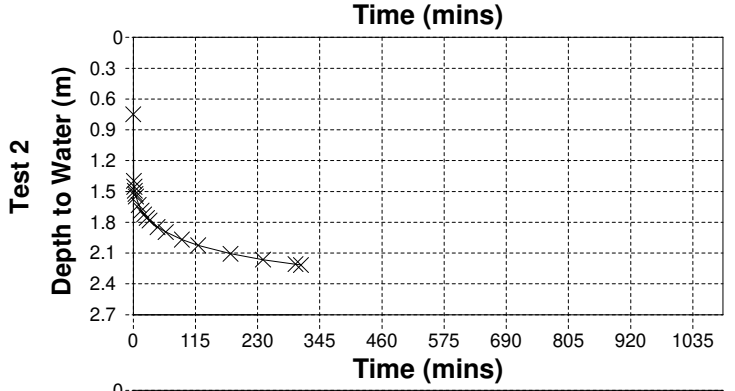
Remarks

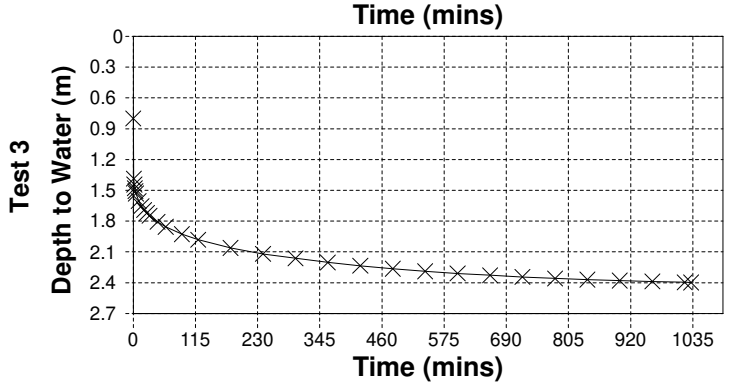
1. Soakage test undertaken between 0.7 and 2.7m
2. Datalogger serial no. 10259030
3. Groundwater encountered at 2.58m
4. Test 1 undertaken on 4/5/22 and tests 2 & 3 undertaken on 5/5/22.

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

Elapsed time (mins)	Depth to Water Test 1	Depth to Water Test 2	Depth to Water Test 3
0	0.724	0.749	0.801
1	1.379	1.396	1.386
2	1.439	1.454	1.444
3	1.478	1.493	1.48
4	1.511	1.525	1.508
5	1.536	1.549	1.531
10	1.624	1.632	1.605
15	1.682	1.686	1.654
20	1.723	1.725	1.691
25	1.757	1.758	1.721
30	1.785	1.784	1.747
45	1.849	1.847	1.808
60	1.901	1.895	1.855
90	1.978	1.969	1.927
120	2.037	2.025	1.981
180	2.121	2.107	2.061
240	2.179	2.164	2.119
300	2.226	2.208	2.162
310.333		2.216	
360	2.268		2.202
420	2.301		2.235
480	2.33		2.264
540	2.353		2.289
600	2.371		2.309
660	2.388		2.327
720	2.399		2.344
780	2.408		2.358
840	2.417		2.37
900	2.426		2.379
960	2.431		2.387
1020	2.438		2.396
1031.667			2.398
1080	2.444		
1090.833	2.445		







A F Howland Associates
Geotechnical Engineers

Ground Gas Monitoring Results

Site : Tollgate Road, Colney Heath

Client : Stantec (UK) Ltd

Engineer :

Job Number 22.045

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BH/WS	Date / Time	Serial Number	Security Code	Date Last Calibration	Date Factory Calibration	Operator	Site Condition	Standpipe Condition	Wind Speed (Knots)
BH01	25/05/2022 10:19	G507110	[6E8910AC]	25/05/2022	06/07/2021	RCER	Overcast Light rain Ground muddy	Tap fully closed	15.0
BH01	31/05/2022 13:40	G507110	[1403B219]	30/05/2022	06/07/2021	RCER	Overcast Ground dry	Tap fully closed 3.31	3.1
BH01	10/06/2022 10:23	G507110	[C13D4B77]	08/06/2022	06/07/2021	RCER	Partly cloudy Sunny	Tap fully closed	4.0
BH02	25/05/2022 10:33	G507110	[6E8910AC]	25/05/2022	06/07/2021	RCER	Overcast Light rain Ground muddy	Tap fully closed	15.0
BH02	31/05/2022 13:29	G507110	[1403B219]	30/05/2022	06/07/2021	RCER	Overcast Ground dry	Tap fully closed 4.17	3.1
BH02	10/06/2022 10:12	G507110	[C13D4B77]	08/06/2022	06/07/2021	RCER	Partly cloudy Sunny	Tap fully closed	4.0
BH03	25/05/2022 10:48	G507110	[6E8910AC]	25/05/2022	06/07/2021	RCER	Overcast Light rain Ground muddy	Tap fully closed	15.0
BH03	31/05/2022 13:15	G507110	[1403B219]	30/05/2022	06/07/2021	RCER	Overcast Ground dry	Tap fully closed 1.22	3.1
BH03	10/06/2022 09:56	G507110	[C13D4B77]	08/06/2022	06/07/2021	RCER	Partly cloudy Sunny	Tap fully closed	4.0
WS01	19/05/2022 09:42	G507110	[5BFF96CC]	19/05/2022	06/07/2021	RCER	Overcast Ground dry	Tap fully closed	5.0
WS01	25/05/2022 10:00	G507110	[6E8910AC]	25/05/2022	06/07/2021	RCER	Overcast Light rain Ground muddy	Tap fully closed	15.0
WS01	31/05/2022 12:10	G507110	[1403B219]	30/05/2022	06/07/2021	RCER	Overcast Ground dry	Tap fully closed 2.16	3.1
WS01	10/06/2022 10:48	G507110	[C13D4B77]	08/06/2022	06/07/2021	RCER	Partly cloudy Sunny	Tap fully closed	4.0
WS02	25/05/2022 11:09	G507110	[6E8910AC]	25/05/2022	06/07/2021	RCER	Overcast Light rain Ground muddy	Tap fully closed	15.0
WS02	31/05/2022 12:43	G507110	[1403B219]	30/05/2022	06/07/2021	RCER	Overcast Ground dry	Tap fully closed 4.58	3.1
WS02	10/06/2022 10:36	G507110	[C13D4B77]	08/06/2022	06/07/2021	RCER	Partly cloudy Sunny	Tap fully closed Dip - dry	4.0
WS03	25/05/2022 11:23	G507110	[6E8910AC]	25/05/2022	06/07/2021	RCER	Overcast Light rain Ground muddy	Tap fully closed	15.0
WS03	31/05/2022 12:56	G507110	[1403B219]	30/05/2022	06/07/2021	RCER	Overcast Ground dry	Tap fully closed 2.46	3.1
WS03	10/06/2022 09:45	G507110	[C13D4B77]	08/06/2022	06/07/2021	RCER	Partly cloudy Sunny	Tap fully closed	4.0

Site : Tollgate Road, Colney Heath

Client : Stantec (UK) Ltd

Engineer :

Job Number 22.045

Sheet 2 / 4

BH/WS	Date / Time	Flow Pod (l/h)	CH4 (%)	Peak CH4 (%)	CH4 LEL (%)	CO2 (%)	PEAK CO2 (%)	O2 (%)	Min O2 (%)	Balance (%)	Baro (mb)	Rel Pressure (mb)	CO (ppm)	H2S (ppm)	Temp (°C)
BH01	25/05/2022 10:05:00	0.0	0.0	0.0	0.0	1.1	1.1	19.3	19.3	79.6	1005	0.1	0.0	0.0	16.0
BH01	25/05/2022 10:06:00		0.0	0.0	0.0	1.1	1.1	19.3	19.3	79.6			0.0	0.0	16.0
BH01	25/05/2022 10:06:00		0.0	0.0	0.0	1.1	1.1	19.3	19.3	79.6			0.0	0.0	16.0
BH01	25/05/2022 10:07:00		0.0	0.0	0.0	1.1	1.2	19.2	19.2	79.7			0.0	0.0	16.0
BH01	25/05/2022 10:07:00		0.0	0.0	0.0	1.2	1.2	19.1	19.1	79.7			0.0	0.0	16.0
BH01	25/05/2022 10:08:00		0.0	0.0	0.0	1.2	1.2	19.2	19.1	79.6			0.0	0.0	16.0
BH01	25/05/2022 10:08:00		0.0	0.0	0.0	1.2	1.2	19.1	19.1	79.7			0.0	0.0	16.0
BH01	30/05/2022 13:34:00	0.0	0.0	0.0	0.0	1.6	1.6	19.4	19.4	79.0	1007	0.0	0.0	0.0	14.0
BH01	30/05/2022 13:35:00		0.0	0.0	0.0	1.6	1.6	19.3	19.3	79.1			0.0	0.0	14.0
BH01	30/05/2022 13:35:00		0.0	0.0	0.0	1.6	1.6	19.3	19.3	79.1			0.0	0.0	14.0
BH01	30/05/2022 13:36:00		0.0	0.0	0.0	1.6	1.6	19.2	19.2	79.2			0.0	0.0	14.0
BH01	30/05/2022 13:36:00		0.0	0.0	0.0	1.7	1.7	19.1	19.1	79.2			0.0	0.0	14.0
BH01	30/05/2022 13:37:00		0.0	0.0	0.0	1.7	1.7	19.1	19.1	79.2			0.0	0.0	14.0
BH01	30/05/2022 13:37:00		0.0	0.0	0.0	1.8	1.8	19.0	19.0	79.2			0.0	0.0	14.0
BH01	10/06/2022 10:17:00	-0.1	0.0	0.0	0.0	1.6	1.6	17.0	17.0	81.4	1012	0.0	1.0	0.0	23.0
BH01	10/06/2022 10:18:00		0.0	0.0	0.0	1.6	1.6	17.1	17.1	81.3			1.0	0.0	23.0
BH01	10/06/2022 10:18:00		0.0	0.0	0.0	1.6	1.6	17.0	17.0	81.4			1.0	0.0	23.0
BH01	10/06/2022 10:19:00		0.0	0.0	0.0	1.6	1.6	17.0	17.0	81.4			1.0	0.0	23.0
BH01	10/06/2022 10:19:00		0.0	0.0	0.0	1.6	1.6	17.0	17.0	81.4			1.0	0.0	23.0
BH01	10/06/2022 10:20:00		0.0	0.0	0.0	1.6	1.6	16.9	16.9	81.5			1.0	0.0	23.0
BH01	10/06/2022 10:20:00		0.0	0.0	0.0	1.7	1.7	16.9	16.9	81.4			1.0	0.0	23.0
BH02	25/05/2022 10:25:00	0.0	0.0	0.0	0.0	3.1	3.1	16.6	16.6	80.3	1006	0.0	1.0	0.0	16.0
BH02	25/05/2022 10:25:00		0.0	0.0	0.0	3.0	3.0	16.7	16.7	80.3			1.0	0.0	16.0
BH02	25/05/2022 10:26:00		0.0	0.0	0.0	3.1	3.1	16.6	16.6	80.3			1.0	0.0	16.0
BH02	25/05/2022 10:26:00		0.0	0.0	0.0	3.1	3.1	16.6	16.6	80.3			1.0	0.0	16.0
BH02	25/05/2022 10:27:00		0.0	0.0	0.0	3.1	3.1	16.6	16.6	80.3			1.0	0.0	16.0
BH02	25/05/2022 10:27:00		0.0	0.0	0.0	3.1	3.1	16.6	16.6	80.3			1.0	0.0	16.0
BH02	25/05/2022 10:28:00		0.0	0.0	0.0	3.1	3.1	16.6	16.6	80.3			1.0	0.0	16.0
BH02	30/05/2022 13:23:00	0.0	0.0	0.0	0.0	1.4	1.4	19.3	19.3	79.3	1007	-0.1	0.0	0.0	14.0
BH02	30/05/2022 13:23:00		0.0	0.0	0.0	1.3	1.3	19.3	19.3	79.4			0.0	0.0	14.0
BH02	30/05/2022 13:24:00		0.0	0.0	0.0	1.6	1.6	19.0	19.0	79.4			0.0	0.0	14.0
BH02	30/05/2022 13:24:00		0.0	0.0	0.0	1.9	1.9	18.6	18.6	79.5			0.0	0.0	14.0
BH02	30/05/2022 13:25:00		0.0	0.0	0.0	2.3	2.3	17.9	17.9	79.8			1.0	0.0	14.0
BH02	30/05/2022 13:25:00		0.0	0.0	0.0	2.5	2.5	17.6	17.6	79.9			0.0	0.0	14.0
BH02	30/05/2022 13:26:00		0.0	0.0	0.0	2.6	2.6	17.4	17.4	80.0			0.0	0.0	14.0
BH02	10/06/2022 10:04:00	-0.1	0.0	0.0	0.0	3.0	3.0	16.4	16.4	80.6	1012	-0.1	1.0	0.0	23.0
BH02	10/06/2022 10:04:00		0.0	0.0	0.0	2.9	2.9	16.4	16.4	80.7			1.0	0.0	23.0
BH02	10/06/2022 10:05:00		0.0	0.0	0.0	3.0	3.0	16.3	16.3	80.7			1.0	0.0	23.0
BH02	10/06/2022 10:05:00		0.0	0.0	0.0	3.0	3.0	16.3	16.3	80.7			1.0	0.0	23.0
BH02	10/06/2022 10:06:00		0.0	0.0	0.0	3.0	3.0	16.3	16.3	80.7			1.0	0.0	23.0
BH02	10/06/2022 10:06:00		0.0	0.0	0.0	3.0	3.0	16.3	16.3	80.7			1.0	0.0	23.0
BH02	10/06/2022 10:07:00		0.0	0.0	0.0	3.0	3.0	16.3	16.3	80.7			1.0	0.0	23.0
BH03	25/05/2022 10:41:00	0.0	0.0	0.0	0.0	3.6	3.6	16.3	16.3	80.1	1005	0.0	1.0	0.0	16.0
BH03	25/05/2022 10:42:00		0.0	0.0	0.0	3.5	3.5	16.3	16.3	80.2			1.0	0.0	16.0
BH03	25/05/2022 10:42:00		0.0	0.0	0.0	3.6	3.6	16.2	16.2	80.2			1.0	0.0	16.0
BH03	25/05/2022 10:43:00		0.0	0.0	0.0	3.6	3.6	16.2	16.2	80.2			1.0	0.0	16.0
BH03	25/05/2022 10:43:00		0.0	0.0	0.0	3.6	3.6	16.2	16.2	80.2			1.0	0.0	16.0
BH03	25/05/2022 10:44:00		0.0	0.0	0.0	3.6	3.7	16.1	16.1	80.3			1.0	0.0	16.0
BH03	25/05/2022 10:44:00		0.0	0.0	0.0	3.7	3.7	16.1	16.1	80.2			1.0	0.0	16.0
BH03	30/05/2022 13:02:00	0.0	0.0	0.0	0.0	3.7	3.7	18.0	18.0	78.3	1007	0.1	0.0	0.0	14.0
BH03	30/05/2022 13:03:00		0.0	0.0	0.0	3.6	3.6	18.0	18.0	78.4			0.0	0.0	14.0
BH03	30/05/2022 13:03:00		0.0	0.0	0.0	3.7	3.7	17.9	17.9	78.4			0.0	0.0	14.0
BH03	30/05/2022 13:04:00		0.0	0.0	0.0	3.7	3.7	17.9	17.9	78.4			0.0	0.0	14.0
BH03	30/05/2022 13:04:00		0.0	0.0	0.0	3.8	3.8	17.9	17.9	78.3			0.0	0.0	14.0
BH03	30/05/2022 13:05:00		0.0	0.0	0.0	3.8	3.8	17.9	17.9	78.3			0.0	0.0	14.0
BH03	30/05/2022 13:05:00		0.0	0.0	0.0	3.8	3.8	17.9	17.9	78.3			0.0	0.0	14.0
BH03	30/05/2022 13:06:00		0.0	0.0	0.0	3.8	3.8	17.9	17.9	78.3			0.0	0.0	14.0
BH03	30/05/2022 13:06:00		0.0	0.0	0.0	3.8	3.8	17.9	17.9	78.3			0.0	0.0	14.0
BH03	30/05/2022 13:07:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:07:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:08:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:09:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:09:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:10:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:10:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:11:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:11:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:12:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:12:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	30/05/2022 13:13:00		0.0	0.0	0.0	3.9	3.9	17.9	17.9	78.2			0.0	0.0	14.0
BH03	10/06/2022 09:50:00	0.0	0.0	0.0	0.0	3.5	3.5	17.3	17.2	79.2	1012	0.0	0.0	0.0	23.0
BH03	10/06/2022 09:51:00		0.0	0.0	0.0	3.4	3.4	17.3	17.3	79.3			0.0	0.0	23.0
BH03	10/06/2022 09:51:00		0.0	0.0	0.0	3.5	3.5	17.2	17.2	79.3			0.0	0.0	23.0
BH03	10/06/2022 09:52:00		0.0	0.0	0.0	3.5	3.5	17.2	17.2	79.3			0.0	0.0	23.0
BH03	10/06/2022 09:52:00		0.0	0.0	0.0	3.5	3.5	17.2	17.2	79.3			0.0	0.0	23.0
BH03	10/06/2022 09:53:00		0.0	0.0	0.0	3.5	3.5	17.2	17.2	79.3			0.0	0.0	23.0
BH03	10/06/2022 09:53:00		0.0	0.0	0.0	3.5	3.5	17.2	17.2	79.3			0.0	0.0	23.0
WS01	19/05/2022 09:32:26	0.0	0.0	0.0	0.0	1.8	1.8	19.6	19.6	78.6		0.0	0.0	0.0	16.0
WS01	19/05/2022 09:33:27		0.0	0.0	0.0	1.7	1.7	19.6	19.6	78.7			0.0	0.0	16.0
WS01	19/05/2022 09:33:57		0.0	0.0	0.0	1.8	1.8	19.6	19.6	78.6			0.0	0.0	16.0
WS01	19/05/2022 09:34:27		0.0	0.0	0.0	1.8	1.8	19.6	19.6	78.6			0.0	0.0	16.0

Site : Tollgate Road, Colney Heath

Client : Stantec (UK) Ltd

Engineer :

Job Number 22.045

Sheet 3 / 4

BH/WS	Date / Time	Flow Pod (l/h)	CH4 (%)	Peak CH4 (%)	CH4 LEL (%)	CO2 (%)	PEAK CO2 (%)	O2 (%)	Min O2 (%)	Balance (%)	Baro (mb)	Rel Pressure (mb)	CO (ppm)	H2S (ppm)	Temp (°C)
WS01	19/05/2022 09:34:57		0.0	0.0	0.0	1.8	1.8	19.6	19.6	78.6			0.0	0.0	16.0
WS01	19/05/2022 09:35:28		0.0	0.0	0.0	1.8	1.8	19.5	19.5	78.7			0.0	1.0	16.0
WS01	19/05/2022 09:35:58		0.0	0.0	0.0	1.8	1.8	19.5	19.5	78.7			0.0	1.0	16.0
WS01	25/05/2022 09:48:00	0.0	0.0	0.0	0.0	1.9	1.9	19.5	19.5	78.6	1005	0.0	0.0	0.0	16.0
WS01	25/05/2022 09:49:00		0.0	0.0	0.0	1.8	1.8	19.5	19.5	78.7			0.0	0.0	16.0
WS01	25/05/2022 09:49:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	16.0
WS01	25/05/2022 09:50:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	16.0
WS01	25/05/2022 09:50:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	16.0
WS01	25/05/2022 09:51:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	16.0
WS01	25/05/2022 09:51:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	16.0
WS01	30/05/2022 12:02:00	0.0	0.0	0.0	0.0	1.8	1.9	19.4	19.4	78.8	1006	-0.1	0.0	0.0	14.0
WS01	30/05/2022 12:04:00		0.0	0.0	0.0	1.7	1.7	19.5	19.5	78.8			0.0	0.0	14.0
WS01	30/05/2022 12:04:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	14.0
WS01	30/05/2022 12:05:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	14.0
WS01	30/05/2022 12:05:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	14.0
WS01	30/05/2022 12:06:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	14.0
WS01	30/05/2022 12:06:00		0.0	0.0	0.0	1.9	1.9	19.4	19.4	78.7			0.0	0.0	14.0
WS01	10/06/2022 10:41:00	0.0	0.0	0.0	0.0	1.8	1.8	19.0	19.0	79.2	1012	0.1	1.0	0.0	23.0
WS01	10/06/2022 10:42:00		0.0	0.0	0.0	1.8	1.8	18.9	18.9	79.3			1.0	0.0	23.0
WS01	10/06/2022 10:42:00		0.0	0.0	0.0	1.8	1.8	18.9	18.9	79.3			1.0	0.0	23.0
WS01	10/06/2022 10:43:00		0.0	0.0	0.0	1.8	1.8	18.9	18.9	79.3			1.0	0.0	23.0
WS01	10/06/2022 10:43:00		0.0	0.0	0.0	1.8	1.8	18.9	18.9	79.3			0.0	0.0	23.0
WS01	10/06/2022 10:44:00		0.0	0.0	0.0	1.8	1.8	18.9	18.9	79.3			1.0	0.0	23.0
WS01	10/06/2022 10:44:00		0.0	0.0	0.0	1.8	1.8	18.9	18.9	79.3			1.0	0.0	23.0
WS02	25/05/2022 10:57:00	0.0	0.0	0.0	0.0	1.9	1.9	16.9	16.9	81.2	1006	-0.1	1.0	0.0	16.0
WS02	25/05/2022 10:58:00		0.0	0.0	0.0	1.9	1.9	17.0	17.0	81.1			0.0	0.0	16.0
WS02	25/05/2022 10:58:00		0.0	0.0	0.0	2.0	2.0	16.6	16.6	81.4			0.0	0.0	16.0
WS02	25/05/2022 10:59:00		0.0	0.0	0.0	2.0	2.0	16.2	16.2	81.8			0.0	0.0	16.0
WS02	25/05/2022 10:59:00		0.0	0.0	0.0	2.1	2.1	15.9	15.9	82.0			0.0	0.0	16.0
WS02	25/05/2022 11:00:00		0.0	0.0	0.0	2.1	2.1	15.7	15.7	82.2			0.0	0.0	16.0
WS02	25/05/2022 11:00:00		0.0	0.0	0.0	2.1	2.1	15.4	15.4	82.5			0.0	0.0	16.0
WS02	30/05/2022 12:18:00	0.0	0.0	0.0	0.0	3.2	3.3	10.1	10.1	86.7	1006	0.1	0.0	0.0	14.0
WS02	30/05/2022 12:26:00	0.0	0.0	0.0	0.0	3.2	3.2	10.2	10.2	86.6			0.0	0.0	14.0
WS02	30/05/2022 12:28:00		0.0	0.0	0.0	3.1	3.1	10.2	10.2	86.7			0.0	0.0	14.0
WS02	30/05/2022 12:28:00		0.0	0.0	0.0	3.2	3.2	9.9	9.9	86.9			0.0	0.0	14.0
WS02	30/05/2022 12:29:00		0.0	0.0	0.0	3.3	3.3	9.9	9.9	86.8			0.0	0.0	14.0
WS02	30/05/2022 12:29:00		0.0	0.0	0.0	3.3	3.3	9.8	9.8	86.9			0.0	0.0	14.0
WS02	30/05/2022 12:30:00		0.0	0.0	0.0	3.3	3.3	9.8	9.8	86.9			0.0	0.0	14.0
WS02	30/05/2022 12:30:00		0.0	0.0	0.0	3.3	3.3	9.8	9.8	86.9			0.0	0.0	14.0
WS02	30/05/2022 12:31:00		0.0	0.0	0.0	3.3	3.3	9.8	9.8	86.9			0.0	0.0	14.0
WS02	30/05/2022 12:31:00		0.0	0.0	0.0	3.3	3.3	9.8	9.8	86.9			0.0	0.0	14.0
WS02	30/05/2022 12:32:00		0.0	0.0	0.0	3.3	3.3	9.9	9.8	86.8			0.0	0.0	14.0
WS02	30/05/2022 12:32:00		0.0	0.0	0.0	3.3	3.3	10.0	9.9	86.7			0.0	0.0	14.0
WS02	30/05/2022 12:35:00	0.0	0.0	0.0	0.0	3.3	3.3	10.1	10.0	86.6			0.0	0.0	14.0
WS02	30/05/2022 12:35:00		0.0	0.0	0.0	3.2	3.2	10.1	10.1	86.7			0.0	0.0	14.0
WS02	30/05/2022 12:36:00		0.0	0.0	0.0	3.3	3.3	10.2	10.1	86.5			0.0	0.0	14.0
WS02	30/05/2022 12:36:00		0.0	0.0	0.0	3.2	3.3	10.4	10.2	86.4			0.0	0.0	14.0
WS02	30/05/2022 12:37:00		0.0	0.0	0.0	3.2	3.2	10.5	10.4	86.3			0.0	0.0	14.0
WS02	30/05/2022 12:37:00		0.0	0.0	0.0	3.2	3.2	10.7	10.5	86.1			0.0	0.0	14.0
WS02	30/05/2022 12:38:00		0.0	0.0	0.0	3.2	3.2	10.9	10.7	85.9			0.0	0.0	14.0
WS02	30/05/2022 12:38:00		0.0	0.0	0.0	3.2	3.2	11.2	10.9	85.6			0.0	0.0	14.0
WS02	30/05/2022 12:39:00		0.0	0.0	0.0	3.2	3.2	11.6	11.2	85.2			0.0	0.0	14.0
WS02	30/05/2022 12:39:00		0.0	0.0	0.0	3.2	3.2	11.9	11.6	84.9			0.0	0.0	14.0
WS02	30/05/2022 12:40:00		0.0	0.0	0.0	3.1	3.2	12.2	11.9	84.7			0.0	0.0	14.0
WS02	10/06/2022 10:30:00	0.0	0.0	0.0	0.0	3.1	3.1	14.8	14.8	82.1	1012	0.1	1.0	0.0	23.0
WS02	10/06/2022 10:31:00		0.0	0.0	0.0	3.0	3.0	14.8	14.8	82.2			1.0	0.0	23.0
WS02	10/06/2022 10:31:00		0.0	0.0	0.0	3.1	3.1	14.8	14.8	82.1			1.0	0.0	23.0
WS02	10/06/2022 10:32:00		0.0	0.0	0.0	3.1	3.1	14.8	14.8	82.1			0.0	0.0	23.0
WS02	10/06/2022 10:32:00		0.0	0.0	0.0	3.1	3.1	14.8	14.8	82.1			1.0	0.0	23.0
WS02	10/06/2022 10:33:00		0.0	0.0	0.0	3.1	3.1	14.9	14.8	82.0			0.0	0.0	23.0
WS02	10/06/2022 10:33:00		0.0	0.0	0.0	3.1	3.1	14.9	14.9	82.0			1.0	0.0	23.0
WS03	25/05/2022 11:15:00	0.0	0.0	0.0	0.0	1.9	1.9	16.9	16.9	81.2	1006	0.0	1.0	0.0	16.0
WS03	25/05/2022 11:16:00		0.0	0.0	0.0	2.0	2.0	17.0	17.0	81.1			0.0	0.0	16.0
WS03	25/05/2022 11:16:00		0.0	0.0	0.0	2.0	2.0	16.6	16.6	81.4			0.0	0.0	16.0
WS03	25/05/2022 11:17:00		0.0	0.0	0.0	2.0	2.0	16.2	16.2	81.8			0.0	0.0	16.0
WS03	25/05/2022 11:17:00		0.0	0.0	0.0	2.0	2.0	16.1	16.1	82.0			0.0	0.0	16.0
WS03	25/05/2022 11:18:00		0.0	0.0	0.0	2.0	2.0	15.9	15.9	82.2			0.0	0.0	16.0
WS03	25/05/2022 11:18:00		0.0	0.0	0.0	2.0	2.0	15.9	15.9	82.5			0.0	0.0	16.0
WS03	30/05/2022 12:51:00	0.0	0.0	0.0	0.0	1.0	1.0	20.4	20.4	78.6	1006	0.0	0.0	0.0	14.0
WS03	30/05/2022 12:52:00		0.0	0.0	0.0	1.0	1.0	20.4	20.4	78.6			0.0	0.0	14.0
WS03	30/05/2022 12:52:00		0.0	0.0	0.0	1.0	1.0	20.4	20.4	78.6			0.0	0.0	14.0
WS03	30/05/2022 12:53:00		0.0	0.0	0.0	1.0	1.0	20.4	20.4	78.6			0.0	0.0	14.0
WS03	30/05/2022 12:53:00		0.0	0.0	0.0	1.0	1.0	20.4	20.4	78.6			0.0	0.0	14.0
WS03	30/05/2022 12:54:00		0.0	0.0	0.0	1.0	1.0	20.4	20.4	78.6			0.0	0.0	14.0
WS03	30/05/2022 12:54:00		0.0	0.0	0.0	1.0	1.0	20.4	20.4	78.6			0.0	0.0	14.0
WS03	10/06/2022 09:37:00	0.0	0.0	0.0	0.0	1.2	1.2	19.4	19.4	79.4	1012	0.0	0.0	0.0	23.0
WS03	10/06/2022 09:38:00		0.0	0.0	0.0	1.2	1.2	19.4	19.4	79.4			0.0	0.0	23.0
WS03	10/06/2022 09:38:00		0.0	0.0	0.0	1.2	1.2	19.4	19.4	79.4			0.0	0.0	23.0
WS03	10/06/2022 09:39:00		0.0	0.0	0.0	1.2	1.2	19.4	19.4	79.4			0.0	0.0	23.0
WS03	10/06/2022 09:39:00		0.0	0.0	0.0	1.2	1.2	19.3	19.3	79.5			0.0	0.0	23.0
WS03	10/06/2022 09:40:00		0.0	0.0	0.0	1.2	1.2	19.3	19.3	79.5			0.0	0.0	23.0

A F Howland Associates
Geotechnical Engineers

Ground Gas Monitoring Results

Site : Tollgate Road, Colney Heath

Client : Stantec (UK) Ltd

Engineer :

Job Number 22.045

Sheet 4 / 4

BH/WS	Date / Time	Flow Pod (l/h)	CH4 (%)	Peak CH4 (%)	CH4 LEL (%)	CO2 (%)	PEAK CO2 (%)	O2 (%)	Min O2 (%)	Balance (%)	Baro (mb)	Rel Pressure (mb)	CO (ppm)	H2S (ppm)	Temp (°C)
WS03	10/06/2022 09:40:00		0.0	0.0	0.0	1.2	1.2	19.3	19.3	79.5			0.0	0.0	23.0

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Location	Depth (m)	Sample Ref	Type	Description	WC %	LL %	PL %	PI %	<425 µm %	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 g/L	W/S Mg mg/L	
BH01	5.10	U1	U	Very stiff dark grey gravelly CLAY. Gravel is chalk.	14.6					2.23	1.95	Undisturbed	100	444	222				
BH01	5.60	D4	D	Grey CLAY with rare fine to medium gravel sized chalk.	14.4	39	18	21	87										
BH02	1.30-1.80	B2	B	Brown clayey silty very sandy GRAVEL.															Particle Size Distribution
BH02	9.50	D2	D	Grey CLAY with rare sand and gravel.	15.1	37	15	22	98										
BH03	5.00	UT1	U	Stiff grey gravelly CLAY. Gravel is fine to medium chalk.	14.1					2.28	2.00	Undisturbed	100	207	103				
SA01	1.50-3.00	B1	B	Yellowish brown mottled dark brown slightly gravelly slightly sandy silty CLAY.	20.2	55	22	33	79										Particle Size Distribution
SA02	1.10-1.80	D3	D	Brown clayey silty very sandy GRAVEL.															Particle Size Distribution
SA03	0.30-3.00	B1	B	Orangish brown silty clayey very sandy GRAVEL.															Particle Size Distribution
TP01	1.00	B1	B	Orangish brown very sandy GRAVEL.															Particle Size Distribution
TP02	0.80	D1	D	Yellowish brown gravelly sandy CLAY . Gravel is fine to medium.	15.0	40	18	22	58										

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS®

SUMMARY OF GEOTECHNICAL TESTING

Sample details					Classification Tests					Density Tests		Undrained Triaxial Compression				Chemical Tests			Other tests and comments
Location	Depth (m)	Sample Ref	Type	Description	WC %	LL %	PL %	PI %	<425 µm %	Bulk Mg/m³	Dry Mg/m³	Condition	Cell Pressure kPa	Deviator Stress kPa	Shear Stress kPa	pH	2:1 W/S SO4 g/L	W/S Mg mg/L	
TP03	1.50	B2	B	Orangish brown silty clayey very sandy GRAVEL.															Particle Size Distribution
TP04	1.50	B2	B	Orangish brown gravelly very sandy silty CLAY.															Particle Size Distribution
TP05	2.00	D2	D	Yellowish brown silty CLAY with rare fine to medium gravel.	19.2	36	18	18	99										
TP06	0.50	B1	B	Brown silty clayey very sandy GRAVEL.															Particle Size Distribution
TP07	1.50	B2	B	Brown mottled grey sandy CLAY with rare fine to medium gravel. Sand is fine.	15.6	26	13	13	98										

Sample type: B (Bulk disturb.) BLK (Block) C (Core) D (Disturbed) LB (Large Bulk dist.) U (Undisturbed)

Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS®

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

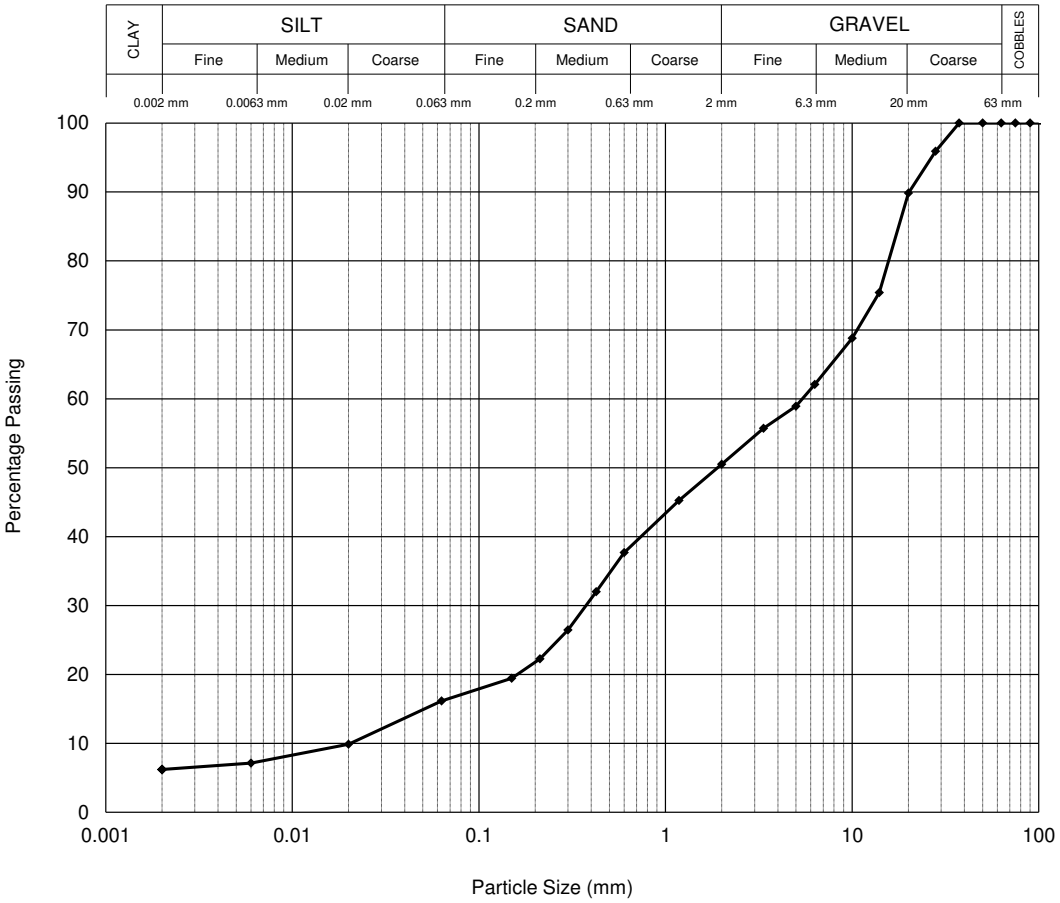
Location	BH02
Sample Ref	B2
Depth (m)	1.30-1.80
Sample Type	B

Description

Brown clayey silty very sandy GRAVEL.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve
BS EN ISO 17892-4 : 2016 : Clause 5.4 - Sedimentation by Pipette

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	96
20.0 mm	90
14.0 mm	75
10.0 mm	69
6.30 mm	62
5.00 mm	59
3.35 mm	56
2.00 mm	50
1.18 mm	45
600 µm	38
425 µm	32
300 µm	26
212 µm	22
150 µm	19
63 µm	16



Sedimentation	
No Pre-treatment used	
Temp (°C)	25.0
Size	% Pass
20 µm	10
6 µm	7
2 µm	6
Particle Density 2.70(A) Mg/m³	

Particle Proportions	
Cobbles	0.0
Gravel	49.5
Sand	34.3
Silt	9.9
Clay	6.3

Tested by AW
Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS®
UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

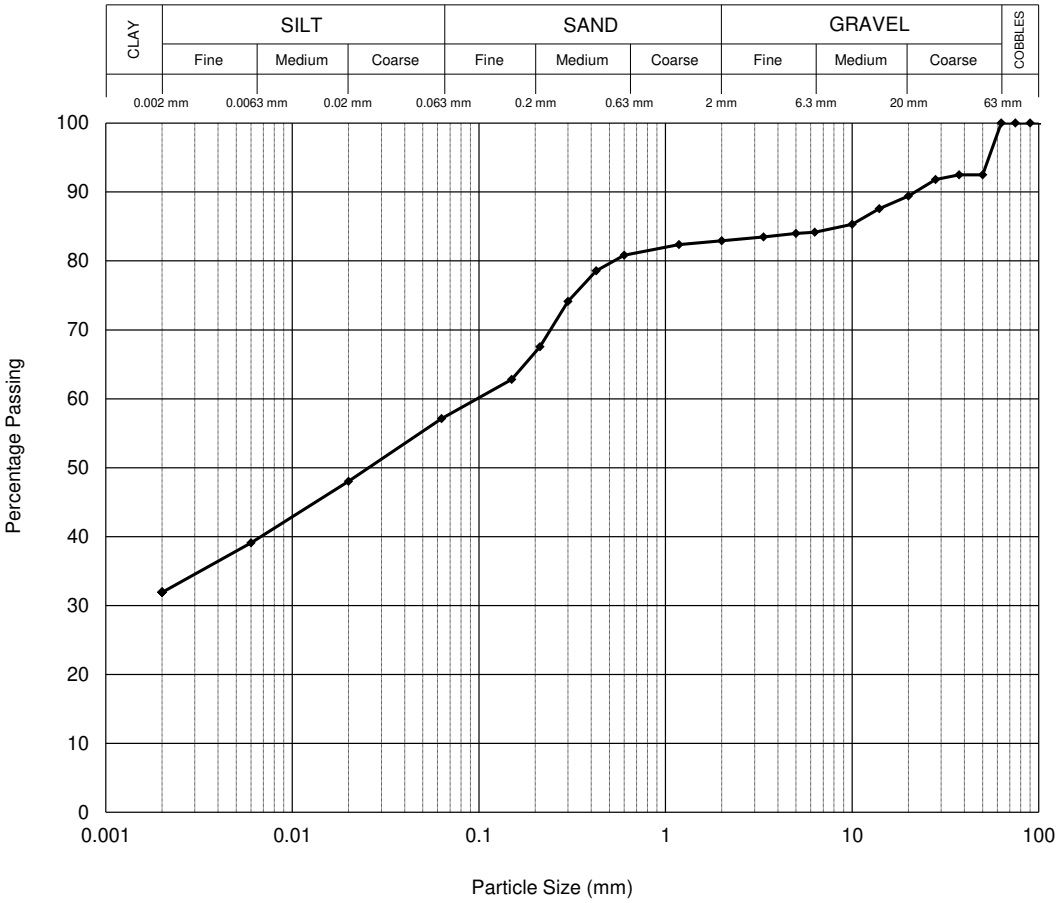
Location	SA01
Sample Ref	B1
Depth (m)	1.50-3.00
Sample Type	B

Description

Yellowish brown mottled dark brown slightly gravelly slightly sandy silty CLAY.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve
BS EN ISO 17892-4 : 2016 : Clause 5.4 - Sedimentation by Pipette

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	92
37.5 mm	92
28.0 mm	92
20.0 mm	89
14.0 mm	88
10.0 mm	85
6.30 mm	84
5.00 mm	84
3.35 mm	83
2.00 mm	83
1.18 mm	82
600 µm	81
425 µm	79
300 µm	74
212 µm	68
150 µm	63
63 µm	57



Sedimentation	
No Pre-treatment used	
Temp (°C)	25.0
Size	% Pass
20 µm	48
6 µm	39
2 µm	32
Particle Density 2.70(A) Mg/m³	

Particle Proportions	
Cobbles	0.0
Gravel	17.1
Sand	25.8
Silt	25.2
Clay	31.9

Tested by AW
Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS

UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

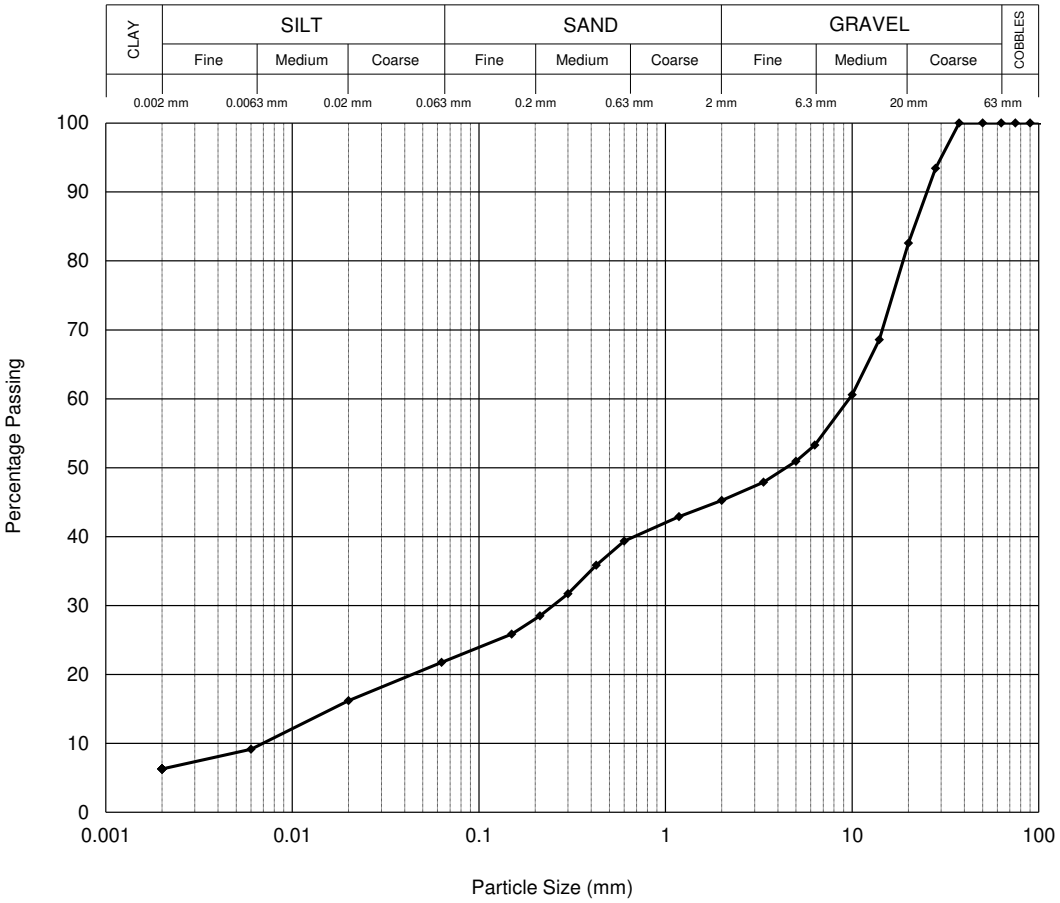
Location	SA02
Sample Ref	D3
Depth (m)	1.10-1.80
Sample Type	D

Description

Brown clayey silty very sandy GRAVEL.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve
BS EN ISO 17892-4 : 2016 : Clause 5.4 - Sedimentation by Pipette

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	93
20.0 mm	83
14.0 mm	69
10.0 mm	61
6.30 mm	53
5.00 mm	51
3.35 mm	48
2.00 mm	45
1.18 mm	43
600 µm	39
425 µm	36
300 µm	32
212 µm	29
150 µm	26
63 µm	22



Sedimentation	
No Pre-treatment used	
Temp (°C)	25.0
Size	% Pass
20 µm	16
6 µm	9
2 µm	6

Particle Density 2.70(A) Mg/m³

Particle Proportions	
Cobbles	0.0
Gravel	54.8
Sand	23.5
Silt	15.4
Clay	6.3

Tested by AW
Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS®
UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

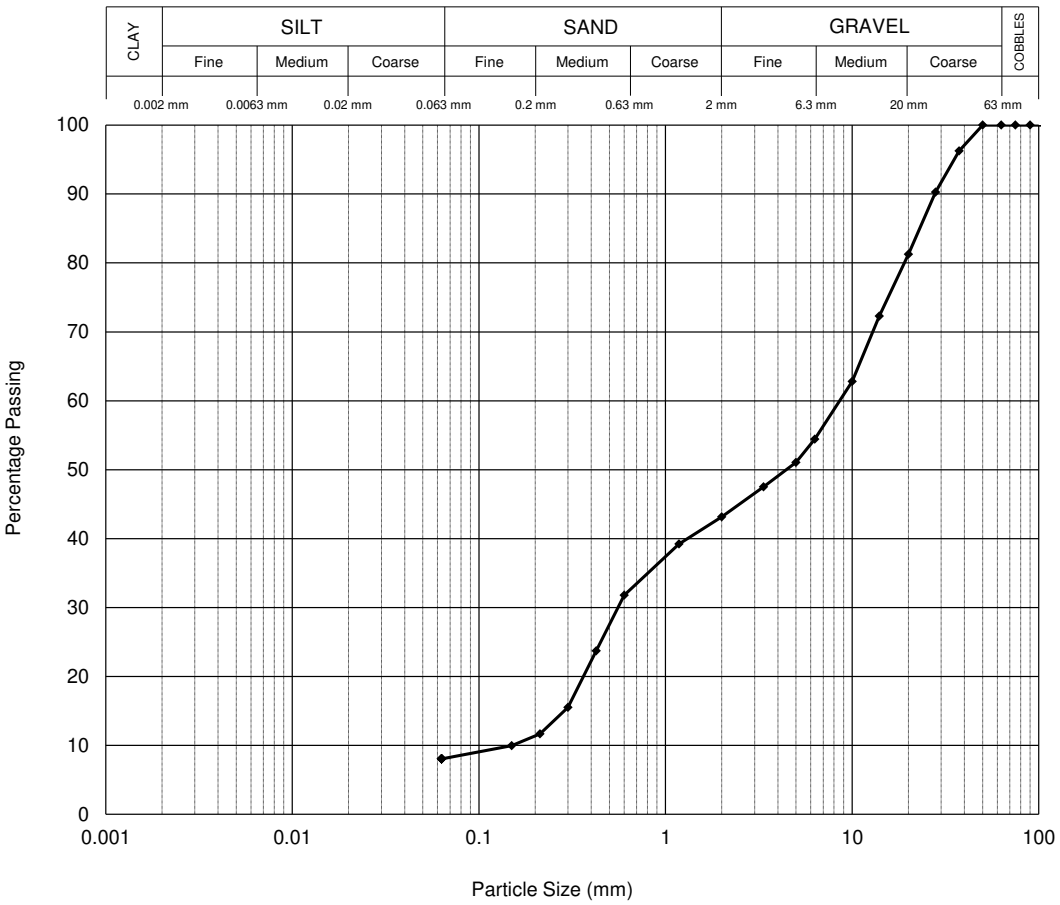
Location	SA03
Sample Ref	B1
Depth (m)	0.30-3.00
Sample Type	B

Description

Orangish brown silty clayey very sandy GRAVEL.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	96
28.0 mm	90
20.0 mm	81
14.0 mm	72
10.0 mm	63
6.30 mm	54
5.00 mm	51
3.35 mm	47
2.00 mm	43
1.18 mm	39
600 µm	32
425 µm	24
300 µm	16
212 µm	12
150 µm	10
63 µm	8



Particle Proportions	
Cobbles	0.0
Gravel	56.9
Sand	35.1
Silt & Clay	8.0

Tested by AW
Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

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BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

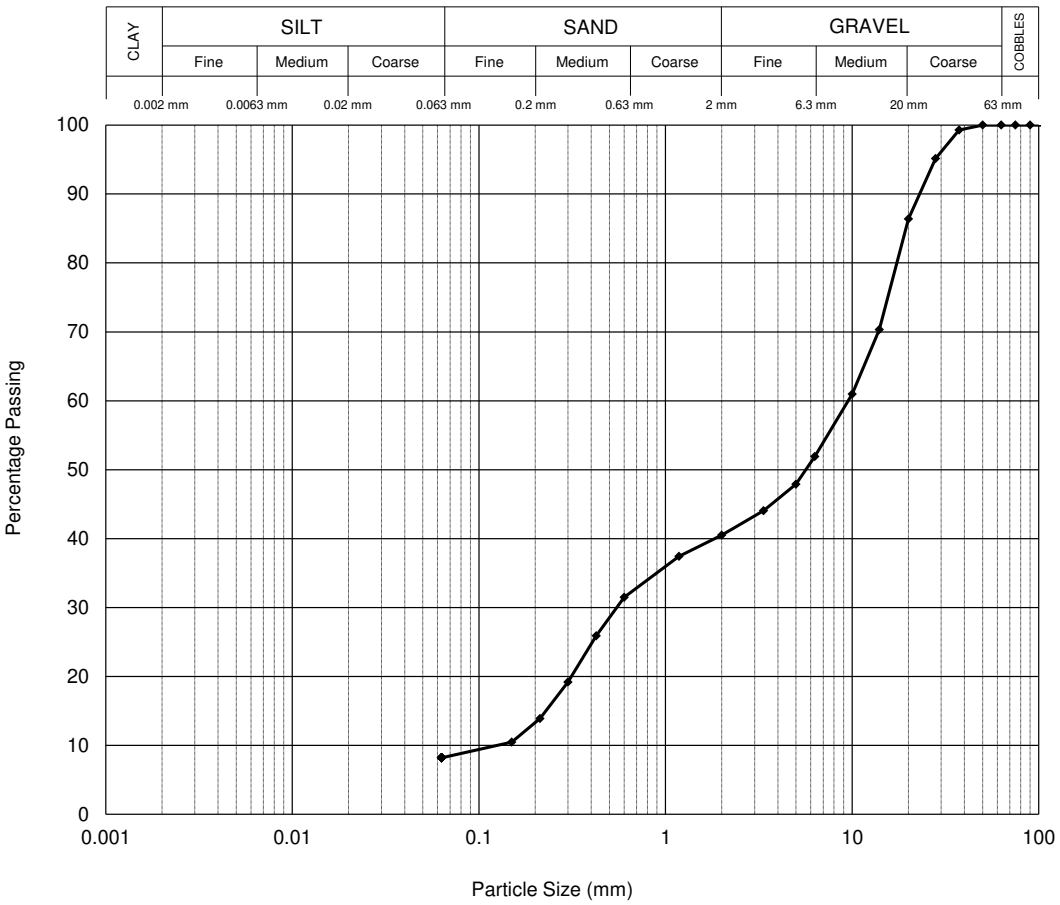
Location	TP01
Sample Ref	B1
Depth (m)	1.00
Sample Type	B

Description

Orangish brown very sandy GRAVEL.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	99
28.0 mm	95
20.0 mm	86
14.0 mm	70
10.0 mm	61
6.30 mm	52
5.00 mm	48
3.35 mm	44
2.00 mm	40
1.18 mm	37
600 µm	31
425 µm	26
300 µm	19
212 µm	14
150 µm	10
63 µm	8



Particle Proportions	
Cobbles	0.0
Gravel	59.5
Sand	32.3
Silt & Clay	8.2

Tested by AW
Checked and Approved by

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS

UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

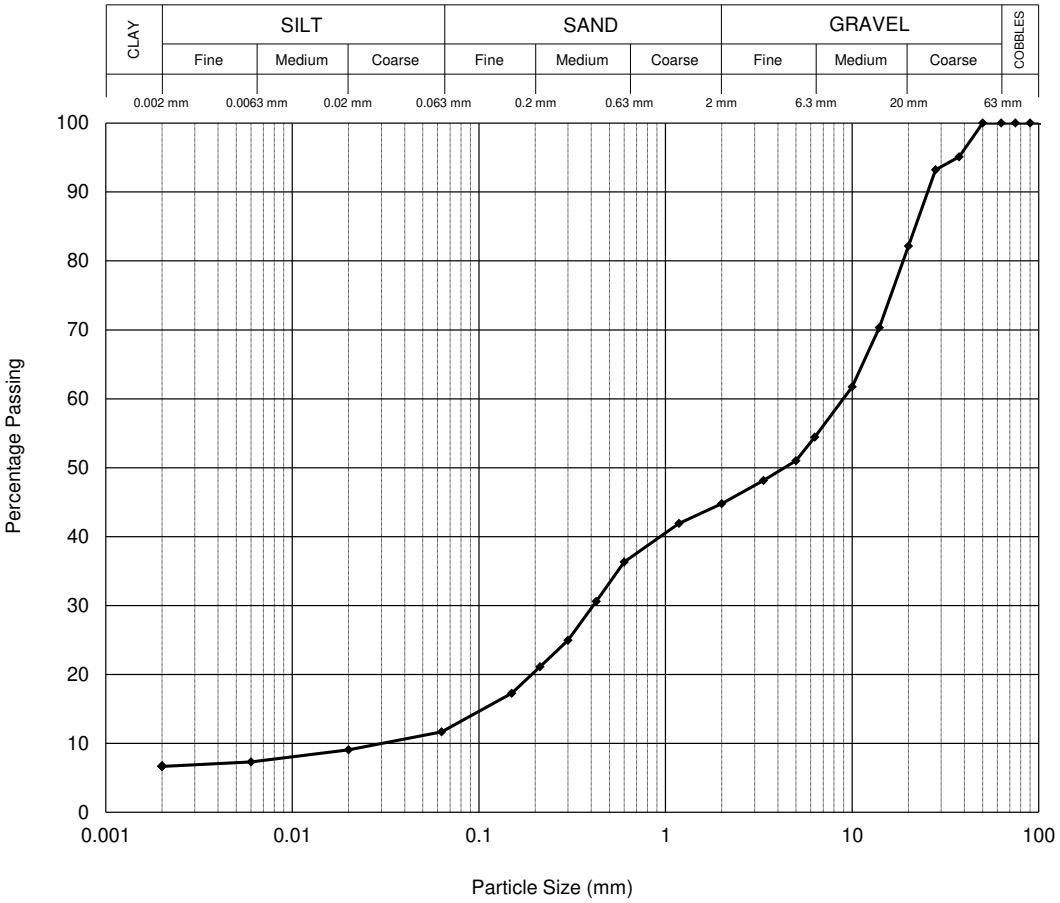
Location	TP03
Sample Ref	B2
Depth (m)	1.50
Sample Type	B

Description

Orangish brown silty clayey very sandy GRAVEL.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve
BS EN ISO 17892-4 : 2016 : Clause 5.4 - Sedimentation by Pipette

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	95
28.0 mm	93
20.0 mm	82
14.0 mm	70
10.0 mm	62
6.30 mm	54
5.00 mm	51
3.35 mm	48
2.00 mm	45
1.18 mm	42
600 µm	36
425 µm	31
300 µm	25
212 µm	21
150 µm	17
63 µm	12



Sedimentation	
No Pre-treatment used	
Temp (°C)	25.0
Size	% Pass
20 µm	9
6 µm	7
2 µm	7
Particle Density 2.70(A) Mg/m³	

Particle Proportions	
Cobbles	0.0
Gravel	55.2
Sand	33.1
Silt	5.0
Clay	6.7

Tested by AW
Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

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UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

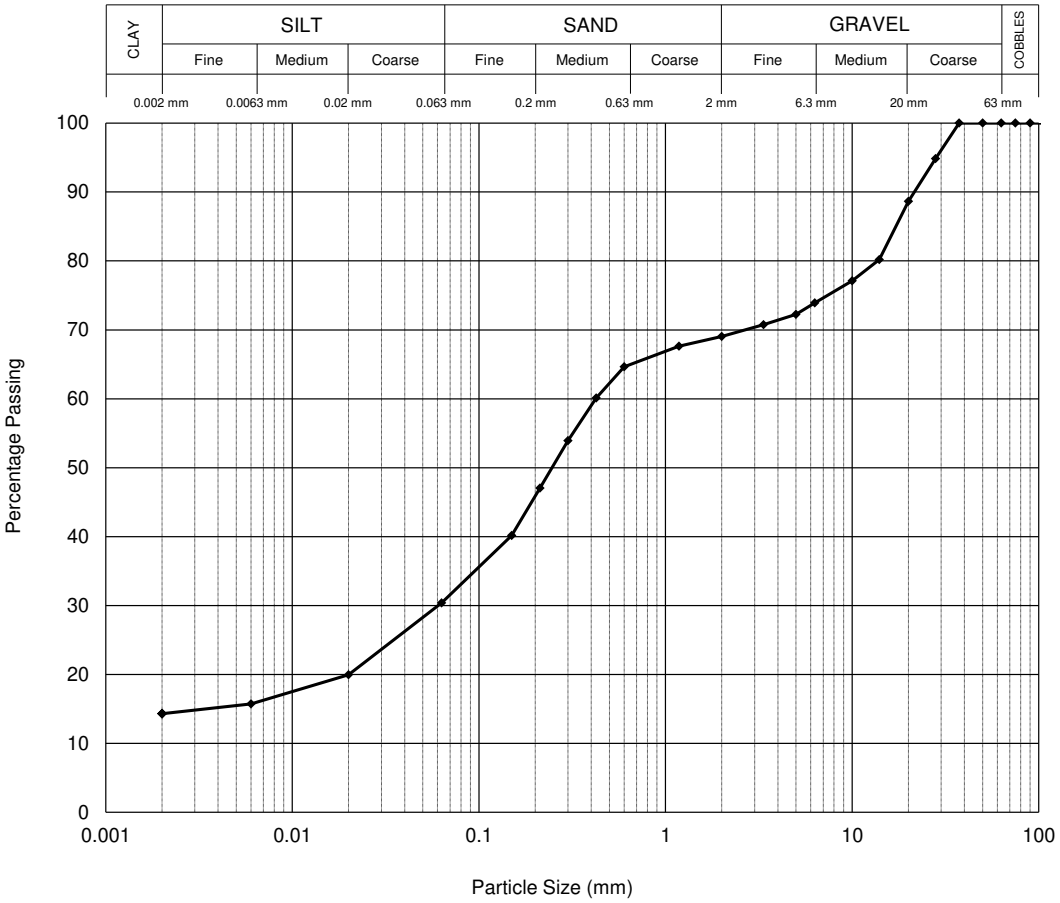
Location	TP04
Sample Ref	B2
Depth (m)	1.50
Sample Type	B

Description

Orangish brown gravelly very sandy silty CLAY.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve
BS EN ISO 17892-4 : 2016 : Clause 5.4 - Sedimentation by Pipette

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	95
20.0 mm	89
14.0 mm	80
10.0 mm	77
6.30 mm	74
5.00 mm	72
3.35 mm	71
2.00 mm	69
1.18 mm	68
600 µm	65
425 µm	60
300 µm	54
212 µm	47
150 µm	40
63 µm	30



Sedimentation	
No Pre-treatment used	
Temp (°C)	25.0
Size	% Pass
20 µm	20
6 µm	16
2 µm	14

Particle Density 2.70(A) Mg/m³

Particle Proportions	
Cobbles	0.0
Gravel	30.9
Sand	38.7
Silt	16.1
Clay	14.3

Tested by AW
Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS

UKAS TESTING 1982

BS EN ISO 17892-4 : 2016

PARTICLE SIZE DISTRIBUTION

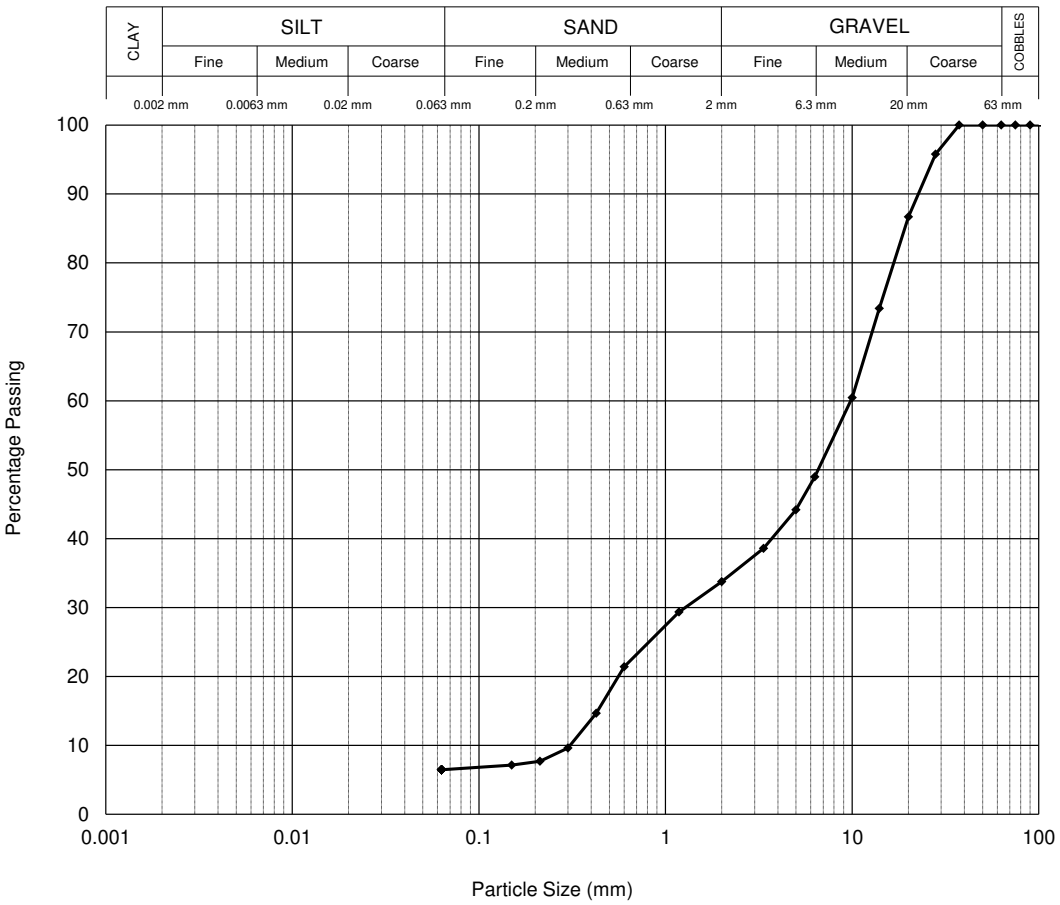
Location	TP06
Sample Ref	B1
Depth (m)	0.50
Sample Type	B

Description

Brown silty clayey very sandy GRAVEL.

BS EN ISO 17892-4 : 2016 : Clause 5.2 - Wet Sieve

Sieve	
Size	% Pass
200.0 mm	100
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	96
20.0 mm	87
14.0 mm	73
10.0 mm	60
6.30 mm	49
5.00 mm	44
3.35 mm	39
2.00 mm	34
1.18 mm	29
600 µm	21
425 µm	15
300 µm	10
212 µm	8
150 µm	7
63 µm	6



Particle Proportions	
Cobbles	0.0
Gravel	66.3
Sand	27.3
Silt & Clay	6.4

Tested by AW
Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS®
UKAS TESTING 1982

BS EN ISO 17892-8 : 2018

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION

Location	BH01
Sample Ref	U1
Depth (m)	5.10
Sample Type	U

Description:

Very stiff dark grey gravelly CLAY. Gravel is chalk.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	200.3
Diameter	(mm)	102.0
Moisture content	(%)	14.6
Bulk density	(Mg/m³)	2.23
Dry density	(Mg/m³)	1.95
Test Details		
Latex membrane thickness	(mm)	0.3
Specimen height prior to shearing	(mm)	200.3
Membrane correction	(kPa)	1.1
Mean rate of shear	(%/min)	2.0
Cell pressure	(kPa)	100
Strain at failure	(%)	18.5
Maximum deviator stress	(kPa)	444
Shear Stress Cu	(kPa)	222

Mode of failure

Orientation of the sample	Vertical
Distance from top of tube mm	70

Tested by SB
Checked and Approved by

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS® UKAS TESTING 1982

BS EN ISO 17892-8 : 2018

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION

Location	BH03
Sample Ref	UT1
Depth (m)	5.00
Sample Type	U

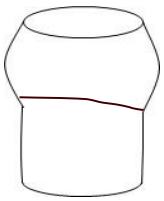
Description:

Stiff grey gravelly CLAY. Gravel is fine to medium chalk.

Specimen Details

Specimen conditions		Undisturbed
Length	(mm)	200.0
Diameter	(mm)	101.8
Moisture content	(%)	14.1
Bulk density	(Mg/m³)	2.28
Dry density	(Mg/m³)	2.00
Test Details		
Latex membrane thickness	(mm)	0.3
Specimen height prior to shearing	(mm)	200.0
Membrane correction	(kPa)	1.1
Mean rate of shear	(%/min)	2.0
Cell pressure	(kPa)	100
Strain at failure	(%)	20.0
Maximum deviator stress	(kPa)	207
Shear Stress Cu	(kPa)	103

Mode of failure



Orientation of the sample	Vertical
Distance from top of tube mm	60

Tested by SB
Checked and Approved by

S Burke

S Burke - Senior Technician
06/06/2022

Project Number:

GEO / 35461

Project Name:

TOLGATE ROAD, COLNEY HEATH
KPB/22.045/00/01

GEOLABS® UKAS TESTING 1982

Karl Blanke
AF Howland Associates Ltd
Cordell Works
Cordell Road
Long Melford
Suffolk
CO10 9EH

Derwentside Environmental Testing Services Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 22-04318

Site Reference:	Tollgate Road, Colney Heath
Project / Job Ref:	22.045
Order No:	KPB/22.045/00/02
Sample Receipt Date:	13/05/2022
Sample Scheduled Date:	13/05/2022
Report Issue Number:	1
Reporting Date:	18/05/2022

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. 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 except in full, without the prior written approval of the laboratory.

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
DETS Report No: 22-04318	**Date Sampled**	11/05/22	11/05/22	11/05/22	11/05/22	11/05/22
AF Howland Associates Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Tollgate Road, Colney Heath	**TP / BH No**	SA02	TP02	TP04	BH01	BH02
Project / Job Ref: 22.045	**Additional Refs**	D3	D1	B2	D4	D2
Order No: KPB/22.045/00/02	**Depth (m)**	1.10 - 1.80	0.80	1.50	5.60	9.50
Reporting Date: 18/05/2022	**DETS Sample No**	597852	597853	597854	597855	597856

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	7.8	7.7	6.0	7.7	8.0
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	14	< 10	29	85	131
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.01	< 0.01	0.03	0.09	0.13

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
DETS Report No: 22-04318	**Date Sampled**	11/05/22				
AF Howland Associates Ltd	**Time Sampled**	None Supplied				
Site Reference: Tollgate Road, Colney Heath	**TP / BH No**	BH03				
Project / Job Ref: 22.045	**Additional Refs**	D7				
Order No: KPB/22.045/00/02	**Depth (m)**	5.50				
Reporting Date: 18/05/2022	**DETS Sample No**	597857				

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	8.0				
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	96				
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.10				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Sample Descriptions
DETS Report No: 22-04318
AF Howland Associates Ltd
Site Reference: Tollgate Road, Colney Heath
Project / Job Ref: 22.045
Order No: KPB/22.045/00/02
Reporting Date: 18/05/2022

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
597852	SA02	D3	1.10 - 1.80	9.8	Brown sandy clay with stones
597853	TP02	D1	0.80	11.8	Light brown sandy clay with stones
597854	TP04	B2	1.50	9.3	Light brown sandy clay with stones
597855	BH01	D4	5.60	11.9	Brown sandy clay
597856	BH02	D2	9.50	13.9	Brown sandy clay
597857	BH03	D7	5.50	11.5	Brown sandy clay

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample I/S
Unsuitable Sample U/S

DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

4480

Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 22-04318
AF Howland Associates Ltd
Site Reference: Tollgate Road, Colney Heath
Project / Job Ref: 22.045
Order No: KPB/22.045/00/02
Reporting Date: 18/05/2022

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Appendix C Geochemical Laboratory Results

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Amended Report

Report No.:	22-17050-2		
Initial Date of Issue:	17-May-2022	**Date of Re-Issue:**	19-May-2022
Client	Stantec UK Limited		
Client Address:	3rd Floor 50-60 Station Road Cambridge CB1 2JH		
Contact(s):	Matt Green		
Project	332510994 Tollgate Rd, Colney Heath		
Quotation No.:		**Date Received:**	09-May-2022
Order No.:	011220	**Date Instructed:**	11-May-2022
No. of Samples:	16		
Turnaround (Wkdays):	10	**Results Due:**	24-May-2022
Date Approved:	19-May-2022		
Approved By:			
Details:	Stuart Henderson, Technical Manager		

Results - Soil

Project: 332510994 Tollgate Rd, Colney Heath

Client: Stantec UK Limited		**Chemtest Job No.:**			22-17050	22-17050	22-17050	22-17050	22-17050	22-17050	22-17050	22-17050	22-17050
Quotation No.:		**Chemtest Sample ID.:**			1424730	1424731	1424732	1424734	1424735	1424737	1424738	1424740	1424741
		Sample Location:			SA1	WS2	SA3	WS1	SA2	TP7	TP7	TP6	TP5
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.10	0.20	0.20	0.30	0.10	0.50	0.10	0.10	0.60
		Date Sampled:			04-May-2022	03-May-2022	04-May-2022	03-May-2022	04-May-2022	05-May-2022	05-May-2022	05-May-2022	05-May-2022
		Asbestos Lab:			DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Asbestos by Gravimetry	U	2192	%	0.001									
Total Asbestos	U	2192	%	0.001									
Moisture	N	2030	%	0.020	5.4	10	7.0	5.3	11	5.5	5.8	9.1	4.5
Natural Moisture Content	N	2030	%	0.020	5.7	11	7.5	5.6	12	5.8	6.2	10	4.7
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones and Roots	Stones	Stones	Stones	Stones	Stones	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
pH	M	2010		4.0	6.8	7.9	8.1	8.1	7.4	7.8	7.6	7.6	7.5
Arsenic	M	2455	mg/kg	0.5	4.4	5.7	6.2	8.1	4.8	3.8	2.7	2.9	2.9
Cadmium	M	2455	mg/kg	0.10	0.18	0.23	0.18	0.14	0.20	< 0.10	< 0.10	< 0.10	< 0.10
Chromium	M	2455	mg/kg	0.5	7.5	8.6	8.4	13	7.5	9.2	10	9.5	11
Mercury Low Level	M	2450	mg/kg	0.05	0.08	0.07	0.12	0.08	0.12	< 0.05	< 0.05	< 0.05	< 0.05
Copper	M	2455	mg/kg	0.50	6.7	16	9.3	15	13	3.1	4.1	3.3	4.2
Nickel	M	2455	mg/kg	0.50	4.7	7.5	5.9	11	4.6	5.6	6.1	5.4	6.5
Lead	M	2455	mg/kg	0.50	25	51	40	39	82	7.3	7.5	6.2	7.3
Selenium	M	2455	mg/kg	0.25	0.45	0.52	0.53	0.63	0.36	0.48	0.60	0.49	0.63
Zinc	M	2455	mg/kg	0.50	25	79	34	40	61	13	15	13	16
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	8.1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	110	130	26	130	150	< 1.0	30	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	110	130	26	140	150	< 5.0	30	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	49	< 1.0	330	< 1.0	< 1.0	< 1.0	18	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	51	860	< 1.0	1000	50	< 1.0	< 1.0	62	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	69	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 332510994 Tollgate Rd, Colney Heath

Client: Stantec UK Limited		**Chemtest Job No.:**			22-17050	22-17050	22-17050	22-17050	22-17050	22-17050	22-17050	22-17050	22-17050
Quotation No.:		**Chemtest Sample ID.:**			1424730	1424731	1424732	1424734	1424735	1424737	1424738	1424740	1424741
		Sample Location:			SA1	WS2	SA3	WS1	SA2	TP7	TP7	TP6	TP5
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.10	0.20	0.20	0.30	0.10	0.50	0.10	0.10	0.60
		Date Sampled:			04-May-2022	03-May-2022	04-May-2022	03-May-2022	04-May-2022	05-May-2022	05-May-2022	05-May-2022	05-May-2022
		Asbestos Lab:			DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	51	900	< 5.0	1400	50	< 5.0	< 5.0	80	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	160	1000	26	1600	200	< 10	30	80	< 10
Naphthalene	N	2800	mg/kg	0.010	0.34	0.44	0.37	0.42	0.16	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthylene	N	2800	mg/kg	0.010	0.050	1.4	0.095	0.33	0.069	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthene	N	2800	mg/kg	0.010	0.029	0.30	0.042	0.12	0.051	< 0.010	< 0.010	< 0.010	< 0.010
Fluorene	N	2800	mg/kg	0.010	0.039	0.42	0.065	0.22	0.041	< 0.010	< 0.010	< 0.010	< 0.010
Phenanthrene	N	2800	mg/kg	0.010	0.37	10	0.47	5.5	0.42	0.037	0.044	0.047	< 0.010
Anthracene	N	2800	mg/kg	0.010	0.086	3.4	0.13	1.1	0.13	0.016	< 0.010	< 0.010	< 0.010
Fluoranthene	N	2800	mg/kg	0.010	0.90	31	1.2	13	1.1	0.045	0.064	0.049	< 0.010
Pyrene	N	2800	mg/kg	0.010	0.74	27	1.1	10	0.93	0.061	0.048	0.054	< 0.010
Benzo[a]anthracene	N	2800	mg/kg	0.010	0.40	15	0.68	5.6	0.56	< 0.010	< 0.010	< 0.010	< 0.010
Chrysene	N	2800	mg/kg	0.010	0.43	15	0.62	5.3	0.48	< 0.010	< 0.010	< 0.010	< 0.010
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	0.57	21	1.2	7.1	0.76	< 0.010	< 0.010	< 0.010	< 0.010
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	0.24	8.3	0.48	3.0	0.27	< 0.010	< 0.010	< 0.010	< 0.010
Benzo[a]pyrene	N	2800	mg/kg	0.010	0.50	16	1.0	6.1	0.65	< 0.010	< 0.010	< 0.010	< 0.010
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	0.39	12	0.71	4.0	0.51	< 0.010	< 0.010	< 0.010	< 0.010
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	0.10	2.1	0.11	0.72	0.091	< 0.010	< 0.010	< 0.010	< 0.010
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	0.41	12	0.70	3.8	0.52	< 0.010	< 0.010	< 0.010	< 0.010
Total Of 16 PAH's	N	2800	mg/kg	0.20	5.6	180	9.0	66	6.7	< 0.20	< 0.20	< 0.20	< 0.20
Organic Matter BS1377	N	2930	%	0.10	4.2	4.2	3.7	4.0	4.1	1.8	2.3	2.5	1.8

Results - Soil

Project: 332510994 Tollgate Rd, Colney Heath

Client: Stantec UK Limited		**Chemtest Job No.:**			22-17050	22-17050	22-17050	22-17050	22-17050	22-17050	22-17050
Quotation No.:		**Chemtest Sample ID.:**			1424742	1424743	1424745	1424746	1424747	1424748	1424750
		Sample Location:			TP5	TP4	TP4	TP3	TP2	TP2	TP1
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.20	0.30	0.10	0.10	0.40	0.10	0.10
		Date Sampled:			05-May-2022	05-May-2022	05-May-2022	05-May-2022	05-May-2022	05-May-2022	05-May-2022
		Asbestos Lab:			DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
ACM Type	U	2192		N/A	-	-	-	-	-	Cement	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	Chrysotile	No Asbestos Detected
Asbestos by Gravimetry	U	2192	%	0.001						0.52	
Total Asbestos	U	2192	%	0.001						0.52	
Moisture	N	2030	%	0.020	5.0	6.9	6.1	4.3	7.1	6.9	14
Natural Moisture Content	N	2030	%	0.020	5.2	7.4	6.5	4.5	7.7	7.5	16
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones	Stones	Stones and Roots	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Sand	Sand	Sand	Sand
pH	M	2010		4.0	7.4	7.1	7.1	7.3	7.0	6.8	6.8
Arsenic	M	2455	mg/kg	0.5	19	4.4	5.4	5.8	7.9	5.3	4.8
Cadmium	M	2455	mg/kg	0.10	0.10	< 0.10	< 0.10	< 0.10	0.13	0.11	0.11
Chromium	M	2455	mg/kg	0.5	8.8	6.7	8.9	7.4	13	9.9	8.6
Mercury Low Level	M	2450	mg/kg	0.05	0.05	0.06	0.07	< 0.05	0.09	0.09	0.09
Copper	M	2455	mg/kg	0.50	8.3	4.9	6.0	4.6	8.9	8.0	7.6
Nickel	M	2455	mg/kg	0.50	11	4.4	5.7	5.4	8.9	6.8	6.0
Lead	M	2455	mg/kg	0.50	14	16	19	12	24	22	21
Selenium	M	2455	mg/kg	0.25	0.53	0.39	0.45	0.33	0.67	0.46	0.43
Zinc	M	2455	mg/kg	0.50	39	19	22	17	33	28	26
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	110	42	140	100	140	140	150
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	110	42	140	100	140	140	150
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	52	50	33	51	51	55
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 332510994 Tollgate Rd, Colney Heath

Client: Stantec UK Limited		**Chemtest Job No.:**			22-17050	22-17050	22-17050	22-17050	22-17050	22-17050	22-17050
Quotation No.:		**Chemtest Sample ID.:**			1424742	1424743	1424745	1424746	1424747	1424748	1424750
			Sample Location:		TP5	TP4	TP4	TP3	TP2	TP2	TP1
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.20	0.30	0.10	0.10	0.40	0.10	0.10
			Date Sampled:		05-May-2022	05-May-2022	05-May-2022	05-May-2022	05-May-2022	05-May-2022	05-May-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	52	50	33	51	51	55
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	110	94	190	140	190	190	200
Naphthalene	N	2800	mg/kg	0.010	0.29	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthylene	N	2800	mg/kg	0.010	0.095	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthene	N	2800	mg/kg	0.010	0.67	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Fluorene	N	2800	mg/kg	0.010	0.73	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Phenanthrene	N	2800	mg/kg	0.010	9.4	< 0.010	< 0.010	< 0.010	0.56	< 0.010	0.60
Anthracene	N	2800	mg/kg	0.010	1.7	< 0.010	< 0.010	< 0.010	0.11	< 0.010	0.13
Fluoranthene	N	2800	mg/kg	0.010	11	0.65	0.45	0.21	1.4	0.56	1.0
Pyrene	N	2800	mg/kg	0.010	9.0	0.65	0.42	0.20	1.1	0.50	0.88
Benzo[a]anthracene	N	2800	mg/kg	0.010	4.2	0.29	0.25	< 0.010	0.65	0.28	0.56
Chrysene	N	2800	mg/kg	0.010	4.7	0.27	0.24	< 0.010	0.56	0.24	0.54
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	4.6	< 0.010	< 0.010	< 0.010	0.83	0.39	0.56
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	1.8	< 0.010	< 0.010	< 0.010	0.23	0.17	0.28
Benzo[a]pyrene	N	2800	mg/kg	0.010	3.5	< 0.010	< 0.010	< 0.010	0.70	0.30	0.51
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	2.2	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	0.37	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	1.9	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total Of 16 PAH's	N	2800	mg/kg	0.20	56	1.9	1.4	0.41	6.1	2.4	5.1
Organic Matter BS1377	N	2930	%	0.10	2.5	1.9	2.2	1.7	1.7	1.8	2.1

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
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.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	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-MS
2930	Organic Matter	Organic Matter	Acid Dichromate digestion/Titration

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"
SOP	Standard operating procedure
LOD	Limit of detection

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 30 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 D Evaluation Criteria for Generic Quantitative Risk Assessment

Stantec/UK/I&B: Evaluation Criteria for Generic Quantitative Risk Assessment (England)

1 INTRODUCTION

The aim of this document is to present an explanation for the selection of the evaluation criteria routinely used by Stantec UK Ltd when undertaking a land contamination Tier 2 Generic Quantitative Risk Assessment (GQRA).

A GQRA uses published criteria to screen the site-specific contamination testing data and identify potential hazards to specific receptors. Generic criteria are typically conservative in derivation and exceedance does not indicate that a site is statutorily contaminated and/or unsuitable for use in the planning context. These criteria are used to identify situations where further assessment and/or action may be required. This document is divided into general introductory text and sections on soils, waters and gases.

2 GENERAL NOTES

This document should be read in conjunction with another entitled "Stantec Methodology for Assessment of Land Contamination" which summarises the legislative regime and our approach to ground contamination and risk assessment.

Any Stantec interpretation of contamination test results is based on a scientific and engineering appraisal. The perceptions of, for example, banks, insurers, lay people etc are not taken into account.

Any tables included in this document are produced for ease of reference to the criteria, they do not in any way replace the documents of origin (which are fully referenced) and which should be read to ensure appropriate use and interpretation of the data.

Generic criteria provide an aid to decision-making, but they do not replace the need for sound professional judgement in risk assessment (EA, 2006). The criteria are based on numerous and complex assumptions. The appropriateness of these assumptions in a site-specific context requires confirmation on a project by project basis. Our interpretative report will comment on the appropriateness of the routine criteria for project objectives or ground conditions. In some cases the published criteria whilst typically conservative may in some circumstances not be suitable for the site being assessed, either because they do not address the identified pollutant linkages or because they may not be sufficiently precautionary in the context of the site. Under these circumstances it may be necessary to recommend deriving site-specific assessment criteria. Any deviation from the routine criteria and/or selection of criteria for parameters not covered in this document will be described in the report text.

3 CRITERIA FOR EVALUATING SOIL RESULTS

3.1 Potential Harm to Human Health

The criteria used by Stantec UK Ltd to assess the potential for harm to human health are:-

- Category 4 Screening Levels (C4SLs) (Phase 1 substances DEFRA, 2014 and Phase 2 substances CLAIRE, 2021).
- Suitable 4 Use Levels (S4ULs) (Nathanail *et al*, 2015).
- CL:AIRE/EIC/AGS Generic Assessment Criteria (GAC) (CL:AIRE, 2010).
- Soil Guideline Values (SGVs) (EA, 2009a).

These criteria have been generated using the Contaminated Land Exposure Assessment model (CLEA) and supporting technical guidance (EA, 2009b, 2009c, 2009d, 2009e). The CLEA model uses generic assumptions about the fate and transport of chemicals in the environment and a generic conceptual model for site conditions and human behaviour to estimate child and adult exposures to soil contaminants for those potentially living, working, and/or playing on contaminated sites over long time periods (EA, 2009c).

The S4ULs, SGVs and GACs are all based on use of minimal/tolerable risk Health Criteria Values (HCVs) as the toxicological benchmark whereas the C4SL are based on use of a "low level of toxicological concern" (LLTC) as the toxicological benchmark. The LLTC represents a slightly higher level of risk than the HCV.

An update to the software (1.071) was published on 04/09/2015 (the handbook (EA 2009f) referring to version 1.05 is still valid). The update includes the library data sets from the DEFRA research project SP1010 (Development of Category 4 Screening Levels for assessment of land affected by contamination).

The CLEA model uses ten exposure pathways (Ingestion (outdoor soil, indoor dust, homegrown vegetables and soil attached to homegrown vegetables), Dermal Contact (outdoor soil and indoor dust) and Inhalation (outdoor dust, indoor dust, outdoor vapours and indoor vapours)). There are exposure pathways not included in the CLEA model such as the permeation of organics into plastic water supply pipes.

The presence and/or significance of each of the potential exposure pathways is dependent on the land use being considered. The model uses standard land use scenarios as follows:-

Residential – habitation of a dwelling up to two

storeys high with various default material and design parameters, access to either private or nearby community open space with soil track back to form indoor dust. Assumes ingestion of homegrown produce.

Allotments – the model has default parameters for use and consumption of vegetables but not animals or their products (eggs).

Industrial/Commercial – assumes office or light physical work in a permanent three storey structure with breaks taken outside and that the site is NOT covered in hardstanding.

Public Open Space – two public open space (POS) scenarios are considered: POS_{resi} is shared communal space within a residential development where tracking back of soil into the home is assumed to occur. POS_{park} is intended for a public park sufficiently distant from housing (i.e. not adjacent to housing) such that tracking back of soil into the home is negligible. Note that the POS assessment criteria may not be appropriate for assessing sports fields.

The assessment criteria generated using CLEA can be used as a conservative starting point for evaluating long-term risks to human health from chemicals in soil.

It is important to note that the model does not assess all the potential exposure scenarios, for example risk to workers in excavations (short term exposure) or diffusion of contaminants through drinking water pipes.

Recent guidance (DEFRA 2012) introduces a four stage classification system where Category 1 sites are clearly contaminated land and Category 4 sites are definitely not contaminated land as defined by EPA 1990. Outside of these categories further specific risk assessment is required to determine if the site should fall into Category 2 (contaminated land) or Category 3 (not contaminated land). Category 4 screening values are considered to be more pragmatic than the current published SGV/GAC criteria but still strongly precautionary with the aim of allowing rapid identification of sites where the risk is above minimal but still low/acceptable.

Category 4 Screening Levels (C4SLs)

At the end of 2013, technical guidance in support of DEFRA's revised Statutory Guidance (SG) was published and then revised in 2014 (CL:AIRE 2014) which provided:

- A methodology for deriving C4SLs for the standard land-uses and two new public open space scenarios using the updated assumptions relating to the modelling of human exposure to soil contaminants; and
- A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

Following issue of an Erratum in December 2014, a Policy Companion Document was published (DEFRA 2014).

A letter from Lord de Mauley dated 3rd September 2014 provides more explicit direction to local authorities on the use of the C4SL in a planning context. The letter identifies four key points:

1) that the screening values were developed expressly with the planning regime in mind

2) their use is recommended in DCLG's planning guidance

3) soil concentrations below a C4SL limit are considered to be 'definitely not contaminated' under Part IIA of the 1990 Environmental Protection Act and pose at most a 'low level of toxicological concern' and,

4) exceedance of a C4SL screening value does not mean that land is definitely contaminated land, just that further investigation may be warranted.

Stantec use the C4SLs as the Tier 2 soil screening criteria protective of human health for substances with C4SL available. Table 1 summarises the C4SL for each of the published substances.

Note that, with the exception of benzene, the DEFRA published C4SL are not dependent on soil organic matter content (SOM) ("*Given that BaP is non volatile and that empirical soil to plant concentration factors have been used, soil organic matter content has a negligible influence on the C4SLs for this chemical"*). The DEFRA published C4SL for benzene is based on an SOM of 6%. Stantec has used the CLEA model (v1.071) to derive C4SL for benzene for 1% and 2.5% SOM which are also shown in Table 1.

Note that an industry led project to derive C4SL for a further 20 substances has commenced (CL:AIRE, 2018). The project is being project managed by CL:AIRE and is funded by the Soil and Groundwater Technology Association (SAGTA), the Society of Brownfield Briefing (SoBRA) and others. A dedicated steering group, made up of representatives from SAGTA, DEFRA, Welsh Government, Public Health England, Environment Agency, Natural Resources Wales, Food Standards Agency, Homes England and further Land Forum representatives, has been set up to oversee the project. The new C4SL will be added to this document as they are published.

Suitable 4 Use Levels (S4ULs)

In July 2009, Generic Assessment Criteria (GACs)

for 82 substances were published (LQM and CIEH, 2009) using the then current version of the CLEA software v1.04 and replaced those generated in 2006 using the original version of the model CLEA UK *beta*. In 2015 S4ULs were published by LQM/CIEH (Nathanail *et al*, 2015) to replace the second edition GACs. Table 2 summarises the S4ULs which are reproduced with permission; Publication Number S4UL3202.

Soil Guideline Values (SGVs) and Generic Assessment Criteria (GAC)

In 2009, Soil Guideline Values (SGVs) were published by the Environment Agency for arsenic, cadmium, mercury, nickel, selenium, benzene, toluene, ethyl benzene, xylenes, phenol and dioxins, furans and dioxin-like PCBs. These were derived using the CLEA model for residential, allotments and commercial land-uses.

These SGVs have now largely been superseded by the C4SLs and the S4ULs, with the exception of the SGVs for dioxins, furans and dioxin-like PCBs which are shown in Table 3.

In January 2010, Generic Assessment Criteria (GAC) derived using CLEA were published by CL:AIRE for 35 substances. These GAC are listed in Table 4.

Note that the SGVs for dioxins, furans and dioxin like PCBs and CL:AIRE GAC were derived using an older version of CLEA (v1.06) than used to derive the S4UL and C4SL (v1.07). This older version used slightly more conservative values for some exposure parameters and therefore the derived SGVs/GAC are still considered suitably precautionary for use as screening criteria.

Note on Mercury, Chromium and Arsenic

The analytical testing routinely undertaken by Stantec determines total concentration, however, the toxicity depends on the form of the contaminant.

If a source of Mercury, Chromium or Arsenic is identified or the total concentration exceeds the relevant worst case speciated criteria it will be desirable/necessary to undertake additional speciated testing and further assessment.

Note on Polycyclic Aromatic Hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are a family of hundreds of different congeners whose chemical structures contain two or more fused aromatic rings. Whilst it is recognised that there is an ongoing debate on the most appropriate method to assess health effects of PAH mixtures, in 2010 the Health Protection Agency recommended the use of benzo[a]pyrene (BaP) as a surrogate marker approach in the assessment of carcinogenic risks posed by PAHs in soils (HPA, 2010).

In most cases, BaP is chosen as the surrogate marker (SM) due to its ubiquitous nature and the vast amount of data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. The SM approach estimates the carcinogenic toxicity of a mixture of PAHs in an environmental matrix by using toxicity data for a PAH mixture for which the composition is known.

Exposure to the SM is assumed to represent exposure to all PAHs in that matrix therefore the toxicity of the SM represents the toxicity of the mixture. The SM approach relies on a number of assumptions (HPA, 2010).

- The SM (BaP) must be present in all the samples.
- The profile of the different PAH relative to BaP should be similar in all samples.
- The PAH profile in the soil samples should be sufficiently similar to that used in the pivotal toxicity study on which HBGV was based i.e. the Culp study (Culp et al. (1998)).

In order to justify the use of a surrogate marker assessment criterion (C4SL for benzo(a)pyrene and S4UL coal tar) the LQM PAH Profiling Tool is used by Stantec to assess the similarity of the PAH profile in a soil sample to that of the toxicity study. The spreadsheet calculates the relative proportions of the genotoxic PAHs and plots them relative to the composition of the two coal mixtures used by Culp et al. Provided that the relative proportions are within an order of magnitude of those from the Culp Study (as suggested by HPA) Stantec will use the C4SL for benzo(a)pyrene as a surrogate marker for the carcinogenic PAHs, i.e. benzo(a)pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(ah)anthracene, indeno(123-cd)pyrene and benzo(ghi)perylene. For projects where this approach is appropriate the results will be assessed using the Coal Tar criterion (BAP C4SL) and the criteria for non-carcinogenic PAHs (S4ULs), i.e. naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene and pyrene.

Note on Total Petroleum Hydrocarbons

The S4UL for Total Petroleum Hydrocarbon (TPH) fractions are based on ‘threshold’ health effects. In accordance with Environment Agency guidance (EA, 2005) and the S4UL report (Nathanail *et al*, 2015) the potential for additivity of toxicological effects between fractions should be considered. Practically, to address this issue the hazard quotient (HQ) for each fraction should be calculated by dividing the measured concentration of the fraction by the GAC. The HQs are then added to form a hazard index (HI) for that sample. An HI greater than 1 indicates an exceedance.

Note on Dioxins, Furans and Dioxin-like PCBs

The SGVs for dioxins, furans and dioxin-like PCBs are based on an assumed congener profile for urban soils. The total measured concentration of dioxin, furan and dioxin-like PCB congeners listed in the SGV report (EA, 2009a) should be compared with the SGVs to make an initial assessment of risk. A more accurate assessment can be made using the Environment Agency's site specific worksheet for dioxins, furans and dioxin like PCBs available from https://www.claire.co.uk/useful-government-legislation-and-guidance-by-country/77-risk-assessment-info-ra/199-dioxins-site-specific-worksheets.

Note on Asbestos

Asbestos in soil and made ground is currently under review by a number of bodies. There are no current published guidance values for asbestos in soil other than the waste classification values given in the EA's Technical Guidance WM3, Hazardous Waste – Interpretation of the definition and classification of hazard waste (EA, 2015). This guidance is only appropriate for soils that are being discarded as waste.

Testing for asbestos will be carried out on selected samples of made ground encountered during investigation, initially samples will be subjected to an asbestos screen and, if asbestos is found to be present, subjected to quantification depending on the project specific requirements. The reader is directed to the report text for guidance on the approach adopted in respect to any asbestos found to be present.

Further guidance is also available in publication C733, Asbestos in soil and made ground: a guide to understanding and managing risks (CIRIA 2014).

Note on Soil Saturation Concentration

The soil saturation concentration is the concentration of an organic constituent in soil at which either the pore water or soil vapour has theoretically become saturated with the substance, i.e. the substance concentration has reached its maximum aqueous solubility or vapour pressure. The soil saturation concentration is related to the properties of the substance as well as the properties of the soil (including soil organic matter content).

The soil saturation concentrations are shown in Table 2 in brackets where exceeded by the assessment criteria and in Table 4 for all substances. Measured concentrations in excess of the soil saturation concentration have various potential implications as discussed below.

Firstly, where measured concentrations exceed the soil saturation concentration, the risk from vapour inhalation and/or consumption of produce may be limited. The CLEA model calculates the soil saturation concentration but it does not limit exposure where this concentration is exceeded. This adds an additional level of conservatism for CLEA derived assessment criteria where these exceed the calculated soil saturation concentration. Secondly, the soil saturation concentration is sometimes used to flag the potential presence of non-aqueous phase liquid (NAPL, a.k.a. free phase) in soil. The presence of NAPL is an important consideration in the Tier 2 assessment because, where present, the risks from NAPL may need to be considered separately. Theoretically, where a measured concentration exceeds the soil saturation concentration NAPL could be present. However, using theoretical saturation values is not always reliable for the following reasons: The soil saturation concentration is based on the aqueous solubility and vapour pressure of a pure substance and not a mixture, of which NAPLs are often comprised; and

The soil saturation concentration does not account for the sorption capacity of the soil. As a result, exceedance of the soil saturation concentration does not necessarily imply that NAPL is present. This is particularly the case for longer chain hydrocarbons such as PAHs which have low solubility and vapour pressure and hence a low soil saturation concentration but that are strongly sorbed to soil.

The measured concentrations will be compared to the soil saturation concentrations shown in Tables 2 and 4. Where exceeded Stantec will use additional lines of evidence (such as visual evidence and concentration of total TPH) to determine whether or not NAPL is likely to be present. If the presence of NAPL is deemed plausible the implications will be considered in the risk assessment.

3.2 Potential Harm to the Built Environment

Land contamination can pose risks to buildings, building materials and services (BBM&S) in a number of ways. Volatile contaminants and gases can accumulate and cause explosion or fire. Foundations and buried services can be damaged by corrosive substances and contaminants such as steel slags can create unstable ground conditions through expansion causing structural damage.

Stantec use the following primary guidance to assess the significance of soil chemistry with respect to its potential to harm the built environment.

i) Approved Document C - Site Preparation and Resistance to Contaminants and Moisture. (DCLG, 2013);
ii) Concrete in aggressive ground SD1 (BRE 2005);
iii) Guidance for the selection of water supply pipes to be used in brownfield sites (UK WIR 2011);

iv) Protocols published by agreement between Water UK and the Home Builders Federation providing supplementary guidance which includes the Risk Assessment for Water Pipes (the 'RA') (Water UK 2014).
v) Performance of Building Materials in Contaminated Land report BR255 (BRE 1994).
vi) Risks of Contaminated Land to Buildings, Building Materials and Services. A Literature Review - Technical Report P331 (EA, 2000).
vii) Guidance on assessing and managing risks to buildings from land contamination - Technical Report P5 035/TR/01 (EA, 2001).

3.3 Potential to Harm Ecosystems, Animals, Crops etc

The criteria routinely used by Stantec as Tier 2 screening values to assess the potential of soil chemistry to harm ecosystems are taken from the following guidance and are summarised in Table 5.

i) Derivation and Use of Soil Screening Values for assessing ecological risks (EA, 2017a);
ii) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing (ICRCL 70/90, 1990);
iii) Sewage sludge on farmland: code of practice for England, Wales and Northern Ireland (DEFRA, 2018); and
iv) BS 3882:2015 Specification for topsoil and requirements for use (BSI, 2015).

Unless stated in the report the assessment is solely for phytotoxic parameters and additional assessment is required to determine suitability as a growing medium.

4 CRITERIA FOR EVALUATING LIQUID RESULTS

4.1 Potential Harm to Human Health via Ingestion

The Tier 2 water screening values routinely adopted by Stantec for assessing the potential for harm to human health via ingestion (presented as Table 6) are taken from The Water Supply (Water Quality) Regulations (S.I. 2018/647) unless otherwise indicated.

It should be noted that some of the prescribed concentrations listed in the Water Supply Regulations have been set for reasons other than their potential to cause harm to human health. The concentrations of iron and manganese are controlled because they may taint potable water with an undesirable taste, odour or colour or may potentially deposit precipitates in water supply pipes.

4.2 Potential Harm to Human Health via Inhalation of Vapours

The Tier 2 water screening values adopted by Stantec for assessing the potential for chronic human health risk from the inhalation of vapours from volatile contaminants in groundwater are presented in Table 7. These generic assessment criteria have been taken from a report published by the Society of Brownfield Risk Assessment (SoBRA) (SoBRA, 2017). The methodology adopted in their generation is considered compatible with the UK approach to deriving GAC and adopts a precautionary approach. As with all published GAC the suitability for use on the site being assessed has to be decided by the assessor based on a thorough understanding of the methodology and assumptions used in their derivation. Note, that the SoBRA groundwater vapour GAC are not intended for assessing risks to ground workers from short-term exposure.

Note that Table 7 shows the theoretical maximum aqueous solubility for each contaminant and indicates the GAC that exceed solubility. Measured concentrations in excess of solubility may be an indication that NAPL is present. As for the assessment of soils, if the presence of NAPL is deemed plausible the implications will be considered in the risk assessment.

4.3 Potential to Harm Controlled Waters

When assessing ground condition data and the potential to harm Controlled Waters Stantec uses the approach presented in the groundwater protection position statements published 14.03.17 (EA, 2017b) which describe the Environment Agency's approach to managing and protecting groundwater. They update and replace Groundwater Protection: principles and practice (GP3). Controlled Waters are rivers, estuaries, coastal waters, lakes and groundwaters. Water in the unsaturated zone is not groundwater but does come within the scope of the term "ground waters" as used and defined in the Water Resources Act 1991. It will continue to be a technical decision for the Environment Agency to determine what is groundwater in certain circumstances for the purposes of the Regulations. As discussed in our Methodology for Assessment of Land Contamination perched water is not considered a receptor in Stantec assessments.

The EU Water Framework Directive (WFD) 2000/60/EC provides for the protection of sub-surface, surface, coastal and territorial waters through a framework of river basin management.

The EU Updated Water Framework Standards Directive 2014/101/EU amended the EU WFD to update the international standards therein; it entered into force on 20 November 2014 with the requirement for its provisions to be transposed in Member State law by 20 May 2016.

Member States are required under the EU WFD to update their river basin management plans every six years. The first river basin management plans for England and Wales, Scotland and Northern Ireland were published in December 2009, and these were updated in 2015.

Other EU Directives in the European water management framework include:

- the EU Priority Substances Directive 2013/39/EU;
- EU Groundwater Pollutants Threshold Values Directive 2014/80/EU amending the EU Groundwater Daughter Directive (GWDD) 2006/118/EC; and
- the EU Biological Monitoring Directive 2014/101/EU.

The Priority Substances Directive set environmental quality standards (EQS) for the substances in surface waters (river, lake, transitional and coastal) and confirmed their designation as priority or priority hazardous substances (PS), the latter being a subset of particular concern. Environmental Quality Standards for PS are determined at the European level and apply to all Member States. Member States identify and develop standards for 'Specific Pollutants'. Specific Pollutants (SP) are defined as substances that can have a harmful effect on biological quality.

The Water Framework Directive (Standards and Classification) Directions (England and Wales) (DEFRA, 2015) were issued to the Environment Agency as an associated document of the Water Environment (WFD) (England and Wales) Regulations 2015 (S.I. 2015/1623) and provide directions for the classification of surface water and groundwater bodies. Schedule 3 parts 2 and 3 relate to surface water standards for specific pollutants in fresh or salt water bodies and priority substances in inland (rivers, lakes and related modified/artificial bodies) or other surface waters respectively. Although Schedule 5 presents threshold values for groundwater the Direction specifically excludes their use as part of site-specific investigations.

Table 6 presents the criteria routinely used by Stantec as Tier 2 screening values. This table only presents a selection of the more commonly analysed parameters and the source documents should be consulted for other chemicals. For screening groundwater the criteria selected are the standards for surface water and/or human consumption as appropriate together with the following:-

For a **hazardous substance** Stantec adopts the approach that, if the concentration in a discharge to groundwater is less than the Minimum Reporting Value (MRV), the input is regarded as automatically meeting the Article 2 (b) 'de-minimus' requirement of exemption 6 (3) (b) of the GWDD. Stantec has selected hazardous substances from the latest list published by the Joint Agencies Groundwater Directive Advisory Group (JAGDAG, 2018). MRV is the lowest concentration of a substance that can be routinely determined with a known degree of confidence, and may not be equivalent to limit of detection. MRVs have been identified from DEFRA's guidance on Hazardous Substances to Groundwater: Minimum Reporting Values (DEFRA, 2017), and are shown in Table 6.

Note that for land contamination assessments, where hazardous substances have already entered groundwater, remediation targets would typically be based on achieving appropriate water quality standards (e.g. drinking water standard or EQS) at a compliance point rather than an MRV. For this reason, when assessing measured groundwater or soil leachate concentrations, the values for human consumption, fresh water and salt water shown in Table 6 (whichever is appropriate for the context of the site) will be used as the Tier 2 assessment criteria rather than MRV. For hazardous substances with no water quality standard the laboratory method detection limit will be used as the assessment criteria.

For **non-hazardous substances** the GWDD requires that inputs be limited to avoid deterioration. UKTAG guidance equates deterioration with pollution. Non-hazardous substances are all substances not classified as hazardous. For Stantec assessments the values for human consumption, fresh water and salt water shown in Table 6 (whichever is appropriate for the context of the site) are used as the assessment criteria for non-hazardous substances.

Note on Copper, Lead, Manganese, Nickel and Zinc

$EQS_{bioavailable}$ have been developed for UK Specific Pollutants copper, zinc and manganese and the EU priority substances lead and nickel. An EQS is the concentration of a chemical in the environment below which there is not expected to be an adverse effect on the specific endpoint being considered, e.g. the protection of aquatic life.

It is very difficult to measure the bioavailable concentration of a metal directly. The UK has developed simplified Metal Bioavailability Assessment Tool (M-BAT) for copper, zinc, nickel and manganese which uses local water chemistry data, specifically pH, dissolved organic carbon (DOC) (mg/L) and Calcium (Ca) (mg/L).

Where the recorded total dissolved concentration exceeds the screening criteria for these parameters ($EQS_{bioavailable}$) further assessment will be undertaken using the tools downloaded from http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat

The models calculate a risk characterisation ratio

(RCR) and where this is greater than 1 this indicates the bioavailable concentration is above the EQS and the parameter is then identified as a potential hazard. The report will discuss this identified hazard noting that the pH, calcium and, in particular, the dissolved organic carbon (DOC) in groundwater may be quite different to the receiving water (e.g. due to the presence to leaf litter or organic sediments dissolving in the water).

5 CRITERIA FOR EVALUATING GAS RESULTS

Stantec use the following primary guidance on gas monitoring methods and investigation, the assessment of risk posed by soil gases (including Volatile Organic Compounds (VOCs)) and mitigation measures/risk reduction during site development.

i) BS 8576:2013 – Guidance on Ground Gas Investigations: Permanent gases and Volatile Organic Compounds (VOCs) (BSI, 2013);
ii) TB18 Continuous Ground-Gas Monitoring and the Lines of Evidence Approach to Risk Assessment CL:AIRE Technical Bulletin TB18 (CL:AIRE 2019)
iii) RB17 A pragmatic approach to Ground Gas Risk Assessment. CL:AIRE Research Bulletin RB17 (Card et al, 2012);
iv) The VOCs Handbook. C682 (CIRIA, 2009).
v) Assessing risks posed by hazardous gases to buildings C665 (CIRIA, 2007);
vi) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. (NHBC, 2007); and
vii) BS 8485:2015+A1:2019- Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (BSI, 2019).

Gas and borehole flow data are used to obtain the gas screening value (GSV) for methane and carbon dioxide. The GSV is used to establish the characteristic situation and to make recommendations for gas protection measures for buildings if required.

Radon

Stantec use the following primary guidance to assess the significance of the radon content of soil gas.

i) Radon: guidance on protective measures for new dwellings. Report BR211 (BRE, 2015); and
ii) Indicative Atlas of Radon in England and Wales (HPA & BGS, 2007).

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Table 1: Category 4 Screening Levels (C4SL)

	Allotments	Residential (with home-grown produce)	Residential (without home-grown produce)	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	49	37	40	640	79	170
Benzene - 1% SOM* - 2.5% SOM* - 6% SOM	 0.039 0.081 0.18	 0.20 0.41 0.87	 0.89 1.6 3.3	 27 50 98	 140 140 140	 190 210 230
Benzo(a)pyrene (as a surrogate marker for carcinogenic PAHs)	5.7	5.0	5.3	77	10	21
Cadmium	3.9	22	150	410	220	880
Chromium VI	170	21	21	49	21	250
Lead	80	200	310	2300	630	1300
Vinyl Chloride/ Chloroethene/ Chloroethylene, (CAS No. 75-01-4)	 0.0017 0.0031 0.0058	 0.0064 0.010 0.017	 0.015 0.019 0.029	 1.1 1.4 2.2	 7.8 7.8 7.8	 18 19 19
Trichloroethene / Trichloroethylene/ TCE or 'Trike' (CAS No. 79-01-06)	 0.032 0.072 0.16	 0.0093 0.020 0.043	 0.0097 0.020 0.045	 0.73 1.5 3.4	 76 78 79	 41 54 69
Tetrachloroethene/ Tetrachloroethylene/ Perchloroethylene, PCE or 'perc', (CAS No. 127-18-4)	 2.0 4.8 11.0	 0.31 0.70 1.60	 0.32 0.71 1.60	 24 55 130	 3,200 3,300 3,400	 1,400 1,900 2,500

Units mg/kg dry weight

Values taken from SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (Department for Environment, Food and Rural Affairs December 2014), unless stated otherwise

Public Open Space 1 – for grassed area adjacent to residential housing

Public Open Space 2 - Park Type Public Open Space Scenario

Based on a sandy loam as defined in SR3 (Environment Agency, 2009b)

Note that, with the exception of benzene, these C4SL are not SOM dependent

* - Stantec derived C4SL using CLEA v1.071

Table 2: Suitable 4 Use Levels (S4UL)

Determinand	Allotment	$R_{W}HP$	$R_{WO}HP$	Commercial/ Industrial	POSresi	POSpark
Metals						
Arsenic (**Inorganic**)[a, b, c]	43	37	40	640	79	170
Beryllium [a, b, d, e]	35	1.7	1.7	12	2.2	63
Boron [a, b, d]	45	290	11000	240000	21000	46000
Cadmium (**pH6-8**) [a, b, d, f]	1.9	11	85	190	120	560
Chromium (trivalent) [a, b, d, g]	18000	910	910	8600	1500	33000
Chromium (hexavalent) [a, b, c]	1.8[h]	6[i]	6[i]	33[i]	7.7[i]	220[i]
Copper [a, b, c]	520	2400	7100	68000	12000	44000
Mercury (elemental) [a, b, c, j]	21	1.2	1.2	58[vap] (25.8)	16	30[vap] (25.8)
Mercury (inorganic) [a, b, c]	19	40	56	1100	120	240
Methylmercury [a, b, c]	6	11	15	320	40	68
Nickel [a, b, c]	53[k]	130[e]	180[e]	980[e]	230[e]	800[k]
Selenium [a, b, c]	88	250	430	12000	1100	1800
Vanadium [a, b, c, i, j]	91	410	1200	9000	2000	5000
Zinc [a, b, c]	620	3700	40000	730000	81000	170000
BTEX Compounds (SOM 1%/ 2.5%/ 6%)						
Benzene [a, b, l, m]	0.017/0.034/ 0.075	0.087/0.17/ 0.37	0.38/0.7/1.4	27 / 47 / 90	72 / 72 / 73	90 / 100 / 110
Toluene [a, b, l, m]	22 / 51 / 120	130 / 290 / 660	880[vap] (869) /1900/3900	56000[vap] (869) / 110000[vap] (1920)/ 180000[vap] (4360)	56000 / 56000 / 56000	87000[vap](869)/ 95000[vap](1920)/ 100000[vap](4360)
Ethylbenzene [a, b, l, m]	16 / 39 / 91	47 / 110 / 260	83 / 190 / 440	5700[vap] (518) / 13000[vap] (1220) / 27000[vap] (2840)	24000 / 24000 / 25000	17000[vap] (518) / 22000[vap](1220) / 27000[vap] (2840)
O – Xylene [a, b, l, m, n]	28 / 67 / 160	60 / 140 / 330	88 / 210 / 480	6600[sol] (478) / 15000[sol] (1120) / 33000[sol] (2620)	41000 / 42000 / 43000	17000[sol] (478) / 24000[sol] (1120) / 33000[sol] (2620)
M – Xylene [a, b, l, m, n]	31 / 74 / 170	59 / 140 / 320	82 / 190 / 450	6200[vap] (625) / 14000[vap] (1470) / 31000[vap] (3460)	41000 / 42000 / 43000	17000[vap] (625) / 24000[vap](1470) / 32000[vap] (3460)
P – Xylene [a, b, l, m, n]	29 / 69 / 160	56 / 130 / 310	79 / 180 / 430	5900[sol] (576) / 14000[sol] (1350) / 30000[sol] (3170)	41000 / 42000 / 43000	17000[sol] (576) / 23000[sol] (1350) / 31000[sol] (3170)

Determinand	Allotment	R_WHP	R_{WO}HP	Commercial/ Industrial	POSresi	POSpark
Total xylenes [t]	28 / 67 / 160	56 / 130 / 310	79 / 180 / 430	5900[sol] (576) / 14000[sol] (1350) / 30000[sol] (3170)	41000 / 42000 / 43000	17000[sol] (576) / 23000[sol] (1350) / 31000[sol] (3170)
Polycyclic Aromatic Hydrocarbons (SOM 1%/ 2.5%/ 6%) [a, b, l, p]						
Acenaphthene	34 / 85 / 200	210 / 510 / 1100	3000[sol](57.0)/ 4700[sol] (141)/ 6000[sol] (336)	84000[sol] (57.0)/ 97000[sol] (141)/ 100000	15000 / 15000 / 15000	29000/ 30000/ 30000
Acenaphthylene	28 / 69 / 160	170 / 420 / 920	2900[sol](86.1)/ 4600[sol] (212)/ 6000[sol] (506)	83000[sol] (86.1)/ 97000[sol] (212)/ 100000	15000 / 15000 / 15000	29000 / 30000 / 30000
Anthracene	380 / 950 / 2200	2400 / 5400 / 11000	31000[sol](1.17) /35000/ 37000	520000/ 540000/ 540000	74000 / 74000 / 74000	150000 / 150000 / 150000
Benzo(a)anthracene	2.9 / 6.5 / 13	7.2 / 11 / 13	11 / 14 / 15	170 / 170 / 180	29 / 29 / 29	49 / 56 / 62
Benzo(a)pyrene (Bap) [u]	0.97 / 2.0 / 3.5	2.2 / 2.7 / 3.0	3.2 / 3.2 / 3.2	35 / 35 / 36	5.7 / 5.7 / 5.7	11 / 12 / 13
Benzo(b)fluoranthene	0.99 / 2.1 / 3.9	2.6 / 3.3 / 3.7	3.9 / 4.0 / 4.0	44 / 44 / 45	7.1 / 7.2 / 7.2	13 / 15 / 16
Benzo(g,h,i)perylene	290 / 470 / 640	320 / 340 / 350	360 / 360 / 360	3900 / 4000 / 4000	640 / 640 / 640	1400 / 1500 / 1600
Benzo(k)fluoranthene	37 / 75 / 130	77 / 93 / 100	110 / 110 / 110	1200 / 1200 /1200	190 / 190 / 190	370 / 410 / 440
Chrysene	4.1 / 9.4 / 19	15 / 22 / 27	30 / 31 / 32	350 / 350 / 350	57 / 57 / 57	93 / 110 / 120
Dibenzo(ah)anthracene	0.14 / 0.27 / 0.43	0.24 / 0.28 / 0.3	0.31 / 0.32 / 0.32	3.5 / 3.6 / 3.6	0.57 / 0.57 / 0.58	1.1 / 1.3 / 1.4
Fluoranthene	52 / 130 / 290	280 / 560 / 890	1500 / 1600 / 1600	23000 / 23000 / 23000	3100 / 3100 / 3100	6300 / 6300 / 6400
Fluorene	27 / 67 / 160	170 / 400 / 860	2800[sol] (30.9) /3800[sol] (76.5) /4500[sol] (183)	63000[sol] (30.9) / 68000 / 71000	9900 / 9900 / 9900	20000 / 20000 / 20000
Indeno(1,2,3-cd)pyrene	9.5 / 21 / 39	27 / 36 / 41	45 / 46 / 46	500 / 510 / 510	82 / 82 / 82	150 / 170 / 180
Naphthalene [q]	4.1 / 10 / 24	2.3 / 5.6 / 13	2.3 / 5.6 / 13	190[sol] (76.4) / 460[sol] (183) / 1100[sol] (432)	4900/ 4900/ 4900	1200[sol] (76.4) / 1900[sol] (183) / 3000
Phenanthrene	15 / 38 / 90	95 / 220 / 440	1300[sol](36.0) / 1500 / 1500	22000 / 22000 / 23000	3100 / 3100 / 3100	6200 / 6200 / 6300
Pyrene	110 / 270 / 620	620 / 1200 / 2000	3700 / 3800 / 3800	54000 / 54000 / 54000	7400 / 7400 / 7400	15000 / 15000 / 15000
Coal Tar (Bap as surrogate marker) [u]	0.32 / 0.67 / 1.2	0.79 / 0.98 / 1.1	1.2 / 1.2 / 1.2	15 / 15 / 15	2.2 / 2.2 / 2.2	4.4 / 4.7 / 4.8
Explosives [a, b, l, p]						
2, 4, 6 Trinitrotoluene	0.24 / 0.58 / 1.40	1.6 / 3.7 / 8.0	65 / 66 / 66	1000 / 1000 / 1000	130 / 130 / 130	260 / 270 / 270
RDX (Royal Demolition Explosive $C_3H_6N_6O_6$)	17 / 38 / 85	120 / 250 / 540	13000 / 13000 / 13000	210000 / 210000 / 210000	26000 / 26000 / 27000	49000[sol] (18.7) / 51000 / 53000
HMX (High Melting Explosive $C_4H_8N_8O_8$)	0.86 / 1.9 / 3.9	5.7 / 13 / 26	6700 / 6700 / 6700	110000 / 110000 / 110000	13000 / 13000 / 13000	23000[vap] (0.35) /23000[vap] (0.39) /24000[vap] (0.48)
Petroleum Hydrocarbons (SOM 1%/ 2.5%/ 6%) [a, b, l, m]						
Aliphatic EC 5-6	730 / 1700 / 3900	42 / 78 / 160	42 / 78 / 160	3200[sol] (304) / 5900[sol] (558) / 12000[sol] (1150)	570000[sol](304) 590000 / 600000	95000[sol] (304) / 130000[sol] (558)/ 180000[sol](1150)
Aliphatic EC >6-8	2300 / 5600 / 13000	100 / 230 / 530	100 / 230 / 530	7800[sol] (144) / 17000[sol] (322) / 40000[sol] (736)	600000 / 610000 / 620000	150000[sol] (144) 220000[sol] (322)/ 320000[sol] (736)
Aliphatic EC >8-10	320 / 770 / 1700	27 / 65 / 150	27 / 65 / 150	2000[sol] (78) / 4800[vap] (190) / 11000[vap] (451)	13000 / 13000 / 13000	14000[sol] (78) / 18000[vap] (190) / 21000[vap] (451)
Aliphatic EC >10-12	2200 / 4400 / 7300	130v[ap] (48) / 330[vap] (118) / 760[vap] (283)	130v[ap] (48) / 330[vap] (118) / 770[vap] (283)	9700[sol] (48) / 23000[vap] (118) / 47000[vap] (283)	13000 / 13000 / 13000	21000[sol] (48) / 23000[vap] (118) / 24000[vap] (283)
Aliphatic EC >12-16	11000 / 13000 / 13000	1100[sol] (24) / 2400[sol] (59) / 4300[sol] (142)	1100[sol] (24) / 2400[sol] (59) / 4400[sol] (142)	59000[sol] (24) / 82000[sol] (59) / 90000[sol] (142)	13000 / 13000 / 13000	25000[sol] (24) / 25000[sol] (59) / 26000[sol] (142)
Aliphatic EC >16-35 °	260000 / 270000 / 270000	65000[sol](8.48 92000[sol] (21) 110000	65000[sol] (8.48 92000[sol] (21) 110000	1600000 / 1700000 / 1800000	250000 / 250000 / 250000	450000 / 480000 / 490000
Aliphatic EC >35-44 °	260000 / 270000 / 270000	65000[sol](8.48 92000[sol] (21) / 110000	65000[sol](8.48 92000[sol] (21) 110000	1600000 / 1700000 / 1800000	250000 / 250000 / 250000	450000 / 480000 / 490000
Aromatic EC 5-7 (benzene)	13 / 27 / 57	70 / 140 / 300	370 / 690 / 1400	26000[sol] (1220) / 46000[sol] (2260) / 86000[sol] (4710)	56000 / 56000 / 56000	76000[sol] (1220) /84000[sol](2260)/ 92000[sol] (4710)
Aromatic EC >7-8 (toluene)	22 / 51 / 120	130 / 290 / 660	860 / 1800 / 3900	56000[vap] (869)/ 110000[sol] (1920)/ 180000[vap] (4360)	56000 / 56000 / 56000	87000[vap](869) / 95000[sol] (1920)/ 100000[vap](4360)
Aromatic EC >8-10	8.6 / 21 / 51	34 / 83 / 190	47 / 110 / 270	3500[vap] (613) / 8100[vap] (1500) / 17000[vap] (3580)	5000 / 5000 / 5000	7200[vap](613) / 8500[vap] (1500) / 9300[vap] (3580)

Determinand	Allotment	$R_{W}HP$	$R_{WO}HP$	Commercial/ Industrial	POSresi	POSpark
Aromatic EC >10-12	13 / 31 / 74	74 / 180 / 380	250 / 590 / 1200	16000[sol] (364) / 28000[sol] (899) / 34000[sol] (2150)	5000 / 5000 / 5000	9200[sol] (364) / 9700[sol] (899) / 10000
Aromatic EC >12-16	23 / 57 / 130	140 / 330 / 660	1800 / 2300[sol] (419) / 2500	36000[sol] (169) / 37000 / 38000	5100 / 5100 / 5000	10000 / 10000 / 10000
Aromatic EC >16-21 °	46 / 110 / 260	260 / 540 / 930	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7600 / 7700 / 7800
Aromatic EC >21-35 °	370 / 820 / 1600	1100 / 1500 / 1700	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7800 / 7800 / 7900
Aromatic EC >35-44 °	370 / 820 / 1600	1100 / 1500 / 1700	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7800 / 7800 / 7900
Aliphatic + Aromatic EC >44-70 °	1200 / 2100 / 3000	1600 / 1800 / 1900	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7800 / 7800 / 7900
Chloroalkanes & Chloroalkenes (SOM 1%/ 2.5%/ 6%) [a, b, l, p]						
1,2-Dichloroethane	0.0046 / 0.0083 / 0.016	0.0071 / 0.011 / 0.019	0.0092 / 0.013 / 0.023	0.67 / 0.97 / 1.7	29 / 29 / 29	21 / 24 / 28
1,1,1 Trichloroethane (TCA)	48 / 110 / 240	8.8 / 18 / 39	9.0 / 18 / 40	660 / 1300 / 3000	140000 / 140000 / 140000	57000[vap](1425) 76000[vap](2915)/ 100000[vap](6392)
1,1,1,2 Tetrachloroethane	0.79 / 1.9 / 4.4	1.2 / 2.8 / 6.4	1.5 / 3.5 / 8.2	110 / 250 / 560	1400 / 1400 / 1400	1500 / 1800 / 2100
1,1,2,2 Tetrachloroethane	0.41 / 0.89 / 2.0	1.6 / 3.4 / 7.5	3.9 / 8.0 / 17	270 / 550 / 1100	1400 / 1400 / 1400	1800 / 2100 / 2300
Tetrachloromethane (Carbon Tetrachloride)	0.45 / 1.0 / 2.4	0.026 / 0.056 / 0.13	0.026 / 0.056 / 0.13	2.9 / 6.3 / 14	890 / 920 / 950	190 / 270 / 400
Trichloromethane (Chloroform)	0.42 / 0.83 / 1.7	0.91 / 1.7 / 3.4	1.2 / 2.1 / 4.2	99 / 170 / 350	2500 / 2500 / 2500	2600 / 2800 / 3100
Phenol & Chlorophenols [a, b, l, p]						
Phenol	23 / 42 / 83	120 / 200 / 380	440 / 690 / 1200	440[dir] (26000) / 690[dir] (30000) / 1300[dir] (34000)	440[dir] (10000)/ 690[dir](10000) 1300[dir](10000)	440[dir] (7600) / 690[dir] (8300) / 1300[dir] (93000)
Chlorophenols (excluding PCP) [r]	0.13[s] / 0.3 / 0.7	0.87[s] / 2.0 / 4.5	94 / 150 / 210	3500 / 4000 / 4300	620 / 620 / 620	1100 / 1100 / 1100
Pentachlorophenol (PCP)	0.03 / 0.08 / 0.19	0.22/ 0.52 / 1.2	27[vap] (16.4) / 29 / 31	400 / 400 / 400	60 / 60 / 60	110 / 120 / 120
Other [a, b, l, p]						
Carbon Disulphide	4.8 / 10 / 23	0.14 / 0.29 / 0.62	0.14 / 0.29 / 0.62	11 / 22 / 47	11000 / 11000 / 12000	1300 / 1900 / 2700
Hexachlorobutadiene (HCBD)	0.25 / 0.61 / 1.4	0.29 / 0.7 / 1.6	0.32 / 0.78 / 1.8	31 / 66 / 120	25 / 25 / 25	48 / 50 / 51
Pesticides (SOM 1%/ 2.5%/ 6%) [a, b, l, p]						
Aldrin	3.2 / 6.1 / 9.6	5.7/ 6.6 /7.1	7.3 / 7.4 / 7.5	170 / 170 / 170	18 / 18 / 18	30 / 31 / 31
Atrazine	0.5 / 1.2 / 2.7	3.3 / 7.6 / 17.4	610 / 620 / 620	9300 / 9400 / 9400	1200 / 1200 / 1200	2300 / 2400 / 2400
Dichlorvos	0.0049 / 0.010 / 0.022	0.032 / 0.066 / 0.14	6.4 / 6.5 / 6.6	140 / 140 / 140	16 / 16 / 16	26 / 26 / 27
Dieldrin	0.17/0.41/0.96	0.97/ 2 / 3.5	7.0 / 7.3 / 7.4	170 / 170 / 170	18 / 18 / 18	30 / 30 / 31
Alpha - Endosulfan	1.2 / 2.9 / 6.8	7.4 / 18 / 41	160[vap] (0.003)/ 280[vap] (0.007)/ 410[vap] (0.016)	5600[vap] (0.003) / 7400[vap] (0.007) / 8400[vap] (0.016)	1200 / 1200 / 1200	2400 / 2400 / 2500
Beta - Endosulfan	1.1 / 2.7 / 6.4	7.0 / 17 / 39	190[vap](0.00007) /320[vap](0.0002) /440[vap](0.0004)	6300[vap](0.00007) /7800[vap](0.0002) / 8700	1200 / 1200 / 1200	2400 / 2400 / 2500
Alpha-Hexachlorocyclohexane	0.035/0.087/ 0.21	0.23/0.55 / 1.2	6.9 / 9.2 / 11	170 / 180 / 180	24 / 24 / 24	47 / 48 / 48
Beta - Hexachlorocyclohexane	0.013 / 0.032 / 0.077	0.085 / 0.2 / 0.46	3.7 / 3.8 / 3.8	65 / 65 / 65	8.1 / 8.1 / 8.1	15 / 15 / 16
Gamma – Hexachlorocyclohexane	0.0092 / 0.023 / 0.054	0.06 / 0.14 / 0.33	2.9 / 3.3 / 3.5	67 / 69 / 70	8.2 / 8.2 / 8.2	14 / 15 / 15
Chlorobenzenes [a, b, l, p]						
Chlorobenzene	5.9 / 14 / 32	0.46 / 1.0 / 2.4	0.46 / 1.0 / 2.4	56 / 130 / 290	11000 / 13000 / 14000	1300[sol](675)/ 2000[sol](1520)/ 2900
1,2-dichlorobenzene (1,2-DCB)	94 / 230 / 540	23 / 55 / 130	24 / 57 / 130	2000[sol] (571) / 4800[sol] (1370) / 11000[sol] (3240)	90000 / 95000 / 98000	24000[sol] (571) / 36000[sol] (1370) /51000[sol] (3240)
1,3-dichlorobenzene (1,3-DCB)	0.25 / 0.6 / 1.5	0.4 / 1.0 / 2.3	0.44 /1.1 / 2.5	30 / 73 / 170	300 / 300 / 300	390 / 440 / 470
1-4-dichlorobenzene (1,4-DCB)	15[i] / 37[i] / 88 [i]	61[q] / 150[q] /350 [q]	61[q] / 150[q] / 350[q]	4400[vap,q] (224) / 10000[vap,q] (540) / 25000[vap,q] (1280)	17000[i] / 17000[i] / 17000[i]	36000[vap,i] (224) 36000[vap, i](540)/ 36000[vap,i](1280)
1,2,3-Trichlorobenzene	4.7 / 12 / 28	1.5 / 3.6 / 8.6	1.5 / 3.7 / 8.8	102 / 250 / 590	1800 / 1800 / 1800	770[vap] (134) / 1100[vap] (330) / 1600[vap] (789)
1,2,4- Trichlorobenzene	55 / 140 / 320	2.6 / 6.4 / 15	2.6 / 6.4 / 15	220 / 530 / 1300	15000 / 17000 / 19000	1700[vap] (318) / 2600[vap] (786) / 4000[vap] (1880)

Determinand	Allotment	R_WHP	$R_{WO}HP$	Commercial/ Industrial	POSresi	POSpark
1,3,5- Trichlorobenzene	4.7 / 12 / 28	0.33 / 0.81 / 1.9	0.33 / 0.81 / 1.9	23 / 55 / 130	1700 / 1700 / 1800	380^{vap} (36.7) / 580^{vap} (90.8) / 860^{vap} (217)
1,2,3,4-Tetrachlorobenzene	4.4 / 11 / 26	15 / 36 / 78	24 / 56 / 120	1700^{vap} (122) / 3080^{vap} (304) / 4400^{vap} (728)	830 / 830 / 830	1500^{vap} (122) / 1600 / 1600
1,2,3,5- Tetrachlorobenzene	0.38 / 0.90 / 2.2	0.66 / 1.6 / 3.7	0.75 / 1.9 / 4.3	49^{vap} (39.4) / 120^{vap} (98.1) / 240^{vap} (235)	78 / 79 / 79	110^{vap} (39.4) / 120 / 130
1,2,4,5- Tetrachlorobenzene	0.06 / 0.16 / 0.37	0.33 / 0.77 / 1.6	0.73 / 1.7 / 3.5	42^{sol} (19.7) / 72^{sol} (49.1) / 96	13 / 13 / 13	25 / 26 / 26
Pentachlorobenzene (P_ECB)	1.2 / 3.1 / 7.0	5.8 / 12 / 22	19 / 30 / 38	640^{sol} (43.0) / 770^{sol} (107) / 830	100 / 100 / 100	190 / 190 / 190
Hexachlorobenzene (HCB)	0.47 / 1.1 / 2.5	1.8^{vap} (0.20) / 3.3^{vap} (0.5) / 4.9	4.1^{vap} (0.20) / 5.7^{vap} (0.5) / 6.7^{vap} (1.2)	110^{vap} (0.20) / 120 / 120	16 / 16 / 16	30 / 30 / 30

Units are mg/kg Dry Weight

R_WHP Residential with homegrown produce
$R_{WO}HP$ Residential without homegrown produce
POSresi public open spaces near residential housing
POSpark public open space for recreational use but not dedicated sports pitches
SOM Soil Organic Matter – ***the S4UL for all organic compounds will vary according to SOM***

a Based on a sandy loam soil as defined in SR3 (Environment Agency, 2009b) and 6% soil organic matter (SOM)
b Figures rounded to two significant figures
c Based only on a comparison of oral and dermal soil exposure with oral Index Dose
d The background ADE is limited to being no larger than the contribution from the relevant soil ADE
e Based on comparison of inhalation exposure with inhalation TDI only
f Based on a lifetime exposure via the oral, dermal and inhalation pathways
g Based on localised effects comparing inhalation exposure with inhalation ID only
h Based on comparison of inhalation exposure with inhalation ID
i Based on comparison of oral and dermal exposure with oral TDI
j Based on comparison of oral, dermal and inhalation exposure with inhalation TDI
k Based on comparison of all exposure pathways with oral TDI
l S4ULs assume that free phase contamination is not present
m S4ULs based on a sub-surface soil to indoor air correction factor of 10
n The HCV applied is based on the intake of total Xylene and therefore exposure should not consider an isomer in isolation
o Oral, dermal and inhalation exposure compared with oral HCV
p S4ULs based on a sub-surface soil to indoor air correction factor of 1
q Based on a comparison of inhalation exposure with the inhalation TDI for localised effects
r Based on 2,4-dichlorophenol unless otherwise stated
s Based on 2,3,4,6-tetrachlorophenol
t Based on lowest GAC for all three xylene isomers
u Measured concentrations of benzo(a)pyrene should be compared to the S4UL for benzo(a)pyrene as a single compound and to the S4UL for benzo(a)pyrene as a surrogate marker of genotoxic PAHs.

vap S4UL presented exceeded the vapour saturation limit, which is presented in brackets
sol S4UL presented exceeds the solubility saturation limit, which is presented in brackets
dir S4ULs based on a threshold protective of direct skin contact, guideline in brackets based on the health effects following long term exposure provided for illustration only

Table 3: Soil Guideline Values (SGVs) for dioxins, furans and dioxin like PCBs

Determinand	Allotments	Residential with consumption of homegrown produce	Residential without consumption of homegrown produce	Commercial
Sum of PCDDs, PCDFs and dioxin-like PCBs	0.008	0.008	0.008	0.24

Units are mg/kg Dry Weight

Table 4: EIC/AGS/CL:AIRE Generic Assessment Criteria (GAC)

	Allotments	Residential with consumption of homegrown produce	Residential without consumption of homegrown produce	Commercial	Soil Saturation Concentration
Metals					
Antimony	ND	ND	550	7500	NA
Barium	ND	ND	1300	22000	NA
Molybdenum	ND	ND	670	17000	NA
Organics (SOM 1%/ 2.5%/ 6%)					
1,1,2 Trichloroethane	0.28 / 0.61 / 1.4	0.6 / 1.2 / 2.7	0.88 / 1.8 / 3.9	94 / 190 / 400	4030 / 8210 / 18000
1,1-Dichloroethane	9.2 / 17 / 35	2.4 / 3.9 / 7.4	2.5 / 4.1 / 7.7	280 / 450 / 850	1830 / 2960 / 5600
1,1-Dichloroethene	2.8 / 5.6 / 12	0.23 / 0.4 / 0.82	0.23 / 0.41 / 0.82	26 / 46 / 92	2230 / 3940 / 7940
1,2,4-Trimethylbenzene	0.38 / 0.93 / 2.2	0.35 / 0.85 / 2	0.41 / 0.99 / 2.3	42 / 99 / 220	557 / 1360 / 3250
1,2-Dichloropropane	0.62 / 1.2 / 2.6	0.024 / 0.042 / 0.084	0.024 / 0.042 / 0.085	3.3 / 5.9 / 12	1190 / 2110 / 4240
2,4-Dimethylphenol	3.1 / 7.2 / 17	19 / 43 / 97	210 / 410 / 730	16000 / 24000 / 30000	1380 / 3140 / 7240
2,4-Dinitrotoluene	0.22 / 0.49 / 1.1	1.5 / 3.2 / 7.2	170 / 170 / 170	3700 / 3700 / 3800	141 / 299 / 669
2,6-Dinitrotoluene	0.12 / 0.27 / 0.61	0.78 / 1.7 / 3.9	78 / 84 / 87	1900 / 1900 / 1900	287 / 622 / 1400
2-Chloronaphthalene	40 / 98 / 230	3.7 / 9.2 / 22	3.8 / 9.3 / 22	390 / 960 / 2200	114 / 280 / 669
Biphenyl	14 / 35 / 83	66 / 160 / 360	220 / 500 / 980	18000 / 33000 / 48000	34.4 / 84.3 / 201
Bis (2-ethylhexyl) phthalate	47 / 120 / 280	280 / 610 / 1100	2700 / 2800 / 2800	85000 / 86000 / 86000	8.68 / 21.6 / 51.7
Bromobenzene	3.2 / 7.6 / 18	0.87 / 2 / 4.7	0.91 / 2.1 / 4.9	97 / 220 / 520	853 / 1970 / 4580
Bromodichloromethane	0.016 / 0.032 / 0.068	0.016 / 0.03 / 0.061	0.019 / 0.034 / 0.07	2.1 / 3.7 / 7.6	1790 / 3220 / 6570
Bromoform	0.95 / 2.1 / 4.6	2.8 / 5.9 / 13	5.2 / 11 / 23	760 / 1500 / 3100	2690 / 5480 / 12000
Butyl benzyl phthalate	220 / 550 / 1300	1400 / 3300 / 7200	42000 / 44000 / 44000	940000 / 940000 / 950000	26.3 / 64.7 / 154
Chloroethane	110 / 200 / 380	8.3 / 11 / 18	8.4 / 11 / 18	960 / 1300 / 2100	2610 / 3540 / 5710
Chloromethane	0.066 / 0.13 / 0.23	0.0083 / 0.0098 / 0.013	0.0085 / 0.0099 / 0.013	1 / 1.2 / 1.6	1910 / 2240 / 2990
Cis 1,2 Dichloroethene	0.26 / 0.5 / 1	0.11 / 0.19 / 0.37	0.12 / 0.2 / 0.39	14 / 24 / 47	3940 / 6610 / 12900
Dichloromethane	0.1 / 0.19 / 0.34	0.58 / 0.98 / 1.7	2.1 / 2.8 / 4.5	270 / 360 / 560	7270 / 9680 / 15300
Diethyl Phthalate	19 / 41 / 94	120 / 260 / 570	1800 / 3500 / 6300	150000 / 220000 / 290000	13.7 / 29.1 / 65
Di-n-butyl phthalate	2 / 5 / 12	13 / 31 / 67	450 / 450 / 450	15000 / 15000 / 15000	4.65 / 11.4 / 27.3
Di-n-octyl phthalate	940 / 2100 / 3900	2300 / 2800 / 3100	3400 / 3400 / 3400	89000 / 89000 / 89000	32.6 / 81.5 / 196
Hexachloroethane	0.27 / 0.67 / 1.6	0.2 / 0.48 / 1.1	0.22 / 0.54 / 1.3	22 / 53 / 120	8.17 / 20.1 / 48.1
Isopropylbenzene	32 / 79 / 190	11 / 27 / 64	12 / 28 / 67	1400 / 3300 / 7700	390 / 950 / 2250
Methyl tert-butyl ether (MTBE)	23 / 44 / 90	49 / 84 / 160	73 / 120 / 220	7900 / 13000 / 24000	20400 / 33100 / 62700
Propylbenzene	34 / 83 / 200	34 / 82 / 190	40 / 97 / 230	4100 / 9700 / 21000	402 / 981 / 2330
Styrene	1.6 / 3.7 / 8.7	8.1 / 19 / 43	35 / 78 / 170	3300 / 6500 / 11000	626 / 1440 / 3350
Total Cresols (2-, 3- and 4-methylphenol)	12 / 27 / 63	80 / 180 / 400	3700 / 5400 / 6900	160000 / 180000 / 180000	15000 / 32500 / 73300
Trans 1,2 Dichloroethene	0.93 / 1.9 / 4	0.19 / 0.34 / 0.7	0.19 / 0.35 / 0.71	22 / 40 / 81	3420 / 6170 / 12600
Tributyl tin oxide	0.042 / 0.1 / 0.24	0.25 / 0.59 / 1.3	1.4 / 3.1 / 5.7	130 / 180 / 200	41.3 / 101 / 241

Units are mg/kg Dry Weight

Table 5: Tier 2 Criteria for the Assessment of Soils – Protection of Flora and Fauna

Parameter	ICRCL 70/90 [a]		SSVs [b]	Code of Practice for Agricultural Use of Sewage Sludge [c]	BS 3882:2015 Specification for topsoil and requirements for use
	Maximum				Phytotoxic contaminants
	Livestock	Crop Growth			
	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW
Antimony			37		
Arsenic	500	1000		50	
Cadmium	30	50	0.6	3	
Chromium				400	
Cobalt			4.2		
Copper	500	250	35.1	80/ 100/ 135/ 200 [d]	<100/<135/<200 [e]
Fluoride	1000			500	
Lead	1000			300	
Mercury				1	
Molybdenum			5.1	4	
Nickel			28.2	50/ 60/ 75/ 110 [d]	<60/<75/<110 [e]
Selenium				3	
Silver			0.3		
Vanadium			2.0		

Parameter	ICRCL 70/90 [a]		SSVs [b]	Code of Practice for Agricultural Use of Sewage Sludge [c]	BS 3882:2015 Specification for topsoil and requirements for use
	Maximum				Phytotoxic contaminants
	Livestock	Crop Growth			
	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW
Zinc	3000	1000	35.6	200/200/200/300 [d]	<200/<200/<300 [e]
Benzo(a)pyrene			0.15		
Bis(2-ethylhexyl) phthalate			13		
Hexachlorobenzene			0.002		
Pentachlorobenzene					
Pentachlorophenol			0.6		
Perfluorooctanoic acid			0.022		
Perfluorooctane sulfonate			0.014		
Polychlorinated alkanes medium chain			11.9		
Tetrachloroethene					
Toluene					
Triclosan			0.13		
Tris(2-chloroethyl)phosphate			1.1		
Tris(2-chloro-1-methylethyl) phosphate			1.8		

a. Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) 70/90 Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 1st edition 1990.
b. Soil screening values for assessing ecological risks, EA 2017a Report – ShARE id26
c. Maximum permissible concentration of potentially toxic elements for Arable land from the Sewage sludge in agriculture: code of practice.. There are also criteria for Grassland which are higher than for Arable.
d. Where four values are presented, concentrations are for soils with pH values 5.0-5.5/ 5.5-6.0/ 6.0-7.0/ >7.0 (and the soils contain more than 5% calcium carbonate)
e. Where three values are presented, concentrations are for soils with pH values <6.0/ 6.0-7.0/ >7.0

Table 6: Tier 2 Criteria for Screening Liquids

	Screening Concentration (mg/l)			
	Minimum Reporting Value	Human Consumption	Fresh Water/Inland	Salt Water/Other
Arsenic SP	-	0.01	0.05 (2)	0.025 (2)
Boron	-	1	-	-
Cadmium PS	0.0001	0.005	≤0.00008, 0.00008, 0.00009, 0.00015, 0.00025 (14)	0.0002
Chromium (total)	-	0.05	-	-
Chromium (III) SP	-	-	0.0047	-
Chromium (VI) SP	-	-	0.0034	0.0006
Copper SP	-	2	0.001 bioavailable	0.00376 bioavailable
Iron SP	-	0.2	1	1
Lead PS	-	0.01	0.0012 bioavailable	0.0013 bioavailable
Mercury compounds PS	0.00001	0.001	0.00007 max	0.00007 max
Manganese SP	-	0.05	0.123 bioavailable	-
Nickel PS	-	0.02	0.004 bioavailable	0.0086 bioavailable
Selenium	-	0.01	-	-
Zinc SP	-	5(3)	0.0109bioavailable(13)	0.0068bioavailable (13)
Chlorinated Compounds				
C10-13 chloroalkanes PS short chain chlorinated paraffins	-	-	0.0004	0.0004
Dichloromethane PS	-	-	0.02	0.02
1,2-Dichloroethane PS	0.001	0.003	0.01	0.01

	Screening Concentration (mg/l)			
	Minimum Reporting Value	Human Consumption	Fresh Water/Inland	Salt Water/Other
Trichloroethene PS	0.0001	0.01[5]	0.01	0.01
1,1,1-Trichloroethane	0.0001	-	-	-
1,1,2-Trichloroethane	0.0001	-	-	-
Trichloromethanes PS	-	0.1[1]	0.0025	0.0025
1, 2, 4-Trichlorobenzene	0.00001			
Tetrachloroethene PS	0.0001	0.01[5]	0.01	0.01
Tetrachloromethane/ Carbon tetrachloride PS	0.0001	0.003	0.012	0.012
Tetrachloroethane SP	-		0.140	
Vinyl chloride	-	0.0005	-	-
Trichlorobenzene (TCB) PS	-	-	0.0004	0.0004
Chloroform	0.0001			
Chloronitrotoluenes(CNT)[11]	0.001	-	-	-
Hexachlorobutadiene PS	0.000005	-	0.0006 max	0.0006 max
Hexachlorocyclohexanes (HCH) PS	0.000001	-	0.00002	0.000002
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	-	-	-	-
Acenaphthylene	-	-	-	-
Anthracene PS	-	-	0.0001	0.0001
Benzo(a)anthracene	-	-	-	-
Benzo(b)fluoranthene PS	-	0.0001 [10]	0.000017 max [12]	0.000017 max [12]
Benzo(a)pyrene PS	-	0.00001	0.00000017	0.00000017
Benzo(k)fluoranthene PS	-	0.0001 [10]	0.000017 max [12]	0.000017 max [12]
Benzo(g,h,i)perylene PS	-	0.0001 [10]	0.0000082 max [12]	0.00000082 max [12]
Indeno(1,2,3-cd)pyrene PS	-	0.0001 [10]	- [12]	- [12]
Chrysene		-	-	-
Dibenzo(a,h)anthracene		-	-	-
Fluoranthene PS	-	-	0.0000063	0.0000063
Fluorene	-	-	-	-
Phenanthrene	-	-	-	-
Pyrene	-	-	-	-
Naphthalene PS	-	-	0.002	0.002
Polycyclic Aromatic Hydrocarbons		0.0001[10]		
Petroleum hydrocarbons				
Petroleum hydrocarbons/Mineral oil	-	0.01[3]	-	-
Benzene PS	0.001	0.001	0.01	0.008
Toluene SP	0.004	0.7[9]	0.074	0.074
Ethylbenzene	-	0.3[9]	-	-
Xylenes	0.003[4]	0.5[9]		
Methyl tert-butyl ether (MTBE)	-	0.015[7]	-	-
Pesticides and Herbicides				
Alachlor PS	-	-	0.0003	0.0003
Aldrin PS	0.000003	0.00003	0.00001[8]	0.000005[8]
Dieldrin PS	0.000003	0.00003		
Endrin PS	0.000003	0.0006[9]		
Isodrin	0.000003	-	-	-
2,4 dichlorophenol SP	0.0001	-	0.0042	0.00042
2,4 D ester SP	0.0001	-	0.0003	0.0003
op and pp DDT (each) PS	0.000002	0.001[6]	0.000025 [6]	0.000025 [6]
op and pp DDE (each)	0.000002			
op and pp TDE (each)	0.000002			
Dimethoate SP	0.00001	-	0.00048	0.00048
Endosulfan PS	0.000005	-	0.000005	0.0000005
Hexachlorobenzene PS	0.000001		0.00005 max	0.00005 max
Permethrin SP	0.000001	-	0.000001	0.0000002
Atrazine PS	0.00003	-	0.0006	0.0006
Simazine PS	0.00003	-	0.001	0.001
Linuron SP	-	-	0.0005	0.0005
Mecoprop SP		-	0.018	0.018
Trifluralin PS	0.00001	-	0.00003	0.00003
Total pesticides	-	0.0005		

	Screening Concentration (mg/l)			
	Minimum Reporting Value	Human Consumption	Fresh Water/Inland	Salt Water/Other
Miscellaneous				
Ammoniacal nitrogen (as NH4+)	-	0.5	0.26 [16] 0.39 [17]	-
Ammoniacal nitrogen (as N)	-	0.39	0.2 [16] 0.3 [17]	-
Unionised Ammonia (NH3) SP	-	-	-	0.021
Chloride	-	250		
Chlorine SP			0.002	0.01 max
Cyanide SP (hydrogen cyanide)	-	0.05	0.001	0.001
Nitrate (as NO_3)	-	50	-	-
Nitrite (as NO_2)	-	0.1	-	-
Phenol SP	-	0.005 [(3)]	0.0077	0.0077
Pentachlorophenol PS	0.0001	-	0.0004	0.0004
PCBs (individual congeners)	0.000001	-	-	-
Sodium	-	200	-	-
Sulphate	-	250		-
Tributyl and triphenyl tin compounds (each) PS	0.000001	-	0.0000002	0.0000002
Di(2-ethylhexyl)-phthalate PS	-	-	0.0013	0.0013

Substances highlighted in yellow are hazardous substances, PS = Priority Substances, SP = Specific Pollutants, '-' screening concentration is not available, 'max' – maximum allowable concentration used where no annual average provided

Notes:

1. Concentration for trihalomethanes is the sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
2. Concentration is the dissolved fraction of a water sample obtained by filtration through a 0.45um filter.
3. Concentration is taken from Statutory Instrument 1989 No. 1147. The Water Supply (Water Quality) Regulations 1989, as amended.
4. Concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
5. Concentration is the Sum of TCE and PCE.
6. Concentration is for Total DDT. Para DDT on its own has a target concentration of 0.00001mg/l.
7. Concentration for MTBE is taken from Environment Agency guidance, dated 2006.
8. Concentration is the sum of aldrin, dieldrin, endrin.
9. Concentration is taken from WHO (2004) guidelines for drinking-water quality.
10. Sum of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene
11. Concentration is for 2,6-CNT, 4,2-CNT, 4,3-CNT, 2,4-CNT, 2,5-CNT
12. BAP can be considered as a marker of the other PAHs for comparison with the annual average
13. Concentration plus ambient background concentration (dissolved)
14. For cadmium and its compounds the EQS depends on the hardness of the water (Class 1: < 40 mg CaCO3/l, Class 2: 40 to < 50 mg CaCO3/l, Class 3: 50 to < 100 mg CaCO3/l, Class 4: 100 to < 200 mg CaCO3/l and Class 5: ≥ 200 mg CaCO3/l).
15. Manufactured and used in industrial applications, such as flame retardants and plasticisers, as additives in metal working fluids, in sealants, paints, adhesives, textiles, leather fat and coatings. Persistent, bioaccumulate and toxic to aquatic life (carcinogen in rat studies). Candidate Persistent Organic Pollutant (POP).
16. Acceptable 90th percentile concentration for a freshwater lake/river with "High" chemical quality standard and alkalinity (as mg/l CaCO3) < 50 mg/L or alkalinity < 200 mg/L where river elevation > 80 m above Ordnance Datum (mAOD). See the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 for further details.
17. Acceptable 90th percentile concentration for a freshwater lake/river with "High" chemical quality standard and alkalinity (as mg/l CaCO3) ≥ 50 mg/L where river elevation < 80 m mAOD or > 200 mg/l where river elevation > 80 mAOD. See the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 for further details.

Table 7: Tier 2 Criteria for Screening Groundwater Vapour Generation Hazard

Chemical	CAS	GAC_{gwvap}(µg/l)[1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
Petroleum Hydrocarbons				
1,2,4-Trimethylbenzene	95-63-6	24	2,200	559,000
Benzene [3]	71-43-2	210	20,000	1,780,000
Ethylbenzene [3]	100-41-4	10,000	*960,000 (sol)*	180,000
Isopropylbenzene	98-82-8	850	*86,000 (sol)*	56,000
Propylbenzene	103-65-1	2,700	*240,000 (sol)*	54,100
Styrene	100-42-5	8,800	*810,000 (sol)*	290,000
Toluene [3]	108-88-3	230,000	*21,000,000 (sol)*	590,000
TPH Aliphatic EC5-EC6 [3]		1,900	*190,000 (sol)*	35,900
TPH Aliphatic >EC6-EC8 [3]		1,500	*150,000 (sol)*	5,370
TPH Aliphatic >EC8-EC10 [3]		57	*5,700 (sol)*	427
TPH Aliphatic >EC10-EC12 [3]		37	*3,600 (sol)*	34
TPH Aromatic >EC5-EC7 [2,3]		210,000	*20,000,000 (sol)*	1,780,000
TPH Aromatic >EC7-EC8 [3]		220,000	*21,000,000 (sol)*	590,000
TPH Aromatic >EC8-EC10 [3]		1,900	*190,000 (sol)*	64,600
TPH Aromatic >EC10-EC12 [3]		6,800	*660,000 (sol)*	24,500
TPH Aromatic >EC12-EC16 [3]		39,000	*3,700,000 (sol)*	5,750
meta-Xylene [3,5]	108-38-3	9,500	*940,000 (sol)*	200,000
ortho-Xylene [3,5]	95-47-6	12,000	*1,100,000 (sol)*	173,000
para-Xylene [3,5]	106-42-3	9,900	*980,000 (sol)*	200,000
Polycyclic Aromatic Hydrocarbons (PAH)				
Acenaphthene	83-32-9	*170,000 (sol)*	*15,000,000 (sol)*	4,110
Acenaphthylene	208-96-8	*220,000 (sol)*	*20,000,000 (sol)*	7,950
Fluorene	86-73-7	*210,000 (sol)*	*18,000,000 (sol)*	1,860
Naphthalene	91-20-3	220	*23,000 (sol)*	19,000
Pesticides				
Aldrin	309-00-2	*47 (sol)*	*3,700 (sol)*	20
alpha-Endosulfan	959-98-8	*7,400 (sol)*	*590,000 (sol)*	530
beta-Endosulfan	33213-65-9	*7,500 (sol)*	*600,000 (sol)*	280
Halogenated Organics				
1,1,1,2-Tetrachloroethane	79-34-5	240	22,000	1,110,000
1,1,1-Trichloroethane	71-55-6	3,000	290,000	1,300,000
1,1,2,2-Tetrachloroethane	79-35-4	1,600	150,000	2,930,000
1,1,2-Trichloroethane	79-00-5	520	49,000	4,491,000
1,1-Dichloroethane	75-34-3	2,700	260,000	3,666,000
1,1-Dichloroethene	75-35-4	160	1,6000	3,100,000
1,2,3,4-Tetrachlorobenzene	634-66-2	240	*31,000 (sol)*	7,800
1,2,3,5-Tetrachlorobenzene	634-90-2	7.0	*600*	3,500
1,2,3-Trichlorobenzene	87-61-7	35	3,100	21,000
1,2,4,5-Tetrachlorobenzene	95-94-3	8.1	*700 (sol)*	600
1,2,4-Trichlorobenzene	120-82-1	68	7,200	41,400
1,2-Dichlorobenzene	95-50-1	2,000	*220,000 (sol)*	133,000
1,2-Dichloroethane	107-06-2	8.9	850	8,680,000
1,2-Dichloropropane	78-87-5	22	2,600	2,050,000
1,3,5-Trichlorobenzene	108-70-3	7.4	660	6,000
1,3-Dichlorobenzene	541-73-1	31	2,800	103,000
1,4-Dichlorobenzene	106-46-7	5,000	*460,000 (sol)*	51,200
Bromobenzene	108-86-1	220	20,000	388,040
Bromodichloromethane	75-27-4	17	1,600	3,000,000
Bromoform (Tribromomethane)	75-25-2	3,100	400,000	3,000,000
Chlorobenzene	108-90-7	98	15,000	387,000
Chloroethane	75-00-3	10,000	1,000,000	5,742,000
Chloroethene (Vinyl Chloride)	75-01-4	0.62	63	2,760,000
Chloromethane	74-87-3	14	1,400	5,350,000
cis-1,2-Dichloroethene	156-59-2	130	13,000	7,550,000
Dichloromethane	75-09-2	3,300	370,000	20,080,000
Hexachlorobenzene	118-74-1	*16 (sol)*	*1,400 (sol)*	10
Hexachlorobutadiene	87-68-3	1.7	230	4,800
Hexachloroethane	67-72-1	8.5	740	49,900

Chemical	CAS	GAC_{gwvap}(µg/l)[1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
Pentachlorobenzene	608-93-5	140	*12,000 (sol)*	500
Tetrachloroethene	127-18-4	34	4,600	225,000
Tetrachloromethane (Carbon Tetrachloride)	56-23-5	5.3	770	846,000
trans-1,2-Dichloroethene	156-60-5	160	16,000	5,250,000
Trichloroethene	79-01-6	5.7	530	1,370,000
Trichloromethane (Chloroform)	67-66-3	790	85,000	8,950,000
Others (organic and inorganic)				
2-Chloronaphthalene	91-58-7	160	*14,000 (sol)*	11,700
Biphenyl (Lemonene)	92-52-4	*15,000 (sol)*	*1,300,000 (sol)*	4,060
Carbon Disulphide	75-15-0	56	5,600	2,100,000
Mercury, elemental	7439-97-6	1.1	*95 (sol)*	56
Methyl tertiary butyl ether (MTBE)	1634-04-4	83,000	7,800,000	48,000,000

Notes

1. GAC in *italics* with (sol) exceed aqueous solubility.
2. GAC rounded to two significant figures.
3. The GAC for these petroleum hydrocarbon contaminants have been calculated using a sub-surface soil to indoor air correction factor of 10 in line with the physical-chemical data sources.
4. The GAC for TPH fractions do not account for genotoxic mutagenic effects. Concentrations of TPH Aromatic >EC5-EC7 should therefore also be compared with the GAC for benzene to ensure that such effects are also assessed.
5. The Health Criteria Value used for each xylene isomer was for total xylene. If site specific additivity assessments are not completed, as a conservative measure the sum of isomer concentrations should be compared to the lowest xylene GAC (as is the case for soil GAC).

Appendix E Geoenvironmental Summary Tables and PAH Assessment Tool Plots

TABLE SUMMARISING SOIL RESULTS AND HIGHLIGHTING EXCEEDANCES ABOVE SOIL ASSESSMENT CRITERIA
LAND OF TOLLGATE ROAD, COLNEY HEATH

SOM 2.5%			Assessment Criteria		Strata				No. of Exceedances			Topsoil	Topsoil	Topsoil	Topsoil	Topsoil	errace Deposi	Topsoil	Topsoil	errace Deposi	Topsoil	errace Deposi	Topsoil	Topsoil	errace Deposi	Made Ground	Made Ground
												SA01	SA02	SA03	TP01	TP02	TP02	TP03	TP04	TP04	TP05	TP05	TP06	TP7	TP7	WS1	WS2
Analyte	Units	LOD	RwHP	RwoHP	POSresi	No. of Tests	Min	Max	RwHP	RwoHP	POSresi	0.10	0.10	0.20	0.10	0.10	0.40	0.10	0.10	0.30	0.20	0.60	0.10	0.10	0.50	0.30	0.20
Arsenic*	mg/kg	0.5	37	40	79	16	2.7	19				4.4	4.8	6.2	4.8	5.3	7.9	5.8	5.4	4.4	19	2.9	2.9	2.7	3.8	8.1	5.7
Cadmium*	mg/kg	0.1	22	150	220	16	0.1	0.23				0.18	0.2	0.18	0.11	0.11	0.13	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	0.14	0.23
Chromium Trivalent	mg/kg	0.5	910	910	1500	16	6.7	13				7.5	8.6	8.4	13	7.5	9.2	10	9.5	11	8.8	6.7	8.9	7.4	13	9.9	8.6
Chromium Hexavalent*	mg/kg	0.5	21	21	21	16	0.5	0.5				*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
Copper	mg/kg	0.5	2400	7100	12000	16	3.1	16				6.7	13	9.3	7.6	8	8.9	4.6	6	4.9	8.3	4.2	3.3	4.1	3.1	15	16
Lead*	mg/kg	0.5	200	310	630	16	6.2	82				25	82	40	21	22	24	12	19	16	14	7.3	6.2	7.5	7.3	39	51
Mercury	mg/kg	0.05	40	56	120	16	0.05	0.12				0.08	0.12	0.12	0.09	0.09	0.09	*0.05*	0.07	0.06	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	0.08	0.07
Nickel	mg/kg	0.5	130	180	230	16	4.4	11				4.7	4.6	5.9	6	6.8	8.9	5.4	5.7	4.4	11	6.5	5.4	6.1	5.6	11	7.5
Selenium	mg/kg	0.25	250	430	1100	16	0.33	0.67				0.45	0.36	0.53	0.43	0.46	0.67	0.33	0.45	0.39	0.53	0.63	0.49	0.6	0.48	0.63	0.52
Zinc	mg/kg	0.5	3700	40000	81000	16	13	79				25	61	34	26	28	33	17	22	19	39	16	13	15	13	40	79
Organic matter	mg/kg	0.1	-	-	-	16	1.7	4.2				4.2	4.1	3.7	2.1	1.8	1.7	1.7	2.2	1.9	2.5	1.8	2.5	2.3	1.8	4	4.2
pH	pH Units	4	-	-	-	16	6.8	8.1				6.8	7.4	8.1	6.8	6.8	7	7.3	7.1	7.1	7.4	7.5	7.6	7.6	7.8	8.1	7.9
>C5 to C6 Aliphatic	mg/kg	1	78	78	590000	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C6 to C8 Aliphatic	mg/kg	1	230	230	610000	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C8 to C10 Aliphatic	mg/kg	1	65	65	13000	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C10 to C12 Aliphatic	mg/kg	1	330	330	13000	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C12 to C16 Aliphatic	mg/kg	1	2400	2400	13000	16	1	8.1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	8.1	*1*
>C16 to C21 Aliphatic	mg/kg	1	-	-	-	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C21 to C35 Aliphatic	mg/kg	1	-	-	-	16	1	150				110	150	26	150	140	140	100	140	42	110	*1*	*1*	30	*1*	130	130
>C16 to C35 Aliphatic	mg/kg	2	92000	92000	250000	16	2	151				110	150	26	150	140	140	100	140	42	110	*2*	*2*	30	*2*	130	130
>C35 to C44 Aliphatic	mg/kg	1	92000	92000	250000	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Total Aliphatic C5-C35	mg/kg		-	-	-																						
>C5 to C7 Aromatic	mg/kg	1	140	690	56000	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C7 to C8 Aromatic	mg/kg	1	290	1800	56000	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C8 to C10 Aromatic	mg/kg	1	83	110	5000	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C10 to C12 Aromatic	mg/kg	1	180	590	5000	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C12 to C16 Aromatic	mg/kg	1	330	2300	5100	16	1	1				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C16 to C21 Aromatic	mg/kg	1	540	1900	3800	16	1	330				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	18	*1*	*1*	330	49
>C21 to C35 Aromatic	mg/kg	1	1500	1900	3800	16	1	1000				51	50	*1*	55	51	51	33	50	52	*1*	*1*	62	*1*	*1*	1000	860
>C35 to C44 Aromatic	mg/kg	1	1500	1900	3800	16	1	69				*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	69	*1*
Hazard Index - RwHP	-	-	-	-	-	16	0.1	1.4	**1**			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.4	0.7
Hazard Index - RwoHP	-	-	-	-	-	16	0.1	0.8				0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.5
Hazard Index - POSresi	-	-	-	-	-	16	0.0	0.4				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2
Naphthalene	mg/kg	0.01	5.6	5.6	4900	16	0.01	0.44				0.34	0.16	0.37	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	0.29	*0.01*	*0.01*	*0.01*	*0.01*	0.42	0.44
Acenaphthylene	mg/kg	0.01	420	4600	15000	16	0.01	1.4				0.05	0.069	0.095	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	0.095	*0.01*	*0.01*	*0.01*	*0.01*	0.33	1.4
Acenaphthene	mg/kg	0.01	510	4700	15000	16	0.01	0.67				0.029	0.051	0.042	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	0.67	*0.01*	*0.01*	*0.01*	*0.01*	0.12	0.3
Fluorene	mg/kg	0.01	400	3800	9900	16	0.01	0.73				0.039	0.041	0.065	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	0.73	*0.01*	*0.01*	*0.01*	*0.01*	0.22	0.42
Phenanthrene	mg/kg	0.01	220	1500	3100	16	0.01	10				0.37	0.42	0.47	0.6	*0.01*	0.56	*0.01*	*0.01*	*0.01*	9.4	*0.01*	0.047	0.044	0.037	5.5	10
Anthracene	mg/kg	0.01	5400	35000	74000	16	0.01	3.4				0.086	0.13	0.13	0.13	*0.01*	0.11	*0.01*	*0.01*	*0.01*	1.7	*0.01*	*0.01*	*0.01*	0.016	1.1	3.4
Fluoranthene	mg/kg	0.01	560	1600	3100	16	0.01	31				0.9	1.1	1.2	1	0.56	1.4	0.21	0.45	0.65	11	*0.01*	0.049	0.064	0.045	13	31
Pyrene	mg/kg	0.01	1200	3800	7400	16	0.01	27				0.74	0.93	1.1	0.88	0.5	1.1	0.2	0.42	0.65	9	*0.01*	0.054	0.048	0.061	10	27
Benzo(a)anthracene	mg/kg	0.01	11	14	29	16	0.01	15	**1**	**1**		0.4	0.56	0.68	0.56	0.28	0.65	*0.01*	0.25	0.29	4.2	*0.01*	*0.01*	*0.01*	*0.01*	5.6	15
Chrysene	mg/kg	0.01	22	31	57	16	0.01	15				0.43	0.48	0.62	0.54	0.24	0.56	*0.01*	0.24	0.27	4.7	*0.01*	*0.01*	*0.01*	*0.01*	5.3	15
Benzo(b)fluoranthene	mg/kg	0.01	3.3	4	7.2	16	0.01	21	**3**	**3**	**1**	0.57	0.76	1.2	0.56	0.39	0.83	*0.01*	*0.01*	*0.01*	4.6	*0.01*	*0.01*	*0.01*	*0.01*	7.1	21
Benzo(k)fluoranthene	mg/kg	0.01	93	110	190	16	0.01	8.3				0.24	0.27	0.48	0.28	0.17	0.23	*0.01*	*0.01*	*0.01*	1.8	*0.01*	*0.01*	*0.01*	*0.01*	3	8.3
Benzo(a)pyrene (BaP)	mg/kg	0.01	2.7	3.2	5.7	16	0.01	16	**3**	**3**	**2**	0.5	0.65	1	0.51	0.3	0.7	*0.01*	*0.01*	*0.01*	3.5	*0.01*	*0.01*	*0.01*	*0.01*	6.1	16
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	36	46	82	16	0.01	12				0.39	0.51	0.71	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	2.2	*0.01*	*0.01*	*0.01*	*0.01*	4	12
Dibenzo(a,h)anthracene	mg/kg	0.01	0.28	0.32	0.57	16	0.01	2.1	**3**	**3**	**2**	0.1	0.091	0.11	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	0.37	*0.01*	*0.01*	*0.01*	*0.01*	0.72	2.1
Benzo(g,h,i)perylene	mg/kg	0.01	340	360	640	16	0.01	12				0.41	0.52	0.7	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	1.9	*0.01*	*0.01*	*0.01*	*0.01*	3.8	12
Total PAH	mg/kg	0.2	-	-	-	16	0.2	180				5.6	6.7	9	5.1	2.4	6.1	0.41	1.4	1.9	56	*0.2*	*0.2*	*0.2*	*0.2*	66	180
Asbestos (Presence of)	TEXT		-	-	-	16						No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	Chrysotile	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Asbestos Analysts Comments	TEXT		-	-	-	16						-	-	-	-	Cement	-	-	-	-	-	-	-	-	-	-	-
Asbestos Fibre Count	%	0.001				1	0.52	0.52	**1**	**1**	**1**					0.52											

Assessment Criteria are the Suitable for Use Levels (S4ULs) punlished by LQM/CIEH (Copyright Land Quality Management Limited Reproduced with Permission; Publication Number S4UL3202. All Rights Reserved) unless the analyte is marked with *. Analytes identified with * the Assessment Criteria are Category 4 Screening Levels (C4SL)

This is a summary table and it is possible that not all analytical results are reproduced. Whilst we endeavour to present the data accurately errors can occur during transcribing. The laboratory certificate should be referred to as the authenticated and complete source of results

Land-use Scenarios - RwHP = Residential with Home Grown Produce, RwoHP = Residential without Home Grown Produce, POSresi = Public Open Space within residential, POSpark = Public Open Space not associated with residential

LOD = Limit of Detection. Results in italics are equal to or less than the LOD

This table should be read in conjunction with the accompanying guide on the selection of evaluation crtieria and the project specific note presenting the justification for selection.

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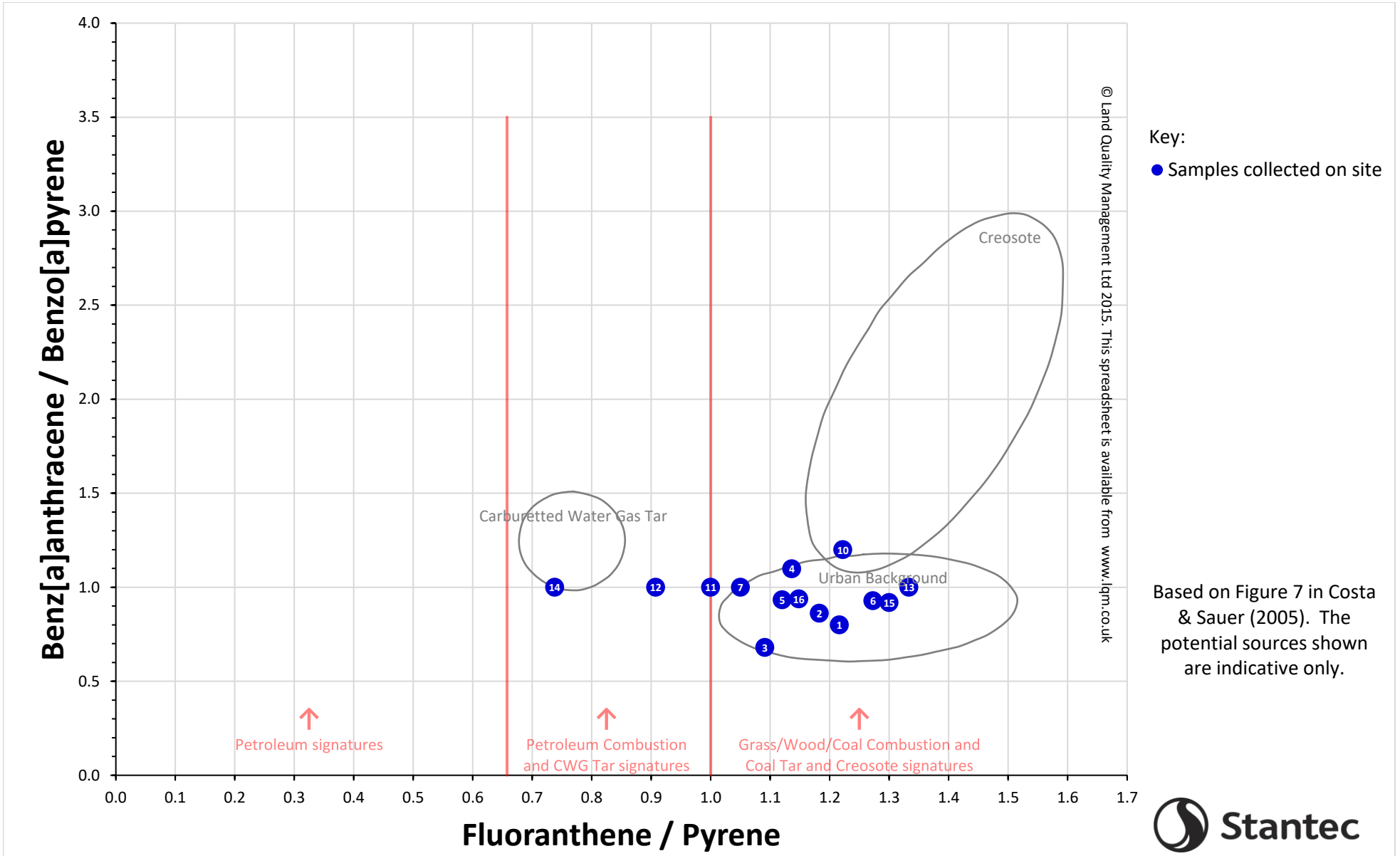

Key:

- Samples collected on site

Based on Figure 7 in Costa & Sauer (2005). The potential sources shown are indicative only.

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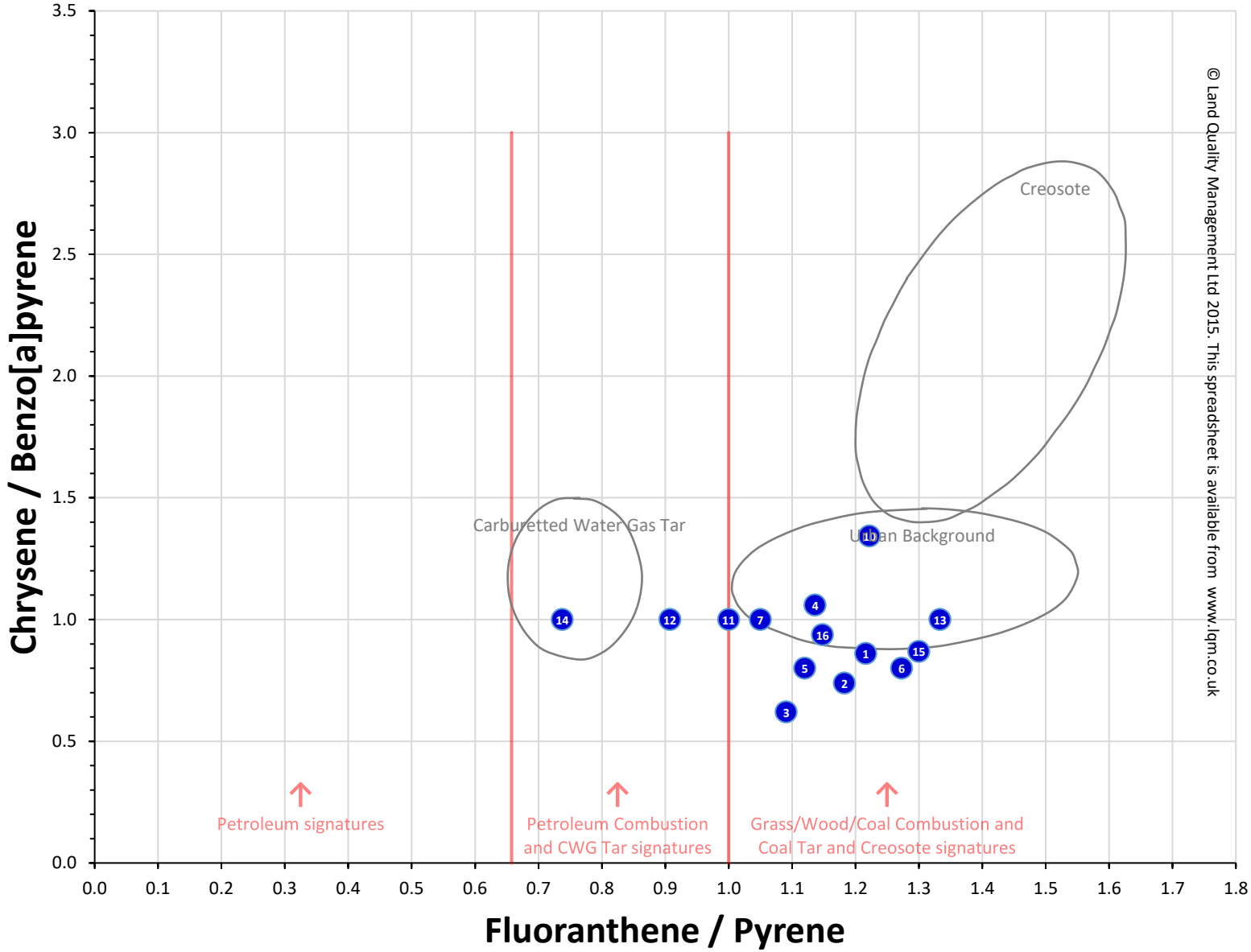

Key:

- Samples collected on site

Based on Figure 8 in Costa & Sauer (2005). The potential sources shown are indicative only.

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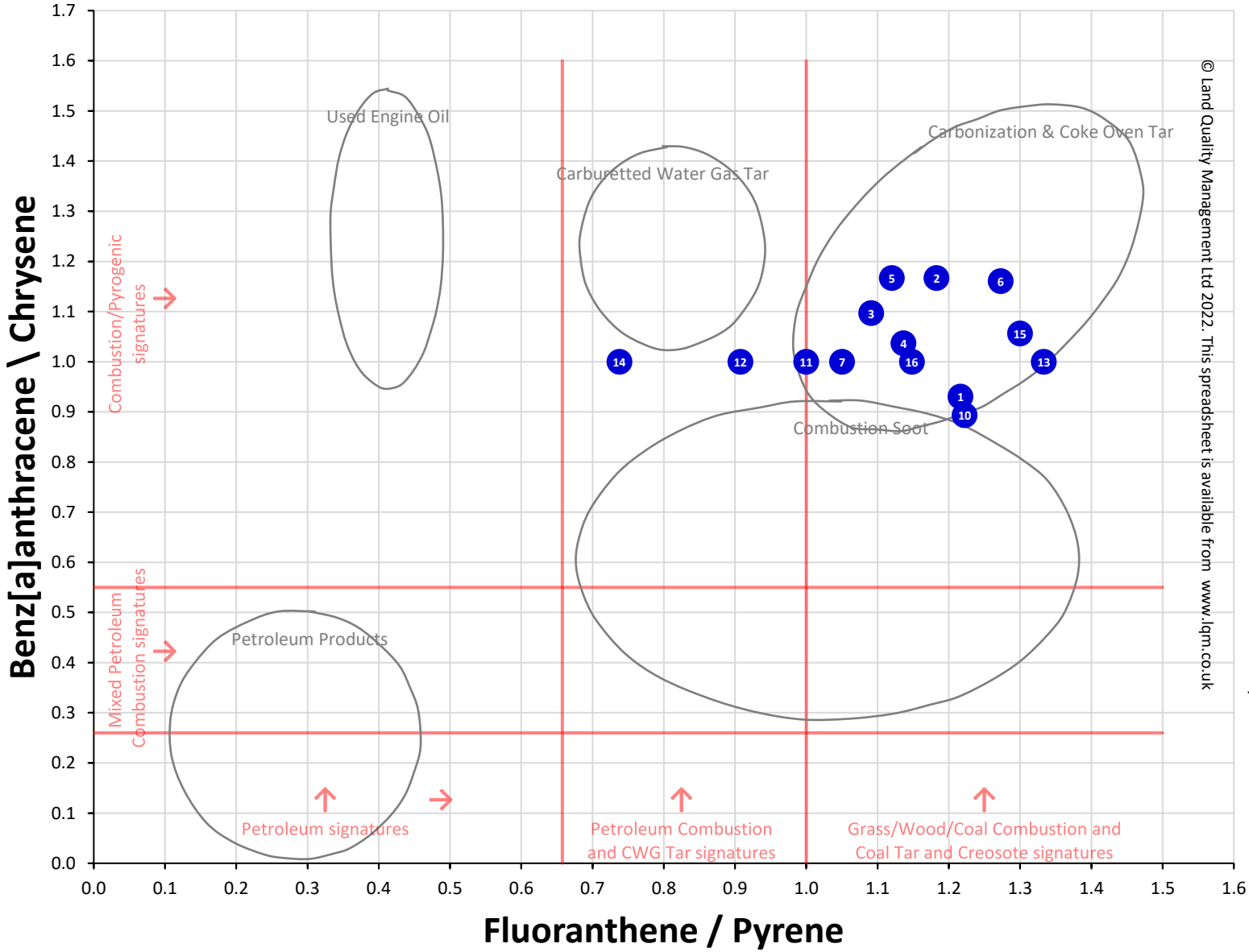

Key:

● Samples collected on site

Based on Figure 6 in Costa & Sauer (2005) with additional details based on a conference presentation by Costa (2005) in San Diego. The potential sources shown are indicative only.

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