

**Blakeney Homes (Breachwood Green)
Limited
Paragon Bank PLC**

**Phase 2 Geo-environmental &
Geotechnical Investigation**

**Heath Road
Breachwood Green
SG4 8PL**

**Report Ref: 24.07.031a-f01
December 2024**

DOCUMENT RECORD

Report Title	Phase 2 Geo-environmental and Geotechnical Investigation Report
Development	Development of former allotments into 10 dwellings
Project Address	Heath Road, Breachwood Green, Hertfordshire SG4 8PL
Project Ref	24.07.031a
Client	Blakeney Homes (Breachwood Green) Limited Paragon Bank PLC

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For and on behalf of ListersGeo, trading name of Listers Geotechnical Consultants Ltd

Issue No	Date	Status
dr01	20 th December 2024	Draft Report
f01	3 rd January 2025	Final Report

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EXECUTIVE SUMMARY

Project Reference	24.07.031a
Site Location	Heath Road, Breachwood Green, Hertfordshire SG4 8PL
OS Grid Reference	514888, 222426
Development Proposals	Ten residential dwellings with associated hardstanding and gardens
Current Site Use	Disused open plot
Existing Buildings	None
Topography	The general topography of the area slopes gently down to the southeast. The site itself generally slopes gently down towards the southeast with a gradient of approximately 1.5%.
Vegetation	The site is covered with low grass and herbaceous vegetation with sporadic tree cover, and continuous tree cover in the southeastern portion of the site.
Published Geology	Superficial geology: Clay-with-flints Formation Bedrock geology: The Lewes Nodular Chalk Formation and Seaford Chalk Formation
Site History	Former Allotment
Potential Sources of Contamination	Former use as an allotment, historic structure in the southern area of the site and a nearby historic brick kiln some 140m south of the site
Ground Conditions Encountered	Topsoil overlying medium to high strength Clay-with-flints Formation which in turn overlies low strength Lewes Nodular Chalk Formation and Seaford Chalk Formation.
Groundwater Encountered	Groundwater was not encountered in any of the exploratory holes during the fieldwork down to 6.00m depth.
Risks to Human Health	Negligible
Ground Gas Risks	Negligible
Risks to Controlled Waters	Negligible
Chemical Attack on Buried Concrete	Design Sulphate Class DS-1 ACEC Class AC-1s
Geotechnical Hazards	Shrink swell clays associated with the Clay-with-flints Formation A moderate-low hazard rating for chalk dissolution features beneath the site. Potential risk of uncharted mining.
Potential Foundation Solutions	Conventional spread foundations Depth: At least 1.0m bgl or 0.2m into the Clay-with-flints Formation Volume change potential: Medium
Allowable Bearing Pressure	110kPa
Floor Slabs	Ground bearing where outside the zone of influence of trees otherwise suspended
Roads and Hardstanding Design	Near surface soils were found to be non-frost susceptible, an equilibrium CBR of 3% is appropriate for the Clay-with-flints Formation

Limitations and Recommendations	Discovery strategy. Waste classification testing could be considered to assist removal of soils, if required. Supplementary investigations are recommended (such as additional borehole/dynamic probing) in an attempt to further establish the extent and possible cause of the low strength chalk encountered in the south of site, to further assess the risk from potential dissolution and uncharted mining/pits and to assist the foundation design. Watching brief during groundworks. Further consideration as to the depth of foundations with respect to the proximity of trees will be required. If strip footings and the required depths are found to be uneconomical then deeper supplementary boreholes may be required to aid pile design. An assessment of drainage has not been undertaken as part of this report. The fine-grained soils encountered are unlikely to be suitable for traditional soakaways.
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This executive summary should be read in conjunction with the main report.

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APPENDICES

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- Exploratory Hole Location Plan - Existing Site Layout
- Exploratory Hole Location Plan - Proposed Site Layout

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PHASE 2 GEO-ENVIRONMENTAL & GEOTECHNICAL INVESTIGATION REPORT

INTRODUCTION

A Phase 2 Geo-environmental & Geotechnical Investigation has been undertaken for a residential development at Heath Road, Breachwood Green, Hertfordshire, SG4 8PL. A Site Location Plan is provided in Appendix A. The Ordnance Survey National Grid reference for the approximate centre of the site is 514888, 222426.

Instructions to undertake the investigation were received from Blakeney Estates Ltd acting on behalf of Paragons, in their email dated 28th October 2024.

This report describes the intrusive site investigation activities carried out by ListersGeo in order to provide an evaluation of the ground conditions and the extent of any soil, gas or groundwater contamination present on the site. The report presents human health and groundwater risk assessments based on the findings of the desk study information and subsequent contamination laboratory testing.

The report also discusses the geotechnical implications with regard to the proposed development based on the findings of the fieldwork and subsequent laboratory testing.

This report supplements a previous Phase 1 desk study report prepared by ListersGeo, report reference 24.07.031-f01, dated August 2024.

This current report should be read in conjunction with the previous report for full details of the investigations undertaken at the site.

This report has been prepared for the sole use of the client and their professional advisors. This report shall not be relied upon by third parties without the express written authority of ListersGeo. If an unauthorised third-party comes into possession of this report, they must not rely on it and the authors owe them no duty of care and skill.

SCOPE OF THE INVESTIGATION

The scope of the investigation as requested by Blakeney Estates Ltd, was to provide an assessment of the geotechnical engineering properties of the ground and the extent of any soil, gas or groundwater contamination on the site as well as providing parameters to aid pavement design. A contaminated land risk assessment was undertaken based on the Contaminated Land Exposure Assessment (CLEA) and Environment Agency (EA) Remedial Targets Methodology (RTM) guidelines.

Following our brief, the report does not include any assessment of the waste classification of soils for removal or soakaway drainage solutions at the site.

PROPOSALS

It is proposed to develop the site to accommodate ten residential dwellings with associated gardens, access roads and car parking. A proposed site layout plan is provided in Appendix A.

The report is based upon the above development proposals and the existing ground levels. Should either of these alter significantly following issue of this report, then the contents will require re-evaluation.

SITE INFORMATION AND RECONNAISSANCE

A reconnaissance of the site and its immediate surrounds was previously undertaken as part of the Phase 1 desk study on the 17th July 2024 and again on the 13th November 2024, preceding the fieldwork. There were no significant changes from the previous site reconnaissance. A selection of site photographs is presented in Appendix A along with a plan showing the existing site layout annotated with the salient features identified.

Setting, Size and Current Use

The site lies in a residential and agricultural area in the northwest of Breachwood Green and is currently occupied by disused allotments. Access to the site was afforded via Heath Road to the east of the site.

The site consists of a generally flat rectangular parcel of land, aligned approximately east-west. With dimensions of approximately 123m by 45m the site extends to approximately 0.52ha.

On the site area itself, there was a small and shallow plastic membrane lined pond in the southeast area, measuring approximately 4m x 6m x 0.35m deep.

There was an indication of a small development platform and a small demolished building, suspected to be a greenhouse due to an abundance of glass, in the southwest of the site.

In the northwest of the site is a small area of mature trees estimated to be 3m in height. Across the northeast, east, and southeast of the site is an area of mature trees estimated to be over 10m in height.

Along the south of the site there are sporadic trees estimated to be up to 8m in height.

Topography and Surface Conditions

The surrounding area slopes gently down to the southeast towards a dry valley approximately 100m away in that direction. The site itself generally slopes gently down towards the southeast with a gradient of approximately 1.5%. The surface of the site itself is uneven with gentle undulations, anticipated from its past use and working as an allotment.

There were no obvious stains, spills or areas of dying vegetation on the site surface that might indicate areas of contaminated ground.

Vegetation

The site is covered with low grass and herbaceous vegetation with sporadic tree cover, and continuous tree cover in the southeastern portion of the site.

In the northwest of the site is a small area of mature trees estimated to be mature fruit trees and approximately 3m in height. Across the northeast, east, and southeast of the site is an area of mature trees estimated to be over 4m to over 10m in height of mixed type including coniferous, deciduous, and mature Hawthorn. In the southwest of the site was a mature tree estimated to be 8m in height estimated to be deciduous. Along the

west of the site was a row of trees estimated to be Oak and 8m in height, beyond which was a hedgerow estimated to be 3m in height which formed the western boundary.

GEOLOGY

Published Geology

Reference to the BGS 1:50,000 scale map, Sheet 221 for Hitchin dated 1995 and other published geological information on the area indicates that the site is underlain by Quaternary age Superficial geology, the Clay-with-Flints Formation above Cretaceous age Bedrock geology, the Lewes Nodular Chalk Formation and Seaford Chalk Formation.

Superficial Deposits

Clay with flints is a residual deposit formed from weathering of underlying bedrock strata and in this area is typically represented by orange brown and red brown sandy clay with abundant nodules and gravel of flint, with local bodies of sand, silty and gravel.

Bedrock

The Lewes Nodular Chalk Formation and Seaford Chalk Formation of the White Chalk Subgroup, are typically represented by hard chalk interbedded with softer chalk and marls (calcareous mudstone) and nodular flints.

Solution Features

Chalk, as a calcium-carbonate rich rock, is highly susceptible to dissolution by water containing carbon dioxide. This dissolution can create three common types of features within the chalk, grouped together under the generic term 'dissolution features'. These features include:

- **Sinkholes:** Depressions at the ground surface caused by the collapse of overlying chalk or superficial deposits into underground voids created by dissolution. The shape and size are dependent on the underlying void feature.
- **Solution pipes:** A feature in the surface of the chalk caused by increased dissolution in an area of closely spaced discontinuities. These features may, or may not, have a ground surface expression. They occur up to 20m in diameter, though are commonly much smaller.
- **Swallow Holes:** A void within the surface of the chalk where a stream is 'swallowed' by the chalk to flow underground. They often occur at the junction of impermeable strata and chalk. Infilled ancient swallow holes do exist where streams used to flow and may not have any surface expression. They can occur up to 14m in diameter, though commonly a few metres.

Dissolution Feature Risk Assessment

The Groundsure report provided a Very Low hazard rating for the site, with Low risk mapped within 100m southeast of the site and Moderate risk some 300m southeast. The increased risk some 300m southeast of the site is likely associated with the steep slope associated with the dry valley in that direction.

The site location was assessed for its susceptibility to dissolution features, using the risk assessment methodology published by Edmonds, 2001, *Predicting natural cavities in chalk*.

The geology of the site comprises Clay-with-flints Formation overlying the Lewes Nodular Chalk Formation and Seaford Chalk Formation (White Chalk Subgroup).

The site lies on a plateau some 19m above a dry valley some 100m towards the southeast.

The Edmonds assessment provides 'Moderate Low subsidence hazard' classification for the site. It should be appreciated that the subsidence from dissolution features hazard rating is based on the statistical relationship of cavity occurrences, adopting database information referenced within the Predicting Natural Cavities in Chalk, 2001 publication. As a result, this rating is not unequivocal and does not take into consideration updated records or the occurrence of new subsidence features that may have occurred. If the client is risk averse to such features, then further detailed investigation should be undertaken, although the benefits may turn out to be minimal.

Deneholes and Chalk Mines

In addition to the above natural cavities found within chalk strata, man-made cavities, such as deneholes or chalk mines, can also be encountered. Deneholes are produced by ancient chalk mining for flint and are commonly vertical shafts excavated through any overburden material and undermined at the base, similar to bell-pits in coal mining areas. Chalk Mines are more modern and are excavated in a similar way to coal mines. Both are often insufficiently backfilled, initiating collapse at a later date. They are seldom found in areas with a high water table.

The desk study information indicates that the area is in a low risk for chalk mining.

However, there have been several sinkhole collapses in Hertfordshire in recent years which have now been attributed to the collapse of un-recorded chalk mines associated with clay pits where lime from the chalk has been extracted for making bricks. As there is a clay pit recorded 42m to the southeast of the site and a brick kiln 140m south of the site, consideration should be given to the potential for uncharted chalk mine workings/Clay-with-flints Formation pits extending beneath the site itself.

UPDATED INITIAL CONTAMINATION CONCEPTUAL SITE MODEL

An updated qualitative Preliminary Risk Assessment (PRA) has been undertaken in line with the EA's online guidance Land Contamination: Risk Management (LCRM).

It is understood that the development proposals are for residential houses with associated gardens and soft landscaping.

Potential sources of contamination and potential receptors have been assessed using the source-pathway-receptor principle to create a Conceptual Site Model (CSM). This takes into account the fact that a complete pathway must exist between a potential source of contamination and a potential receptor for there to be considered a risk.

POTENTIAL CONTAMINATION SOURCES

Potential Solid-, Liquid- and Vapour-phase Contamination Sources

The results of the previous desk study (ListersGeo report ref: 24.07.031) and both walkovers indicate that the following potential sources of soil or groundwater contamination are present at or in close proximity to the site:

- Made Ground is likely to be present at the site associated with historical construction and demolition works, potentially containing metals or asbestos.
- Contaminants associated with historic use of the site as allotments (potential for small bonfires) including metals and PAHs and pesticides.
- Worked out ground is considered possible to be present associated with nearby historic clay pits and the potential for possible unrecorded workings on the site itself.

Potential Ground Gas Contamination Sources

Two main groups of gaseous-phase contamination have been considered: the gases (including methane and carbon-dioxide) that result from organic decomposition of constituents in the ground; and Radon gas that results from the radioactive decay of thorium and uranium (found, in varying quantities, in most soils and rocks).

In consideration of the source-pathway-receptor methodology for ground gas risk assessment set out in CIRIA C665, the sensitivity of the residential development is considered to be high.

The site is located in an area where the risks from ground gases are considered to be low. We have therefore provisionally assessed the risk of ground gas impacting the site, by reference to the CL:AIRE research bulletin RB17, "A pragmatic approach to ground gas risk assessment" 2012.

The following potential sources have been assessed:

- No credible sources or pathways for landfill gas migration from an off-site landfill have been identified.
- The site has not been a registered landfill.
- Any Made Ground present is not expected to be 5m deep or an average of 3m in thickness.
- The site does not lie on a potential naturally organic soil.

- Radon protection measures are not required for this development.

Therefore, no significant sources of ground gases have been identified for the site.

RECEPTORS

The following most sensitive receptors have been identified at the site:

Human Health – Long Term Exposure

- End users of the site - the future residents.
- Nearby residents

The critical receptor is a child under the age of six.

Human Health – Short Term Exposure

- Construction workers (during redevelopment)
- General Public (during redevelopment)
- Maintenance Workers

The critical receptor is an adult.

Controlled Waters and the Environment

- The Lewes Nodular Chalk Formation and Seaford Chalk Formation Principal Aquifer beneath the Clay-with-flints Formation
- Zone 2 Source Protection Zone – considered to be associated with the chalk beneath the Clay-with-flints Formation

Infrastructure

- Substructures
- Water supply pipes

PATHWAYS

It is considered that a number of potential pathways exist between these potential sources and the above identified receptors. The viability of these pathways is discussed in the preliminary risk assessment.

Human Health

- Direct soil ingestion in areas of exposed soil
- Ingestion of soil attached to homegrown produce
- Ingestion of homegrown produce with contamination uptake
- Inhalation of indoor and outdoor vapours and dust
- Dermal contact with contaminated soil

Controlled Waters and Environmental

- Migration/leaching of contaminants through the unsaturated zone
- Migration of contaminants through the groundwater
- Movement of contaminants through drains or services runs

Infrastructure

- Leachable or corrosive contaminants within the soil
- Corrosive contaminants within the groundwater

PRELIMINARY RISK ASSESSMENT

Based on the desk study research, the following potentially-complete pollutant linkages have been assessed and in accordance with CIRIA C552, a consequence and probability rating has been applied to each potential contamination source to create an overall risk rating. The definitions and methodology are presented in Appendix D and the results are presented in the following table:

ON AND OFF-SITE SOURCES

Potential Source	Pathway	Potential Receptor	Revised Probability	Consequence	Revised Risk Classification	Explanation
Contaminants within the shallow soils associated with use as allotments, historic development, and nearby historic brick kiln, and Made Ground <i>heavy metals, PAH, TPH, asbestos and pesticides</i>	Ingestion	End Users - Residents	Low likelihood	Medium	Moderate/Low	On-site contamination of shallow soils considered possible with long term risk to future residents in areas of gardens and soft landscaping.
	Dermal Contact	Nearby Residents	Unlikely	Medium	Low	Exposure to maintenance and construction workers can be mitigated by use of appropriate PPE and maintaining good hygiene levels.
	Inhalation	Construction Workers	Low likelihood	Mild	Low	
	Migration through unsaturated zone, groundwater, drains or service runs	Principal Aquifer beneath the Clay-with-flints Formation	Low likelihood	Mild	Low	There is a Potable Water Supply abstraction located 986m NE of the site and the site is within a Source Protection Zone 2. Due to the low permeability of the overlying superficial deposits it is considered unlikely the Principal aquifer will be at any significant risk in this location.
	Direct Contact	Infrastructure	Unlikely	Medium	Very Low	Sulphate bearing soils are not anticipated Contamination which may affect water pipes is unlikely

An intrusive Phase 2 geoenvironmental investigation and risk assessment will be required to validate this CSM.

INITIAL GEOTECHNICAL GROUND MODEL

The anticipated geology beneath the site comprises limited or shallow Made Ground overlying the Clay-with-flints Formation which in turn overlies the Lewes Nodular Chalk Formation and Seaford Chalk Formation (White Chalk Subgroup).

The previous desk study had identified Low risk with regards to shrinking and swelling clays and Very Low risk with regards to collapsible deposits, ground dissolution of soluble rocks and landslides.

A moderate-low hazard rating for natural cavities has been indicated based on the Edmunds assessment. Furthermore, there are no recorded natural cavities within 500m of the site.

Where such features are absent, shallow foundations are likely suitable founded within either the competent Clay-with-flints Formation and or White Chalk Subgroup.

Further consideration should be given to potential unrecorded chalk mines/Clay-with-flints Formation pits extending beneath the site.

The Clay-with-flints Formation, if selected as a bearing stratum, may present seasonal and tree-related volume-change hazards to foundations.

At this stage, therefore, the main potential geotechnical hazards for the site are considered to be,

- Deepened foundations due to vegetation influence
- Potential for dissolution features
- Potential for uncharted mining beneath the site

The intrusive investigation has been implemented to address these main issues and establish any potential problems for foundations and the general development of the site.

EXPLORATION AND TESTING

As part of the Phase 2 intrusive investigation, a total of eight exploratory holes were formed at the site. The works comprised:

- Three continuous tube sampler boreholes (CT01 to CT03)
- Five mechanically-excavated trial pits (TP01 to TP05)
- In-situ testing (including Standard Penetration Tests and Hand Shear Vane tests)
- Geotechnical laboratory testing
- Chemical laboratory testing

The exploratory holes were formed on the 13th November 2024.

Co-ordinates of the boreholes and trial pits were approximated on the basis of field measurements and extracted from freely available georeferenced online information.

The positions of all exploratory holes undertaken at the site as part of this investigation can be seen on the Exploratory Hole Location Plan in Appendix A. The logs, and field test and monitoring results are provided in Appendix B and the results of the laboratory testing are provided in Appendix C.

Engineering conclusions given in this report are based on data obtained from these sources, but it should be noted that variations, which affect these conclusions, may inevitably occur between and beyond the test locations. Also, water levels may vary seasonally and with other factors.

SAMPLING STRATEGY

The investigation was undertaken in accordance with the scope of works agreed with the client's structural engineer. The positions of the exploratory holes were selected by ListersGeo to provide a wide coverage of information on the site area.

As the desk study and walkover survey had identified a number of potential pollution sources at the site several of the exploratory holes were targeted on these sources. These included:

Potential Source	Type	Exploratory Hole(s)
Allotment (site wide)	Semi regular pattern herringbone	All
Historic structure in the southern area of the site	Point	CT01 and TP05
Nearby historic brick kiln	Diffuse	CT01, CT03, TP04 and TP05

METHODOLOGY

Health and Safety

Prior to commencement of boring and excavation, to minimise the dangers from/to buried services, the proposed locations were scanned using a Cable Avoidance Tool. At the borehole and probe locations, a service avoidance pit was dug, using insulated hand tools, to a depth of around 1.0m below ground level (bgl). No buried services were encountered in the locations of the exploratory holes.

Exploratory Holes

Trial pits TP01 to TP05 were excavated with an 8-tonne rubber-tyred backhoe excavator to a maximum depth of 3.00m, under the supervision of a geotechnical engineer, who made a record of the arisings. Disturbed samples were taken at selected depths down to the base of the holes for subsequent laboratory testing and inspection. Measurements of shear strength were taken using a hand shear vane on samples retrieved from the trial pits, where possible. On completion, all trial pits were carefully backfilled with arisings in thin layers, ensuring that excavated material was replaced in the same order as it had been removed.

Continuous tube sample boreholes CT01 to CT03 were put down using an Archway Competitor Dart rig to a maximum depth of 6.00m. Boreholes were advanced using a plastic lined steel tube sampling system, driven into the ground by a top drive percussive hammer. A near continuous 85mm to 55mm diameter core sample was recovered for subsequent examination, sub-sampling and laboratory testing. Standard Penetration Tests (SPTs) were taken at 1.0m intervals and the energy ratio for the hammer used for these SPT tests was 79%. Measurements of unconfined compressive strength were made in the tube samples in the field using a pocket penetrometer.

Correction to the field 'N' values (to 'N₆₀' values) for the effects of energy delivery in line with the recommendations given in BS EN ISO 22476-3, 2005, National Annex A.

On completion the boreholes were backfilled with arisings, ensuring that excavated material was replaced in the same order as it had been removed up to approximately 6.00m depth below the existing ground level.

GROUND CONDITIONS

The intrusive investigation revealed that the general succession of strata was as follows: a layer of Topsoil above Clay-with-flints Formation overlying the Lewes Nodular Chalk Formation and Seaford Chalk Formation to the full depth of the investigation at 6.00m.

The general succession of strata revealed by the fieldwork is summarised below, followed by further details of each:

Stratum	Locations encountered	Stratum			Comments
		Top (m)	Base (m)	Thickness (m)	
Topsoil	All	GL	0.20 to 0.40		
Made Ground	TP03	0.30	0.70	0.40	
Clay-with-flints Formation	All	0.20 to 0.70	>3.00 to >6.00 (proven to 4.90)	>2.80 to >5.60 (proven as 4.50)	Shallower towards the south (base proven in CT03)
Lewes Nodular Chalk Formation and Seaford Chalk Formation	CT03	4.90	>6.00	>1.10	

TOPSOIL

Topsoil was encountered at each from ground level down to depths of between 0.20m and 0.40m, with an average thickness of 0.30m.

The Topsoil comprised, in general, grass overlying dark brown, slightly gravelly, silty, clay with occasional rootlets and rare fragments of brick.

(It should be noted that use of the term, Topsoil, is in accordance with BS 5930 alone and does not imply compliance of these horizons with any other standard).

MADE GROUND

Made Ground was encountered at TP03 only, below topsoil at 0.30m down to depths of 0.70m.

The Made Ground soils comprised, light brown and orange brown, slightly sandy, slightly gravelly, silty, clay. The gravel content was recorded as angular to rounded, fine and medium of quartzite, flint and brick.

The results of the field strength tests, and other relevant data, are summarised below:

Parameter	Range	Comments
Undrained Shear Strength (kPa)	55	From Hand Shear Vane tests Medium strength (BS 5930-2015, Table 9)

Laboratory testing revealed the following:

Parameter	Range	Comments
Water Content (%)	23	-

CLAY-WITH-FLINTS FORMATION

Clay-with-flints Formation deposits were encountered at each location from between 0.20m and 0.70m depth, down to the base of the trial pits at 3.00m depth, and the boreholes (CT01 and CT02) at 6.00m depth and proven down to 4.90m depth in CT03.

The Clay-with-flints Formation comprised, in general, brown mottled grey and orange brown mottled red brown slightly sandy, slightly gravelly and locally gravelly at depth, clay, locally silt at depth with low cobble content and occasional black speckles at depth.

The gravel and cobble content were recorded as angular to subrounded of flint.

The results of the field strength tests, and other relevant data, are summarised below:

Parameter	Range	Comments
Undrained Shear Strength (kPa)	55 to 78	From Hand Shear Vane tests Medium to High strength (BS 5930-2015, Table 9)
SPT ' N_{60} ' value	18 to 46 (50 and 55 discounted)	Tentatively equivalent to undrained shear strengths of between 81kPa and 207kPa (using Stroud, f_1 , conversion factor = 4.5). Medium to Very High strength (BS 5930-2015, Table 9)

SPT testing revealed within the Clay-with-flints Formation generally increased in strength with depth, however the locally high SPT ' N_{60} ' value of 50 and 55 at 3.00m at CT01 and CT02 are likely influenced by the cobbles of flint encountered and have therefore been discounted.

Laboratory testing revealed the following:

Parameter	Range	Comments
Water Content (%)	14 to 42	-
Liquid Limit (%)	35 to 76	CLAY/SILT of Low to Very High Plasticity (BS5930 Casagrande)
Plastic Limit (%)	18 to 41	
Plasticity Index (%)	6 to 36	
Modified Plasticity Index (%)	7 to 34	Non-shrinkable and Shrinkable soil of Low and Medium Volume-Change Potential (NHBC Standards)
Portion <63mm and >2mm (%)	37.5 to 47.8	Gravel fraction
Portion <2mm and >63µm (%)	4.4 to 11.5	Sand fraction
Retained on 425µm sieve (%)	3.5 to 75.6	BS1377 'coarse soil' fraction
Passing 63µm sieve (%)	24.4 to 96.5	Fines (silt/clay) fraction

Parameter	Range	Comments
Undrained Shear Strength (kPa)	45 to 120	Converted from Pocket Penetrometer (using conversion factor of 30). Medium to High strength (BS 5930-2015, Table 9)
Undrained Shear Strength (kPa)	70 to 111	From Hand Shear Vane tests Medium to High strength (BS 5930-2015, Table 9))

LEWES NODULAR CHALK FORMATION AND SEAFORD CHALK FORMATION

The Lewes Nodular Chalk Formation and Seaford Chalk Formation (White Chalk Subgroup) soils were encountered at CT03 only, in the southern area of site, from 4.90m down to the base of the borehole at 6.00m depth.

The White Chalk Subgroup comprised, Structureless Chalk, Grade Dm, composed of cream white, slightly gravelly, silt with rare thin veins of brown clay. The gravel was recorded as angular and subangular, fine of low density chalk.

It should be noted that Chalk can be significantly affected by percussive sampling methods and that the borehole descriptions of the Chalk reflect this. It is likely that the in-situ state of the Chalk is less weathered than indicated by the borehole logs.

The results of the field strength tests, and other relevant data, are summarised below:

Parameter	Range	Comments
SPT ' N_{60} ' value	5	Tentatively equivalent to undrained shear strengths of between 22 kPa (using Stroud, f_1 , conversion factor = 4.5). Low strength (BS 5930-2015, Table 9)

Laboratory testing revealed the following:

Parameter	Range	Comments
Water Content (%)	36	-
Liquid Limit (%)	35	SILT of Low Plasticity (BS5930 Casagrande)
Plastic Limit (%)	29	
Plasticity Index (%)	6	
Modified Plasticity Index (%)	4.4	Non-shrinkable
Retained on 425µm sieve (%)	33	BS1377 'coarse soil' fraction
Passing 63µm sieve (%)	67	Fines (silt/clay) fraction

GROUNDWATER

Groundwater was not encountered in any of the exploratory holes during the fieldwork down to 6.00m depth below the existing ground level, for the short time that the holes were open.

OBSERVED SOIL CONTAMINATION

No visual or olfactory signs of contamination were noted during the fieldwork.

CONCRETE AGGRESSION TEST RESULTS

The results of laboratory concrete aggression tests on selected samples of soil are summarised below:

Stratum	Water-soluble Sulphate SO ₄ (mg/l)	pH (pH units)	Total Sulphate (% SO ₄)	Total Sulphur (% S)	Number tested
Topsoil	19.5 to 71	6.9 to 7.3	-	-	3
Clay-with-flints Formation	13.1 to 230	6.5 to 8.2	0.03	0.013	9

N.B. Total sulphate is determined using the acid-soluble sulphate method

GROUND CONTAMINATION ASSESSMENT

The contamination risk assessment has been undertaken in line with the EA's online guidance Land Contamination: Risk Management (LCRM) in order to validate the Preliminary Risk Assessment (PRA) using Generic Quantitative Risk Assessment (GQRA), followed by Detailed Quantitative Risk Assessment (DQRA) if required.

SOIL TESTING

Four samples of Topsoil and two samples of natural soil collected on site during this investigation were tested for a range of constituents of potential concern (CoPC). The majority of the samples to be tested were recovered from the test locations targeting the potential sources of contamination listed in the Conceptual Site Model

The suite of testing carried out on the samples was decided upon following consultation of R&D CLR Publications, published as part of the Contaminated Land Exposure Assessment (CLEA), a joint venture between the Department for Environment, Food and Rural Affairs (DEFRA) and the EA.

Due to the former use of the site as an allotment, one sample was tested for the presence of organic pesticides and herbicides.

The test suite included:

Group	Details
Asbestos	Screening for ACMs and fibres with the naked eye and microscopy
Inorganic substances	Arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc Sulphates and magnesium
Organic substances	16 (EPA) speciated polycyclic aromatic hydrocarbons (PAH) Total petroleum hydrocarbons (TPH) Organic pesticides
Other	pH

Unless explicitly stated on the laboratory report, the soil samples were tested to obtain 'Total' values within the soil. The results of the chemical tests from this investigation are included in Appendix C.

RISK ASSESSMENT GUIDELINES – HUMAN HEALTH

The human health risk assessment has been undertaken using the guidance provided in the EA's LCRM guidance and the CLEA guidelines.

This assesses risks associated with the ingestion, dermal contact, and vapour inhalation pathways related to contaminated soils and groundwater. Risks associated with the inhalation of Ground Gas, for example that resulting from landfill, is not addressed by LCRM. The assessment for ground gases has been undertaken separately in the Ground Gas Risk Assessment section of this report.

Human health assessment criteria used are based upon the proposed final land use of the site. As the site is to be redeveloped to accommodate a residential development with gardens, the Generic Assessment Criteria (GACs) for the standard land-use, 'Residential with homegrown produce' have been used.

Consideration has also been given to potential risks to groundworkers coming into contact with the soil during demolition or construction phases.

The results of the soil samples tested have been compared to the following published assessment criteria:

Category 4 Screening Levels (C4SLs)

Published in March 2014 by DEFRA, a limited number of generic Category 4 Screening Levels (C4SLs) were produced to support the revised Statutory Guidance to support Part 2A of the Environmental Protection Act 1990, which was published in April 2012. This Guidance introduced a new four-category system for classifying land under Part 2A for cases of a Significant Possibility of Significant Harm to human health, where Category 1 includes land where the level of risk is clearly unacceptable and Category 4 includes land where the level of risk posed is acceptably low.

Further C4SLs have been and are being produced by CL:AIRE, with support from SoBRA and SAGTA, for a limited number of volatile organic compounds, as time allows.

Suitable 4 Use Levels (S4ULs)

To supplement the small number of C4SL, a set of Suitable for Use Levels (S4UL) were produced, in 2015, by Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH), using the EA's Contaminated Land Exposure Assessment (CLEA) software, version 1.06 (2009), and the revised assumptions used in deriving the C4SL. The S4UL are more conservative than the C4SL and are derived to represent the minimal levels of risk to human health as described in the EA's SR2 guidance, with the intention of being 'suitable for use' under planning.

Data Sources

Where chemical specific data has been used in the above assessments, data has been sourced from available TOX reports, published by DEFRA, The Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) literature and toxicological and physical data obtained from EA Publication, 'Human Health Toxicological Assessment of Contaminants in Soil', August 2008.

RISK ASSESSMENT GUIDELINES – CONTROLLED WATERS

The procedures set out in EA's RTM *Hydrogeological risk assessment for contaminated land* (2006), have been followed.

RESULTS OF ASBESTOS SCREENING

Screening for the presence of asbestos did not reveal any asbestos containing material (ACM) or fibres in the three samples of Topsoil tested.

RESULTS OF TOTAL SOIL TESTS

Results of the total soil testing have been compared to relevant published GAC as discussed above. For S4ULs, a range of values have been published for the organic contaminants based on the soil's organic matter content.

As site-specific soil organic content was not determined for the site, where S4ULs have been adopted for the organic contaminants, analytical results have been compared to the most conservative value, which is that for soils of 1% soil organic matter (SOM) as a preliminary screening tool.

Of the remaining determinands tested for, none recorded values higher than their relevant GAC for human health for a residential with homegrown setting.

The GACs are conservative screening criteria and used initially to determine whether or not a site may pose an unacceptable risk to human health and whether further work or assessment may be required. An exceedance of a GAC does not mean that remediation is required.

Inorganic Substances

Of all of the inorganic substances tested no significantly elevated concentrations were recorded in comparison to typically naturally occurring or urban background levels; and no values were recorded in excess of the referenced GACs.

Total Petroleum Hydrocarbons (TPH)

Three of the four samples tested recorded a total TPH concentration above the limit of detection of 10mg/kg. However, the values were relatively minor (18mg/kg to 25mg/kg) and the individual bands were significantly below the referenced GACs.

Polycyclic Aromatic Hydrocarbons (PAH)

Three of the four samples recorded total PAHs concentrations of 2.52mg/kg to 8.4mg/kg above the limit of detection at 2.0mg/kg; and the individual PAH concentrations were significantly below the referenced GACs.

Organic Pesticides

Of all of the organic pesticides tested in one sample of topsoil, none were recorded above the limit of detection of 10µg/kg.

HUMAN HEALTH RISK ASSESSMENT

The following quantitative risk assessment has been carried out using the source-pathway-receptor principle. Potential sources of contamination identified in the Conceptual Site Model (CSM) have been assessed using the CLEA Guidelines. This takes into account the fact that a complete pathway must exist between a potential source of contamination and a potential receptor for there to be considered a risk.

The potential human receptors evaluated for their individual risk are:

Long-Term Exposure

1. End users of the site – the future residents
2. Nearby residents.

Short-Term Exposure

3. Construction workers and the general public (during redevelopment).
4. Maintenance workers

SOIL CONTAMINATION RISK

The qualitative preliminary risk assessment (PRA) identified a number of potential sources of contamination at the site. Following the intrusive investigation and contamination testing the CSM has thus been reassessed.

The results of the chemical testing are summarised below relating to each potential source:

Potential Source	Chemical Testing Comments
Allotment	No elevated concentrations of pesticides were recorded in that area (TP02)
Historic structure in the southern area of the site	General low levels of TPHs and PAHs were recorded which were below the GACs for this site
Nearby historic brick kiln	General low levels of metals, TPHs and PAHs were recorded which were below the GACs for this site

None of the soil contamination tests carried out as part of this investigation revealed elevated concentrations of contaminants in the soil when compared with the relevant GACs. As such there is considered to be no significant risk of significant harm to the above referenced long term exposure receptors.

Conclusion

It is considered that there are no significant risks to human health from the soil or groundwater contamination at the site. There is, therefore, no requirement for investigation or remedial measures prior to the proposed redevelopment.

CONSTRUCTION WORKERS

For construction workers and maintenance workers that are exposed to the ground, there is a short-term exposure risk (at each site they attend, which contributes to an overall lifetime exposure risk) and the pathway of primary concern is 'direct soil ingestion'.

To reduce the risk to as low as reasonably practicable for the construction workers it is recommended that appropriate health and safety measures be implemented along with the use of Personal Protective Equipment (PPE). All personnel coming into contact with the soil, ground workers in particular, should be instructed to use gloves when on site to avoid dermal contact and restrict inadvertent hand-to-mouth ingestion. Washing facilities should be provided for the site staff to use and should be used prior to eating or smoking. Reference should be made to the HSE Document, "Protection of Workers and the General Public during Development of Contaminated Land".

Asbestos

Although no asbestos was identified in the soils at the site, the presence of asbestos containing material (ACM) and fibres within Made Ground at any site cannot be ruled out. Groundworkers should be made aware of potential risks of asbestos during the groundworks.

Asbestos in soils is not normally hazardous to humans unless it is disturbed and fibres become airborne and can be inhaled. Asbestos is most frequently encountered bonded in cement in fragments of corrugated roofing sheets, in tiles or in insulation materials. Any groundworks involving asbestos needs to be appropriately controlled.

DISCOVERY STRATEGY

The developer should prepare a method statement to cater for unexpected contamination uncovered during the groundworks. Should any suspicious soils or materials be encountered that differ from our ground model, work should cease in that area and further assessment will be necessary by a suitably qualified geoenvironmental engineer. This may require further intrusive investigation or soil sampling along with supplementary contamination risk assessment and potentially remediation. Any further recommendations will require regulatory approval.

REGULATORY APPROVAL

We recommend that the conclusions of this report are agreed with the relevant Local Authority at the earliest stage, to reduce potential delays to the development.

GROUND GAS RISK ASSESSMENT

The preliminary ground gas risk assessment indicated that gas monitoring was not required as there were no significant sources of ground gases indicated on or in close proximity to the site.

The intrusive investigation did not encounter any significant organic rich deep Made Ground or Alluvial soils. The fine-grained soils of the Clay-with-flint Formation were also encountered beneath the site proven down to some 4.90m depth which are considered to be relatively impermeable preventing a pathway for any potential ground gasses to the proposed properties. Therefore, the intrusive investigation confirmed the conceptual site model and no further ground gas risk assessment is required.

Radon Gas

The BGS advises that radon gas protection measures are not necessary for buildings without underground rooms at the site.

Regulatory Approval

The above conclusions regarding ground gases should be agreed with the relevant local Regulatory Authority as soon as possible prior to development.

CONTROLLED WATERS RISK ASSESSMENT

The following Controlled Waters risk assessment has been carried out in accordance with the procedures set out in the EA's RTM *Hydrogeological risk assessment for contaminated land* (2006). Using the source-pathway-receptor principle, this takes into account the fact that a complete pathway must exist between a potential source of contamination and a potential receptor for there to be considered a risk.

The potential Controlled Waters receptors considered during this risk assessment were:

- The Lewes Nodular Chalk Formation and Seaford Chalk Formation Principal Aquifer beneath the Clay-with flint Formation
- Zone 2 Source Protection Zone

DISCUSSION

The site is underlain by the Clay-with-flints Formation (Unproductive Aquifer), limiting any potential pathways leaching from the surface.

Additionally, the Clay-with-flints Formation soils encountered beneath the site were predominantly fine-grained soils and therefore considered to be relatively impermeable further preventing any potential pathways from significant migration of any potential shallow contaminants.

The results of the soil testing did not identify any significantly elevated concentrations of hydrocarbons.

No point sources of contamination or gross contamination were identified during the walkover or on examination of exploratory hole arisings. Furthermore, the fieldwork did not encounter any significant visual or olfactory signs of free phase contamination.

It is, therefore, considered that the Principal Aquifer will not be at any significant risk from potential groundwater pollution at this site.

REGULATORY APPROVAL

The EA is the regulatory body charged with protection of controlled waters and may be a consultee in the planning process. We recommend that the conclusions of this report are agreed with the relevant Local Authority at the earliest stage, to reduce potential delays to the development.

INFRASTRUCTURE RISK ASSESSMENT

SUBSURFACE CONCRETE

Using the results of the concrete aggression tests, the concrete design mix recommendations for subsurface concrete have been assessed in terms of BRE Special Digest 1.

In view of the known site history, the site must be considered as a 'brownfield location' The groundwater beneath the site should be considered as mobile.

The classification is as follows:

Type of Site	Groundwater	Characteristic Sulphate			Characteristic	
		Soil Soluble (mg/l)	Ground-water (mg/l)	Total Potential (%)	Design Sulphate Class	pH (pH units)
Brownfield	Mobile	230	n/a	0.039	DS-1	6.5

The above assessment provides an Aggressive Chemical Environment for Concrete (ACEC) class of AC-1s.

UNDERGROUND SERVICES

Organic contaminants, such as petroleum or polycyclic aromatic hydrocarbons, may attack plastic pipes and remedial measures may be required. The pathway with the contaminated soils could be removed by sleeving the pipe with another material or by removing the contamination source itself.

It should be noted that the utility companies often have their own local guidelines and standards on levels of shallow soil contamination in the ground that may or may not be acceptable for the installation of below ground services. These standards may be different to those specified for assessing risks to human health and groundwater.

The local requirements should be obtained from the particular service supply company as soon as possible to avoid unexpected delays or additional development costs.

Guidance can be sought from the UK Water Industry Research (UKWIR), 'Guidance for the selection of water supply pipes to be used in brownfield sites', reference 10/WM/03/21, 2010. This document proposes that the assessment of the hazard to potable water supply pipes should be based on the following pathways: contact with migrating groundwater, permeation of vapour, and direct contact with soil.

Approval should be sought for the type of pipes proposed before they are installed.

Additional Mitigation Measures

As the site lies in an area where there is the potential for ground dissolution, mitigation measures should be considered for services runs.

For drainage systems, flexible jointed pipes should be used wherever possible and particular care should be taken for the avoidance of leaks in both water supply and drainage pipe work.

In addition, underground drainage and water pipes should be regularly checked for leaks or damage. Prompt repair of any leaking water pipes, surface water drains or associated underground services should then be undertaken.

REVISED CONCEPTUAL SITE MODEL

Following GQRA the CSM has been updated and the Relevant Pollutant Linkages (RPLs) are presented in the following table.

ON AND OFF-SITE SOURCES

Potential Source	Pathway	Potential Receptor	Revised Probability	Consequence	Revised Risk Classification	Explanation
Contaminants within the shallow soils associated with use as allotments, historic development, and nearby historic brick kiln, and Made Ground <i>heavy metals, PAH, TPH, asbestos and pesticides</i>	Ingestion Dermal Contact Inhalation	End Users – Residents	Unlikely	Medium	Low	None of the soil contamination tests carried out as part of this investigation revealed elevated concentrations of contaminants in the soil when compared with the relevant GACs. As such there is considered to be no significant risk of significant harm to the above referenced receptors.
		Nearby Residents	Unlikely	Medium	Low	
		Construction Workers	Unlikely	Mild	Very Low	
	Migration through unsaturated zone, groundwater, drains or service runs	Principal Aquifer beneath the Clay-with-flints Formation	Unlikely	Mild	Very Low	Due to the low permeability of the overlying superficial deposits and generally low limited or low concentrations of contaminants is it considered unlikely the Principal aquifer will be at any significant risk in this location.
	Direct Contact	Infrastructure	Unlikely	Medium	Low	No elevated sulphates recorded. Use appropriate Concrete Design Classification DS-1 AC-1. Check water pipe specification with regional water supply company be anticipated.

The revised CSM indicates that no remedial measures are required at this site and risks to human health and Controlled Waters are considered to be Very Low/Low.

Whilst no remedial measures are required at this site, the developer should ensure that the thickness and physical quality of the soils in the designated areas of soft landscaping are suitable for the intended use.

GEOTECHNICAL ENGINEERING CONCLUSIONS

It is understood that the proposed development comprises the construction of residential housing with associated hardstanding and gardens. A proposed site layout is included in Appendix A.

REVISED GROUND MODEL

The exploratory work from this investigation has proven the expected general strata sequence comprising Topsoil overlying medium to very high strength Clay-with-flints Formation down to between 4.90m and 6.00m.

It should be noted that the high SPT values (50 and 55) recorded in the Clay-with-flints Formation soils are likely influenced by the presence of flint cobbles typically found within these deposits, it is considered that medium to high strength is appropriate for these deposits.

Low strength chalk was encountered at CT03 only, at 4.90m and down to beyond the base of the borehole at 6.00m depth, where the Clay-with-flints formation was found shallower towards the south.

It should be noted that Chalk can be significantly affected by percussive sampling methods and that the borehole descriptions of the Chalk reflect this. It is likely that the in-situ state of the Chalk is less weathered than indicated by the borehole logs.

Made Ground was locally encountered in TP03 below Topsoil, at 0.30m and down 0.70m depth.

Groundwater was not encountered in the exploratory holes during the investigation to 6.00m depth below existing ground level.

The laboratory testing indicates the Clay-with-flints Formation is of low and medium volume change potential of low to high plasticity as defined by NHBC Building Standards, Chapter 4.2. As such, for conservatism, these deposits should be considered to be medium volume change potential.

CHALK CAVITY HAZARDS

The Groundsure report provided a Very Low hazard rating for the site, with Low risk mapped within 100m southeast of the site and Moderate risk some 300m southeast. The increased risk some 300m southeast of the site is likely associated with the steep slope associated with the dry valley in that direction.

The Edmonds assessment provides 'Moderate Low subsidence hazard' classification for the site, although this differs from the hazard rating provided in the Groundsure report (Very Low risk), the 'Moderate Low' hazard rating is considered appropriate for the site. However, our subsequent investigations have not recorded obvious evidence of significant loose/weak or voided ground. Therefore, as with all sites where chalk deposits are present, site operatives should remain vigilant, report any loosening or weak zones of soil and seek advice from a specialist.

Limitations & Considerations

Natural geological features can develop unpredictably in the upper weathered surface of the chalk and, if present, require special measures to be incorporated in foundation design. The desk study records show no

underground workings within 1km of the site, however the site itself is within a wider non-coal mining area, where there is a possibility of sporadic underground mining of restricted extent. As there is a clay pit recorded 42m to the southeast of the site and a brick kiln 140m south of the site, the possible presence of unrecorded chalk mines/ Clay-with-flints Formation pits beneath the site cannot be entirely ruled out; no clear evidence to support their presence was found by this investigation.

Further consideration should be given to potential unrecorded chalk mine/Clay-with-flints Formation pits extending beneath the site.

The risk assessment hazard rating is proportionate to information available at this time and if the client is risk averse, consideration should be given to further work as site conditions allow, such ground penetrating radar and or probing along the footprint of proposed buildings. As a minimum, we recommend a watching brief is prepared during the groundworks and should any evidence of loosened or weak zones of ground be encountered, further advice should be sought from a geotechnical specialist.

Consideration should be given to potential changes in the chalk geology in the future, due to variations in the water table, leaking drains/pipes or influences from off-site drainage.

SITE EXCAVATION

Conventional hydraulic plant should be satisfactory for excavating foundation and service trenches within the Clay-with-flints Formation. Specialist breaking plant may be required to assist in the removal of any former foundations or floor slabs, if present.

In line with HSE guidelines, all excavations requiring personnel access should be adequately supported to avoid the risk of collapse. Consideration should also be given to the stability of open trenches where personnel are working in close proximity. During the fieldwork, excavations within the remained stable for the short time that the trial pits/boreholes were open.

Shallow excavations are likely to remain dry in the short term. It should be appreciated, however, that seasonal variations may exist and hence groundwater entries may occur particularly during wetter months or after periods of inclement weather.

It would be prudent to carry out all ground works in the late summer or autumn when groundwater levels and flows are usually at their lowest.

Foundation excavations should be inspected by a suitably qualified person to assess the soil and groundwater conditions. If conditions differ from those identified within this report, then further assessment may be required. Any roots, organic matter, 'soft/loose' ground, or otherwise unsuitable material, encountered at founding depth should be removed prior to pouring of concrete.

Consideration should be given to the effects of trees and shrubs on service runs that cross the site. Soil movements brought on by the influence of vegetation can severely disrupt the drain runs and mains services, and measures should be incorporated into the excavations to allow for future ground movements.

Should any trees be removed from site, care should be taken to ensure the root ball of each tree is completely removed from the ground. Given time, any remnant root fragments may weather down to produce localised areas of soft organic soils which may induce local differential settlements.

Where new foundations are placed over a felled tree, consideration should be given to spanning these features to ensure no soft spots result in localised settlement.

FOUNDATION SOLUTIONS

Shallow Foundations

Low strength chalk was encountered at depth in CT03 (southern area of site) at 4.90m. This could possibly be attributed with percussive sampling methods and that the borehole descriptions of the Chalk reflect this. It is likely that the in-situ state of the Chalk is less weathered than indicated by the borehole logs.

Notwithstanding this, it should be assumed that low strength chalk is present, the extent of which is not currently well defined and may be shallow in other areas of the site given the potentially karstic nature of chalk, conventional shallow foundations may not be considered appropriate should the low strength horizons be extensive within the White Chalk Subgroup and present at shallower depths across the site. Further investigations are considered necessary in an attempt to further establish the extent and possible cause of the low strength deposits.

Subject to further investigation, the Clay-with-flints Formation is considered to be a suitable bearing stratum for traditional spread foundations.

A minimum foundation depth of 1.0m below existing ground level is recommended, or 0.20m into the top of the formation, whichever is the deeper.

In view of the soft spots within the chalk and to reduce the risks from the assessed Moderate-Low Ground Dissolution Hazard, we recommend that spread foundations should be of the 'cruciform' type, extending beyond the corners and with full reinforcement to span a potential loss of support of suitable size.

Alternatively, a reinforced raft foundation could be utilised, again designed to accommodate an unsupported span, particularly at the corners. The size of the span would have to be agreed with the local building control office but, for preliminary guidance purposes, we suggest an unsupported length/diameter of 3m. It is recommended that early discussions be held with the local building control office to ensure any local building requirements are satisfied in these regards.

The allowable bearing pressure recommended below is made on the assumption of an acceptable total settlement for the proposed structures of 25mm. Should the building design require a significantly different serviceability limit state (tolerance to settlement) then it is recommended that these recommendations be revised accordingly.

At the minimum founding depth provided above, an allowable bearing pressure (or net loading intensity increase) of 110kPa may be adopted for isolated, uniformly loaded, conventional strip footings between 0.45m and 1.00m in width or pad foundations between 1.0m and 2.0m in width.

This allows for a suitable factor of safety against shear failure and should result in acceptable levels of differential and total vertical settlement generally that are likely to take place over a number of years.

If shallow foundations are adopted at the site, it is recommended that foundation excavations are inspected by a suitably qualified engineer, any soft or loose spots removed and replaced with suitably compacted granular fill or lean mix concrete.

Note that additional investigation is recommended at the site prior to adoption of shallow foundation due to the risks associated with the low strength chalk encountered and possible risk of dissolution. This further investigation may reduce the potential risk from dissolution and uncharted mining and therefore allow for conventional shallow foundations for the proposed properties at the site.

Where foundations are to be constructed within the vicinity of existing or former trees or shrubs on this site then they will require deepening in accord with guidelines given in NHBC Building Standards Chapter 4.2. For trees that are not to be removed, mature tree heights should be assumed when determining the foundation depths. The soils should be considered as being of medium volume change potential. A tree survey by a Arboriculturalist could be considered to assist the above.

Where shrinkable soils are present, reference should be made to the NHBC guidelines for the specific requirements for compressible layers, such as Claymaster or Clayshield, to be placed along the sides of foundation excavations or beneath ground beams, in order to accommodate heave forces in the ground where any trees and shrubs are removed in the vicinity of the proposed foundations or if the existing vegetation should die.

Care should be taken to ensure that any new planting in the development will not affect the new foundations.

In order to minimise differential settlement of spread foundations spanning variable soils it is recommended that light reinforcing be placed in the base of foundation excavations to avoid the occurrence of localised movement and the creation of hard spots.

Given the plastic nature of the soils at founding depth, they will be prone to rapid softening when wetted up. In the event that any delays occur between excavating for the foundations, and pouring of the concrete, a blinding layer of concrete should be placed in the base of the open excavations to prevent the occurrence of localized softening. Similarly, in dry conditions, if the soils at the base of the excavation become excessively dried out then the trenches will require re-bottoming prior to concreting.

Pile Foundations

Due to the presence of trees and shrinkable soils, the depth of conventional foundations may prove to be uneconomical and piled foundations could be considered as an alternative solution. Deeper investigation, such as with cable-tool percussion boreholes, is likely to be required, in order to provide the piling contractor with design parameters.

GROUND FLOOR SLABS

The site is underlain by shrinkable soils. The decision as to whether ground floor slabs will be ground bearing or suspended on the main foundations will, in part, depend on the considerations detailed below:

Ground Bearing

All pre-existing building foundations, Fill, Made Ground and disturbed or desiccated soil should be removed from beneath any proposed ground bearing floor area and the exposed surface should be proof-rolled to expose any excessively soft or compressible zones, which should also be removed. Coarse-grained backfill should then be placed in layers and subjected to controlled compaction.

Suspended

In accord with NHBC guidelines: if it is required to deepen the main foundations below 1.50m depth, such as on account of trees or shrubs, then ground floor slab to that building should be suspended.

A void should be left below the floor slab to accommodate future moisture content-related soil movements. This may be achieved by use of a proprietary compressible material such as Clayboard or Cellcore.

Also, a suspended floor slab will be required in shrinkable soils, even in the absence of trees and shrubs, where the soil is seasonally desiccated. Under those circumstances the adoption of a suspended slab is only likely to be avoided if construction of the floor slab takes place during the wetter times of the year.

WORKING PLATFORMS FOR TRACKED PLANT

If construction on the site requires the use of heavy tracked plant then reference will need to be made to the most recent guide for the design of 'Working Platforms for Tracked Plant', 2004, produced by the BRE.

Use of such plant will require construction of either a working platform or an adequate running surface if the subgrade is determined as being already adequate to support the anticipated plant loadings.

The following soil characteristics should be used for preliminary Working Platform design:

Anticipated Subgrade Characteristics Stratum	Typical Depth Range (m)	Soil Type Fine or Coarse	Effective Angle of Shearing Resistance ϕ'_s (degrees)	Undrained Shear Strength S_u (kPa)	Effective Unit Weight γ'_s (kN/m ³)
Made Ground	0.30 to 0.70	Fine	27	55	18
Clay-with-flints Formation	0.20 to 4.90	Fine	27	60 to 100	20

It should be noted that soft spots and zones of poor subgrade may exist on any site at shallow depth that will have a significant influence on the stability of tracked plant. The location of such features will not readily be determined by a general ground investigation for foundation design and more specific investigation at shallow depth may be required before the design of a working platform can be completed.

The advice of a specialist contractor should be sought to determine the most suitable size and thickness of platform required for their specific plant. This will take into account the size of the plant and anticipated loadings imposed on the working platform.

ACCESS ROADS AND PARKING

The structural design of a road or hard standing is based on the strength of the subgrade, which is assessed on the California Bearing Ratio (CBR) scale. With reference to Transport and Road Research Laboratory, Report LR1132 and the laboratory classification tests it is recommended that for formation prepared in the Clay-with-flints Formation, a subgrade CBR value of 3% is adopted for preliminary design purposes based on equilibrium soil conditions, a thin pavement construction, low water table and average construction conditions.

Site conditions should be reassessed at the time of construction and the CBR/pavement design updated accordingly if considered necessary. If pavement construction is undertaken during wetter parts of the year, then a greater pavement thickness or geogrid reinforcement may be required.

Any areas of soft or deleterious material should be excavated and replaced with a properly compacted coarse-grained fill.

The presence of trees will mean that there is potential for soil desiccation issues, which may affect the pavement surfacing within influencing distance. Thus, safeguarding against desiccation in this regard could be considered, such as lime/cement stabilisation to appropriate depth, which can limit shrinkage/swelling desiccation effects by altering the properties of the clay. Alternatively, it could be accepted that some movements may occur, which could be accommodated through flexible surface finishes.

Roads to be adopted by the Local Authority will require more specific testing and verification measures in addition to the results and recommendations presented in this report.

LIMITATIONS AND RECOMMENDATIONS FOR FURTHER WORK

The ground is seldom homogeneous and variations, which affect our conclusions, may inevitably occur between and beyond the test locations. Should ground conditions vary noticeably from our Ground Model, then we recommend further assessment by a suitably qualified person.

Environmental

No elevated concentrations of contaminants were recorded by this investigation and whilst there is considered to be a low risk of contamination at this site, some areas of the site have not been investigated. A Discovery Strategy should therefore be implemented during demolition and groundworks, and should suspicious soils be encountered, work should cease immediately, and the soils be assessed by a suitably qualified engineer.

Waste classification testing could be considered to assist removal of soils, if required.

Geotechnical

Supplementary investigations are recommended (such as additional borehole/dynamic probing) in an attempt to further establish the extent and possible cause of the low strength chalk encountered in the south of site, to further assess the risk from potential dissolution and uncharted mining/pits and to assist the foundation design.

As a precaution, we recommend a watching brief is prepared during groundworks and should any evidence of loosened or weak zones of soil be encountered, then we recommend further advice is sought from a specialist.

Further consideration as to the depth of foundations with respect to the proximity of trees will be required. If strip footings and the required depths are found to be uneconomical then deeper supplementary boreholes may be required to aid pile design.

An assessment of drainage has not been undertaken as part of this report. The fine-grained soils encountered are unlikely to be suitable for traditional soakaways.

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APPENDIX A PLANS



LISTERS GEO

Geotechnical and Geoenvironmental Consultants

Listers Geotechnical Consultants Ltd www.listersgeotechnics.co.uk Tel: 01327 860060

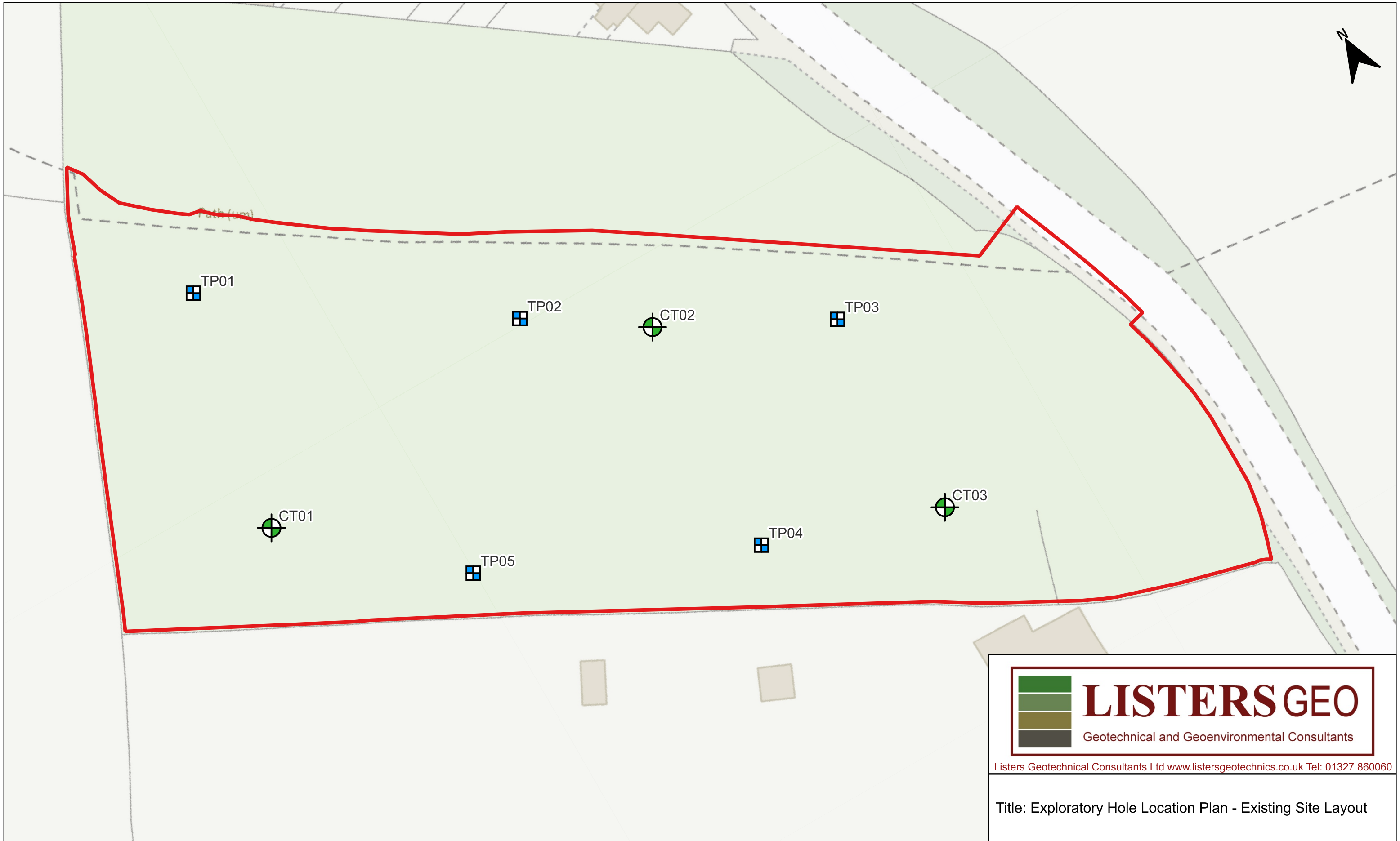
Title: Site Location Plan

Site: Heath Road, Breachwood Green, Hertfordshire,
SG4 8BW

Scale: NTS

Project No: 24.07.031

Drawn By: NA





LISTERS GEO

Geotechnical and Geoenvironmental Consultants

Listers Geotechnical Consultants Ltd www.listersgeotechnics.co.uk Tel: 01327 860060

Title: Exploratory Hole Location Plan - Existing Site Layout

Site: Heath Road, Breachwood Green, SG4 8PL

Key

 Approximate Site Boundary

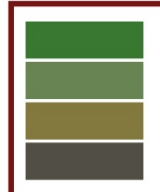
 Continuous Tube Sampler Borehole

 Mechanically-excavated Trial Pit

Reproduced from Ordnance Survey mapping with the permission of the Controller of His Majesty's Stationery Office. Crown Copyright reserved
(Licence No: 100006010)

Scale: 1:400	Job Number: 24.07.031a	Drawn By: YT
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LISTERS GEO

Geotechnical and Geoenvironmental Consultants

Listers Geotechnical Consultants Ltd www.listersgeotechnics.co.uk Tel: 01327 860060

Title: Exploratory Hole Location Plan - Proposed Site Layout

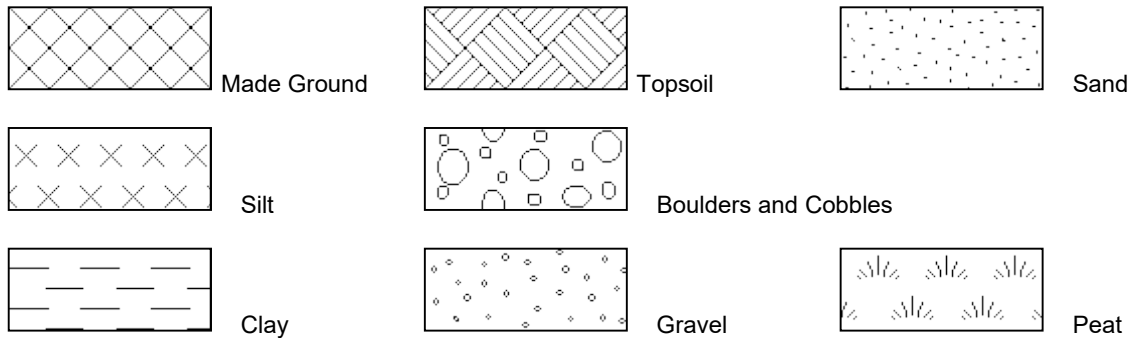
Site: Heath Road, Breachwood Green, SG4 8PL

Scale: 1:400	Job Number: 24.07.031a	Drawn By: YT
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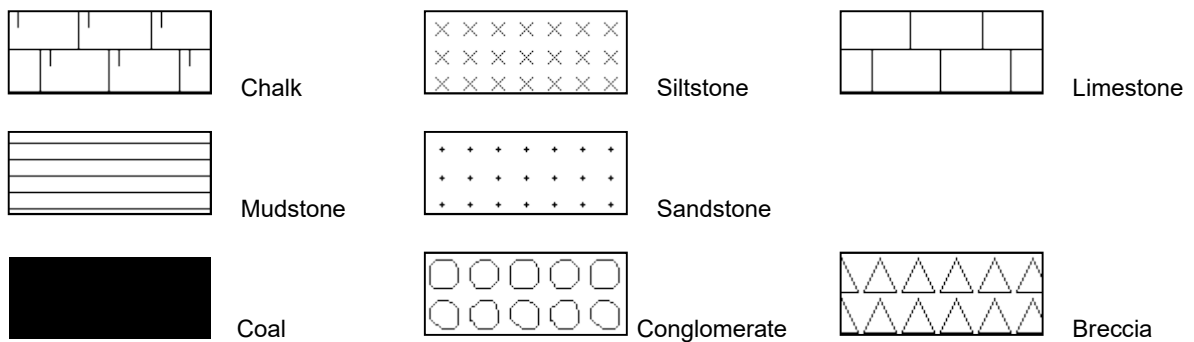
APPENDIX B

FIELDWORK AND TESTING

LEGEND - Soils



LEGEND - Rocks (Sedimentary)



LOG ABBREVIATIONS

W	Water Sample		Water Strike
B	Bulk Sample		Water (Standing Level)
D	Disturbed Sample	PP	Pocket Penetrometer
J	Jar Sample	HV	Hand Vane
U	Undisturbed Sample	SPT	Standard Penetration Test
(No. of blows shown in brackets for U100 samples)		CPT	Cone Penetration Test
WAC	Waste Acceptance Criteria Sample	CBR	California Bearing Ratio
		*	Extrapolated Value

Pocket penetrometer testing provides values of unconfined compressive strength. The results have been converted to an approximate equivalent shear strength which should be used with due circumspection. As the pocket penetrometer tends to overestimate shear strength, we have used an appropriate reduction factor.

LOG KEY

Continuous Tube Sampler Log

Borehole No.

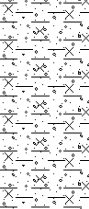
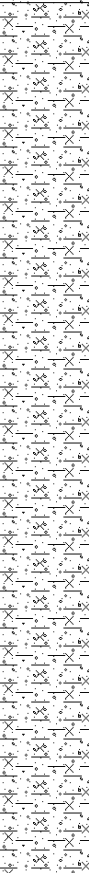
CT 01
Project Location: Heath Road, Breachwood Green, SG4 8PL

Co-ords: 514846E - 222438N

Project Number:
24.07.031a

Level:
Logged By:
Dates: 13/11/2024

 Yuki Tse
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Result						
		0.40 - 1.00	D		0.40			TOPSOIL Grass overlying soft dark brown slightly gravelly slightly sandy CLAY with rare rootlets. Gravel is angular to subrounded of flint and rare brick.	1	
		1.00 - 1.50	D					CLAY-WITH-FLINTS FORMATION Firm brown mottled red brown and light grey slightly sandy gravelly CLAY. Gravel is angular of flint.		
		1.00	PP	2.0kg/cm²						
		1.00	SPT(C)	N=14 (5/3,3,4,4)						
		1.50 - 2.00	D		1.50			CLAY-WITH-FLINTS FORMATION Stiff brown slightly sandy gravelly CLAY with low cobble content and occasional black speckles. Gravel and cobbles are angular to subrounded of flint.	2	
		2.00 - 2.50	D							
		2.00	PP	3.0kg/cm²						
		2.00	SPT(C)	N=32 (15/6,7,8,11)						
		2.50 - 3.00	D							3
		3.00	PP	3.8kg/cm²						
		3.00	SPT(C)	N=42 (18/11,11,11,9)						
		3.50 - 4.00	D							
3.50	PP	3.0kg/cm²					4			
4.00	SPT(C)	N=35 (13/5,7,9,14)								
4.50	PP	3.0kg/cm²								
5.00 - 5.50	D									
5.00	PP	3.2kg/cm²					5			
5.00	SPT(C)	N=29 (11/7,7,6,9)								
5.50	PP	3.2kg/cm²								
6.00	PP	3.0kg/cm²	6.00							
		End of Borehole at 6.00m							6	
									7	

Borehole Diameter: 87mm to 57mm

Groundwater: Not encountered

Instrumentation: Backfilled with arisings

Remarks: Inspection pit excavated to 1.00m


Continuous Tube Sampler Log

Borehole No.

CT 02
Project Location: Heath Road, Breachwood Green, SG4 8PL

Co-ords: 514897E - 222436N

Project Number:
24.07.031a

Level:
Logged By:
Dates: 13/11/2024

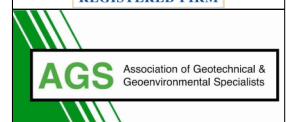
 Yuki Tse
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		0.40 - 1.00	D		0.40			TOPSOIL Grass overlying soft dark brown slightly gravelly slightly sandy CLAY with rare rootlets. Gravel is angular to subrounded of flint and rare brick.	1
		1.00 - 1.50	D					CLAY-WITH-FLINTS FORMATION Firm becoming stiff below 1.50m brown and orange brown mottled red brown slightly sandy slightly gravelly silty CLAY. Gravel is angular to subrounded of flint.	
		1.00	PP	2.2kg/cm²					
		1.50 - 2.00	D						2
		1.50	PP	2.5kg/cm²					
		2.00 - 2.40	D						
		2.00	PP	2.5kg/cm²					3
		2.00	SPT(C)	N=16 (5/3,4,4,5)					
		2.50	PP	3.0kg/cm²					
		3.00 - 3.50	D						4
		3.00	PP	3.5kg/cm²					
		3.00	SPT(C)	N=31 (9/6,8,8,9)					
4.00 - 4.50	D						5		
4.00	PP	3.2kg/cm²							
4.00	SPT(C)	N=31 (8/5,6,10,10)							
4.50	PP	3.2kg/cm²					6		
5.00	PP	3.0kg/cm²	5.00						
5.00	SPT(C)	N=33 (7/6,10,10,7)							
5.50 - 6.00	D						7		
5.50	PP	3.2kg/cm²							
6.00	PP	3.2kg/cm²	6.00						
		6.00	PP	3.2kg/cm²	6.00			End of Borehole at 6.00m	

Borehole Diameter: 87mm to 57mm

Groundwater: Not encountered

Instrumentation: Backfilled with arisings

Remarks: Inspection pit excavated to 1.00m


Continuous Tube Sampler Log

Borehole No.

CT 03
Project Location: Heath Road, Breachwood Green, SG4 8PL

Co-ords: 514916E - 222400N

Project Number:
24.07.031a

Level:
Logged By:
Dates: 13/11/2024

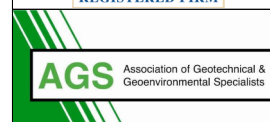
 Yuki Tse
to BS 5930:2015

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Result					
		0.40 - 1.00	D		0.40			TOPSOIL Grass overlying soft dark brown slightly gravelly slightly sandy CLAY. Gravel is angular to subrounded of flint and rare brick and rare brick.	
		1.00 - 1.50	D					CLAY-WITH-FLINTS FORMATION	1
		1.00	PP	1.5kg/cm ²				Firm becoming stiff below 2.00m brown locally mottled grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel and cobbles are angular to subrounded of flint.	
		1.50 - 2.00	D						
		1.50	PP	2.0kg/cm ²					
		2.00	PP	2.8kg/cm ²					2
		2.00	SPT(C)	N=27 (6/3,10,8,6)					
		2.50 - 3.00	D						
		2.50	PP	3.0kg/cm ²					
		3.00	PP	4.0kg/cm ²					3
		3.00	SPT(C)	N=20 (7/4,5,5,6)					
		3.50 - 4.00	D		3.50			CLAY-WITH-FLINTS FORMATION	
		3.50	PP	3.0kg/cm ²				Stiff brown slightly sandy slightly gravelly SILT with occasional black speckles. Gravel is angular to subrounded of flint.	4
		4.00	PP	3.0kg/cm ²					
		4.00	SPT(C)	N=18 (5/4,5,4,5)					
		4.50 - 4.90	D						
		4.50	PP	3.0kg/cm ²					
		5.00	SPT(C)	N=4 (2/1,1,1,1)	4.90			LEWES NODULAR CHALK FORMATION AND SEAFORD CHALK FORMATION, Grade Dm	5
								Structureless CHALK composed of soft cream white slightly gravelly SILT with rare thin veins of brown clay. Gravel is angular and subangular fine of low density chalk.	
		5.50 - 6.00	D						
					6.00			End of Borehole at 6.00m	6
									7

Borehole Diameter: 87mm to 57mm

Groundwater: Not encountered

Instrumentation: Backfilled with arisings

Remarks: Inspection pit excavated to 1.00m


Trial Pit Log

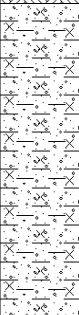
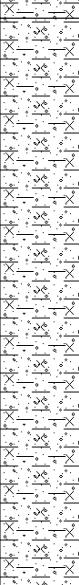
Trial Pit No.
TP 01
Project Location: Heath Road, Breachwood Green, SG4 8PL

Co-ords: 514852E - 222467N

Project Number:
24.07.031a

Level:
Logged By:
Dates: 13/11/2024

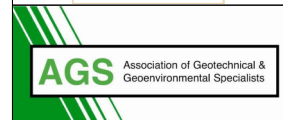
 Yuki Tse
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
	0.20			0.20			TOPSOIL Grass overlying soft dark brown slightly gravelly silty CLAY with occasional rootlets. Gravel is subangular and subrounded fine and medium of quartzite and flint.	1
	0.50 0.50	D HV	65kPa				CLAY-WITH-FLINTS FORMATION Firm light brown and orange brown locally mottled red brown and rare grey slightly sandy slightly gravelly CLAY. Gravel is angular to rounded fine and medium of flint.	
	0.80	D						
	1.20			1.20			CLAY-WITH-FLINTS FORMATION Stiff light brown and orange brown mottled red and grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel and cobbles are angular to subrounded of flint.	2
	1.50 1.50	D HV	101kPa					
	2.20	D						
	3.00			3.00			End of Trial Pit at 3.00m	3
								4

Method of excavation: JCB 3CX

Dimensions: 0.90m(W) x 2.60m(L) x 3.00m(D)

Stability:
Groundwater: Not encountered

Remarks: Backfilled with lightly compacted arisings upon completion.


Trial Pit Log

Trial Pit No.

TP 02
Project Location: Heath Road, Breachwood Green, SG4 8PL

Co-ords: 514884E - 222445N

Project Number:
24.07.031a

Level:
Logged By:
Dates: 13/11/2024

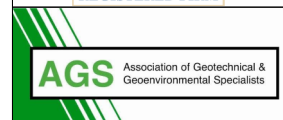
 Yuki Tse
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Grass overlying soft dark brown slightly gravelly silty CLAY with occasional rootlets. Gravel is angular to subrounded of quartzite, flint and brick.	
	0.60	D					CLAY-WITH-FLINTS FORMATION Firm light brown and orange brown mottled grey slightly sandy gravelly CLAY with low cobble content. Gravel and cobbles are angular to subrounded of flint.	1
	0.80	HV	62kPa					
	1.00	D						
	1.35	D						
	1.40	HV	70kPa					
				1.80			CLAY-WITH-FLINTS FORMATION Stiff lightly brown and orange brown mottled grey slightly sandy gravelly CLAY with low to medium cobble content. Gravel and cobbles are angular to subrounded of flint.	2
	2.00	D						
	2.00	HV	81kPa					
				2.60			CLAY-WITH-FLINTS FORMATION Stiff orange brown with rare dark grey veins slightly sandy slightly gravelly SILT. Gravel is angular to subrounded of flint.	
	3.00	D		3.00				3
							End of Trial Pit at 3.00m	4

Method of excavation: JCB 3CX

Dimensions: 0.90m(W) x 2.40m(L) x 3.00m(D)

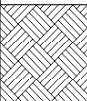
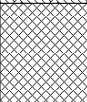
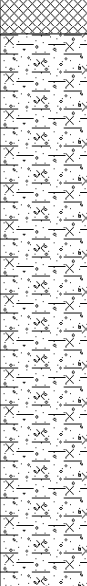
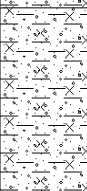
Stability:
Groundwater: Not encountered

Remarks: Backfilled with lightly compacted arisings upon completion.


Trial Pit Log

Trial Pit No.
TP 03

Project Location: Heath Road, Breachwood Green, SG4 8PL	Co-ords: 514916E - 222426N	Project Number: 24.07.031a
	Level:	Logged By: Yuki Tse to BS 5930:2015
Dates: 13/11/2024		

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Grass overlying soft dark brown slightly gravelly silty CLAY with occasional rootlets. Gravel is angular to rounded of quartzite, flint and brick.	
	0.50 0.50	D HV	55kPa	0.70			MADE GROUND Firm light brown and orange brown slightly sandy slightly gravelly silty CLAY. Gravel is angular to rounded fine and medium of quartzite, flint and brick.	
	1.00 1.00	D HV	78kPa				CLAY-WITH-FLINTS FORMATION Stiff grey and brown mottled orange brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel and cobbles are angular to rounded of flint.	1
	1.80 2.00	D HV	79kPa					2
	2.50	HV	90kPa	2.40			CLAY-WITH-FLINTS FORMATION Stiff light brown and orange brown slightly sandy slightly gravelly CLAY. Gravel is subangular and subrounded fine and medium of flint.	
	2.90	D		3.00			End of Trial Pit at 3.00m	3
								4

Method of excavation: JCB 3CX Stability: Groundwater: Not encountered Remarks: Backfilled with lightly compacted arisings upon completion.	Dimensions: 0.90m(W) x 2.70m(L) x 3.00m(D)	 ISO 9001 REGISTERED FIRM
		 Association of Geotechnical & Geoenvironmental Specialists
Listers Geotechnical Consultants LTD www.listersgeotechnics.co.uk Tel: 01327 860060		Sheet 1 of 1

Trial Pit Log

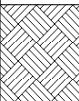
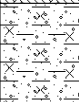
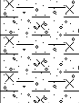
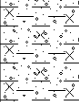
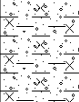
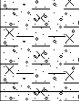
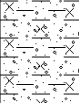
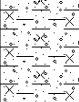
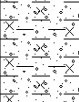
Trial Pit No.
TP 04
Project Location: Heath Road, Breachwood Green, SG4 8PL

Co-ords: 514895E - 222407N

Project Number:
24.07.031a

Level:
Logged By:
Dates: 13/11/2024

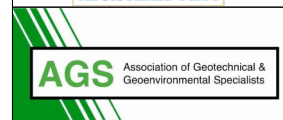
 Yuki Tse
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Result					
				0.30			TOPSOIL Grass overlying soft dark brown slightly gravelly silty CLAY with rare rootlets. Gravel is subangular and subrounded medium of quartzite and flint.	
	0.40	HV	55kPa				CLAY-WITH-FLINTS FORMATION Firm light brown mottled orange brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel and cobbles are angular to subrounded of flint.	1
	0.60	D						
	1.40	D						
	1.40	HV	71kPa					
				1.80			CLAY-WITH-FLINTS FORMATION Stiff orange brown locally mottled brown and grey slightly sandy gravelly CLAY with low cobble content. Gravel and cobbles are angular to subrounded of flint.	2
	2.00	D						
	2.00	HV	80kPa					
				3.00				
							End of Trial Pit at 3.00m	3
								4

Method of excavation: JCB 3CX

Dimensions: 0.90m(W) x 2.80m(L) x 3.00m(D)

Stability:
Groundwater: Not encountered

Remarks: Backfilled with lightly compacted arisings upon completion.


Trial Pit Log

Trial Pit No.

TP 05
Project Location: Heath Road, Breachwood Green, SG4 8PL

Co-ords: 514864E - 222422N

Project Number:
24.07.031a

Level:
Logged By:
Dates: 13/11/2024

 Yuki Tse
to BS 5930:2015

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth (m)	Type	Result						
	0.50	HV	78kPa	0.30			TOPSOIL Grass overlying soft dark brown slightly silty CLAY with occasional rootlets.	1	
							CLAY-WITH-FLINTS FORMATION Stiff light brown locally mottled orange brown and grey slightly sandy slightly gravelly CLAY with low cobble content. Gravel and cobbles are angular to subrounded of flint.		
	1.50	D HV	111kPa	1.50			CLAY-WITH-FLINTS FORMATION Stiff light brown mottled orange brown slightly gravelly CLAY with low cobble content, rare lenses of sand and black speckles. Gravel and cobbles are angular to subrounded of flint.		2
									
	2.00	D HV	93kPa					3	
									
				3.00					4
									
							End of Trial Pit at 3.00m		

Test Location	Depth at Start of Test (m)	Spoon or Cone	Blows per 75mm Penetration (unless otherwise stated)				Field 'N' Value	'N ₆₀ ' Value	Stratum
CT 01	1.00	C	3	3	4	4	14	18	CWF
	2.00	C	6	7	8	11	32	42	
	3.00	C	11	11	11	9	42	55	
	4.00	C	5	7	9	14	35	46	
	5.00	C	7	7	6	9	29	38	
CT 02	1.00	C	3	3	3	4	13	26	CWF
	2.00	C	3	4	4	5	16	31	
	3.00	C	6	8	8	9	31	50	
	4.00	C	5	6	10	10	31	44	
	5.00	C	6	10	10	7	33	42	
CT 03	1.00	C	6	5	3	4	18	24	CWF
	2.00	C	3	10	8	6	27	36	
	3.00	C	4	5	5	6	20	26	
	4.00	C	4	5	4	5	18	24	
	5.00	C	1	1	1	1	4	5	LESE
Key: CWF = CLAY-WITH-FLINTS FORMATION LESE = LEWES NODULAR CHALK AND SEAFORD CHALK FORMATION Corrections in accordance with BS EN ISO 22476-3, 2005, National Annex A; using Energy Ratio (79% CT01 to CT03) from current equipment calibrations									
STANDARD PENETRATION TEST SUMMARY								Report: 24.07.031a Sheet 1 of 1	

APPENDIX C

LABORATORY TEST REPORTS

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD

Telephone:- 01327 860947/860060

Email: lab@listersgeotechnics.co.uk

PROJECT INFORMATION		SAMPLE INFORMATION																																																							
Site Location:- Heath Road, Breachwood Green, SG4 8PL	Laboratory Tests Undertaken:- <table border="1"> <thead> <tr> <th>TEST TYPE</th> <th>TEST METHOD</th> <th>TESTED</th> </tr> </thead> <tbody> <tr> <td>Natural Moisture Contents (MC%)</td> <td>(BS 1377:Part 2:1990 Clause 3.2)</td> <td>✓</td> </tr> <tr> <td>Liquid Limits (%)</td> <td>(BS 1377:Part 2:1990 Clause 4.3)</td> <td>✓</td> </tr> <tr> <td>Plastic Limits (%)</td> <td>(BS 1377:Part 2:1990 Clause 5.3)</td> <td>✓</td> </tr> <tr> <td>Plasticity Index (%)</td> <td>(BS 1377:Part 2:1990 Clause 5.4)</td> <td>✓</td> </tr> <tr> <td>Saturated Moisture Content (%)</td> <td>(BS1377 : Part 2 : 1990, clause 3.3)</td> <td></td> </tr> <tr> <td>PSD - Wet Sieving</td> <td>(BS 1377:Part 2:1990 Clause 9.2)</td> <td>✓</td> </tr> <tr> <td>Engineering Sample Descriptions</td> <td>(BS 5930 : Section 6)</td> <td></td> </tr> <tr> <td>Passing 425/63 (µm)</td> <td>-</td> <td>✓</td> </tr> <tr> <td>Hydrometer</td> <td>(BS 1377:Part 2:1990 Clause 9.5)</td> <td></td> </tr> <tr> <td>Loss on Ignition (%)</td> <td>-</td> <td></td> </tr> <tr> <td>Soil Suctions (kPa)</td> <td>BRE Digest IP 4/93, 1993</td> <td></td> </tr> <tr> <td>Bulk Density (Mg/m³)</td> <td>(BS 1377:Part 2:1990 Clause 7.2)</td> <td></td> </tr> <tr> <td>Strength Tests</td> <td>(BS 1377:Part 7:1990 Clause 8 & 9)</td> <td></td> </tr> <tr> <td>Soluble Sulphate Content (SO₄g/l)</td> <td>(BS 1377:Part 3:1990 Clause 5.3)</td> <td>✓</td> </tr> <tr> <td>pH value</td> <td>(BS 1377:Part 3:1990 Clause 9.4)</td> <td>✓</td> </tr> <tr> <td>California Bearing Ratios (CBR)</td> <td>(BS 1377:Part 4:1990 Clause 7)</td> <td></td> </tr> <tr> <td>Compaction Tests</td> <td>(BS 1377:Part 4:1990 Clauses 3.0-3.6)</td> <td></td> </tr> </tbody> </table>	TEST TYPE	TEST METHOD	TESTED	Natural Moisture Contents (MC%)	(BS 1377:Part 2:1990 Clause 3.2)	✓	Liquid Limits (%)	(BS 1377:Part 2:1990 Clause 4.3)	✓	Plastic Limits (%)	(BS 1377:Part 2:1990 Clause 5.3)	✓	Plasticity Index (%)	(BS 1377:Part 2:1990 Clause 5.4)	✓	Saturated Moisture Content (%)	(BS1377 : Part 2 : 1990, clause 3.3)		PSD - Wet Sieving	(BS 1377:Part 2:1990 Clause 9.2)	✓	Engineering Sample Descriptions	(BS 5930 : Section 6)		Passing 425/63 (µm)	-	✓	Hydrometer	(BS 1377:Part 2:1990 Clause 9.5)		Loss on Ignition (%)	-		Soil Suctions (kPa)	BRE Digest IP 4/93, 1993		Bulk Density (Mg/m ³)	(BS 1377:Part 2:1990 Clause 7.2)		Strength Tests	(BS 1377:Part 7:1990 Clause 8 & 9)		Soluble Sulphate Content (SO ₄ g/l)	(BS 1377:Part 3:1990 Clause 5.3)	✓	pH value	(BS 1377:Part 3:1990 Clause 9.4)	✓	California Bearing Ratios (CBR)	(BS 1377:Part 4:1990 Clause 7)		Compaction Tests	(BS 1377:Part 4:1990 Clauses 3.0-3.6)			
TEST TYPE	TEST METHOD	TESTED																																																							
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pH value	(BS 1377:Part 3:1990 Clause 9.4)	✓																																																							
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Compaction Tests	(BS 1377:Part 4:1990 Clauses 3.0-3.6)																																																								
Client Reference:- 																																																									
Date Samples Received:- 14 November 2024 Date Testing Completed:- 21 November 2024																																																									
The results relate only to the samples tested																																																									
This test-report may not be reproduced, except with full and written approval of GROUNDTECH LABORATORIES		Laboratory testing in accord with BS EN ISO/IEC 17025-2000 and Quality Management in accord with ISO 9001																																																							
Signed on behalf of GroundTech Laboratories:- _____ Technical Signatory			Quality Assured to ISO 9001																																																						
GEOTECHNICAL LABORATORY TEST RESULTS		Report No:	24.07.031a																																																						

GroundTech Laboratories

Geotechnical Testing Facility

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Email: groundtech@listersgeotechnics.co.uk

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SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS			
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL+ 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m³	Test Type	Cell Pressure kN/m²	Deviator Stress kN/m²	Apparent Cohesion kN/m²	φ	pH Value	Soluble Sulphate Content SO4 g/l		
CT 01	D	0.40	PI/63	30	57	28	29	47	14	CH	43	0.35	30	-0.28									8.2	0.12		
	D	1.00																								
	D	1.50																								
	D	2.00																								
	D	2.50																								
CT 02	D	3.50	PI/63	19	37	19	18	61	11	CI	51	0.51	21	0.00									6.9	0.23		
	D	5.00																								
	D	0.40																								
	D	1.00																								
	D	1.50																								
CT 03	D	2.00	PI/63	28	57	27	30	96	29	CH	92	0.50	26	0.07										6.9	0.06	
	D	3.00																								
	D	4.00																								
	D	5.50																								
	D	0.40																								
TP 01	D	1.00	PI/63	28	58	30	28	75	21	CH	63	0.48	32	-0.07												
	D	1.50																								
	D	2.50																								
	D	3.50																								
	D	4.50																								
	D	5.50	PI/63	36	35	29	6	74	4	ML	67	1.03	31	1.17												
	D	0.50																								
	D	0.80		29																						
Symbols:				U	Undisturbed Sample					R	Remoulded				PI	Plasticity Index			T	Triaxial Undrained				L	100mm specimen	
				D	Disturbed Sample					63	Passing 63μm				F	Filter Paper Suction Tests			M	Multistage Triaxial				S	38mm specimen	
				B	Bulk Sample					H	Hydrometer				CC	Continuous Core			HP	Hand Penetrometer						
				W	Water Sample					PSD	Wet Sieving								V	Vane Test						
LABORATORY TEST RESULTS																					Project Reference 24.07.031A					

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SAMPLES				CLASSIFICATION TESTS							CLASSIFICATION TESTS							STRENGTH TESTS					CHEMICAL TESTS			
Test Location	Sample Type	Sample Depth -m	Test Type	WC %	LL %	PL %	PI %	Passing 425 μm %	Modified PI %	Class	Passing 63 μm %	WC/ LL	PL + 2%	Liquidity Index	Loss on Ignition %	Soil Suction kPa	Bulk Density Mg/m³	Test Type	Cell Pressure kN/m²	Deviator Stress kN/m²	Apparent Cohesion kN/m²	φ	pH Value	Soluble Sulphate Content SO4 g/l		
TP 01	D	1.50	PI/63	29	54	27	27	89	24	CH	82	0.54	29	0.07									6.5	0.06		
	D	2.20	PI/63	29	48	26	22	81	18	CI	76	0.60	28	0.14												
TP 02	D	0.60		23																						
	D	1.00	PI/63	28	61	31	30	83	25	CH	77	0.46	33	-0.10												
TP 03	D	1.35	PSD	35																						
	D	2.00	PI/63	20	50	25	25	61	15	CI	50	0.40	27	-0.20									6.6	0.12		
	D	3.00	PI/63	38	66	38	28	98	28	MH	96	0.58	40	0.00												
	D	0.50		23																						
	D	1.00	PI/63	33	55	27	28	77	22	CH	75	0.60	29	0.21												
TP 04	D	1.80		22																						
	D	2.90	PI/63	24	40	23	17	95	16	CI	91	0.60	25	0.06												
	D	0.60		21																						
TP 05	D	1.40	PSD	33																						
	D	2.00	PI/63	28	49	25	24	61	15	CI	53	0.57	27	0.13									6.5	0.08		
	D	1.00	PI/63	24	38	22	16	96	15	CI	89	0.63	24	0.13									6.8	0.04		
	D	1.50		15																						
	D	2.00	PI/63	28	44	25	19	96	18	CI	82	0.64	27	0.16												
Symbols:				U	Undisturbed Sample					R	Remoulded				PI	Plasticity Index			T	Triaxial Undrained				L	100mm specimen	
				D	Disturbed Sample					63	Passing 63μm				F	Filter Paper Suction Tests			M	Multistage Triaxial				S	38mm specimen	
				B	Bulk Sample					H	Hydrometer				CC	Continuous Core			HP	Hand Penetrometer						
				W	Water Sample					PSD	Wet Sieving								V	Vane Test						
LABORATORY TEST RESULTS																				Project Reference 24.07.031A						

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD

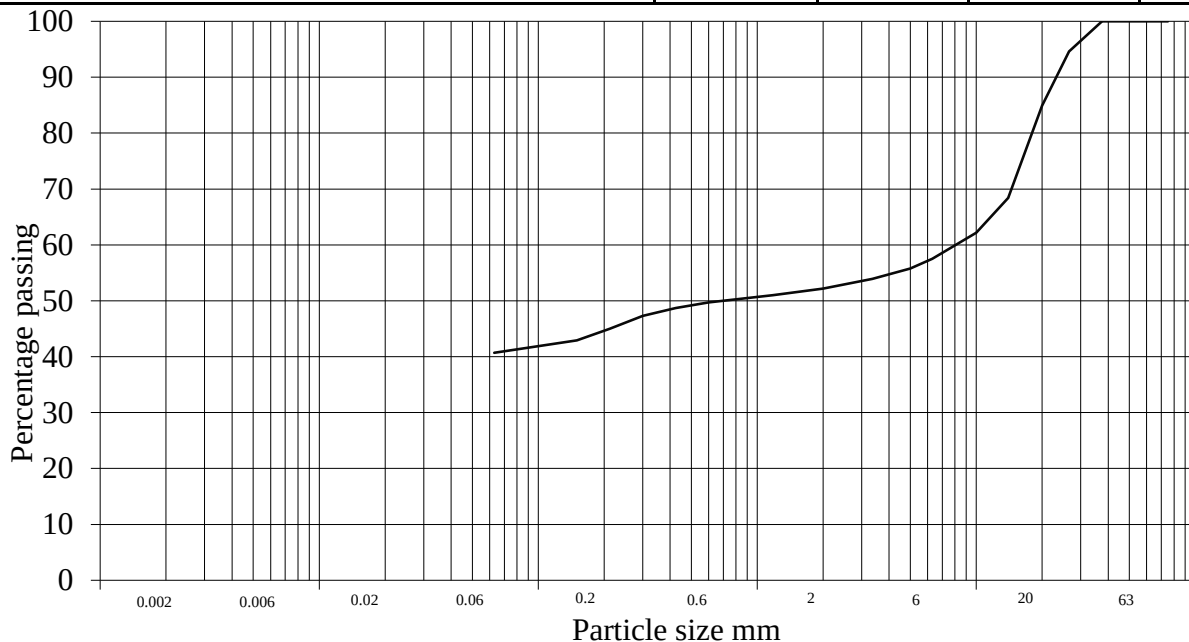
Telephone: 01327 860947/860060

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		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site:	Heath Road, Breachwood Green, SG4 8PL	75mm	100.00		
		63mm	100.00		
Test Location:	CT 01	50mm	100.00		
		37.5mm	100.00		
Sample Depth:	2.00m -2.50m	26.5mm	94.60		
		20mm	84.90		
Hydrometer No.:		14mm	68.40		
		10mm	62.20		
SG Gs:		6.3mm	57.50		
		5mm	55.80		
Water Visc. (N):		3.5mm	53.90		
		2mm	52.20		
Dry Mass of Soil after pretreatment (g):		1.18mm	51.00		
		600µm	49.70		
		425µm	48.70		
		300µm	47.30		
		212µm	45.00		
		150µm	42.90		
		63µm	40.70		



CLAY	SILT			SAND			GRAVEL			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
41%				12%			48%			0%

PARTICLE SIZE DISTRIBUTION

Project Reference
24.07.031A

GroundTech Laboratories

Geotechnical Testing Facility

Slapton Hill Barn, Blakesley Road, Slapton, Towcester, Northants. NN12 8QD

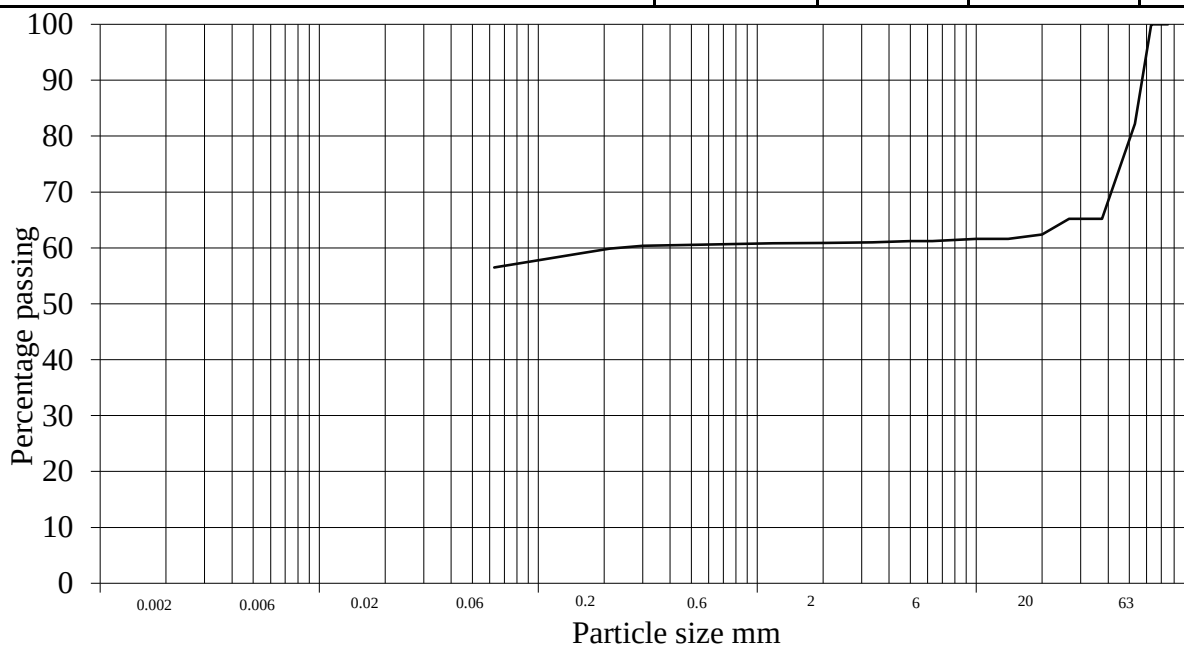
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**Quality
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ISO 9001**

		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site:	Heath Road, Breachwood Green, SG4 8PL	75mm	100.00		
		63mm	100.00		
Test Location:	TP 02	50mm	82.20		
Sample Depth:	1.35m	37.5mm	65.20		
		26.5mm	65.20		
		20mm	62.40		
		14mm	61.60		
		10mm	61.60		
		6.3mm	61.20		
		5mm	61.20		
Hydrometer No.:		3.5mm	61.00		
SG Gs:		2mm	60.90		
Water Visc. (N):		1.18mm	60.80		
Dry Mass of Soil after pretreatment (g):		600µm	60.60		
		425µm	60.50		
		300µm	60.40		
		212µm	59.90		
		150µm	58.90		
		63µm	56.50		



CLAY	SILT			SAND			GRAVEL			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
57%				4%			39%			0%

PARTICLE SIZE DISTRIBUTION

Project Reference
24.07.031A

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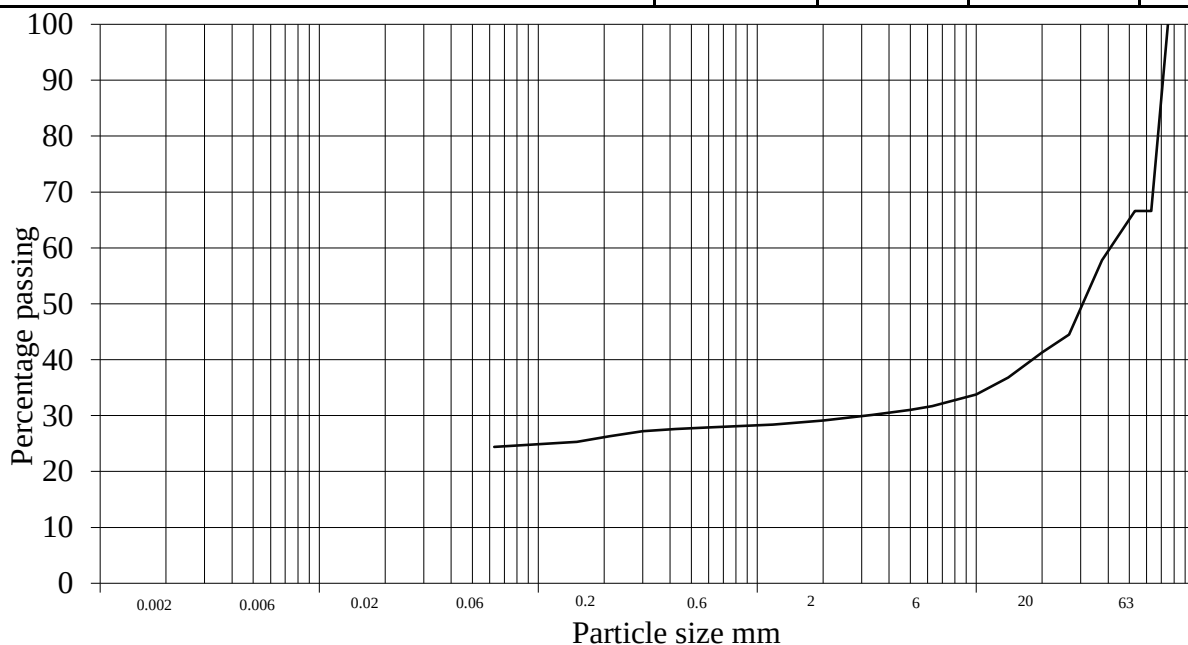
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Email: groundtech@listersgeotechnics.co.uk

**Quality
Assured
ISO 9001**

		Test Method: BS 1377 : Part 2 : 1990 : 9.2			
		BS test sieve	Cumulative Passing - %	Hydrometer Particle Diameter	Cumulative Passing - %
Site: Heath Road, Breachwood Green, SG4 8PL Test Location: TP 04 Sample Depth: 1.40m Hydrometer No.: SG Gs: Water Visc. (N): Dry Mass of Soil after pretreatment (g):		75mm	100.00		
		63mm	66.60		
		50mm	66.60		
		37.5mm	57.80		
		26.5mm	44.50		
		20mm	41.30		
		14mm	36.80		
		10mm	33.80		
		6.3mm	31.70		
		5mm	31.00		
		3.5mm	30.10		
		2mm	29.10		
		1.18mm	28.40		
		600µm	27.90		
		425µm	27.60		
		300µm	27.20		
		212µm	26.30		
		150µm	25.30		
		63µm	24.40		

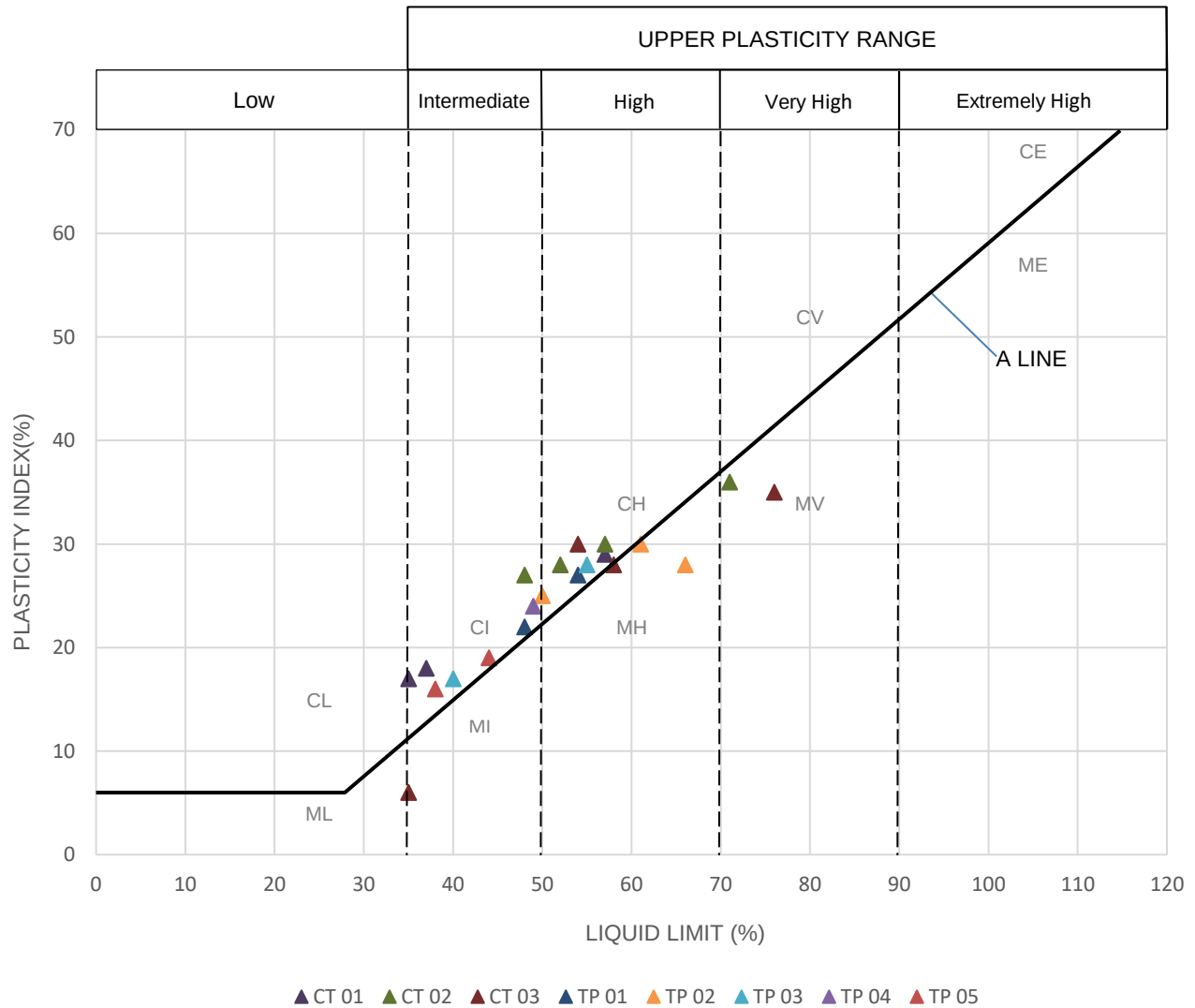


CLAY	SILT			SAND			GRAVEL			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	(i)24%	(ii)37%		(i)5%	(ii)7%		(i)38%	(ii)56%		33%

(i) Percentage of whole sample (ii) Percentage of sample excluding very coarse soils

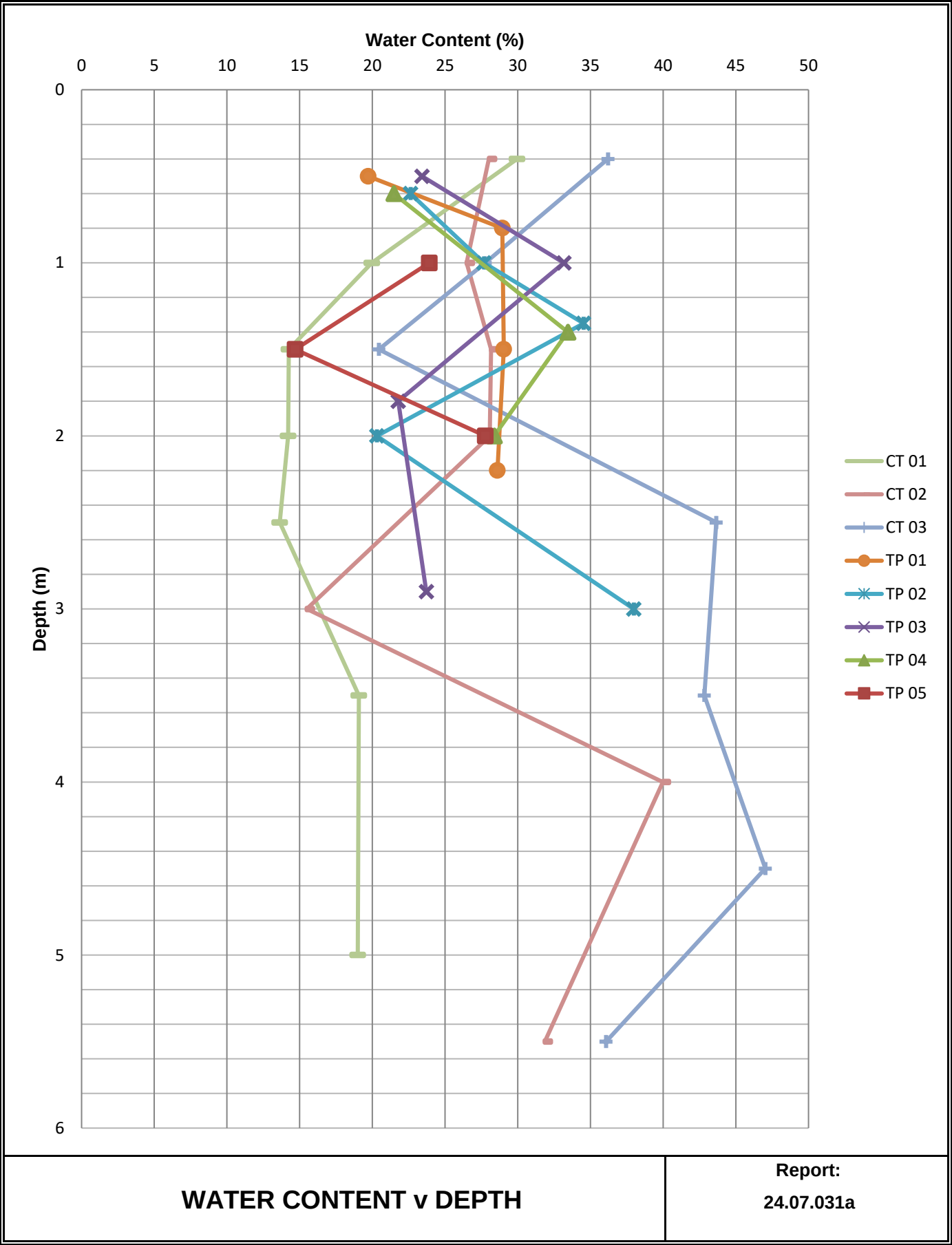
PARTICLE SIZE DISTRIBUTION

Project Reference
24.07.031A



PLASTICITY CHART

Report:
24.07.031a





Listers Geo
Slapton Hill Barn, Blakesley Road
Slapton
Towcester
Northamptonshire
NN12 8QD

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

e: yuki@listersgeotechnics.co.uk

Analytical Report Number : 24-054527

Project / Site name:	Heath Road, Breachwood Green, SG4 8PL	Samples received on:	18/11/2024
Your job number:	24.07.031	Samples instructed on/ Analysis started on:	18/11/2024
Your order number:	24.07.031A 803	Analysis completed by:	25/11/2024
Report Issue Number:	1	Report issued on:	25/11/2024
Samples Analysed:	6 soil samples		

Signed: _____

Anna Goc
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-054527
Project / Site name: Heath Road, Breachwood Green, SG4 8PL
Your Order No: 24.07.031A 803

Lab Sample Number				382998	382999	383000	383001	383002
Sample Reference				CT03	CT03	TP01	TP05	TP05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Water Matrix				N/A	N/A	N/A	N/A	N/A
Depth (m)				0.10	0.40	0.10	0.10	1.00
Date Sampled				13/11/2024	13/11/2024	13/11/2024	13/11/2024	13/11/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Test Limit of detection	Test Accreditation Status		

Stone Content	%	0.1	NONE	< 0.1	< 0.1	59.7	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	19	26	15	20	18
Total mass of sample received	kg	0.1	NONE	0.4	0.2	0.5	0.4	0.5

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	-	Not-detected	Not-detected	-
Asbestos Analyst ID	N/A	N/A	N/A	KSZ	-	KSZ	KSZ	-

General Inorganics

pH (L005B)	pH Units	N/A	MCERTS	7.1	7.4	6.9	7.3	7.5
Total Sulphate as SO ₄	%	0.005	MCERTS	-	-	-	-	0.03
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	71	26	39	56	40
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	-	-	0.0197
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	35.4	13.1	19.5	28.2	19.7
Total Sulphur	mg/kg	50	MCERTS	-	-	-	-	130
Total Sulphur	%	0.005	MCERTS	-	-	-	-	0.013

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Acenaphthylene	mg/kg	0.05	MCERTS	0.07	< 0.05	< 0.05	< 0.05	-
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Phenanthrene	mg/kg	0.05	MCERTS	0.38	< 0.05	0.14	0.2	-
Anthracene	mg/kg	0.05	MCERTS	0.13	< 0.05	< 0.05	0.07	-
Fluoranthene	mg/kg	0.05	MCERTS	1.4	< 0.05	0.37	0.5	-
Pyrene	mg/kg	0.05	MCERTS	1.2	< 0.05	0.34	0.49	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.76	< 0.05	0.25	0.26	-
Chrysene	mg/kg	0.05	MCERTS	0.76	< 0.05	0.21	0.34	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	1.1	< 0.05	0.42	0.45	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.48	< 0.05	0.1	0.15	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.92	< 0.05	0.27	0.26	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.51	< 0.05	0.17	0.17	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.14	< 0.05	< 0.05	< 0.05	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.63	< 0.05	0.24	0.2	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	8.4	< 0.80	2.52	3.08	-
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Analytical Report Number: 24-054527

Project / Site name: Heath Road, Breachwood Green, SG4 8PL

Your Order No: 24.07.031A 803

Lab Sample Number				382998	382999	383000	383001	383002
Sample Reference				CT03	CT03	TP01	TP05	TP05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Water Matrix				N/A	N/A	N/A	N/A	N/A
Depth (m)				0.10	0.40	0.10	0.10	1.00
Date Sampled				13/11/2024	13/11/2024	13/11/2024	13/11/2024	13/11/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status					

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	22	16	14	14	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.7	< 0.2	0.5	0.6	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	29	61	26	24	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	53	23	38	43	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	140	25	150	180	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	0.4	< 0.3	< 0.3	< 0.3	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	34	35	20	21	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	2	< 1.0	1.7	1.5	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	160	71	160	180	-

Magnesium (leachate equivalent)	mg/l	2.5	NONE	-	-	-	-	8.3
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Petroleum Hydrocarbons

TPH (>EC10 - EC12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	-
TPH (>EC12 - EC16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	-
TPH (>EC16 - EC21) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	-
TPH (>EC21 - EC40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	17	< 10	12	13	-

TPH (EC10 - EC40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	25	< 10	21	18	-
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Pesticides

Alpha-BHC (Benzene Hexachloride)	µg/kg	10	NONE	-	-	-	-	-
Alachlor	µg/kg	10	NONE	-	-	-	-	-
Bifenthrin	µg/kg	10	NONE	-	-	-	-	-
Cyhalothrin (Lambda)	µg/kg	10	NONE	-	-	-	-	-
Gamma-BHC (Lindane, gamma HCH)	µg/kg	10	NONE	-	-	-	-	-
Omethoate	µg/kg	10	NONE	-	-	-	-	-
1,2,3-Trichlorobenzene	µg/kg	10	NONE	-	-	-	-	-
1,3,5-Trichlorobenzene	µg/kg	10	NONE	-	-	-	-	-
2,6-Dichlorobenzonitrile	µg/kg	10	NONE	-	-	-	-	-
Dimethylvinphos	µg/kg	10	NONE	-	-	-	-	-
Demeton-O	µg/kg	10	NONE	-	-	-	-	-
Demeton-S	µg/kg	10	NONE	-	-	-	-	-
Endrin Aldehyde	µg/kg	10	NONE	-	-	-	-	-
Endrin Ketone	µg/kg	10	NONE	-	-	-	-	-
Hexachlorobutadiene	µg/kg	10	NONE	-	-	-	-	-
Phosphamidon (Sum)	µg/kg	10	NONE	-	-	-	-	-
1,2,4,5-Tetrachlorobenzene	µg/kg	10	NONE	-	-	-	-	-
Cis-Permethrin	µg/kg	10	NONE	-	-	-	-	-
Endosulfan sulfate	µg/kg	10	NONE	-	-	-	-	-
Etrinfos	µg/kg	10	NONE	-	-	-	-	-
Fenvalerate (Sum)	µg/kg	10	NONE	-	-	-	-	-
Hexachlorobenzene	µg/kg	10	NONE	-	-	-	-	-
Mevinphos, E+Z	µg/kg	10	NONE	-	-	-	-	-
Pentachlorobenzene	µg/kg	10	NONE	-	-	-	-	-
Pirimiphos-ethyl	µg/kg	10	NONE	-	-	-	-	-
Propetamphos	µg/kg	10	NONE	-	-	-	-	-
Tecnazene	µg/kg	10	NONE	-	-	-	-	-
Triadimefon	µg/kg	10	NONE	-	-	-	-	-
Trans-Permethrin	µg/kg	10	NONE	-	-	-	-	-
Aldrin	µg/kg	10	NONE	-	-	-	-	-

Analytical Report Number: 24-054527

Project / Site name: Heath Road, Breachwood Green, SG4 8PL

Your Order No: 24.07.031A 803

Lab Sample Number				382998	382999	383000	383001	383002
Sample Reference				CT03	CT03	TP01	TP05	TP05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Water Matrix				N/A	N/A	N/A	N/A	N/A
Depth (m)				0.10	0.40	0.10	0.10	1.00
Date Sampled				13/11/2024	13/11/2024	13/11/2024	13/11/2024	13/11/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status					
Azinphos-methyl	µg/kg	10	NONE	-	-	-	-	-
Beta-BHC	µg/kg	10	NONE	-	-	-	-	-
Cis-Chlordane	µg/kg	10	NONE	-	-	-	-	-
Chlorfenvinphos	µg/kg	10	NONE	-	-	-	-	-
Chlorpyrifos	µg/kg	10	NONE	-	-	-	-	-
Chlorothalonil	µg/kg	10	NONE	-	-	-	-	-
Carbophenothion	µg/kg	10	NONE	-	-	-	-	-
Cyfluthrin (Sum)	µg/kg	10	NONE	-	-	-	-	-
Delta-BHC	µg/kg	10	NONE	-	-	-	-	-
Dieldrin	µg/kg	10	NONE	-	-	-	-	-
Deltamethrin	µg/kg	10	NONE	-	-	-	-	-
Heptachlor Exo-epoxide	µg/kg	10	NONE	-	-	-	-	-
Endrin	µg/kg	10	NONE	-	-	-	-	-
Endosulfan I (alpha isomer)	µg/kg	10	NONE	-	-	-	-	-
Endosulfan II (beta isomer)	µg/kg	10	NONE	-	-	-	-	-
Fenthion	µg/kg	10	NONE	-	-	-	-	-
Isodrin	µg/kg	10	NONE	-	-	-	-	-
Methacrifos	µg/kg	10	NONE	-	-	-	-	-
O,p'-DDD	µg/kg	10	NONE	-	-	-	-	-
O,p'-DDE	µg/kg	10	NONE	-	-	-	-	-
O,p'-DDT	µg/kg	10	NONE	-	-	-	-	-
Parathion	µg/kg	10	NONE	-	-	-	-	-
Parathion-methyl	µg/kg	10	NONE	-	-	-	-	-
Pendimethalin	µg/kg	10	NONE	-	-	-	-	-
Phorate	µg/kg	10	NONE	-	-	-	-	-
Phosalone	µg/kg	10	NONE	-	-	-	-	-
P,p'-DDD	µg/kg	10	NONE	-	-	-	-	-
P,p'-DDE	µg/kg	10	NONE	-	-	-	-	-
P,p'-DDT	µg/kg	10	NONE	-	-	-	-	-
P,p'-Methoxychlor	µg/kg	10	NONE	-	-	-	-	-
Propyzamide	µg/kg	10	NONE	-	-	-	-	-
Triazophos	µg/kg	10	NONE	-	-	-	-	-
Trans-Chlordane	µg/kg	10	NONE	-	-	-	-	-
Cypermethrin (Sum)	µg/kg	10	NONE	-	-	-	-	-
Dichlorvos	µg/kg	10	NONE	-	-	-	-	-
Dimethoate	µg/kg	10	NONE	-	-	-	-	-
Diazinon	µg/kg	10	NONE	-	-	-	-	-
Ethion	µg/kg	10	NONE	-	-	-	-	-
Fenitrothion	µg/kg	10	NONE	-	-	-	-	-
Malathion	µg/kg	10	NONE	-	-	-	-	-
Pirimiphos-methyl	µg/kg	10	NONE	-	-	-	-	-
Trifluralin	µg/kg	10	NONE	-	-	-	-	-
Azinphos-ethyl	µg/kg	10	NONE	-	-	-	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected



Analytical Report Number: 24-054527
Project / Site name: Heath Road, Breachwood Green, SG4 8PL
Your Order No: 24.07.031A 803

Lab Sample Number				383003
Sample Reference				TP02
Sample Number				None Supplied
Water Matrix				N/A
Depth (m)				0.30
Date Sampled				13/11/2024
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status	

Stone Content	%	0.1	NONE	16.7
Moisture Content	%	0.01	NONE	21
Total mass of sample received	kg	0.1	NONE	0.2

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	-
Asbestos Analyst ID	N/A	N/A	N/A	-

General Inorganics

pH (L005B)	pH Units	N/A	MCERTS	-
Total Sulphate as SO ₄	%	0.005	MCERTS	-
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-
Total Sulphur	mg/kg	50	MCERTS	-
Total Sulphur	%	0.005	MCERTS	-

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-
Acenaphthylene	mg/kg	0.05	MCERTS	-
Acenaphthene	mg/kg	0.05	MCERTS	-
Fluorene	mg/kg	0.05	MCERTS	-
Phenanthrene	mg/kg	0.05	MCERTS	-
Anthracene	mg/kg	0.05	MCERTS	-
Fluoranthene	mg/kg	0.05	MCERTS	-
Pyrene	mg/kg	0.05	MCERTS	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-
Chrysene	mg/kg	0.05	MCERTS	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-
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Analytical Report Number: 24-054527
Project / Site name: Heath Road, Breachwood Green, SG4 8PL
Your Order No: 24.07.031A 803

Lab Sample Number				383003
Sample Reference				TP02
Sample Number				None Supplied
Water Matrix				N/A
Depth (m)				0.30
Date Sampled				13/11/2024
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status	

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-

Magnesium (leachate equivalent)	mg/l	2.5	NONE	-
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Petroleum Hydrocarbons

TPH (>EC10 - EC12) EH_CU_1D_TOTAL	mg/kg	2	MCERTS	-
TPH (>EC12 - EC16) EH_CU_1D_TOTAL	mg/kg	4	MCERTS	-
TPH (>EC16 - EC21) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	-
TPH (>EC21 - EC40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	-

TPH (EC10 - EC40) EH_CU_1D_TOTAL	mg/kg	10	MCERTS	-
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Pesticides

Alpha-BHC (Benzene Hexachloride)	µg/kg	10	NONE	< 10
Alachlor	µg/kg	10	NONE	< 10
Bifenthrin	µg/kg	10	NONE	< 10
Cyhalothrin (Lambda)	µg/kg	10	NONE	< 10
Gamma-BHC (Lindane, gamma HCH)	µg/kg	10	NONE	< 10
Omethoate	µg/kg	10	NONE	< 10
1,2,3-Trichlorobenzene	µg/kg	10	NONE	< 10
1,3,5-Trichlorobenzene	µg/kg	10	NONE	< 10
2,6-Dichlorobenzonitrile	µg/kg	10	NONE	< 10
Dimethylvinphos	µg/kg	10	NONE	< 10
Demeton-O	µg/kg	10	NONE	< 10
Demeton-S	µg/kg	10	NONE	< 10
Endrin Aldehyde	µg/kg	10	NONE	< 10
Endrin Ketone	µg/kg	10	NONE	< 10
Hexachlorobutadiene	µg/kg	10	NONE	< 10
Phosphamidon (Sum)	µg/kg	10	NONE	< 10
1,2,4,5-Tetrachlorobenzene	µg/kg	10	NONE	< 10
Cis-Permethrin	µg/kg	10	NONE	< 10
Endosulfan sulfate	µg/kg	10	NONE	< 10
Etrinfos	µg/kg	10	NONE	< 10
Fenvalerate (Sum)	µg/kg	10	NONE	< 10
Hexachlorobenzene	µg/kg	10	NONE	< 10
Mevinphos, E+Z	µg/kg	10	NONE	< 10
Pentachlorobenzene	µg/kg	10	NONE	< 10
Pirimiphos-ethyl	µg/kg	10	NONE	< 10
Propetamphos	µg/kg	10	NONE	< 10
Tecnazene	µg/kg	10	NONE	< 10
Triadimefon	µg/kg	10	NONE	< 10
Trans-Permethrin	µg/kg	10	NONE	< 10
Aldrin	µg/kg	10	NONE	< 10



Analytical Report Number: 24-054527
Project / Site name: Heath Road, Breachwood Green, SG4 8PL
Your Order No: 24.07.031A 803

Lab Sample Number				383003
Sample Reference				TP02
Sample Number				None Supplied
Water Matrix				N/A
Depth (m)				0.30
Date Sampled				13/11/2024
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status	
Azinphos-methyl	µg/kg	10	NONE	< 10
Beta-BHC	µg/kg	10	NONE	< 10
Cis-Chlordane	µg/kg	10	NONE	< 10
Chlorfenvinphos	µg/kg	10	NONE	< 10
Chlorpyrifos	µg/kg	10	NONE	< 10
Chlorothalonil	µg/kg	10	NONE	< 10
Carbophenothion	µg/kg	10	NONE	< 10
Cyfluthrin (Sum)	µg/kg	10	NONE	< 10
Delta-BHC	µg/kg	10	NONE	< 10
Dieldrin	µg/kg	10	NONE	< 10
Deltamethrin	µg/kg	10	NONE	< 10
Heptachlor Exo-epoxide	µg/kg	10	NONE	< 10
Endrin	µg/kg	10	NONE	< 10
Endosulfan I (alpha isomer)	µg/kg	10	NONE	< 10
Endosulfan II (beta isomer)	µg/kg	10	NONE	< 10
Fenthion	µg/kg	10	NONE	< 10
Isodrin	µg/kg	10	NONE	< 10
Methacrifos	µg/kg	10	NONE	< 10
O,p'-DDD	µg/kg	10	NONE	< 10
O,p'-DDE	µg/kg	10	NONE	< 10
O,p'-DDT	µg/kg	10	NONE	< 10
Parathion	µg/kg	10	NONE	< 10
Parathion-methyl	µg/kg	10	NONE	< 10
Pendimethalin	µg/kg	10	NONE	< 10
Phorate	µg/kg	10	NONE	< 10
Phosalone	µg/kg	10	NONE	< 10
P,p'-DDD	µg/kg	10	NONE	< 10
P,p'-DDE	µg/kg	10	NONE	< 10
P,p'-DDT	µg/kg	10	NONE	< 10
P,p'-Methoxychlor	µg/kg	10	NONE	< 10
Propyzamide	µg/kg	10	NONE	< 10
Triazophos	µg/kg	10	NONE	< 10
Trans-Chlordane	µg/kg	10	NONE	< 10
Cypermethrin (Sum)	µg/kg	10	NONE	< 10
Dichlorvos	µg/kg	10	NONE	< 10
Dimethoate	µg/kg	10	NONE	< 10
Diazinon	µg/kg	10	NONE	< 10
Ethion	µg/kg	10	NONE	< 10
Fenitrothion	µg/kg	10	NONE	< 10
Malathion	µg/kg	10	NONE	< 10
Pirimiphos-methyl	µg/kg	10	NONE	< 10
Trifluralin	µg/kg	10	NONE	< 10
Azinphos-ethyl	µg/kg	10	NONE	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected



Analytical Report Number : 24-054527
Project / Site name: Heath Road, Breachwood Green, SG4 8PL

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
382998	CT03	None Supplied	0.1	Brown loam and clay with vegetation
382999	CT03	None Supplied	0.4	Brown clay with chalk
383000	TP01	None Supplied	0.1	Brown loam and clay with vegetation and stones
383001	TP05	None Supplied	0.1	Brown loam and clay with gravel and vegetation
383002	TP05	None Supplied	1	Brown clay and sand with gravel and vegetation
383003	TP02	None Supplied	0.3	Brown loam and clay with vegetation and stones

Analytical Report Number : 24-054527

Project / Site name: Heath Road, Breachwood Green, SG4 8PL

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)

Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
pH at 20°C in soil	Determination of pH in soil by addition of water followed by electrometric measurement	In-house method	L005B	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES	In-house method based on TRL 447	L038B	D	NONE
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES	In-house method	L038B	D	MCERTS
Pesticides by GC-MS/MS	Determination of Pesticides in soil by GC MS/MS	In-house method	L055B	W	NONE
Speciated PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
TPH Chromatogram in soil	TPH Chromatogram in soil	In-house method	L064B	D	NONE



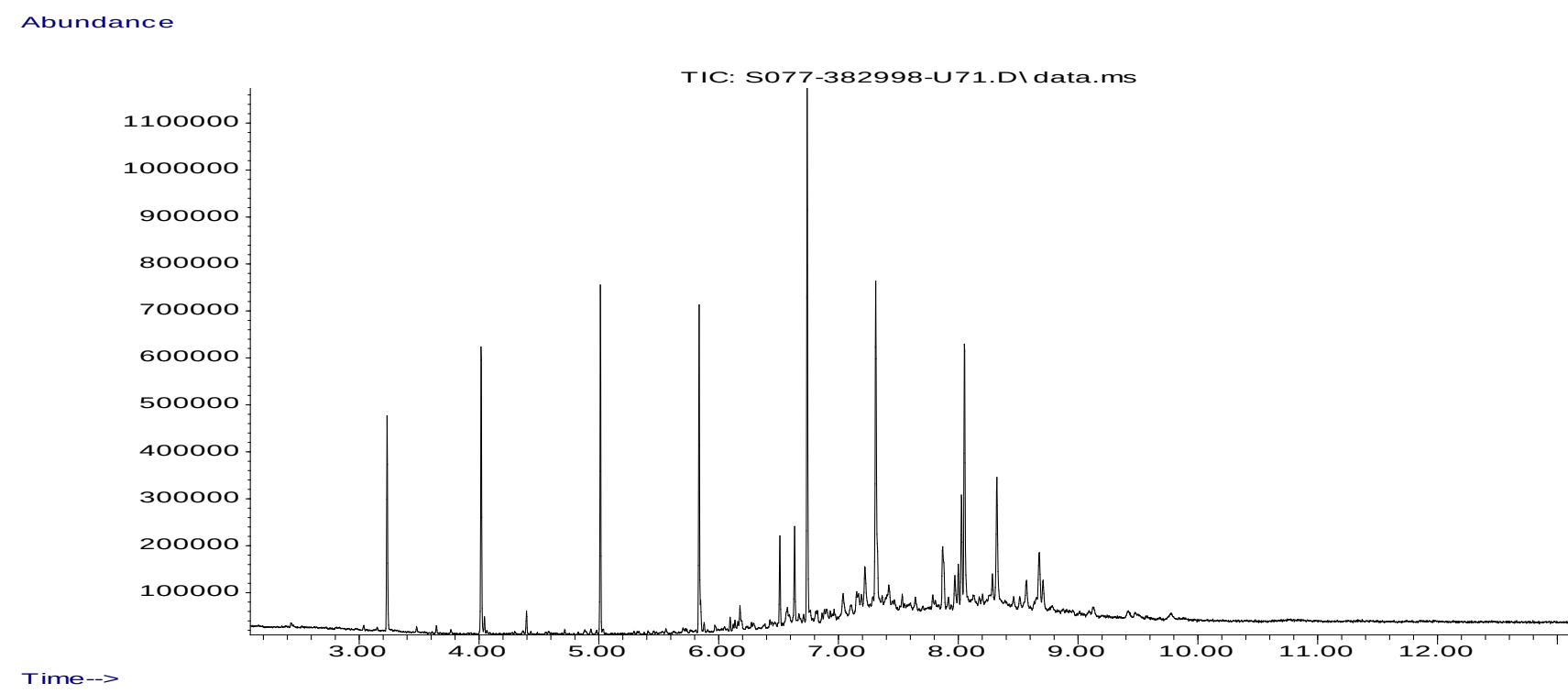
Analytical Report Number : 24-054527
Project / Site name: Heath Road, Breachwood Green, SG4 8PL

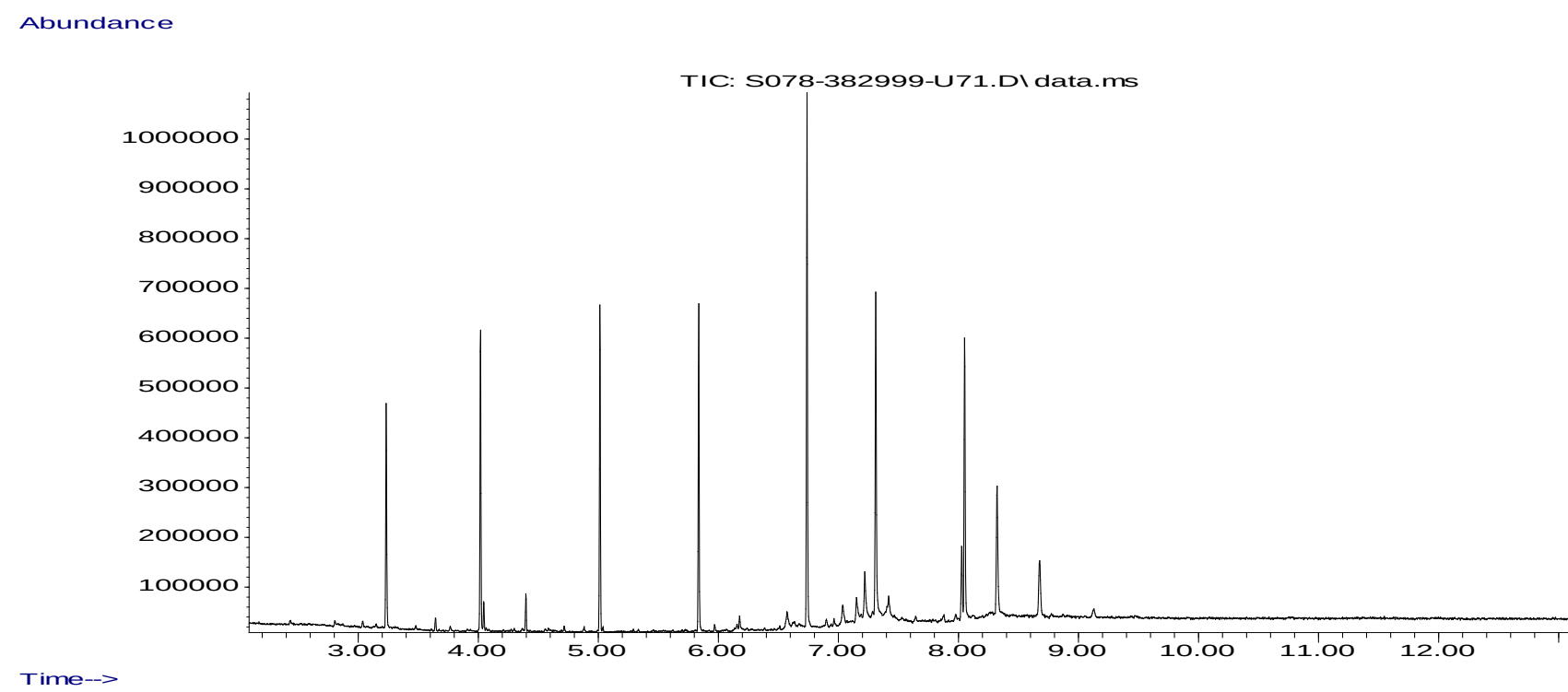
Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)
Final Sewage Effluent (FSE) Landfill Leachate (LL)

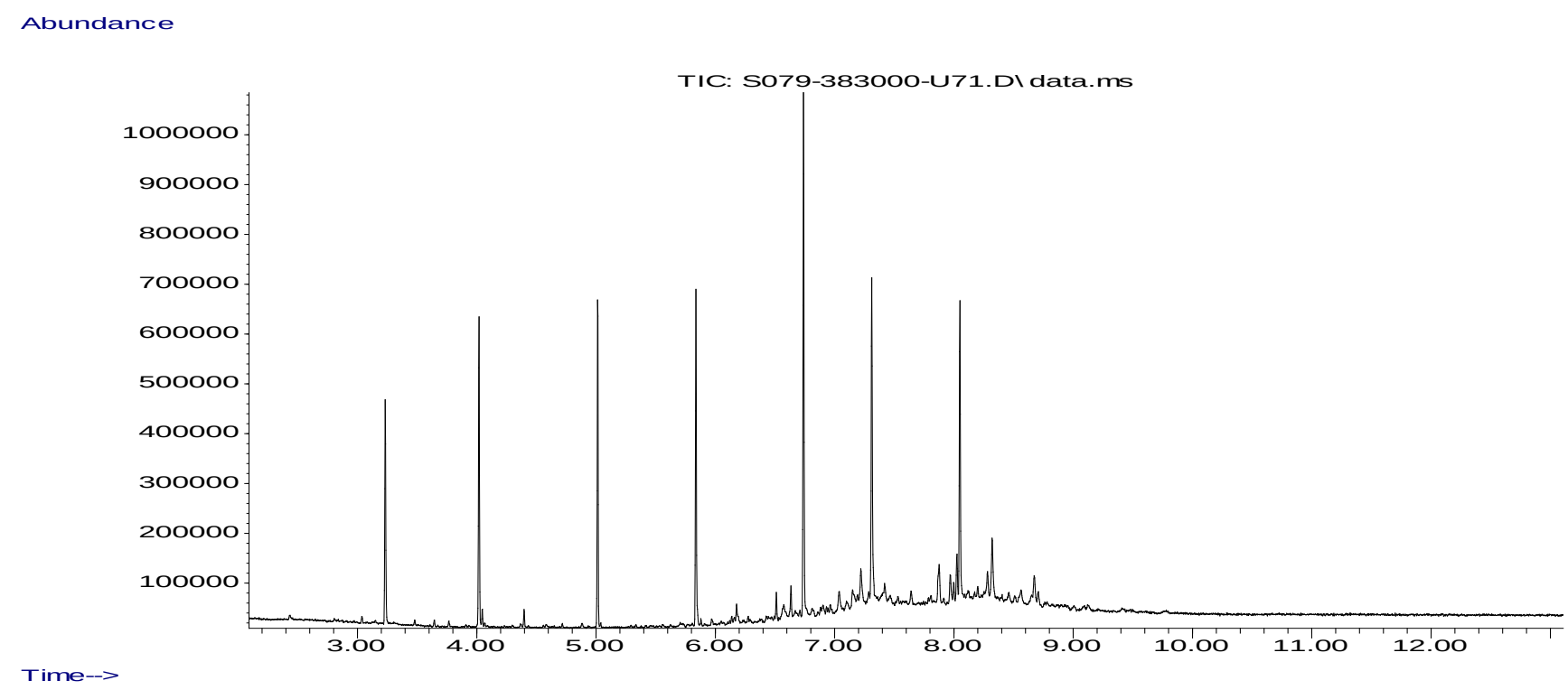
Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total petroleum hydrocarbons by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS	In-house method	L076B/L088-PL	D/W	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution







APPENDIX D CONTAMINATION RISK ASSESSMENT

Contaminated Land Risk Assessment – Definition of Methodology

The Contaminated Land Risk Assessment methodology followed in this report is based on Environment Agency's (EA) online guidance, Land Contamination: Risk Management (LCRM), published in June 2019. The new guidance is based upon the principles of the EA's CLR11 guidance, Model procedures for the management of land contamination, published in 2004.

The preliminary Conceptual Site Model (CSM) has been assessed using the methodology set out in CIRIA C552, Contaminated Land Risk Assessment - A Guide to Good Practice, published in 2001, as detailed below.

Risk evaluation determines the magnitude of risks present by assessing the likelihood of a particular risk being present alongside the severity of the consequence, should that event occur. The overall risk classification is a combination of the two and provides a qualitative assessment upon which to base any further work or remedial measures, where deemed necessary.

Where complete pollutant linkages are present, the probability of a contamination risk occurring at the site has been classified in accordance with the terms listed and defined in the table below.

Classification	Definition of Probability
High Likelihood	An event appears very likely in the short term and almost inevitable in the long term; or there is evidence at the receptor that harm or pollution is occurring.
Likely	It is probable that an event will occur, however, the event is not inevitable. It is possible in the short term and is likely over the long term.
Low Likelihood	Circumstances are possible under which an event could occur. However, it is uncertain that the event would occur even over a longer period and even less likely in the short term.
Unlikely	Circumstances are such that it is improbable that an event would occur even in the very long term.

The magnitude of the consequence of a contamination event occurring at this site is classified in accordance with the definitions listed in the following table. The classification of the consequence does not take into account the probability of the consequences being realised.

Classification	Definition of Consequence	Examples
Severe	Short term (acute) risk to human health likely to result in “significant harm” as defined by the Environment protection Act (1990), Part IIA. Short term risk of pollution of controlled waters. Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion causing building collapse (can also equate to a short-term human health risk if buildings are occupied.).
Medium	Chronic damage to Human Health (“significant harm”). Pollution of controlled waters. A significant change in a particular ecosystem, or organism forming part of such ecosystem.	Concentrations of contaminants from site exceeding generic or site-specific screening criteria. Leaching of contaminants into a major or minor aquifer. Death of species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy. (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by measures such as protective clothing etc). Easily reparable effects of damage to buildings, structures and services	The presence of contaminants at such concentration that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discolouration of concrete.

Once the probability and consequence of each pathway has been classified, the potential overall risk classification can be evaluated using the following matrix.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

The definitions of the risk categories provided in CIRIA C552, together with actions that are likely to be necessary, are presented below.

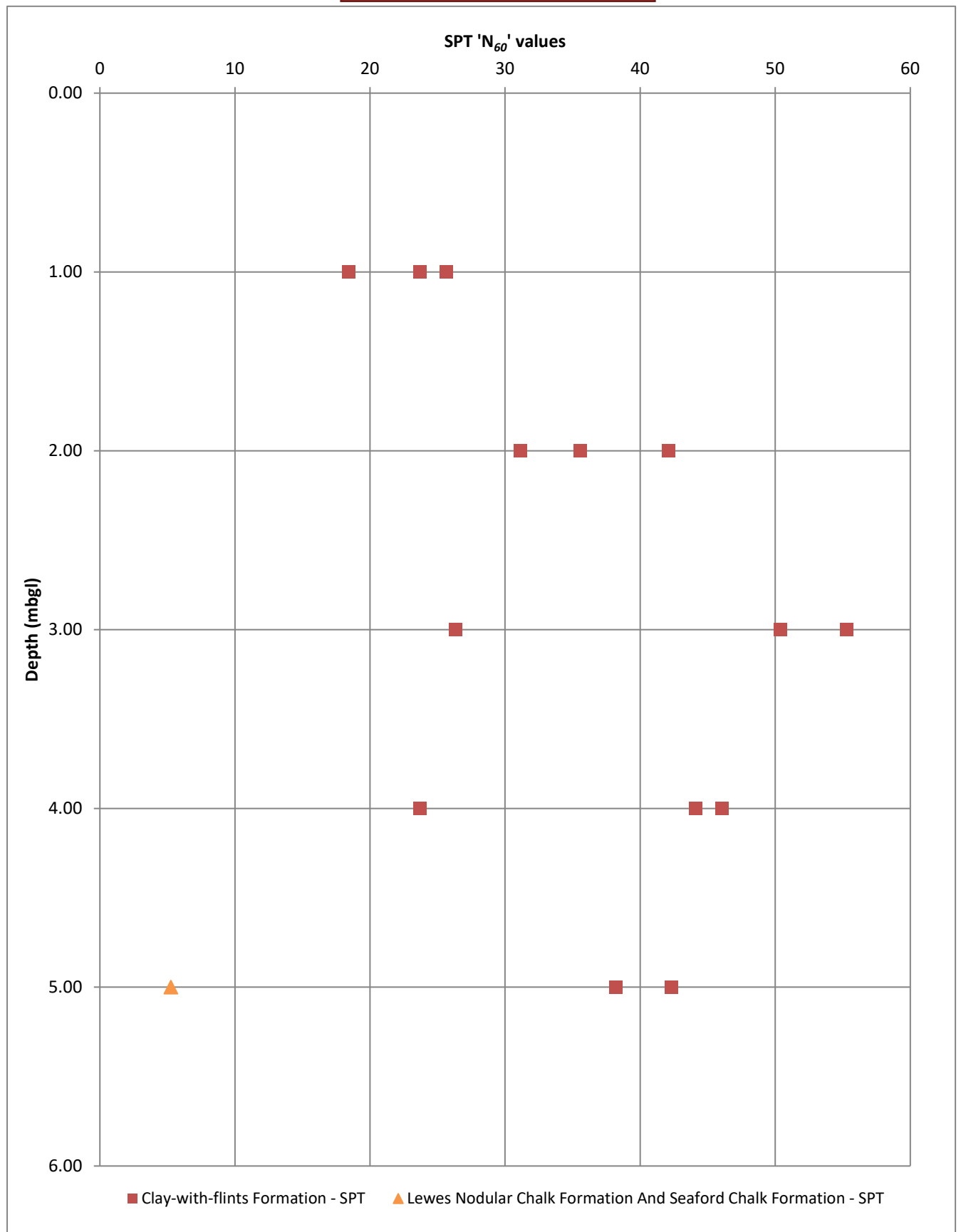
Classification	Definition of Risk and Likely Actions Required
Very high Risk	• High probability that severe harm could arise or that severe harm is already occurring • This risk, if realised, is likely to result in a substantial liability • Urgent investigation and remediation are likely to be required
High Risk	• Harm is likely to arise • The risk, if realised, is likely to present a substantial liability • Urgent investigation is required and remediation may be necessary in the short term and likely over the longer term
Moderate Risk	• It is possible that harm could arise, however, it is unlikely that any harm would be severe and more likely it would be relatively mild • Investigation is likely to be required to clarify the risk and determine potential liability • Some remediation may be required in the longer term
Low Risk	• It is possible that harm could arise, but is likely that this harm, if realised, would be mild at worst
Very low Risk	• There is a low possibility that harm could arise • If realised, such harm is not likely to be severe

Reference:

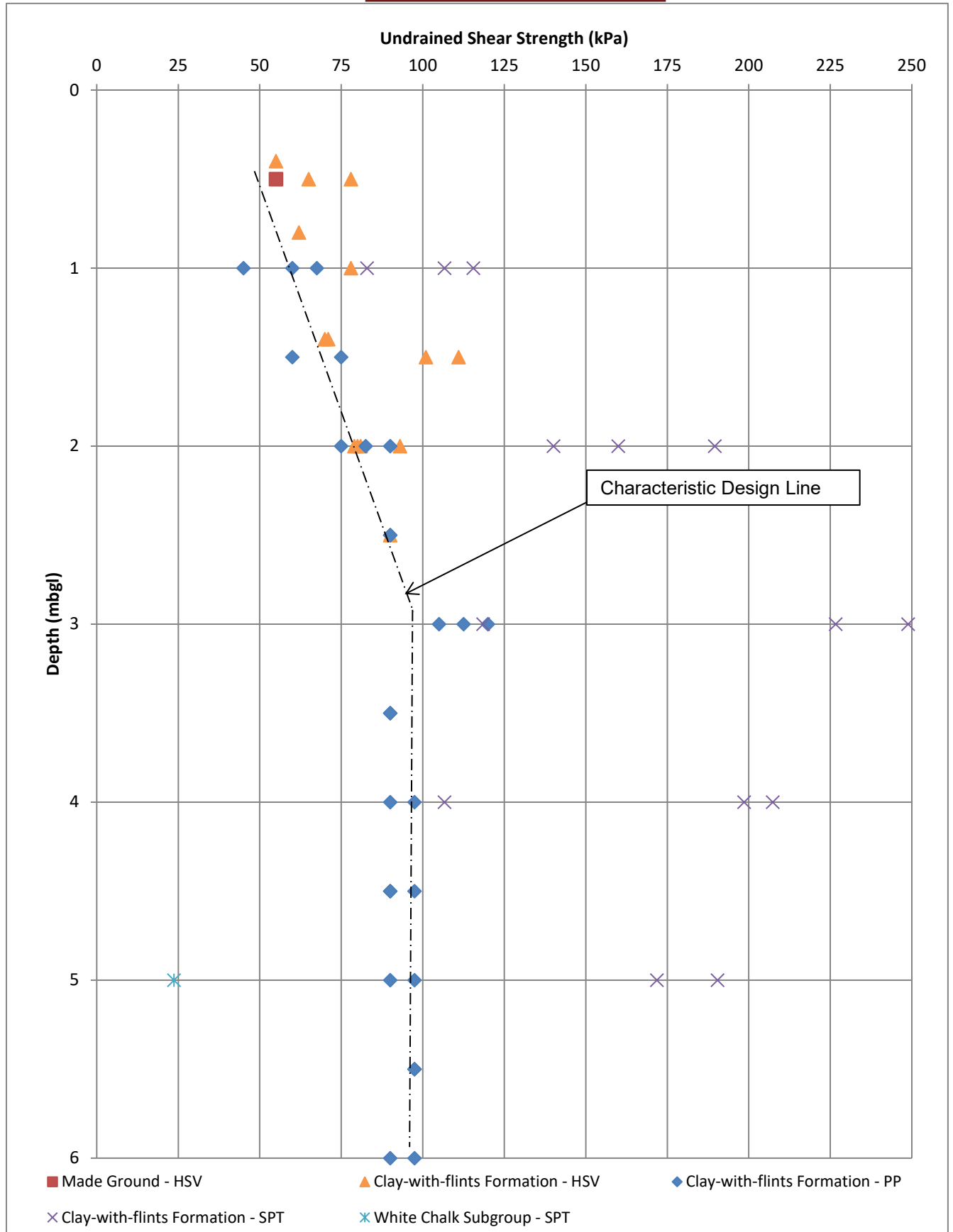
Rudland, D J, Lancefield, R M, Mayell, P N, Contaminated land Risk Assessment. A guide to Good Practice, CIRIA Report C552, 2001.

APPENDIX E

GEOTECHNICAL PLOTS AND TABLES



Corrections in accordance with BS EN ISO 22476-3, 2005, National Annex A; using Energy Ratios (79% [CT01 to CT03]) from current equipment calibrations



Stroud conversion factor, $f_1=4.5$ applied to SPT N_{60} values