



Main Investigation Report

at

Nightingale Avenue, Eastleigh, Hampshire SO50 9JA

for

Doswell Projects

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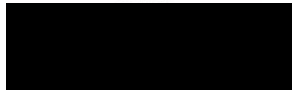
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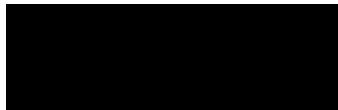
Prepared by

R Gardner BSc. (Hons.), MSc., FGS.



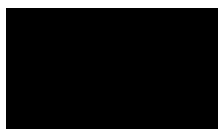
First check by

C Morrison BSc (Hons), FGS, MEnvSc.



Second check by

Eur Ing R B Higginson BSc, PGDip, CEng, MICE, FGS.



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Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Commission

Soils Limited were commissioned by Doswell Projects to provide an update to this Main Investigation Report for the site referred to as Nightingale Avenue, Eastleigh, Hampshire SO50 9JA to reflect a change in the proposed development scheme. The original report (Ref: 19473/MIR) was commissioned by Vivid Housing Limited and full reliance on the original report by Doswell Projects was in the process of being obtained at the time of this update. The scope of the investigation was outlined in the original Soils Limited quotation reference Q24753 rev 102, dated 7th June 2021. Updates to the report were agreed within the Soils Limited quotation reference Q27649, dated 17th April 2023.

This document comprises the Main Investigation Report and incorporates the results, discussion and conclusions to the original intrusive works in relation to the new proposed scheme.

This Main Investigation Report must be read in conjunction with the Preliminary Investigation Report undertaken on the above site by Soils Limited, Report ref: 20875/PIR, dated April 2023.

Standards

The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards:

- BS 5930:2015 and BS EN ISO 22476-2 2005+A1:2011
- BS 5930:2015 and BS EN ISO 22476-2&3:2005+A1:2011
- BS 5930:2015 and BS EN ISO 22476-3:2005+A1:2011
- BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design
- BS EN ISO 14688-1:2018 - Geotechnical investigation and testing - Identification and description
- BS EN ISO 14688-2:2018 - Geotechnical investigation and testing - Principles for a classification
- BS 10175:2011+A2:2017 - Investigation of potentially contaminated sites
- LCRM 2021 Environment Agency
- BS 8004:2015 – Code of practice for foundations
- BS 1377:1990 Parts 1 to 8
- BRE Digest 241 “Low-rise buildings on shrinkable clay soils: Part 2
- BRE Special Digest 1, 2005, ‘Concrete in Aggressive Ground’
- Stroud, M. A. 1974, “The Standard Penetration Test – its application and interpretation”, Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.
- N.E. Simons, B.K. Menzies, “A Short Course in Foundation Engineering”

- NHBC Standards Chapter 4.2, January 2022.
- SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination December 2014
- Google Earth
- British Geological Survey Website & iGeology App

The geotechnical laboratory testing was performed by GEO Site & Testing Services Ltd (GSTL) in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice was adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

The chemical analyses were undertaken by Derwentside Environmental Testing Services (DETS) in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to produce a trial hole.

Limitations and Disclaimers

This Main Investigation Report relates to the site located at Nightingale Avenue, Eastleigh, Hampshire SO50 9JA and was prepared for the sole benefit of Doswell Projects (The “Client”). The report was prepared solely for the brief described in Section 1.1 of this report.

The contents, recommendations and advice given in the report are subject to the Terms and Conditions given in Q27649, dated 17th April 2023 as accepted by the client in the associated signed Job Order Form.

Soils Limited disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Conditions of Contract of Business and taking into account the resources devoted to us by agreement with the Client.

The report is personal and confidential to the Client and Soils Limited accept no responsibility of whatever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly at its own risk.

The Client may not assign the benefit of the report or any part to any third party without the written consent of Soils Limited.

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the Client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

If the term “competent person” is used in this report or any Soils Limited document, it means an engineering geologist or civil engineer with a minimum of three years post graduate experience in the understanding and application of the appropriate codes of practice.

Unless the site investigation works have been designed and specified in accordance with EC7, this report is a Geotechnical Investigation Report and is not necessarily a Ground Investigation Report as defined by EC7 (Eurocode 7 Part 1, §3.4, Part 2, §6.1) or a Geotechnical Design Report (Eurocode 7 Part 1, §2.8) as defined by Eurocode 7 and as such may not characterise the ground conditions and additional works may be required to comply with the requirements of EC7.

Within the report reference to ground level relates to the site level at the time of the investigation, unless otherwise stated.

Exploratory hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sample borehole implies the specific technique used to produce an exploratory hole.

The depth to roots and/or of desiccation may vary from that found during the investigation. The Client is responsible for establishing the depth to roots and/or of desiccation on a plot by plot basis prior to the construction of foundations. Supplied site surveys may not include substantial shrubs or bushes and is also unlikely to have data or any trees, bushes or shrubs removed prior to or following the site survey.

Where trees are mentioned in the text this means existing trees, substantial bushes or shrubs, recently removed trees (approximately 20 years to full recovery on cohesive soils) and those planned as part of the site landscaping).

The geotechnical laboratory testing was performed by GEO Site & Testing Services Ltd (GSTL) in accordance with the methods given in BS 1377:1990 Parts 1 to 8 and their UKAS accredited test methods.

For the preparation of this report, the relevant BS code of practice were adopted for the geotechnical laboratory testing technical specifications, in the absence of the relevant Eurocode specifications (ref: ISO TS 17892).

The chemical analyses were undertaken by Derwentside Environmental Testing Services (DETS) in accordance with their UKAS and MCERTS accredited test methods or their documented in-house testing procedures. This investigation did not comprise an environmental audit of the site or its environs.

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. "Contaminated Land" is defined in Section 57 of the Environment Act 1995 (as updated 2021) as:

"Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being, or is likely to be caused".

It must be noted that a detailed survey of the possible presence or absence of invasive species, such as Japanese Knotweed, is outside of the scope of investigation.

Deleterious materials may be present in any Made Ground that pose a potential risk to site workers, end users and adjacent vulnerable receptors. These could include a range of contaminants, including asbestos, especially if the material includes large fractions of demolition derived materials.

The investigation, analysis or recommendations in respect of contamination are made solely in respect of the prevention of harm to vulnerable receptors, using where possible best practice at the date of preparation of the report. The investigation and report do not address, define or make recommendations in respect of environmental liabilities. A separate environmental audit and liaison with statutory authorities is required to address these issues.

All environmental works are undertaken in the context of, and in compliance with, BS10175+A2 2017 and LCRM (EA 2021) and all other pertinent planning, standards, documentation and guidance appropriate to the site at the time of production which may include, but are not necessarily limited to, documents provided by BS/CEN/ISO, NHBC, AGS, CIEH, CIRIA, SoBRA and CLAIRE.

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Section I Introduction

I.1 Objective of Investigation

Soils Limited was originally commissioned by Vivid Housing Limited to undertake an intrusive ground investigation and to prepare a Main Investigation Report to supply the client and their designers with information regarding ground conditions, to assist in preparing a foundation scheme for development that was appropriate to the settings present on the site. This updated report for the same site was commissioned by Doswell Projects (The Client) to reflect the changes to the proposed development scheme and uses the data collected during the original site investigation and is subject to confirmation of formal reliance.

The investigation was to be undertaken to provide comment on appropriate foundation options for the proposed residential development. The investigation was to be made by means of in-situ testing and geotechnical laboratory testing undertaken on soil samples taken from the trial holes.

Soil samples were taken for chemical laboratory testing to enable recommendations for the safe redevelopment of the site and the protection of site workers, end-users and the public from any contamination identified as dictated by the Conceptual Site Model (CSM) in the Preliminary Investigation Report undertaken for the site by Soils Limited (Report ref: 20875/PIR, April 2023) and/or the Revised Conceptual Site Model presented in Appendix C.1.

I.2 Location

The site was located at Nightingale Avenue, Eastleigh, Hampshire SO50 9JA and had an approximate O.S Land Ranger Grid Reference of SU 44141 18377.

The site location plan is given in Figure 1.

I.3 Site Description

The application site comprised a vacant site with two derelict single-storey domestic garage structures situated centrally with the south westernmost garage with possible asbestos roofing. The site was relatively flat with a slightly easterly dip (<3 degrees). The site surfacing comprised predominantly of grass with localised areas of concrete hardstanding around the garage units and areas of gravel surfacing comprising concrete, ash and clinker, and there were several stockpiles of general waste/fly tipped wastes onsite. A line of semimature and mature trees lined the northeast corner of the site, a single tree was situated centrally within the site and majority of the site was overgrown with general shrubs and vegetation. The site was bounded by residential housing, and commercial premises to the north of the access road.

An aerial photograph showing the site and near environs has been included in Figure 2.

1.4 Proposed Development

The proposed development was to comprise clearance and demolition of the on-site structures and subsequent construction of a two-storey residential property comprised of four attached plots. The proposal included areas of hard landscaping for access road, parking and pavements and areas of soft landscaping to include private gardens.

The proposed development initially comprised the construction of a three-storey residential apartment block with external single storey bike and bin shed. The proposal included areas of hard landscaping for access road, parking and pavements and areas of soft landscaping to include private gardens for ground floor units and areas of public open space within the wider site. The original investigation and report were based on the previous proposed layout.

In compiling this report reliance was placed on drawing number 22206 – P10 dated 29th March 2023 prepared by OSP Architecture. The recommendations provided within this report are made exclusively in relation to the scheme outlined above and must not be applied to any other scheme without further consultation with Soils Limited. Soils Limited must be notified about any change or deviation from the scheme outlined.

Development plans provided by the client are presented in Appendix D.

1.5 Anticipated Geology

The 1:50,000 BGS map showed the site to be located upon London Clay Formation bedrock with overlying superficial deposits of River Terrace Deposits.

1.5.1 River Terrace Deposits

The rivers Test and Itchen have deposited extensive spreads of River Terrace Deposits in the Southampton area, representative of ancient floodplains. In total, eleven terraces have been recorded. The River Terrace Deposits consist predominantly of gravels made up of subangular to subrounded flints with a significant sand component locally with lenses of silt, clay or peat. The five highest terraces have appreciable clay content. Poorly sorted, clayey and sandy silts and silty clays overlie the 1st, 3rd, 5th and 6th terraces and locally at above terrace gravels.

1.5.2 London Clay Formation

The London Clay Formation in the Hampshire region comprises silty and sandy clay, clayey and sandy silt, silty sand; sporadic claystones and thin beds of flint pebbles. The formation includes the Bognor Sand, Whitecliff Sand, Durley Sand, Portsmouth Sand and Nursling Sand Members. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay, and precautions against sulphate attack to concrete are sometimes required. The lowest part of the London Clay Formation rests on the Reading Formation (Lambeth Group).

Section 2 Site Works

2.1 Proposed Project Works

The proposed intrusive investigation was designed to provide information on the ground conditions and to aid the design of foundations for the proposed residential development. The intended investigation, as outlined within the original Soils Limited quotation (Q24753 Rev 101, dated 7th June 2021) was to comprise the following items:

- 4No. up to 4m deep windowless sampler boreholes
- 4No. up to 6m deep dynamic probes
- 2No. monitoring well installations
- 1No. monitoring visit (post works)
- Infiltration testing (within machine excavated trial pit)
- Geotechnical laboratory testing
- Contamination laboratory testing

2.1.1 Actual Project Works

The actual project site works were undertaken between 26th and 27th July 2021, with laboratory testing and reporting undertaken thereafter, and comprised:

- 4No. windowless sampler boreholes (WS1 – WS4)
- 4No. super heavy dynamic probes (DP1 – DP4)
- 2No. combined groundwater and ground gas monitoring wells (WS1 & WS3)
- 1No. machine excavated trial pit (TP1)
- Infiltration testing to BRE 365
- 1No. post works monitoring visit
- Geotechnical laboratory testing
- Contamination laboratory testing

The actual site investigation works carried out were selected based on the original proposed development scheme. However, whilst the new scheme differs in terms of size and position on the site, given the relatively small size of the site the actual works carried out were also considered appropriate for the new scheme.

Two windowless sampler boreholes (WS1 & WS3) were backfilled with gravel and bentonite following the installation of monitoring wells. The remaining windowless sampler boreholes were backfilled with gravel and the trial pit was backfilled with arisings.

All trial hole locations have been presented in Figure 3.

Following completion of site works, soil cores were logged and sub sampled so that samples could be sent to the laboratory for both contamination and geotechnical testing.

2.2 Ground Conditions

On 26th July 2021, one trial pit (TP1) was machine excavated to a depth of 2.70m (full reach of the machine) below ground level (bgl) at a location selected by Soils Limited and confirmed by the original client. Infiltration testing in accordance with the principles of BRE 365 was subsequently undertaken within the open trial pit. The full available water resource (2,000 litres) was discharged into the pit over the period of approximately ten minutes but did not achieve a suitable head for monitoring.

On 27th July 2021 four windowless sampler boreholes (WS1 – WS4) were drilled to depths of 4.00m bgl at locations selected by Soils Limited using a development plan provided by the original client.

Four super heavy dynamic probes (DP1 – DP4) were driven prior and adjacent to their corresponding windowless sampler borehole to depths of 6.00m bgl.

Two standpipes were installed within window sample borehole locations WS1 and WS3 to allow for continued monitoring of both groundwater and soils gas, where present.

The maximum depths of trial holes have been included in Table 2.1.

All trial holes were scanned with a Cable Avoidance Tool (C.A.T.) and GENNY prior to excavation to ensure the health and safety of the operatives.

Table 2.1 Final Depth of Trial Holes

Trial Hole	Depth (m bgl)	Probe Hole	Depth (m bgl)
WS1 ^w	4.00	DPI	6.00
WS2	4.00	DP2	6.00
WS3 ^w	4.00	DP3	6.00
WS4	4.00	DP4	6.00
TP1	2.70		

Note: w - well installation: response zone 1m – 4m bgl

The approximate trial hole locations are shown on Figure 3.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the trial hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For more complete information about the soils encountered within the general area of the site reference should be made to the detailed records given within Appendix A, but for the purposes of discussion, the succession of conditions encountered in the trial holes in descending order can be summarised as:

Made Ground (MG)
River Terrace Deposits (RTD)
London Clay Formation (LCF)

The ground conditions encountered in the trial holes are summarised in Table 2.2.

Table 2.2 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Anthropocene	0.00	0.20 – 0.60	0.40	Dark orange and brown slightly gravelly slightly sandy CLAY.
RTD	Pleistocene	0.20 – 0.60	2.70 – 4.00 ²	3.00	Orangish brown slightly gravelly slightly sandy CLAY over orangish and brown slightly clayey to clayey sandy to very sandy GRAVEL.
LCF	Eocene	2.70 – 4.00 ²	>6.00 ^{1,2}	Not proven	Light grey slightly sandy CLAY.

Note: ¹ Final depth of trial hole. ² Inferred from dynamic probe. ³ Base of strata not encountered. 0.00 denotes ground level.

2.3 Ground Conditions Encountered in Trial Holes

The ground conditions encountered in trial holes have been described below in descending order. The engineering logs are presented in Appendix A.1.

2.3.1 Made Ground

Soils described as Made Ground were encountered in all five trial holes from ground level to depths ranging between 0.20m and 0.60m bgl.

The Made Ground typically comprised dark orange and brown slightly gravelly slightly sandy CLAY. Gravel comprised fragments predominantly of brick, concrete and flint with rare plastic, limestone and ash. Tarmac inclusions recorded in TP1.

The depths of Made Ground have been included in Table 2.3.

Table 2.3 Final Depth of Made Ground

Trial Hole	Depth (m bgl)
WS1	0.20
WS2	0.40
WS3	0.60
WS4	0.50
TPI	0.30

2.3.2 River Terrace Deposits

Soils described as River Terrace Deposits were encountered as a predominantly cohesive unit over a granular unit directly underlying Made Ground.

The cohesive unit typically comprised orangish brown slightly gravelly slightly sandy CLAY and persisted to depths of between 1.30m and 1.90m bgl.

The granular unit underlying the cohesive unit persisted to depths of between 2.70m bgl to the full exploratory depth of 4.00m bgl and comprised orange and brown slightly clayey to clayey sandy to very sandy GRAVEL, with the fraction of fines decreasing with depth. Gravel was medium to coarse occasionally fine angular to sub rounded clasts of flint.

The depth of River Terrace Deposits has been included in Table 2.4.

Table 2.4 Final Depth of River Terrace Deposits

Trial Hole	Cohesive material Depth (m bgl)	Granular material Depth (m bgl)
WS1	1.30	2.70
WS2	1.50	3.40
WS3	1.80	3.80
WS4	1.70	>4.00 ¹
TPI	1.90	>2.70 ¹
DPI	1.30	3.00 ²
DP2	1.30	2.80 ²
DP3	1.80	4.00 ²
DP4	1.40	4.10 ²

Note: ¹ Final depth of trial hole. ² Inferred from dynamic probe

2.3.3 London Clay Formation

Soils described as London Clay Formation were encountered within three of the five trial holes, where the River Terrace Deposits was fully penetrated, and persisted to the full investigatory depth of 4.00m bgl in the windowless sampler boreholes and inferred to the full depth of 6.00m bgl in the dynamic probes.

The London Clay Formation comprised light grey slightly sandy CLAY with rare shell fragments and rare selenite crystals. The depth of London Clay Formation has been included in Table 2.5.

Table 2.5 Final Depth of London Clay Formation

Trial Hole	Depth (m bgl)
WS1	>4.00 ¹
WS2	>4.00 ¹
WS3	>4.00 ¹
WS4	Not encountered
TPI	Not encountered
DPI	>6.00 ^{1,2}
DP2	>6.00 ^{1,2}
DP3	>6.00 ^{1,2}
DP4	>6.00 ^{1,2}

Note: ¹ Final depth of trial hole. ² Inferred from dynamic probe

2.4 Roots

Roots/rootlets were observed in four out of the five trial holes persisted to depths ranging between 0.50 and 1.50m bgl.

The depths of root penetration have been included in Table 2.6.

Table 2.6 Depth of Root Penetration

Trial Hole	Depth (m bgl)
WS1	1.30
WS2	None observed
WS3	1.50
WS4	0.50
TPI	0.70

Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs.

It must be emphasised that the probability of determining the maximum depth of roots from a narrow diameter borehole is low. A direct observation such as from within a trial pit is necessary to gain a better indication of the maximum root depth.

2.5 Groundwater

Groundwater was encountered within two of the five trial holes struck at depths of between 2.50m and 3.00m bgl.

Changes in groundwater level occur for a number of reasons including seasonal effects

and variations in drainage. The investigation was conducted in July (2021), when groundwater levels should be reducing from the annual maximum (highest) elevation which typically occurs around March.

A single groundwater monitoring visit was conducted within the standpipes installed on site following completion of site works and has been presented in Table 2.7.

Table 2.7 Groundwater Monitoring

Trial Hole	Well Depth (m bgl)	Depth to Water (m bgl) 12/08/2021
WS1	2.88	2.57
WS3	2.97	DRY

Groundwater equilibrium conditions may only be conclusively established, if a series of observations are made via groundwater monitoring wells, which did not form part of the original brief.

Section 3 Discussion of Geotechnical In-Situ and Laboratory Testing

3.1 Dynamic Probe Tests

Dynamic probing (DPSH) was undertaken at four locations (DP1 – DP4) adjacent and prior to the drilling of their corresponding windowless sampler borehole to depths of 6.00m bgl. The results were converted to equivalent SPT “N60” values based on dynamic energy using commercial computer software (Geostru). The results were then interpreted based on the classifications outlined in Appendix B.1.

The SPT “N60” values presented have been corrected in accordance with BS EN 22476 Part 3, to account for the rigs trip hammer efficiency, borehole depth, overburden factors etc. Further correction of the ‘N’ values should therefore not be necessary. The energy ratio of the drilling rig was 82.11%.

The River Terrace Deposits recorded equivalent SPT “N60” values between <2 and 4 in the cohesive unit and between 4 and 20 in the underlying granular unit, showing variability with depth.

The cohesive unit was classified as extremely low to low strength with an inferred undrained cohesive strength of <10kPa to 20kPa.

The granular unit was classified as loose to medium dense relative density, showing variability with depth.

The London Clay Formation recorded equivalent SPT “N60” values between 4 and 12 classifying the cohesive soils as low to medium strength with undrained cohesions of 20kPa to 60kPa, with no significant improvement with depth identified.

A full interpretation of the DPSH tests is outlined in Appendix B.2, Table B.2.1.

3.2 Infiltration Tests

Infiltration testing was undertaken in TP1 within the granular River Terrace Deposits following the principles of BRE Digest 365:2016. BRE 365 states that for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test can only be ended once 75% of the water present has drained away.

The full available water resource (2000 litres) was discharged to the open trial pit over a period of approximately ten minutes which did not achieve a measurable head of water.

Based on 2000 litres discharged over ten minutes, a soakage rate of at least 3.3×10^{-3} m³/sec was calculated for the granular River Terrace Deposits.

3.3 Atterberg Limit Tests

Atterberg Limit tests were performed on two samples obtained from the cohesive River Terrace Deposits and two from the London Clay Formation. The results were classified in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The River Terrace Deposits was classified as low volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2. One test undertaken on the predominantly granular River Terrace Deposits resulted in a non-plastic result.

The London Clay Formation was classified as medium to high volume change potential in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

A full interpretation of the Atterberg Limit tests is outlined in Table B.2.2, Appendix B.2 and the laboratory report in Appendix B.3.

3.4 Particle Size Distribution Tests

Particle Size Distribution (PSD) tests were performed on four samples from the granular River Terrace Deposits.

The PSD tests classified the one of the samples as having a volume change potential in accordance BRE Digest 240 recording a fines fraction >15%. None of the samples had a volume change potential in accordance with NHBC Standards Chapter 4.2. Note that a cohesive soil is only classified as having a volume change potential if it is also plastic and an Atterberg Limit test can be conducted on the strata.

A full interpretation of the PSD tests is outlined in Table B.2.3, Appendix B.2 and the laboratory report in Appendix B.3.

3.5 Sulphate and pH Tests

Two samples were taken from the River Terrace Deposits and one from the London Clay Formation for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

The tests recorded water soluble sulphate between 24mg/l and 207mg/l with pH values of 6.9 to 7.5.

The significance of the sulphate and pH test results are discussed in Section 4.4 and the laboratory report in Appendix B.3.

Section 4 Foundation Design

4.1 General

An engineering appraisal of the soil types encountered during the site investigation and likely to be encountered during the redevelopment of this site is presented. Soil descriptions are based on analysis of disturbed samples taken from the trial holes.

4.1.1 Made Ground and Topsoil

The terms *Fill* and *Made Ground (non-engineered fill)* are used to describe material, which has been placed by man either for a particular purpose e.g. to form an embankment, or to dispose of unwanted material. For the former use, the Fill and/or Made Ground may well have been selected for the purpose and placed and compacted in a controlled manner. With the latter, great variations in material type, thickness and degree of compaction invariably occur and there can be deleterious or harmful matter, as well as potentially methanogenic organic material.

The BSI Code of Practice for Foundations, BS 8004:2015, Clause 4.1.2.2 states, *'Spread foundations should not be placed on non-engineered fill unless such use can be justified on the basis of a thorough ground investigation and detailed design.'*

Soils described as Made Ground were encountered in all five trial holes from ground level to depths ranging between 0.20m and 0.60m bgl. The Made Ground typically comprised dark orange and brown slightly gravelly slightly sandy CLAY. Gravel comprised fragments predominantly of brick, concrete and flint with rarer plastic, limestone and ash.

A result of the inherent variability, particularly of uncontrolled Topsoil, Fill and/or Made Ground is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should, therefore, be taken through any Topsoil and/or Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

4.1.2 River Terrace Deposits

Soils described as River Terrace Deposits were encountered as a predominantly cohesive unit over granular unit directly underlying Made Ground.

The cohesive unit typically comprised orangish brown slightly gravelly slightly sandy CLAY and persisted to depths of between 1.10m and 1.90m bgl.

The granular unit underlying the cohesive unit persisted to depths of between 2.70m bgl and full exploratory depth of 4.00m bgl and comprised orange and brown slightly clayey to clayey sandy to very sandy GRAVEL, with the fraction of fines decreasing with depth. Gravel was medium to coarse occasionally fine angular to sub rounded clasts of flint.

The results from DPSH testing inferred that the cohesive soils of the River Terrace Deposits were of extremely low to low strength, with undrained cohesions of between <10kPa and 20kPa. The granular soils of the River Terrace Deposits were inferred as loose to medium dense relative density.

The results from Atterberg Limits tests showed that the cohesive soils of the River Terrace Deposits had low volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2. Atterberg Limit testing confirmed a non-plastic result for the granular soils.

The results from PSD testing recorded one of the four samples tested as having a volume change potential in accordance with BRE Digest 240. None of the samples had a volume change potential in accordance with NHBC Standards Chapter 4.2.

Soils of the River Terrace Deposits are normally consolidated, predominantly cohesive over predominantly granular soils and are expected to display low to moderate bearing capacities with moderate to high settlement characteristics. The granular soils of the River Terrace Deposits were considered suitable for the proposed two-storey development.

4.1.3 London Clay Formation

Soils described as London Clay Formation were encountered three of the five trial holes, where the River Terrace Deposits was fully penetrated, and persisted to the full investigatory depth of 4.00m bgl in the windowless sampler boreholes and were inferred to the full depth of 6.00m bgl in the dynamic probes. The London Clay Formation comprised light grey slightly sandy CLAY with rare shell fragments and rare selenite crystals.

The results from DPSH testing inferred that the soils of the London Clay Formation were of low to medium strength with undrained cohesions of 20kPa to 60kPa, showing no significant improvement with depth.

The results from Atterberg Limit testing showed the cohesive soils of the London Clay Formation had medium to high volume change potential in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

Soils of the London Clay Formation are heavily overconsolidated predominantly cohesive soils and anticipated to display moderate bearing and settlement characteristics. The soils of the London Clay Formation were considered a suitable bearing stratum for the adoption of piled foundations, should these be required, given the depth to its upper horizon.

4.1.4 Roots

Roots/rootlets were observed in four out of the five trial holes persisted to depths ranging between 0.50 and 1.50m bgl. Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed

both within the site and its close environs.

The northeast boundary of the site was lined with mature/semi mature trees and a single tree positioned centrally within the site. The central and southeast area of the site was overgrown with bushes and shrubs.

4.1.5 Groundwater

Groundwater was encountered within two of the five trial holes struck at a depths of between 2.50m and 3.00m bgl.

A single groundwater monitoring visit was conducted within the standpipes installed on site following completion of site works and has been presented in Table 2.7.

4.2 Foundation Scheme General

The proposed development was to comprise clearance and demolition of the on-site structures and subsequent construction of a two-storey residential property comprised of four attached plots. The proposal included areas of hard landscaping for access road, parking and pavements and areas of soft landscaping to include private gardens.

In compiling this report reliance was placed on drawing number 22206 – P10 dated 29th March 2023 prepared by OSP Architecture. The recommendations provided within this report are made exclusively in relation to the scheme outlined above and must not be applied to any other scheme without further consultation with Soils Limited. Soils Limited must be notified about any change or deviation from the scheme outlined.

Development plans provided by the client are presented in Appendix D.

4.2.1 Guidance on Shrinkable Soils

The Building Research Establishment (BRE) Digests 240, 241 and 242 provide guidance on ‘best practice’ for the design and construction of foundations on shrinkable soils.

The results from Atterberg Limits tests showed that the River Terrace Deposits had low volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

The London Clay Formation had a medium to high volume change potential in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

High volume change potential must therefore be adopted where foundations pass through the London Clay Formation.

Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs.

It must be emphasised that the probability of determining the maximum depth of roots from a narrow diameter borehole is low. A direct observation such as from within a trial pit is necessary to gain a better indication of the maximum root depth.

4.3 Foundation Scheme

The River Terrace Deposits comprised soft to firm clay over loose to medium dense granular soils of variable thickness. Given that the proposed structure would be of a low to moderate foundation load (two-storey residential structure) it is recommended that the main structure is not founded within the shallow cohesive deposits of the River Terrace Deposits and foundations should be extended into the granular deposits.

Foundations **must not** be constructed within any Made Ground/Topsoil or cohesive River Terrace Deposits due to the likely variability and potential for large load induced settlements both total and differential.

Roots/rootlets were observed in four out of the five trial holes persisted to depths ranging between 0.50 and 1.50m bgl. If roots are encountered during the construction phase foundations **must not be placed within any live root penetrated or desiccated cohesive soils or those with a volume change potential**. Should the foundation excavations reveal such materials, the excavations **must** be extended to greater depth in order to bypass these unsuitable soils. Excavations must be checked by a qualified geotechnical engineer prior to concrete being poured.

Considering the type of development, a shallow foundation solution was considered suitable.

4.3.1 Shallow Foundations into the Granular River Terrace Deposits

Based on a 5.00 by 0.75m strip foundation, using commercial software Table 4.1 shows the calculated bearing values and anticipated settlement characteristics.

Table 4.1 Allowable Bearing Capacities in the Granular River Terrace Deposits

Depth (m bgl)	Size (m)	Bearing Capacity (kPa)	Anticipated Settlement (mm)
1.30 – 1.70	5.00 x 0.75	120	<25

Note(s): The bearing capacity value presented above can be applicable at various depths depending on the location and the variability of the ground conditions.

The bearing capacity value presented above can be applicable at various depths depending on the location. Therefore, further works or thorough foundation inspections will be required due to the variability in the encountered ground conditions. The foundations must be installed with the upper horizons of the granular deposits of the River Terrace Deposits, extending beneath the shallow horizons of cohesive strata.

All foundation formations must be examined, recorded, and signed off by a competent person.

The use of reinforced trench fill foundations reduces the potential for differential settlement affecting the foundations.

For the allowable bearing value given above, settlements should not exceed the presented values, provided that excavation bases are carefully bottomed out and blinded or concreted as soon after excavation as possible and kept dry.

Foundations must not be constructed over former structures and other hard spots. The foundations design must be suitable for the conditions present at the site.

The anticipated settlement includes both elastic settlement and long-term drained settlement (in the case of cohesive soils).

Anticipated settlements may be taken as proportional to the bearing capacity adopted (for the same configuration of foundation), therefore if the bearing value is halved the anticipated settlement will halve.

All loose material, cohesive River Terrace Deposits in the upper horizons, soft spots and Made Ground must be removed from the base of the excavations. Failure to do so could result in increased and/or differential settlements.

It has been assumed that the foundations to any existing structures have been grubbed out. Where foundations have been grubbed out the new foundation must be taken through any backfill material into suitable natural ground as outlined in this report.

4.3.2 Ground Floor Slab

NHBC Standards 2021 states ground floors should be constructed as suspended floors where:

- *“the foundation depth dictated by the NHBC Standards 2021, Chapter 4.2.10 would exceed 1.5m bgl;”*
- *“ground floor construction is undertaken when the surface soils are seasonally desiccated;”*
- *“the depth of fill exceeds 600mm;”*
- *“there is shrinkable soil that could be subject to movement, expansive material or other unstable soils;”*
- *“the ground has been subject to vibratory improvement;” or*
- *“ground or fill is not suitable to support ground-bearing slabs.”*

Given presence of root penetrated shrinkable River Terrace Deposits with poor engineering properties, ground floor slabs must be designed as suspended.

4.4 Subsurface Concrete

Sulphate concentration measured in 2:1 water/soil extracts fell into Class **DS-1** of the BRE Special Digest 1 2005, '*Concrete in Aggressive Ground*'. Table C2 of the Digest indicated ACEC (Aggressive Chemical Environment for Concrete) site classifications of **AC-1**. The pH of the soils tested ranged between 6.9 and 8.4. The classification given was determined using the mobile groundwater case, in the view of groundwater being encountered. The laboratory results are presented in Appendix B.3.

The London Clay Formation is potentially pyritic and the percentage of oxidisable sulphate (OS) was therefore calculated, indicating an OS of 1.73% and Total Potential Sulphate (TPS) of 1.86%. On this basis, dependant on the extent to which the pyritic soils are to be disturbed during construction, the classification of DS-4 AC-4 would be appropriate for the London Clay.

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1 2005, '*Concrete in Aggressive Ground*' taking into account any possible exposure of potentially pyrite bearing natural ground and the pH of the soils.

4.5 Excavations

Shallow and deep excavations at the site are unlikely to be stable and will require support. Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported or battered back to a safe angle of repose.

Excavations beneath the groundwater table are likely to be unstable and dewatering of foundation trenches may be necessary.

4.6 Soakaways

An infiltration test was undertaken in TP1 within the granular River Terrace Deposits in line with the principles of BRE 365:2016. No measurable head was achieved with the available water supply onsite and an indicative soakage rate of at least $3.3 \times 10^{-3} \text{ m}^3/\text{sec}$ was calculated.

Notwithstanding the above, based on the groundwater observations made to date recording a highest water level of 2.50m bgl within the granular River Terrace Deposits, longer term groundwater information over the winter period must be obtained for the site prior to confirming the viability of adopting a soakaway structure at the site.

Section 5 Determination of Chemical Analysis

5.1 Site Characterisation and Revised Conceptual Site Model

The Preliminary Investigation Report undertaken by Soils Limited (report ref: 20875/PIR dated April 2023) identified a very low to moderate/low risk of ground contamination from historical and current usage of the site.

The Main Investigation Report identified Made Ground to depths between 0.20m and 0.60m bgl. The Made Ground typically comprised dark orange and brown slightly gravelly slightly sandy CLAY. Gravel comprised fragments predominantly of brick, concrete and flint with rare plastic, limestone and ash.

Superficial deposits of River Terrace Deposits were encountered underlying the Made Ground. Shallow groundwater was encountered within the granular River Terrace Deposits in two of five trial holes.

Bedrock soils of the London Clay Formation were proven underlying the superficial deposits.

5.2 Soil Sampling

A non-targeted sampling strategy is appropriate when there is:

- No adequate information available regarding the likely locations of contamination
- No sensitive areas where there is a need for a high degree of confidence

A targeted sampling strategy is appropriate when there is:

- Adequate information available regarding the likely locations of contamination
- Sensitive areas where there is a need for a high degree of confidence

A non-targeted sampling pattern was adopted in this case to provide a suitable coverage of the entire site. Table 5.1 outlines the sampling undertaken.

Table 5.1 Sampling Strategy

Sample	Stratum	Proposed Use
WS1:0.10	Made Ground	Soft Landscaping
WS3:0.20	Made Ground	
WS3:1.00	Natural	
WS4:0.20	Made Ground	
WS4:0.60	Natural	
TPI:0.20	Made Ground	Car park
WS2:0.10	Made Ground	
WS2:0.80	Natural	

5.3 Determination of Chemical Analysis

The driver for determination of the analysis suite was the information obtained from the Preliminary Investigation Report and Main Investigation Report intrusive investigation. Table 5.2 outlines the specification for each sample tested.

Table 5.2 Chemical Analysis Specification

Substance	Location:Depth (m bgl)							
	WS1:0.10 ^s	WS2:0.10 ^s	WS2:0.80 ^s	WS3:0.20 ^s	WS3:1.00 ^s	WS4:0.20 ^s	WS4:0.60 ^s	TPI:0.20
Asbestos Screen	✓	✓	✓	✓	✓	✓	✓	✓
Total Phenols	✓	✓	✓	✓	✓	✓	✓	✓
Organic Matter	✓	✓	✓	✓	✓	✓	✓	✓
pH	✓	✓	✓	✓	✓	✓	✓	✓
Metals	✓	✓	✓	✓	✓	✓	✓	✓
Metalloids	✓	✓	✓	✓	✓	✓	✓	✓
Organics	✓	✓	✓	✓	✓	✓	✓	✓
WAC						✓		

Notes: **Metals:** Cd, Cr, Pb, Hg, Ni, Se, Cu, Zn, Bo, V. **Metalloids:** As. **Organics:** USEPA 16 speciated PAH, EPH Texas Banded **WAC:** Waste Acceptance Criteria BS EN 12457/2 **Asbestos screening** was undertaken in accordance with HSG 248. ^s = Soil sample.

Section 6 Qualitative Risk Assessment

6.1 Assessment Criteria

The assessment criteria used to determine risks to human health are derived and explained within Appendix C.3.

6.2 Representative Contamination Criteria - Soil

The proposed development was to comprise clearance and demolition of the on-site structures and subsequent construction of a two-storey residential property comprised of four attached plots. The proposal included areas of hard landscaping for access road, parking and pavements and areas of soft landscaping to include private gardens.

In compiling this report reliance was placed on drawing number 22206 – P10 dated 29th March 2023 prepared by OSP Architecture. The recommendations provided within this report are made exclusively in relation to the scheme outlined above and must not be applied to any other scheme without further consultation with Soils Limited. Soils Limited must be notified about any change or deviation from the scheme outlined.

Based on the proposed development, with private garden space indicated, the results of the chemical analysis have been compared against generic guidance values for a '**residential with home grown produce***' end use, as presented in SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination December 2014 (C4SL), derived for the protection of human health. Where this document has not published screening values for determinants, generic screening values derived for the same end use have been adopted from the following published guidance; DEFRA Soil Guideline Values (SGV) and LQM/CIEH/Suitable 4 Use Level (S4UL).

To assess the potential toxicity of organic determinants (Petroleum Hydrocarbons and Polyaromatic Hydrocarbons) to the human health, soils samples were analysed for Soil Organic Matter (SOM). The selected samples analysed recorded, SOM values of between 0.2% and 3.7%. For each soil sample tested, the resultant Soil Organic Matter allowed for the correct comparison to be made with the appropriate guideline value for each organic determinants analysed. Table 6.1 outlines the samples that have exceeded their relevant assessment criteria. The full laboratory report is presented in Appendix C.2.

Table 6.1 Summary of Chemical Analysis of Soils Sample Exceedance

Substance	Sample locations where SGV, C4SL or S4UL adopted were exceeded for the 'residential with home grown produce' land-use scenario
EPH (>C21-C40)	2778 against 1500mg/kg – TPI:0.20 (S4UL)
Asbestos locations where material found (no threshold just presence)	
Not detected in any of the 8no. samples screened for asbestos	

In summary, one of the samples tested showed concentrations in excess of the relevant S4UL for a residential with home grown produce land-use scenario. In TP1 at 0.20m bgl hydrocarbon bands C21-C40 were recorded at a concentration of 2778mg/kg against adopted S4UL of 1500mg/kg conservatively assuming all the hydrocarbon identified in this banding is Aromatic.

None of the other substances tested recorded concentrations above the residential end-use screening values.

6.2.1 Asbestos

Although no asbestos containing material was identified within any of the eight samples screened for asbestos, it is possible that asbestos is present in other areas of the site. If encountered, care must be taken to ensure any such material is separated and disposed of in an appropriate manner to a licensed waste facility.

6.3 Tier I Quantitative Risk Assessment

Quantitative risk assessments are undertaken for the soil, groundwater and ground gas. The CSM has been updated to take account of the assessments below and presented in Appendix C.1. The full laboratory chemical report is presented in Appendix C.2.

6.3.1 Soils

One of the samples tested recorded concentrations in excess of the relevant screening threshold a residential with home grown produce land-use scenario. In TP1 at 0.20m bgl hydrocarbon Texas bands C21-C40 were recorded at a concentration of 2778mg/kg against adopted S4UL of 1500mg/kg.

PAH ratio analysis of the samples suggest the presence of coal tar and mixed petroleum and coal tar based products and therefore can likely be attributed to the tarmac inclusions noted within the Made Ground descriptions in the associated trial hole logs. If speciated split by CWG the TPH would likely have higher concentration within the aliphatic fractions from such an origin, therefore in context, although technically the result exceeds the aromatic threshold, the aliphatic threshold of 92000 mg/kg is more likely to be appropriate in this case. Based on the shallow depth of the samples, the material is likely to be removed during the strip of the site surface. The Tier 1 Quantitative risk assessment therefore established that there was no significant risk to the human health of future end-user receptors.

6.3.2 Groundwater

The Preliminary Investigation Report did not identify any credible pollutant linkages and therefore, no groundwater testing has been undertaken. The elevated EPH is considered likely to arise from the tarmac inclusions noted within the Made Ground and as such are not considered to be in an accessible or particularly soluble form. It is therefore concluded that risk the underlying groundwater receptor remains very low to negligible.

6.3.3 Ground Gas

The Preliminary Investigation Report identified a low risk of ground gas associated with Made Ground at the site and previous usage of the site.

Monitoring of the ground gas concentrations of the wells installed within WS1 and WS3 was requested on one occasion as a precautionary exercise undertaken on 12th August 2021.

The ground gas monitoring recorded the concentrations of oxygen, methane (total and LEL), carbon dioxide, carbon monoxide, flow rates, atmospheric pressure and differential pressure.

The ground gas monitoring visit recorded the following ranges of ground gases across the two monitoring points:

- Carbon dioxide between 4.5% v/v and 5.1% v/v
- Oxygen concentrations between 10.3% v/v and 15.5%
- Methane was not recorded above the instrument detection limit of <0.1%v/v
- Hydrogen sulphate and carbon monoxide was not recorded above the instrument detection limit of <1ppm.

Gas flow rate was not recorded above the instrument detection limit of <0.1l/hr and the monitoring visit was undertaken during an atmospheric pressure of 1018mb over a level pressure trend period.

To determine the potential risk to the proposed development, a preliminary assessment has been undertaken following the principles of CIRIA C665 and BS8485:2015+A1:2019 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new building to determine the site's underlying gas characteristic situation. The results of the assessment are presented below.

A hazardous flow rate (Q_{hg}) was calculated for each monitoring location and was calculated using Equation 1 presented:

$$Q_{hg} = (C_{hg}/100) * q$$

Equation 1

Where:

C_{hg} is the measured hazardous gas concentration (in percentage volume-by-volume).

q is the flow rate in litres per hour of combined gases found by direct measurement.

Table 6.2 presents the hazardous flow rate (Q_{hg}) for each monitoring location, based on the highest soil gas concentration and the associated recorded flow rate for each monitoring well.

Table 6.2 Hazardous Flow Rates

Monitoring Well	Highest Concentration		Flow Rate (l/h)	Hazardous Flow Rate (Q_{hg} l/h)
	Methane	Carbon Dioxide		
WS1	0.1	4.5	0.1	(Methane) 0.0001 (Carbon Dioxide) 0.0045
WS3	0.1	5.7	0.1	(Methane) 0.0001 (Carbon Dioxide) 0.0057

Note: Where flow rates were recorded below the detection limits of the gas monitor a flow rate of 0.1 l/hr has been adopted in line with current standards and guidance

Hazardous gas flow rates of between 0.0045l/hr and 0.0057l/hr were calculated for carbon dioxide, and 0.0001l/hr for methane. The adoption of these values as a Gas Screening Value with reference to Table 2 of BS8485:2015+A1:2019 would designate the site as being Characteristic Situation (CS1) 1, with all calculated values being significantly below the CS1/CS2 threshold value of 0.07l/hr.

Therefore, based on the single monitoring visit undertaken, the calculated GSV places the site within CS1, where no specific gas protection measures are required. However, it must be noted that both CIRIA C665 and BS8485:2015+A1:2019 state that where concentrations are consistently recorded over 5% v/v for carbon dioxide, consideration should be given to increasing the CS to 2 on a precautionary basis.

Therefore, it is recommended that a further five monitoring visits are undertaken at fortnightly intervals to provide data over a monitoring period that is in accordance with best practice as specified in CIRIA C665 as the precautionary assessment has determined that a potential risk may be present that remains unknown. Following completion of the extended monitoring period, a clearer assessment of the sites gassing regime can be undertaken and reported as an addendum to this report.

Alternatively, it may be prudent to install a precautionary gas membrane following agreement with the appropriate regulator.

6.4 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust is generated as a result of construction activities. The site should be securely fenced at all times to prevent unauthorised access.

Washing facilities should be provided and eating restricted to mess huts.

6.5 Excavated Material

Excavated material as waste must be defined or classified prior to any disposal, transport, recycling or re-use at or by an appropriately licensed or exempt carrier and/or off-site disposal facility. The requirements inherent in both Duty of Care and Health and Safety must also be complied with. In order to determine what is to happen, what is suitable, appropriate and most effective in the disposal of wastes, especially those subject to CDM waste management plan requirements, several factors must be considered and competent advice should always be sought.

The amount, type and nature of the material to be removed will in part determine the amount and type of analysis that may be required to comply with current waste guidance, and thereby allow a competent person to suitably classify the material. Often this data is uncertain or unavailable, especially in the early stages of a project, and therefore further investigation, testing and analysis may be required as additional information regarding the development becomes available.

Wastes must be classified and defined by their solid characteristics to comply with current waste guidance. Existing information and analysis derived for environmental purposes may therefore be suitable for use in this context. Waste Acceptance Criteria (WAC) report the leachability of materials and therefore cannot be used to classify, characterise or define wastes. The only purpose of a WAC analysis is to determine the suitability of a given material for acceptance at one of the three different types of available licenced landfills (inert, stable non-reactive hazardous or hazardous).

One sample from WS4 and 0.20m bgl was testing for WAC in accordance with BS EN 12457/2 to classify for waste disposal purposes, representative of soils of Made Ground at the site. The certificate is presented within the laboratory report in Appendix C.2. The results of the WAC test indicated the sample would likely be suitable for inert waste disposal.

Other options are available that may lead to significant savings against disposal to landfill and expert advice should always be sought from a competent person to advise on their relative costs or benefits and advise on any additional analysis, sampling or investigation that may be required to reduce remaining uncertainties and comply with current guidance. Further consideration of results using HazWasteOnline™ can be undertaken on request to give an indication of potentially hazardous properties in the materials analysed.

6.6 Re-use of Excavated Material On-site

The re-use of on-site soils may be undertaken either under the Environmental Permitting Regulations 2007 (EPR), in which case soils other than uncontaminated soils are classed as waste, or under the CL:AIRE Voluntary Code of Practice (CoP) which was published in September 2008 and is accepted as an alternative regime to the EPR.

Under the EPR, material that is contaminated but otherwise suitable for re-use is also classified as waste and its re-use should be in accordance with the Environmental Permitting Regulations 2007 (EPR). Environmental Permit Exemptions (EPE) are for the re-use of non-hazardous or inert waste only; hazardous waste cannot be re-used under a permit exemption. EPE apply only to imported inert waste materials; inert material arising on site and recovered on site is not classified as waste and does not require an exemption. It is possible that materials arising on-site will be classified as inert and would not need an exemption.

Environmental Permit Exemptions are only allowed for certain activities, placing controls on the quantities that can be stored and re-used. The re-use of waste shall be within areas and levels defined in planning applications and permissions for the development. An EPE requires a site-specific risk assessment for the receptor site to demonstrate that the materials are suitable for use, i.e. that they will not give rise to harm to human health or pollution of the environment.

Under the CL:AIRE voluntary code of practice (CoP) materials excavated on-site are not deemed contaminated if suitable for re-use at specified locations or generally within the site.

Material that may have been classified as hazardous waste under the EPR may be re-used. The CoP regime requires that a 'Qualified Person' as defined under the CoP reviews the development of the Materials Management Plan, including review of Risk Assessments and Remediation Strategy/Design Statement together with documentation relating to Planning and Regulatory issues, and signs a Declaration which is forwarded to the Environment Agency and which confirms compliance with the CoP.

Should it be necessary to import materials from another site where materials are excavated and which is not material from a quarry or produced under a WRAP protocol, then an EPE would be necessary for the imported material whether the work was managed under the CoP or the EPR.

6.7 Imported Material

Any soil, which is to be imported onto the site, must undergo chemical analysis to permit classification prior to its importation and placement in order to ascertain its status with specific regard to contamination, i.e. to prove that it is suitable for the purpose for which it is intended.

6.8 Discovery Strategy

There may be areas of contamination not identified during the course of the investigation. Such occurrences may also be discovered during the demolition and construction phases for the redevelopment of the site.

Care should be taken during excavation works especially to investigate any soils, which appear by eye (e.g. such as fibrous materials, large amounts of ash and unusual discolouration), odour (e.g. fuel, oil and chemical type odours or unusual odours such as sweet odours or fishy odours) or wellbeing (e.g. light headedness and/or nausea, burning of nasal passages and blistering or reddening of skin due to contact with soil) to be contaminated or of unusual and/or different character to standard soils or those analysed.

In the event of any discovery of potentially contaminated soils or materials, this discovery should be quarantined and reported to the most senior member of site staff or the designated responsible person at the site for action. The location, type and quantity must be recorded and the Local Authority, and a competent and appropriate third-party Engineer/Environmental consultant notified immediately. An approval from the Local authority must be sought prior to implementing any proposed mitigation action.

The discovery strategy must remain on site at all times and must demonstrate a clear allocation of responsibility for reporting and dealing with contamination. A copy of the strategy must be placed on the health and safety notice board and /or displayed in a prominent area where all site staff are able to take note of and consult the document at any time. Any member of the workforce entering the site to undertake any excavation must be made aware of the potential to discover contamination and the discovery strategy.

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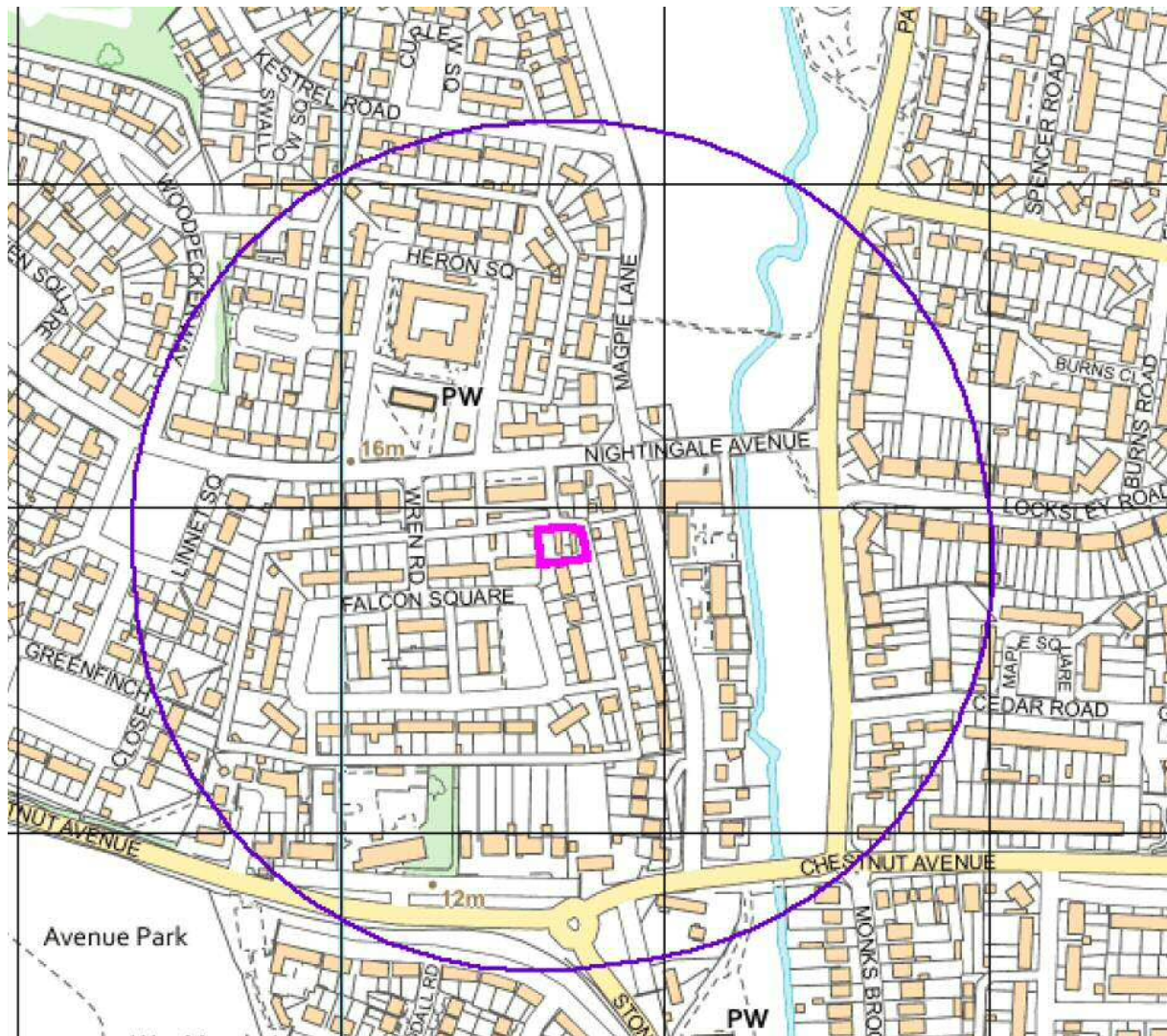


Figure 1 – Site Location Map



Job Number

20875

Project

Nightingale Avenue, Eastleigh, Hampshire SO50 9JA

Client

Doswell Projects

Date

April 2023



Figure 2 – Aerial Photograph

Project

Nightingale Avenue, Eastleigh,
Hampshire SO50 9JA

Client

Doswell Projects

Date

April 2023

Job Number

20875



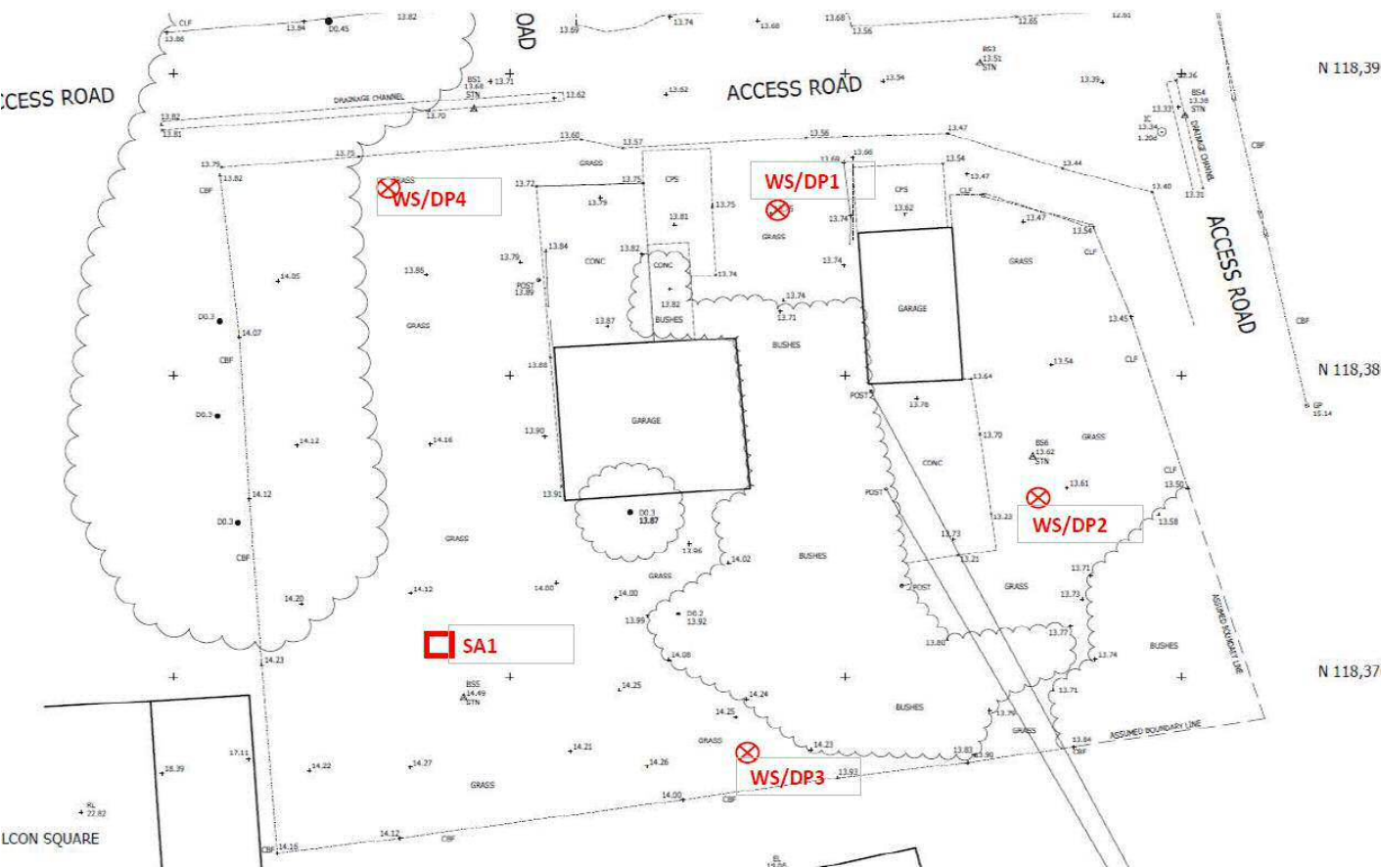


Figure 3 – Trial Hole Plan

Project
Nightingale Avenue, Eastleigh,
Hampshire SO50 9JA

Client
Doswell Projects

Date
April 2023

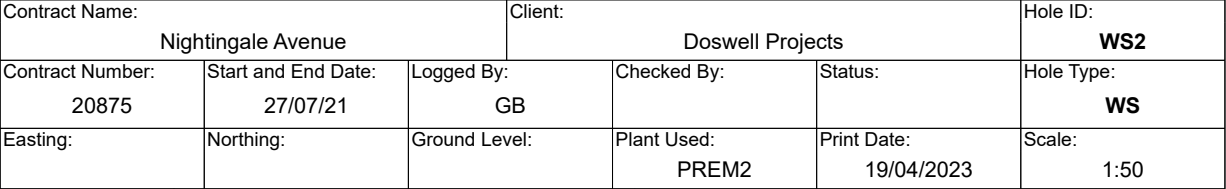
Job Number
20875



Appendix A Field Work

Appendix A.1 Engineers Logs

	Contract Name: Nightingale Avenue				Client: Doswell Projects				Hole ID: WS1					
	Contract Number: 20875		Start and End Date: 27/07/21		Logged By: GB		Checked By:		Status:		Hole Type: WS			
	Easting:		Northing:		Ground Level:		Plant Used: PREM2		Print Date: 19/04/2023		Scale: 1:50			
Weather:			Termination: Scheduled depth									Sheet 1 of 1		
Samples & In Situ Testing					Strata Details								Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description						Water Strike	Backfill/Installation	
0.10	D+J			0.20		Soft dark orange brown slightly sandy silty CLAY. Rare rootlets. Rare fine roots. Rare fine to coarse concrete fragments. Rare fine plastic fragments. Rare fine to coarse angular to sub angular flint gravel. MADE GROUND								
0.50	D+J			(1.10)										
1.00	D+J			1.30		Soft light dark orange brown very sandy clayey GRAVEL. Gravel is angular to sub angular flint . RIVER TERRACE DEPOSITS						1		
1.50	D+J			(1.10)										
2.00	D			2.40 (0.30)		Fine to coarse light orange brown angular to sub angular to sub rounded slightly clayey sandy flint GRAVEL. Sand is fine to coarse. RIVER TERRACE DEPOSITS						2		
2.50	D			2.70 (0.40)										
3.00	D			3.10		Soft light grey slightly sandy CLAY. Rare fine shell fragments. Rare intermittant pockets of light grey fine to coarse sand. Rare fine selenite. LONDON CLAY FORMATION						3		
3.50	D			(0.90)										
4.00	D			4.00	End of Borehole at 4.00m						4			
											5			
											6			
											7			
											8			
											9			
											10			
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)						
Chiselling					Installation				Water Strikes					
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
					0.00	1.00	PLAIN	33						
					1.00	3.00	SLOTTED	33						
Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.														



Weather:	Termination: Scheduled depth	Sheet 1 of 1
----------	------------------------------	--------------

Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)						
Chiselling					Installation				Water Strikes					
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
									3.00			0	0.00	
									Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.					

	Contract Name: Nightingale Avenue				Client: Doswell Projects				Hole ID: WS3					
	Contract Number: 20875		Start and End Date: 27/07/21		Logged By: GB		Checked By:		Status:		Hole Type: WS			
	Easting:		Northing:		Ground Level:		Plant Used: PREM2		Print Date: 19/04/2023		Scale: 1:50			
Weather:			Termination: Scheduled depth									Sheet 1 of 1		
Samples & In Situ Testing					Strata Details								Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description						Water Strike	Backfill/Installation	
0.20	D+J			(0.60)		Soft dark orange brown slightly silty slightly sandy CLAY. Rare rootlets. Rare fine brick, ash, concrete fragments. Rare fine plastic fragments. Rare fine to coarse angular to sub angular to sub rounded flint gravel. MADE GROUND.								
0.50	D+J			0.60		Soft orange brown slightly sandy CLAY. Rare rootlets observed to 1.5m bl/gl. Rare fine brick fragments. Rare fine to coarse angular to sub angular flint gravel. Becoming sandy from 1.0m - 1.8m bl/gl. RIVER TERRACE DEPOSITS						1		
1.00	D+J			(1.20)										
1.50	D+J			1.80		Fine to coarse dark orange brown angular to sub angular to sub rounded slightly sandy clayey flint GRAVEL. Sand is fine to coarse. RIVER TERRACE DEPOSITS						2		
2.00	D			(1.00)										
2.50	D			2.80		Fine to coarse dark orange brown angular to sub angular to sub rounded slightly sandy flint GRAVEL. Sand is fine to coarse. RIVER TERRACE DEPOSITS						3		
3.00	D			(1.00)										
3.50	D			3.80		Soft light grey slightly sandy CLAY. Rare fine shell fragments. Rare pockets of light grey fine to coarse sand. Rare fine selenite. LONDON CLAY FORMATION						4		
4.00	D			4.00		End of Borehole at 4.00m								
												5		
												6		
												7		
												8		
												9		
												10		
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)						
Chiselling					Installation				Water Strikes					
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
					0.00	1.00	PLAIN	33						
					1.00	3.80	SLOTTED	33						
Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.														

	Contract Name: Nightingale Avenue				Client: Doswell Projects				Hole ID: WS4					
	Contract Number: 20875		Start and End Date: 27/07/21		Logged By: GB		Checked By:		Status:		Hole Type: WS			
	Easting:		Northing:		Ground Level:		Plant Used: PREM2		Print Date: 19/04/2023		Scale: 1:50			
Weather:			Termination: Scheduled depth									Sheet 1 of 1		
Samples & In Situ Testing					Strata Details								Groundwater	
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description						Water Strike	Backfill/Installation	
0.20	D+J			(0.50)		Soft dark oprange brown slightly silty slightly sandy CLAY. Rare rootlets. Rare fine to coarse ash, brick, concrete fragments. Rare fine metal, glass fragments. Rare coarse dark red pink limestone scalplings fragments. Rare fine dark brown organic material. Rare fine to coarse angular to sub angular to sub rounded flint gravel. MADE GROUND.						1		
0.60	D+J			0.50										
1.00	D+J			(1.20)		Soft orange brown slightly gravelly CLAY. Occasional fine to coarse angular to sub rounded flint gravel. Becoming gravelly from 1.0m - 1.6m bl/gl. RIVER TERRACE DEPOSITS								
1.50	D+J			1.70										
2.00	D			(1.10)		Fine to coarse dark orange brown angular to sub angular to sub rounded slightly sandy clayey flint GRAVEL. Sand is fine to coarse. RIVER TERRACE DEPOSITS						2		
2.50	D			2.80										
3.00	D			(1.20)		Fine to coarse dark orange brown angular to sub angular to sub rounded sandy flint GRAVEL. Sand is fine to coarse. RIVER TERRACE DEPOSITS						3		
3.50	D			4.00										
4.00	D			4.00		End of Borehole at 4.00m						4		
												5		
												6		
												7		
												8		
												9		
												10		
Start & End of Shift Observations					Borehole Diameter		Casing Diameter		Remarks:					
Date	Time	Depth (m)	Casing (m)	Water (m)	Depth (m)	Dia (mm)	Depth (m)	Dia (mm)						
Chiselling					Installation				Water Strikes					
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
									2.50			0	0.00	
Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.														

**Soils Limited**

Newton House, Cross Road, Tadworth KT20 5SR
Tel: 01737 814221 Email: admin@soilslimited.co.uk

Probe Log

Probe No.

DP1

Sheet 1 of 1

Project Name:	Nightingale Avenue	Project No.	20875	Co-ords:		Hole Type	DP
Location:	Eastleigh, Hampshire SO50 9JA	Level:	m AOD			Scale	1:50
Client:	Doswell Projects	Dates:	27/07/2021			Logged By	

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0	2				5
1	2				
	3				
	5				
	5				
	5				
	4				
2	5				
	4				
	4				
	4				
	3				
	3				
	3				
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	2				
	1				
3	0				
	1				
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Tel: 01737 814221 Email: admin@soilslimited.co.uk

Probe Log

Probe No.

DP2

Sheet 1 of 1

Project Name:	Nightingale Avenue	Project No.	20875	Co-ords:		Hole Type	DP
Location:	Eastleigh, Hampshire SO50 9JA	Level:	m AOD			Scale	1:50
Client:	Doswell Projects	Dates:	27/07/2021			Logged By	

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0	1				
0.1	5				
0.2	6				
0.3	2				
0.4	1				
0.5	1				
0.6	0				
0.7	1				
0.8	0				
0.9	1				
1	0				5
1.1	1				
1.2	2				
1.3	4				
1.4	7				
1.5	8				
1.6	5				
1.7	4				
1.8	4				
1.9	4				
2	4				30
2.1	4				
2.2	4				
2.3	3				
2.4	2				
2.5	2				
2.6	2				
2.7	2				
2.8	1				
2.9	1				30
3	1				
3.1	1				
3.2	1				
3.3	1				
3.4	1				
3.5	1				
3.6	1				
3.7	1				
3.8	1				
3.9	2				30
4	1				
4.1	1				
4.2	2				
4.3	1				
4.4	1				
4.5	2				
4.6	1				
4.7	1				
4.8	2				
4.9	2				
5	2				30
5.1	2				
5.2	2				
5.3	2				
5.4	2				
5.5	2				
5.6	3				
5.7	2				
5.8	3				
5.9	2				
6	2				30
6.1	2				
6.2	2				
6.3	2				
6.4	2				
6.5	2				
6.6	2				
6.7	2				
6.8	2				
6.9	2				
7					
7.1					
7.2					
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7.8					
7.9					
8					
8.1					
8.2					
8.3					
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8.5					
8.6					
8.7					
8.8					
8.9					
9					
9.1					
9.2					
9.3					
9.4					
9.5					
9.6					
9.7					
9.8					
9.9					
10					
Remarks	Fall Height 760mm		Cone Base Diameter 50.5mm		
	Hammer Weight 63.5kg		Final Depth 6m		
	Probe Type DPSH		Energy Ratio (Er) 82.11%		

Project Name:	Nightingale Avenue	Project No.	20875	Co-ords:		Hole Type	DP
Location:	Eastleigh, Hampshire SO50 9JA	Level:	m AOD	Scale	1:50	Logged By	
Client:	Doswell Projects	Dates:	27/07/2021				

Depth (m)	Blows/100mm					Torque (Nm)
	0	10	20	30	40	
0	0					5
1	0					
2	0					
3	0					
4	0					
5	0					5
6	0					
7	0					
8	0					
9	0					
10	0					10
11	0					
12	0					
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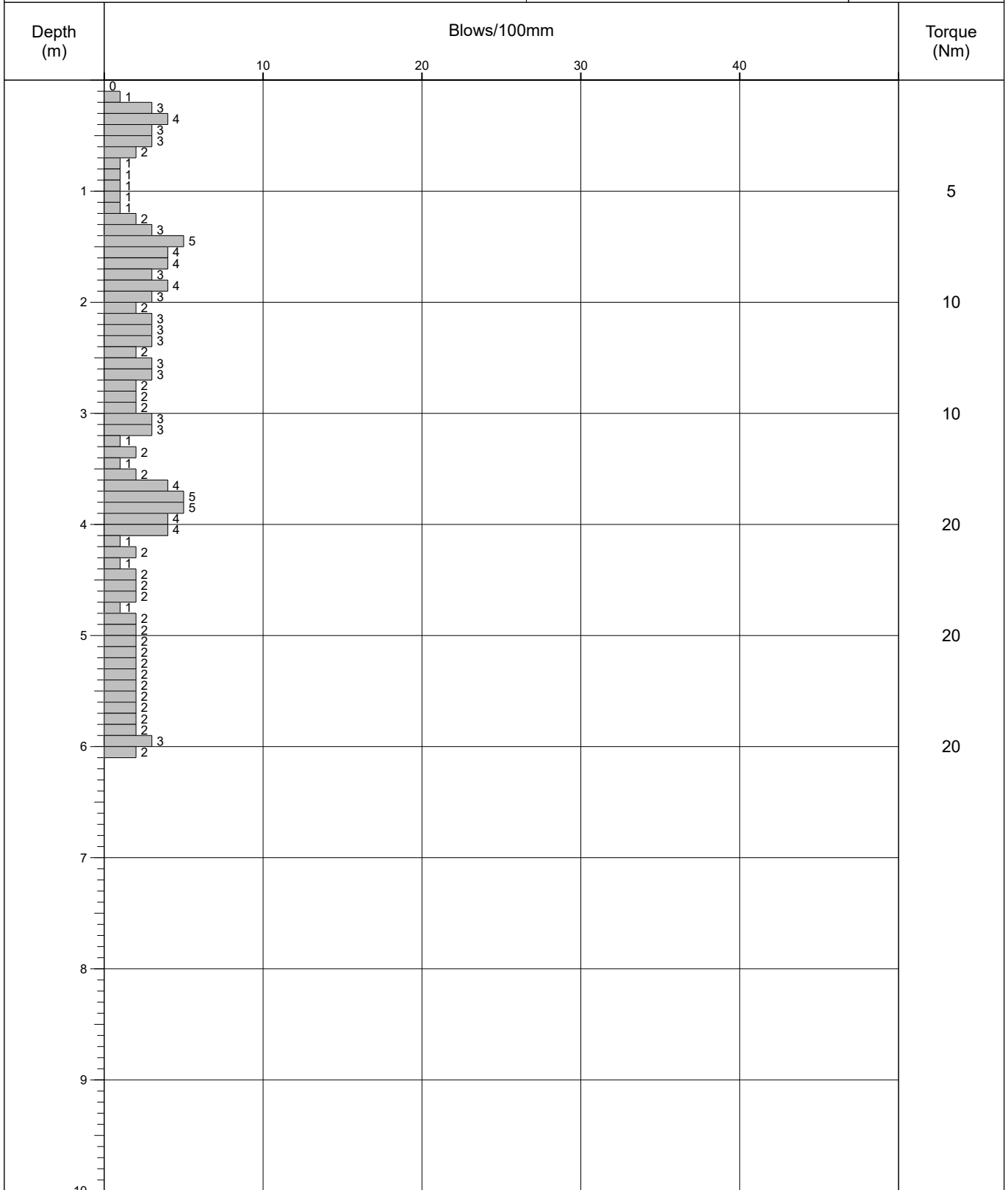
Probe Log

Probe No.

DP4

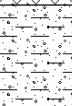
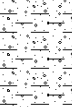
Sheet 1 of 1

Project Name:	Nightingale Avenue	Project No.	20875	Co-ords:		Hole Type	DP
Location:	Eastleigh, Hampshire SO50 9JA	Level:	m AOD			Scale	1:50
Client:	Doswell Projects	Dates:	27/07/2021			Logged By	



Remarks	Fall Height	760mm	Cone Base Diameter	50.5mm
	Hammer Weight	63.5kg	Final Depth	6m
	Probe Type	DPSH	Energy Ratio (Er)	82.11%



		Soils Limited Newton House, Cross Road, Tadworth KT20 5SR Tel: 01737 814221 Email: admin@soilslimited.co.uk			Trial Pit Log		Trial Pit No. TP1 Sheet 1 of 1	
Project Name: Nightingale Avenue				Project No.: 20875		Method: Machine excavated		Hole Type TP
Location: Eastleigh, Hampshire SO50 9JA						Plant:		
Client: Doswell Projects				Trial Pit Length: m		Trial Pit Width: m		Scale 1:25
Dates: 26/07/2021				Level:		Co-ords:		Logged By JC
Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	B ES		0.30			Light brown sandy gravelly SILT. Gravel is fine to coarse angular to to sub-angular flint, brick, concrete, tile and tarmac. frequent brick cobbles, frequent brick cobbles. MADE GROUND	
	0.50	B ES					Brown slightly gravelly SILT. Gravel is fine to medium sub-angular flint. Frequent roots and rootlets. RIVER TERRACE DEPOSITS	
	1.00	B					Orange brown slightly slightly gravelly CLAY. Gravel is fine to medium sub-angular flint. RIVER TERRACE DEPOSITS	
	1.50	B		1.90			Orange brown, very sandy clayey GRAVEL. RIVER TERRACE DEPOSITS	
	2.00	B						
	2.50	B						
			2.70			End of Pit at 2.700m		
General Remarks:								Sample Type D: Disturbed B: Bulk J: Jar W: Water
Groundwater Remarks:								

Appendix B Geotechnical In-Situ and Laboratory Testing

Appendix B.1 Classification

Classification based on SPT “N” values:

The inferred undrained strength of the cohesive soils was based on the SPT “N” blow counts, derived from the relationship suggested by Stroud (1974) and classified using Table B.1.1. (Ref: Stroud, M. A. 1974, “The Standard Penetration Test – its application and interpretation”, Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.).

Table B.1.1 SPT “N” Blow Count Cohesive Classification

Classification	Undrained Cohesive Strength C_u (kPa)
Extremely low	<10
Very low	10 – 20
Low	20 – 40
Medium	40 – 75
High	75 – 150
Very high	150 – 300
Extremely high	> 300

Note: (Ref: BS EN ISO 14688-2:2004+A1:2013 Clause 5.3.)

The relative density of granular soils was classified based of the relationship given in Table B.1.2.

The *UK National Annex to Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing*, NA 3.7 SPT test, BS EN 1997-2:2007, Annex F states “Relative density descriptions on borehole records should also be based on uncorrected SPT N values, unless significantly disturbed, using the density classification in BS 5930:2015, Table 7.

Table B.1.2 SPT “N” Blow Count Granular Classification

Classification	SPT “N” blow count (blows/300mm)
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	Greater than 50

Note: (Ref: The Standard Penetration Test (SPT): Methods and Use, CIRIA Report 143, 1995)

Appendix B.2 Interpretation

Table B.2.1 Interpretation of DPSH Blow Counts

DP	Strata	Equivalent SPT N60 Blow Counts	Inferred Cohesive Strength/Granular Density
DP1	RTD 0.20 – 1.30 CLAY	4	Very low/low ($C_u = 20\text{kPa}$)
	RTD 1.30 – 2.70 GRAVEL	12 – 20	Medium dense
	LCF ¹ 2.70 – 6.00 CLAY	4 – 12	Low to medium ($C_u = 20 - 60\text{kPa}$)
DP2	RTD 0.40 – 1.20 CLAY	>2 – 4	Extremely low to low ($C_u = <10 - 20\text{kPa}$)
	RTD 1.20 – 2.30 GRAVEL	16	Medium dense
	RTD 2.30 – 3.40 GRAVEL	4	Very loose/loose
	LCF ¹ 3.40 – 6.00 CLAY	4 – 8	Low ($C_u = 20 - 40\text{kPa}$)
DP3	RTD 0.60 – 1.70 CLAY	4	Very low/low ($C_u = 20\text{kPa}$)
	RTD 1.70 – 3.80 GRAVEL	8 – 20	Loose to medium dense
	LCF ¹ 3.80 – 6.00 CLAY	4 – 8	Low ($C_u = 20 - 40\text{kPa}$)
DP4	RTD 0.50 – 1.10 CLAY	4	Very low/low ($C_u = 20\text{kPa}$)
	RTD 1.10 – 4.00 GRAVEL	8 – 16	Loose to medium dense
	LCF ¹ 4.00 – 6.00 CLAY	4 – 8	Low ($C_u = 20 - 40\text{kPa}$)

Note: ¹ Ground conditions inferred past the base of windowless sampler boreholes. Er: 82.11%

Table B.2.2 Interpretation of Atterberg Limit Tests

Stratum	Moisture Content (%)	Plasticity Index (%)	Passing 425µm Sieve (%)	Modified Plasticity Index (%)	Soil Classification	Volume Change Potential	
						BRE	NHBC
RTD	15 - 19	11 - 19	74 - 81	8 - 15	CL – CI	Low	Low
LCF	31	37 - 41	100	37 - 41	CH	Medium to high	Medium to high

Note: BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)

NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2

Soils Classification based on British Soil Classification System

The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240. The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates. The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 µm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 µm and some particles, 'rock flour' for example, can be finer than 2 µm but are not clay minerals.

(The Atterberg Limit Tests were undertaken in accordance with BS 1377:Part 2:1990 Clauses 3.2, 4.3 and 5)

Table B.2.3 Interpretation of PSD Tests

Location	Depth (m bgl)	Soil Description	Volume Change Potential		Passing 63µm Sieve (%)
			BRE	NHBC	
WS1	1.50	Very sandy clayey GRAVEL	Yes	No	17
WS1	2.50	Slightly clayey sandy GRAVEL	No	No	4
WS2	2.80	Clayey sandy GRAVEL	No	No	5
WS3	2.50	Very sandy clayey GRAVEL	No	No	7

Note: BRE 240 states that a soil has a volume change potential when the clay fraction **exceeds 15%**. Only the silt and clay combined fraction are determined by sieving therefore the volume change potential is estimated from the percentage passing the 63µm sieve. NHBC Standards Chapter 4.2 states that a soil is shrinkable if the percentage of silt and clay passing the 63µm sieve is greater than 35% and the Plasticity Index is greater than 10%.

(The Particle Size Distribution Tests were undertaken in accordance with BS 1377: Part 2: 1990 Clause 9)

Appendix B.3 Geotechnical In-Situ and Laboratory Results



Laboratory Report



GEO Site & Testing Services Ltd

Contract Number: 55234

Client Ref: **19473**

Report Date: **19-08-2021**

Client PO: **19473**

Client **Soils Limited**
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

Contract Title: **Nightingale Avenue**
For the attention of: **Tim Rudkin**

Date Received: **04-08-2021**

Date Completed: **19-08-2021**

Test Description	Qty
Moisture Content of Soil BS1377 : Part 2 : Clause 3.2 : 1990 - * UKAS	5
1 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.4 & 5.3 - * UKAS	5
PSD Wet & Dry Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	4
Samples Received - @ Non Accredited Test	9
Disposal of samples for job	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**

* - denotes test included in laboratory scope of accreditation

- denotes test carried out by approved contractor

@ - denotes non accredited tests

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved Signatories:

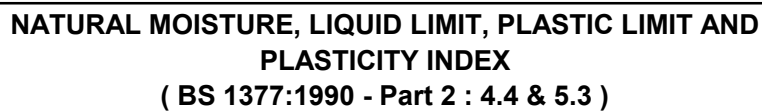
Emma Sharp (Business Support Manager) - Paul Evans (Director) - Richard John (Quality/Technical Manager)

Shaun Jones (Laboratory manager) - Shaun Thomas (Site Manager) - Wayne Honey (Quality Assistant / Administrator / Health and Safety Coordinator)

GEO Site & Testing Services Ltd

Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN

Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk



Contract Number	55234	
Site Name	Nightingale Avenue	
Date Tested	16/08/2021	
	DESCRIPTIONS	

[illegible]

Operators	Checked	19/08/2021	Richard John (Advanced Testing Manager)
Clayton Jenkins	Approved	19/08/2021	Paul Evans (Quality/Technical Manager)





NATURAL MOISTURE, LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX
(BS 1377:1990 - Part 2 : 4.4 & 5.3)

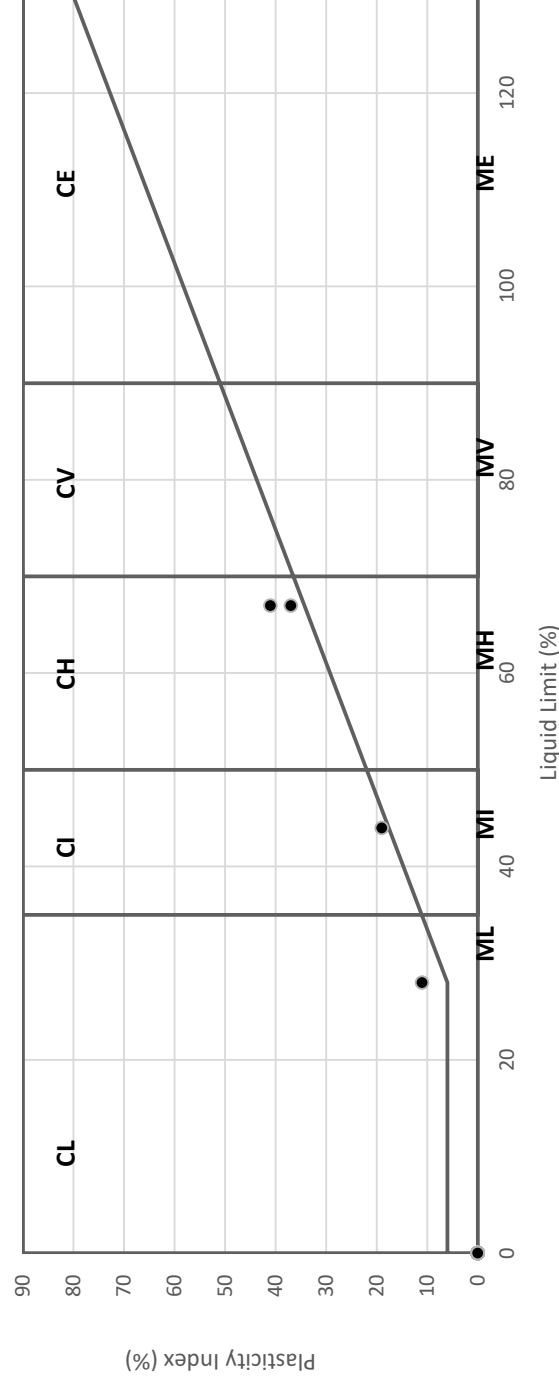
Contract Number	55234
Project Location	Nightingale Avenue
Date Tested	16/08/2021

[illegible]

Symbols: NP : Non Plastic

: Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



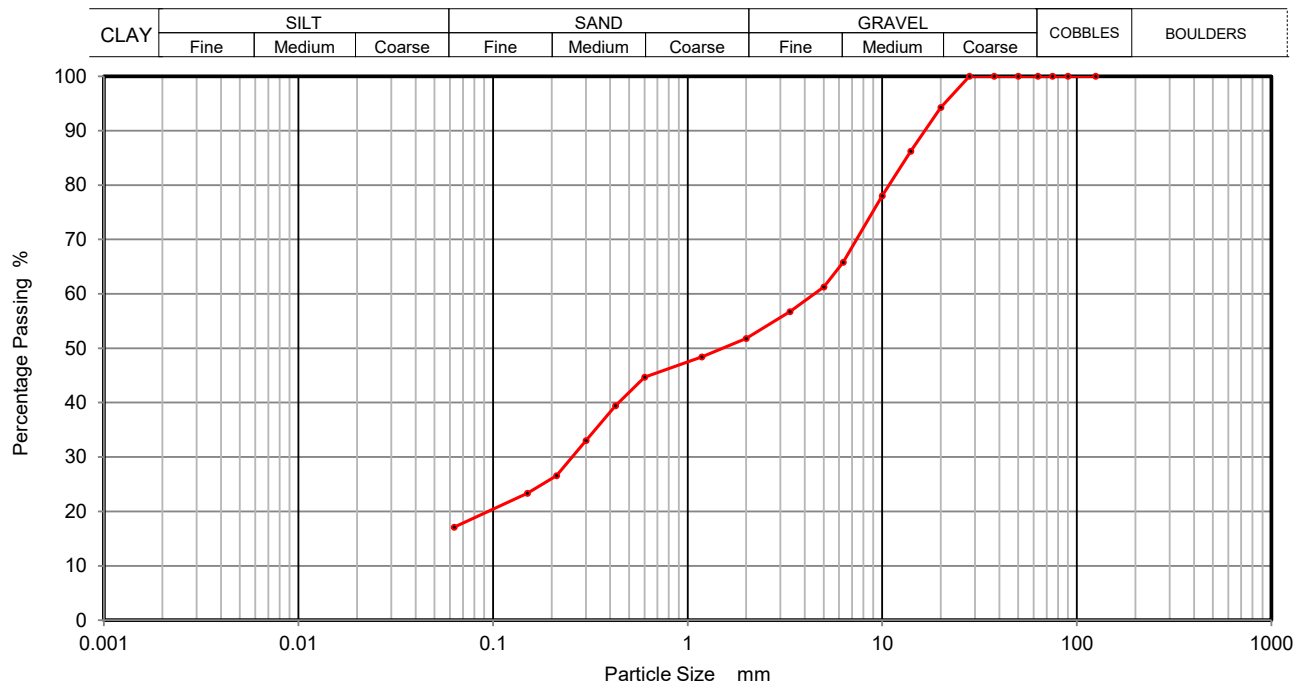
Operators	Checked	19/08/2021	Richard John (Advanced Testing Manager)
Clayton Jenkins	Approved	19/08/2021	Paul Evans (Quality/Technical Manager)





PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2

Contract Number	55234	
	Borehole/Pit No.	
WS1		
Site Name	Nightingale Avenue	
Sample No.		
Soil Description	Brown silty/ clayey fine to coarse sandy fine to coarse GRAVEL	
Depth Top	1.50	
	Depth Base	
Date Tested	18/08/2021	
Sample Type	D	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	94		
14	86		
10	78		
6.3	66		
5	61		
3.35	57		
2	52		
1.18	48		
0.6	45		
0.425	39		
0.3	33		
0.212	27		
0.15	23		
0.063	17		

Sample Proportions	% dry mass
Cobbles	0
Gravel	48
Sand	35
Silt and Clay	17

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	18/08/2021	Richard John
David	Approved	19/08/2021	Paul Evans



2788



PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2

Contract Number 55234

Borehole/Pit No. WS1

Site Name Nightingale Avenue

Sample No.

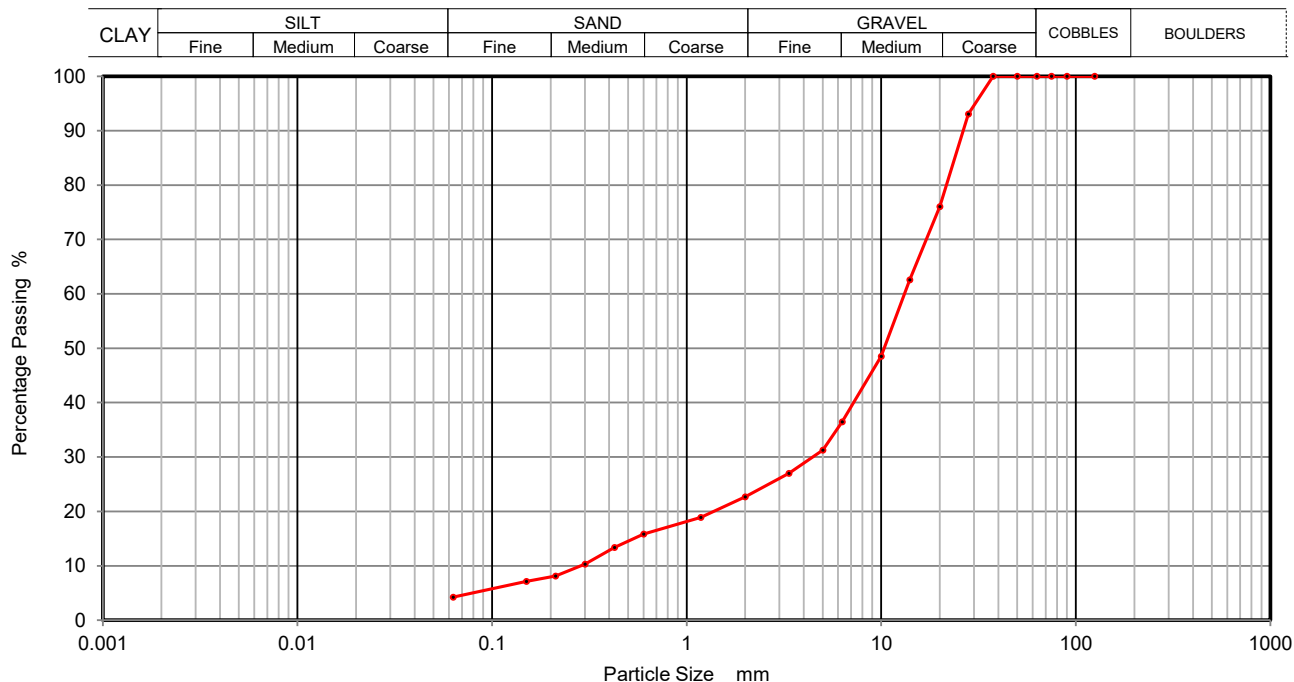
Soil Description Brown slightly silty/ clayey fine to coarse sandy fine to coarse GRAVEL

Depth Top 2.50

Depth Base

Date Tested 18/08/2021

Sample Type D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	93		
20	76		
14	63		
10	48		
6.3	36		
5	31		
3.35	27		
2	23		
1.18	19		
0.6	16		
0.425	13		
0.3	10		
0.212	8		
0.15	7		
0.063	4		

Sample Proportions	% dry mass
Cobbles	0
Gravel	77
Sand	19
Silt and Clay	4

Remarks
Preparation and testing in accordance with BS1377 unless noted below

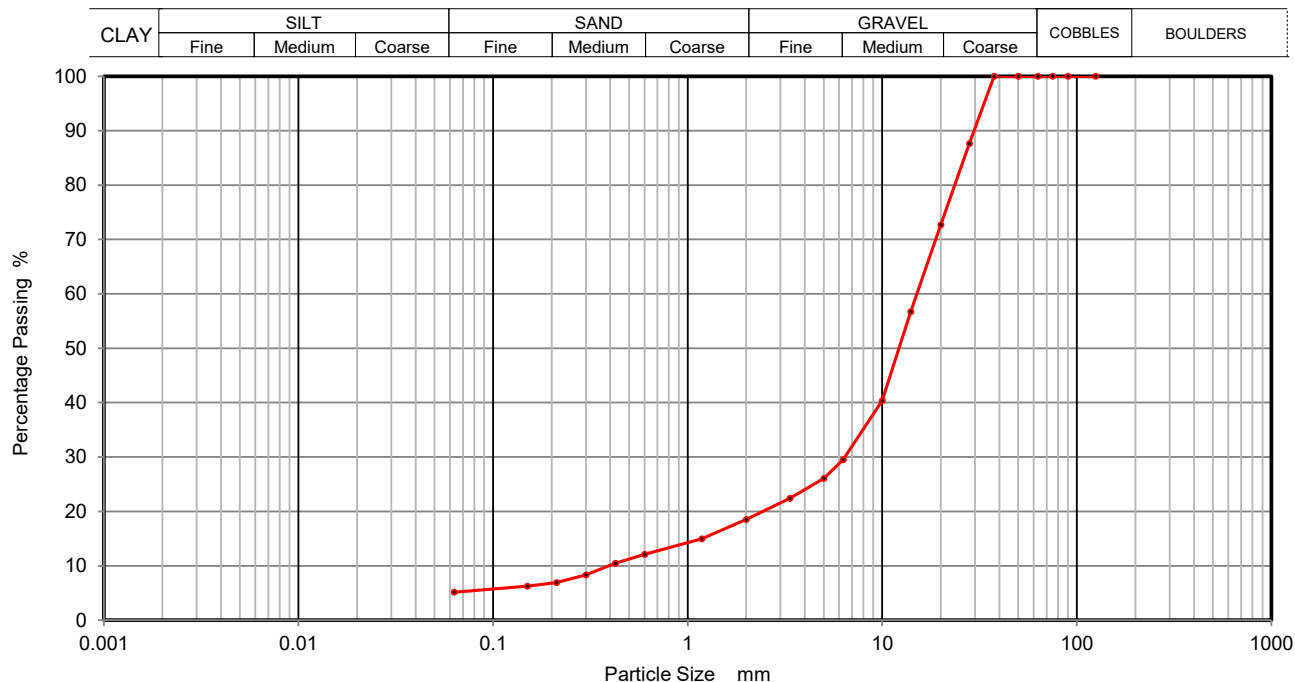
Operator	Checked	18/08/2021	Richard John
David	Approved	19/08/2021	Paul Evans





PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2

Contract Number	55234	
	Borehole/Pit No.	
WS2		
Site Name	Nightingale Avenue	
Sample No.		
Soil Description	Brown slightly silty/ clayey fine to coarse sandy fine to coarse GRAVEL	
Depth Top		2.80
Depth Base		
Date Tested	18/08/2021	Sample Type
		D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	88		
20	73		
14	57		
10	40		
6.3	30		
5	26		
3.35	22		
2	19		
1.18	15		
0.6	12		
0.425	10		
0.3	8		
0.212	7		
0.15	6		
0.063	5		

Sample Proportions	% dry mass
Cobbles	0
Gravel	81
Sand	14
Silt and Clay	5

Remarks
Preparation and testing in accordance with BS1377 unless noted below

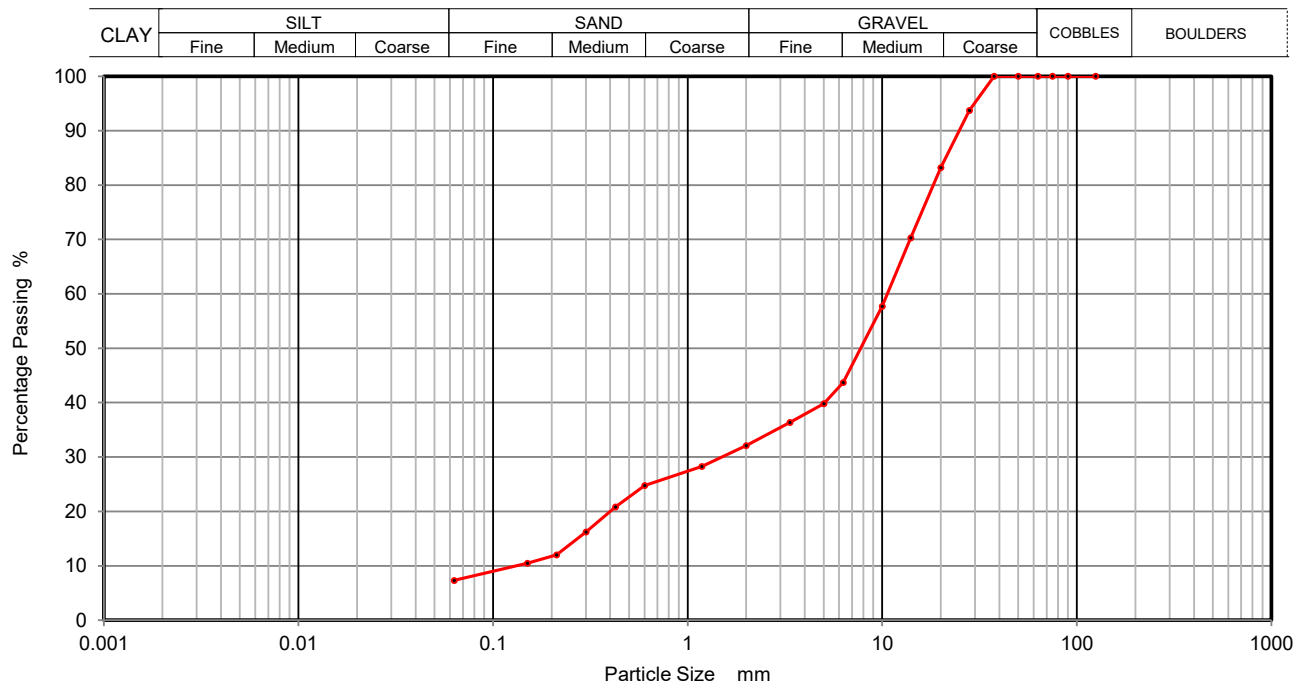
Operator	Checked	18/08/2021	Richard John
David	Approved	19/08/2021	Paul Evans





PARTICLE SIZE DISTRIBUTION
BS 1377 Part 2:1990
Wet Sieve, Clause 9.2

Contract Number	55234	
	Borehole/Pit No.	
WS3		
Site Name	Nightingale Avenue	
Sample No.		
Soil Description	Brown slightly silty/ clayey fine to coarse sandy fine to coarse GRAVEL	
Depth Top		2.50
Depth Base		
Date Tested	18/08/2021	Sample Type
		D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	94		
20	83		
14	70		
10	58		
6.3	44		
5	40		
3.35	36		
2	32		
1.18	28		
0.6	25		
0.425	21		
0.3	16		
0.212	12		
0.15	10		
0.063	7		

Sample Proportions	% dry mass
Cobbles	0
Gravel	68
Sand	25
Silt and Clay	7

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	18/08/2021	Richard John
David	Approved	19/08/2021	Paul Evans



2788

Appendix C Chemical Laboratory Testing

Appendix C.1 Conceptual Site Model

Table C.I.I CSM Revised Post Testing

Source	Identified Contaminant	Exposure Pathway	Receptor	Initial Assessment from Desk Study and Main Investigation Report Information			Comments	Proposed Investigation
				Severity	Probability	Risk		
Made Ground Onsite source of potential contamination.	EPH C21-C40	Inhalation of dust	Site Workers/Site Maintenance	Minor	Unlikely	Very low	Soil chemical analysis recorded EPH C21-C40 in excess of its relevant soil screening value in TPI at 0.20m bgl. Notwithstanding this, given its likely associated with tarmac inclusions recorded in the area, the TPH would likely have a higher concentration within the aliphatic fractions, with SGV threshold 92000mg/kg, where the recorded concentration is not in exceedance. Furthermore, the impacted location sits within proposed hardstanding forming the carpark and, therefore, the impacted soils would be capped/removed as part of the redevelopment.	No further action warranted with respect to the hydrocarbon impacted soils as these will be capped/removed as part of the redevelopment of the site.
			End Users	Minor	Unlikely	Very low		
			Off-site Users	Minor	Unlikely	Very low		
	EPH C21-C40	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Minor	Unlikely	Very low		Additional ground gas monitoring recommended to develop a more robust ground gas risk assessment of the site in line with current guidance. Alternatively, precautionary gas membrane installation upon agreement with LPA.
			End Users	Minor	Unlikely	Very low		
	EPH C21-C40	Migration via surface runoff	Surface Water	-	-	-		
		Migration in solution via groundwater	Surface Water	Minor	Unlikely	Very low		
			Shallow Aquifer	Minor	Unlikely	Very low		
			Deep Aquifer	-	-	-		
			Direct contact with construction material	Buried structures	Minor	Unlikely		
		Buried Services		Minor	Unlikely	Very low		
	CO ₂	Migration of gases via permeable soils	Site Workers/Site Maintenance	Minor	Unlikely	Very low		
			End Users	Minor	Unlikely	Very low		
			Off-site Users	Minor	Unlikely	Very low	Ground gases monitored across two monitoring points on a single occasion recorded a highest CO ₂ level of 5.1%v/v. Gassing regime indicated to likely conform to CSI, however, would require additional monitoring rounds to give a more robust assessment.	
			Building and confined spaces	Minor	Unlikely	Very low		

Appendix C.2 Chemical Laboratory Results



Tim Rudkin
Soils Ltd
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

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

DETS Report No: 21-09691

Site Reference: Nightingale Aveune

Project / Job Ref: 19473

Order No: 19473

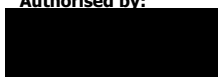
Sample Receipt Date: 04/08/2021

Sample Scheduled Date: 04/08/2021

Report Issue Number: 1

Reporting Date: 10/08/2021

Authorised by:



Technical Manager

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

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

For Topsoil and WAC analysis the expanded uncertainty measurement should be considered while evaluating results against compliance values.



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



Soil Analysis Certificate						
DETS Report No: 21-09691	Date Sampled	27/07/21	27/07/21	27/07/21	27/07/21	27/07/21
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Nightingale Aveune	TP / BH No	WS1	WS2	WS2	WS3	WS3
Project / Job Ref: 19473	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 19473	Depth (m)	0.10	0.10	0.80	0.20	1.00
Reporting Date: 10/08/2021	DETS Sample No	558128	558129	558130	558131	558132

Determinand	Unit	RL	Accreditation	(n)				
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	7.5	9.2	7.5	7.9	7.1
Organic Matter (SOM)	%	< 0.1	NONE	2.2	0.6	1.1	1.7	0.3
Arsenic (As)	mg/kg	< 2	MCERTS	8	8	8	6	8
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Cadmium (Cd)	mg/kg	< 0.2	NONE	0.4	0.3	< 0.2	< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	12	7	18	11	16
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	19	16	11	13	9
Lead (Pb)	mg/kg	< 3	MCERTS	41	19	10	29	9
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	8	4	7	< 3	5
Selenium (Se)	mg/kg	< 2	MCERTS	< 3	< 3	< 3	< 3	< 3
Vanadium (V)	mg/kg	< 1	MCERTS	19	17	29	18	28
Zinc (Zn)	mg/kg	< 3	MCERTS	161	87	45	63	39
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2

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

Subcontracted analysis (S)

(n) Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation



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



Soil Analysis Certificate						
DETS Report No: 21-09691	Date Sampled	27/07/21	27/07/21	26/07/21		
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Nightingale Aveune	TP / BH No	WS4	WS4	TP1		
Project / Job Ref: 19473	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: 19473	Depth (m)	0.20	0.60	0.20		
Reporting Date: 10/08/2021	DETS Sample No	558133	558134	558135		

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	8.0	7.4	8.1		
Organic Matter (SOM)	%	< 0.1	NONE	1.6	0.2	3.7		
Arsenic (As)	mg/kg	< 2	MCERTS	8	9	9		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1		
Cadmium (Cd)	mg/kg	< 0.2	NONE	0.2	< 0.2	0.4		
Chromium (Cr)	mg/kg	< 2	MCERTS	13	19	11		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	31	11	16		
Lead (Pb)	mg/kg	< 3	MCERTS	74	11	63		
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	6	9	12		
Selenium (Se)	mg/kg	< 2	MCERTS	< 3	< 3	< 3		
Vanadium (V)	mg/kg	< 1	MCERTS	21	30	18		
Zinc (Zn)	mg/kg	< 3	MCERTS	103	44	111		
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2		

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



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



Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 21-09691	Date Sampled	27/07/21	27/07/21	27/07/21	27/07/21	27/07/21
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Nightingale Aveune	TP / BH No	WS1	WS2	WS2	WS3	WS3
Project / Job Ref: 19473	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 19473	Depth (m)	0.10	0.10	0.80	0.20	1.00
Reporting Date: 10/08/2021	DETS Sample No	558128	558129	558130	558131	558132

Determinand	Unit	RL	Accreditation	(n)				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.26	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.31	< 0.1	< 0.1	< 0.1	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	0.27	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.13	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	0.15	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.17	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.12	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6

(n) Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation



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



Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 21-09691	Date Sampled	27/07/21	27/07/21	26/07/21		
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Nightingale Aveune	TP / BH No	WS4	WS4	TP1		
Project / Job Ref: 19473	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: 19473	Depth (m)	0.20	0.60	0.20		
Reporting Date: 10/08/2021	DETS Sample No	558133	558134	558135		

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Phenanthrene	mg/kg	< 0.1	MCERTS	0.62	< 0.1	< 0.1		
Anthracene	mg/kg	< 0.1	MCERTS	0.19	< 0.1	< 0.1		
Fluoranthene	mg/kg	< 0.1	MCERTS	1.67	< 0.1	< 0.1		
Pyrene	mg/kg	< 0.1	MCERTS	1.57	< 0.1	0.32		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.98	< 0.1	< 0.1		
Chrysene	mg/kg	< 0.1	MCERTS	0.99	< 0.1	0.51		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	1.37	< 0.1	< 0.1		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.56	< 0.1	< 0.1		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	1.19	< 0.1	< 0.1		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.90	< 0.1	< 0.1		
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	0.20	< 0.1	< 0.1		
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.71	< 0.1	< 0.1		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	11	< 1.6	< 1.6		



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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
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Soil Analysis Certificate - EPH Texas Banded						
DETS Report No: 21-09691	Date Sampled	27/07/21	27/07/21	27/07/21	27/07/21	27/07/21
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Nightingale Aveune	TP / BH No	WS1	WS2	WS2	WS3	WS3
Project / Job Ref: 19473	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 19473	Depth (m)	0.10	0.10	0.80	0.20	1.00
Reporting Date: 10/08/2021	DETS Sample No	558128	558129	558130	558131	558132

Determinand	Unit	RL	Accreditation	(n)				
EPH Texas (C6 - C8)	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
EPH Texas (>C8 - C10)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
EPH Texas (>C10 - C12)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
EPH Texas (>C12 - C16)	mg/kg	< 1	MCERTS	2	< 1	< 1	< 1	< 1
EPH Texas (>C16 - C21)	mg/kg	< 1	MCERTS	7	1	< 1	3	< 1
EPH Texas (>C21 - C40)	mg/kg	< 6	MCERTS	86	60	< 6	44	< 6
EPH Texas (C6 - C40)	mg/kg	< 6	NONE	95	61	< 6	47	< 6

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Soil Analysis Certificate - EPH Texas Banded						
DETS Report No: 21-09691	Date Sampled	27/07/21	27/07/21	26/07/21		
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Nightingale Aveune	TP / BH No	WS4	WS4	TP1		
Project / Job Ref: 19473	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: 19473	Depth (m)	0.20	0.60	0.20		
Reporting Date: 10/08/2021	DETS Sample No	558133	558134	558135		

Determinand	Unit	RL	Accreditation					
EPH Texas (C6 - C8)	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
EPH Texas (>C8 - C10)	mg/kg	< 1	MCERTS	< 1	< 1	< 1		
EPH Texas (>C10 - C12)	mg/kg	< 1	MCERTS	< 1	< 1	< 1		
EPH Texas (>C12 - C16)	mg/kg	< 1	MCERTS	1	< 1	14		
EPH Texas (>C16 - C21)	mg/kg	< 1	MCERTS	16	< 1	105		
EPH Texas (>C21 - C40)	mg/kg	< 6	MCERTS	157	< 6	2778		
EPH Texas (C6 - C40)	mg/kg	< 6	NONE	175	< 6	2897		

Waste Acceptance Criteria Analytical Certificate - BS EN 12457/2																																				
DETS Report No: 21-09691		Date Sampled		27/07/21		Landfill Waste Acceptance Criteria Limits																														
Soils Ltd		Time Sampled		None Supplied																																
Site Reference: Nightingale Aveune		TP / BH No		WS4																																
Project / Job Ref: 19473		Additional Refs		None Supplied																																
Order No: 19473		Depth (m)		0.20																																
Reporting Date: 10/08/2021		DETS Sample No		558133																																
Determinand		Unit		MDL		<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%; text-align: center;">Inert Waste Landfill</th> <th style="width: 33%; text-align: center;">Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill</th> <th style="width: 33%; text-align: center;">Hazardous Waste Landfill</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">3%</td> <td style="text-align: center;">5%</td> <td style="text-align: center;">6%</td> </tr> <tr> <td style="text-align: center;">--</td> <td style="text-align: center;">--</td> <td style="text-align: center;">10%</td> </tr> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">--</td> <td style="text-align: center;">--</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">--</td> <td style="text-align: center;">--</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center;">--</td> <td style="text-align: center;">--</td> </tr> <tr> <td style="text-align: center;">100</td> <td style="text-align: center;">--</td> <td style="text-align: center;">--</td> </tr> <tr> <td style="text-align: center;">--</td> <td style="text-align: center;">>6</td> <td style="text-align: center;">--</td> </tr> <tr> <td style="text-align: center;">--</td> <td style="text-align: center; color: red;">To be evaluated</td> <td style="text-align: center; color: red;">To be evaluated</td> </tr> </tbody> </table>				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill	3%	5%	6%	--	--	10%	6	--	--	1	--	--	500	--	--	100	--	--	--	>6	--	--	To be evaluated	To be evaluated
Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill																																		
3%	5%	6%																																		
--	--	10%																																		
6	--	--																																		
1	--	--																																		
500	--	--																																		
100	--	--																																		
--	>6	--																																		
--	To be evaluated	To be evaluated																																		
TOC		%		< 0.1		0.9																														
Loss on Ignition		%		< 0.01		3.50																														
BTEX ^{MU}		mg/kg		< 0.05		< 0.05																														
Sum of PCBs		mg/kg		< 0.1		< 0.1																														
Mineral Oil ^{MU}		mg/kg		< 10		< 10																														
Total PAH ^{MU}		mg/kg		< 1.7		11																														
pH ^{MU}		pH Units		N/a		8.0																														
Acid Neutralisation Capacity		mol/kg (+/-)		< 1		1.3																														
Eluate Analysis				10:1 mg/l		Cumulative 10:1 mg/kg		Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)																												
Arsenic ^U				< 0.01		< 0.1		0.5	2	25																										
Barium ^U				< 0.02		< 0.2		20	100	300																										
Cadmium ^U				< 0.0005		< 0.005		0.04	1	5																										
Chromium ^U				0.007		0.07		0.5	10	70																										
Copper ^U				< 0.01		< 0.1		2	50	100																										
Mercury ^U				< 0.0005		< 0.005		0.01	0.2	2																										
Molybdenum ^U				0.003		0.03		0.5	10	30																										
Nickel ^U				< 0.007		< 0.07		0.4	10	40																										
Lead ^U				0.007		0.07		0.5	10	50																										
Antimony ^U				< 0.005		< 0.05		0.06	0.7	5																										
Selenium ^U				< 0.005		< 0.05		0.1	0.5	7																										
Zinc ^U				< 0.005		< 0.05		4	50	200																										
Chloride ^U				3.5		35		800	15000	25000																										
Fluoride ^U				0.5		< 5		10	150	500																										
Sulphate ^U				19.5		195		1000	20000	50000																										
TDS				78		780		4000	60000	100000																										
Phenol Index				< 0.01		< 0.1		1	-	-																										
DOC				10.8		108		500	800	1000																										
Leach Test Information																																				
Sample Mass (kg)				0.10																																
Dry Matter (%)				88.5																																
Moisture (%)				13																																
Stage 1																																				
Volume Eluate L10 (litres)				0.89																																
Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Samples Descriptions page describes if the test is performed on the dried or as-received portion																																				
Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepancies with current legislation																																				
M Denotes MCERTS accredited test																																				
U Denotes ISO17025 accredited test																																				



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



Soil Analysis Certificate - Sample Descriptions

DETS Report No: 21-09691	
Soils Ltd	
Site Reference: Nightingale Aveune	
Project / Job Ref: 19473	
Order No: 19473	
Reporting Date: 10/08/2021	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
558128	WS1	None Supplied	0.10	16.1	Brown sandy clay with stones and vegetation
558129	WS2	None Supplied	0.10	5.2	Brown sand with stones
558130	WS2	None Supplied	0.80	13.7	Brown clay
558131	WS3	None Supplied	0.20	9.4	Brown sandy clay with stones and brick
558132	WS3	None Supplied	1.00	13.7	Brown sandy clay
558133	WS4	None Supplied	0.20	11.5	Brown clayey sand with stones
558134	WS4	None Supplied	0.60	14.5	Brown sandy clay
558135	TP1	None Supplied	0.20	3.8	Brown clayey sand with stones

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{1/5}

Unsuitable Sample ^{u/s}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 21-09691

Soils Ltd

Site Reference: Nightingale Avenue

Project / Job Ref: 19473

Order No: 19473

Reporting Date: 10/08/2021

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

D Dried
AR As Received



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



Water Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 21-09691

Soils Ltd

Site Reference: Nightingale Avenue

Project / Job Ref: 19473

Order No: 19473

Reporting Date: 10/08/2021

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Water	UF	Alkalinity	Determination of alkalinity by titration against hydrochloric acid using bromocresol green as the end point	E103
Water	F	Ammoniacal Nitrogen	Determination of ammoniacal nitrogen by discrete analyser.	E126
Water	UF	BTEX	Determination of BTEX by headspace GC-MS	E101
Water	F	Cations	Determination of cations by filtration followed by ICP-MS	E102
Water	UF	Chemical Oxygen Demand (COD)	Determination using a COD reactor followed by colorimetry	E112
Water	F	Chloride	Determination of chloride by filtration & analysed by ion chromatography	E109
Water	F	Chromium - Hexavalent	Determination of hexavalent chromium by acidification, addition of 1,5 diphenylcarbazine followed by	E116
Water	UF	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E115
Water	UF	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through liquid:liquid extraction with cyclohexane	E111
Water	F	Diesel Range Organics (C10 - C24)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Dissolved Organic Content (DOC)	Determination of DOC by filtration followed by low heat with persulphate addition followed by IR detection	E110
Water	UF	Electrical Conductivity	Determination of electrical conductivity by electrometric measurement	E123
Water	F	EPH (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E104
Water	F	Fluoride	Determination of Fluoride by filtration & analysed by ion chromatography	E109
Water	F	Hardness	Determination of Ca and Mg by ICP-MS followed by calculation	E102
Leachate	F	Leachate Preparation - NRA	Based on National Rivers Authority leaching test 1994	E301
Leachate	F	Leachate Preparation - WAC	Based on BS EN 12457 Pt1, 2, 3	E302
Water	F	Metals	Determination of metals by filtration followed by ICP-MS	E102
Water	F	Mineral Oil (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Nitrate	Determination of nitrate by filtration & analysed by ion chromatography	E109
Water	UF	Monohydric Phenol	Determination of phenols by distillation followed by colorimetry	E121
Water	F	PAH - Speciated (EPA 16)	Determination of PAH compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E105
Water	F	PCB - 7 Congeners	Determination of PCB compounds by concentration through SPE cartridge, collection in dichloromethane	E108
Water	UF	Petroleum Ether Extract (PEE)	Gravimetrically determined through liquid:liquid extraction with petroleum ether	E111
Water	UF	pH	Determination of pH by electrometric measurement	E107
Water	F	Phosphate	Determination of phosphate by filtration & analysed by ion chromatography	E109
Water	UF	Redox Potential	Determination of redox potential by electrometric measurement	E113
Water	F	Sulphate (as SO4)	Determination of sulphate by filtration & analysed by ion chromatography	E109
Water	UF	Sulphide	Determination of sulphide by distillation followed by colorimetry	E118
Water	F	SVOC	Determination of semi-volatile organic compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E106
Water	UF	Toluene Extractable Matter (TEM)	Gravimetrically determined through liquid:liquid extraction with toluene	E111
Water	UF	Total Organic Carbon (TOC)	Low heat with persulphate addition followed by IR detection	E110
Water	F	TPH CWG (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C35. C5 to C8 by headspace GC-MS	E104
Water	F	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C44. C5 to C8 by headspace GC-MS	E104
Water	UF	VOCs	Determination of volatile organic compounds by headspace GC-MS	E101
Water	UF	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E101

Key

F Filtered
UF Unfiltered

Parameter	Matrix Type	Suite Reference	Expanded Uncertainty Measurement	Unit
TOC	Soil	BS EN 12457	20.0	%
Loss on Ignition	Soil	BS EN 12457	35.0	%
BTEX	Soil	BS EN 12457	14.0	%
Sum of PCBs	Soil	BS EN 12457	23.0	%
Mineral Oil	Soil	BS EN 12457	9.0	%
Total PAH	Soil	BS EN 12457	11.6	%
pH	Soil	BS EN 12457	0.28	Units
Acid Neutralisation Capacity	Soil	BS EN 12457	18.0	%
Arsenic	Leachate	BS EN 12457	18.7	%
Barium	Leachate	BS EN 12457	11.6	%
Cadmium	Leachate	BS EN 12457	20.3	%
Chromium	Leachate	BS EN 12457	18.3	%
Copper	Leachate	BS EN 12457	24.3	%
Mercury	Leachate	BS EN 12457	23.7	%
Molybdenum	Leachate	BS EN 12457	14.7	%
Nickel	Leachate	BS EN 12457	16.1	%
Lead	Leachate	BS EN 12457	15.7	%
Antimony	Leachate	BS EN 12457	17.9	%
Selenium	Leachate	BS EN 12457	22.0	%
Zinc	Leachate	BS EN 12457	17.4	%
Chloride	Leachate	BS EN 12457	15.3	%
Fluoride	Leachate	BS EN 12457	16.4	%
Sulphate	Leachate	BS EN 12457	20.6	%
TDS	Leachate	BS EN 12457	12.0	%
Phenol Index	Leachate	BS EN 12457	14.0	%
DOC	Leachate	BS EN 12457	10.0	%
Clay Content	Soil	BS 3882: 2015	15.0	%
Silt Content	Soil	BS 3882: 2015	14.0	%
Sand Content	Soil	BS 3882: 2015	13.0	%
Loss on Ignition	Soil	BS 3882: 2015	35.0	%
pH	Soil	BS 3882: 2015	0.14	Units
Carbonate	Soil	BS 3882: 2015	16.0	%
Total Nitrogen	Soil	BS 3882: 2015	12.0	%
Phosphorus (Extractable)	Soil	BS 3882: 2015	24.0	%
Potassium (Extractable)	Soil	BS 3882: 2015	20.0	%
Magnesium (Extractable)	Soil	BS 3882: 2015	26.0	%
Zinc	Soil	BS 3882: 2015	14.9	%
Copper	Soil	BS 3882: 2015	16.0	%
Nickel	Soil	BS 3882: 2015	17.7	%
Available Sodium	Soil	BS 3882: 2015	23.0	%
Available Calcium	Soil	BS 3882: 2015	23.0	%
Electrical Conductivity	Soil	BS 3882: 2015	10.0	%



Tim Rudkin
Soils Ltd
Newton House
Cross Road
Tadworth
Surrey
KT20 5SR

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

DETS Report No: 21-09692

Site Reference: Nightingale Avenue

Project / Job Ref: 19473

Order No: 19473

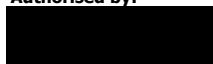
Sample Receipt Date: 04/08/2021

Sample Scheduled Date: 04/08/2021

Report Issue Number: 1

Reporting Date: 10/08/2021

Authorised by:



Dave Ashworth
Technical Manager

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

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.



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



Soil Analysis Certificate						
DETS Report No: 21-09692	Date Sampled	27/07/21	27/07/21	27/07/21		
Soils Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Nightingale Avenue	TP / BH No	WS1	WS1	WS1		
Project / Job Ref: 19473	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: 19473	Depth (m)	1.00	2.00	4.00		
Reporting Date: 10/08/2021	DETS Sample No	558136	558137	558138		

Determinand	Unit	RL	Accreditation				
pH	pH Units	N/a	MCERTS	6.9	7.5	8.4	
Total Sulphate as SO ₄	mg/kg	< 200	MCERTS	291	324	1334	
Total Sulphate as SO ₄	%	< 0.02	MCERTS	0.03	0.03	0.13	
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	34	24	207	
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.03	0.02	0.21	
Total Sulphur	%	< 0.02	NONE	< 0.02	< 0.02	0.62	
Ammonium as NH ₄	mg/kg	< 0.5	MCERTS	2.4	1.6	4.2	
Ammonium as NH ₄	mg/l	< 0.05	MCERTS	0.24	0.16	0.42	
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	6	6	8	
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	2.9	2.9	3.8	
Water Soluble Nitrate (2:1) as NO ₃	mg/kg	< 3	MCERTS	10	17	< 3	
Water Soluble Nitrate (2:1) as NO ₃	mg/l	< 1.5	MCERTS	5	8.5	< 1.5	
W/S Magnesium	mg/l	< 0.1	NONE	2	1.5	8.8	

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



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



Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 21-09692	
Soils Ltd	
Site Reference: Nightingale Avenue	
Project / Job Ref: 19473	
Order No: 19473	
Reporting Date: 10/08/2021	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
558136	WS1	None Supplied	1.00	14.4	Brown sandy clay
558137	WS1	None Supplied	2.00	9.4	Brown sandy clay with chalk and gravel
558138	WS1	None Supplied	4.00	17.9	Grey clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{U/S}

Unsuitable Sample ^{U/S}



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



Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 21-09692

Soils Ltd

Site Reference: Nightingale Avenue

Project / Job Ref: 19473

Order No: 19473

Reporting Date: 10/08/2021

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

D Dried
AR As Received

Appendix C.3 General Assessment Criteria

HUMAN HEALTH RISK ASSESSMENT

Introduction

The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref. 1.1, which was introduced by the Environment Act 1995, ref. 1.2;

‘Land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –

- (a) significant harm is being caused or there is a significant possibility of such harm being caused; or
- (b) pollution of controlled waters is being, or is likely to be, caused.’

The UK guidance on the assessment of contaminated has developed as a direct result of the introduction of these two Acts. The technical guidance supporting the new legislation has been summarised in a number of key documents collectively known as the Contaminated Land Reports (CLRs), a proposed series of twelve documents. Seven were originally published in March 1994, four more were published in April 2002, while the last remaining guidance document, CLR 11, ref 1.3 was published in 2004. In 2008 CLR reports 7 to 10 were withdrawn by DEFRA and the Environment Agency and updated version of CLR 9 and 10 were produced in the form of Science Reports SR2, ref. 1.4 and SR3, ref. 1.5.

In establishing whether a site fulfils the statutory definition of ‘contaminated land’ it is necessary to identify, whether a pollutant linkage exists in respect of the land in question and whether the pollutant linkage:

- is resulting in significant harm being caused to the receptor in the pollutant linkage,
- presents a significant possibility of significant harm being caused to that receptor,
- is resulting in the pollution of the controlled waters which constitute the receptor, or
- is likely to result in such pollution.

A ‘pollutant linkage’ may be defined as the link between a contaminant ‘source’ and a ‘receptor’ by means of a ‘pathway’.

Assessment Methodology

The guidance proposes a four-stage assessment process for identifying potential pollutant linkages on a site. These stages are set out in the table below:

No.	Process	Description
1	Hazard Identification	Establishing contaminant sources, pathways and receptors (the conceptual model).
2	Hazard Assessment	Analysing the potential for unacceptable risks (what linkages could be present, what could be the effects).
3	Risk Estimation	Trying to establish the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it).
4	Risk Evaluation	Deciding whether the risk is unacceptable.

Stages 1 and 2 develop a '*conceptual model*' based upon information collated from desk based studies, and frequently a walkover of the site. The walkover survey should be conducted in general accordance with CLR 2, ref. 1.6. The formation of a conceptual model is an iterative process and as such, it should be updated and refined throughout each stage of the project to reflect any additional information obtained.

The extent of the desk studies and enquiries to be conducted should be in general accordance with CLR 3, ref. 1.7. The information from these enquiries is presented in a desk study report with recommendations, if necessary, for further work based upon the conceptual model. Specific DoE 'Industry Profiles' provide guidance on the nature of contaminants relating to specific industrial processes.

If potential pollutant linkages are identified within the conceptual model, a Phase 2 site investigation and report will be recommended. The investigation should be planned in general accordance with CLR 4, ref 1.8. The number of exploratory holes and samples collected for analysis should be consistent with the size of the site and the level of risk envisaged. This will enable a contamination risk assessment to be conducted, at which point the conceptual model can be updated and relevant pollutant linkages can be identified.

A two-stage investigation may be more appropriate where time constraints are less of an issue. The first stage investigation being conducted as an initial assessment for the presence of potential sources, a second being a more refined investigation to delineate wherever possible the extent of the identified contamination.

All site works should be in general accordance with the British Standards BS 10175:2011, ref. 1.9. and BS 5930:2015, ref. 1.10.

The generic contamination risk assessment screens the results of the chemical analysis against generic guidance values which are dependent on the proposed end-use of the development.

The end-use may be defined as one of the following ref. 1.15;

- Residential with homegrown produce – domestic low rise and low density housing with gardens where vegetables may be grown for home consumption
- Residential without homegrown produce – domestic low density and low density housing where no gardens are present.
- Allotments – specific areas where vegetables are grown for home consumption.
- Public open space in close proximity to residential housing – includes the predominantly grassed area adjacent to high density housing and the central green area around which houses are developed. This land-use includes the smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting.
- Public open space in use as general parkland – provided for recreational use and may be used for family visits and picnics, children's play area, sports grounds and dog walking.
- Commercial – industrial premises where there is limited exposure to soil.

Standard Land-use Scenarios

The standard land-use scenarios used to develop conceptual exposure models are presented in the following sections:

Residential with homegrown produce

Generic scenario assumes a typical two-storey house built on a ground bearing slab with a private garden having a lawn, flowerbeds and a small fruit and vegetable patch.

- | |
|--|
| • Critical receptor is a young female child (zero to six years old) |
| • Exposure duration is six years. |
| • Exposure pathways include direct soil and indoor dust ingestion, consumption of home-grown produce and any adhering soil, skin contact with soils and indoor dust and inhalation of indoor and outdoor dust and vapours. |
| • Building type is a two-storey small terraced house. |

A sub-set of the Residential land-use is **Residential without Homegrown produce**. The generic scenario assumes low density housing with communal landscaped gardens where the consumption of home grown vegetables will not occur.

Allotments

Provision of open space (about 250sq.m) commonly made available to tenants by the local authority to grow fruit and vegetable for their own consumption. Typically, there are a number of plots to a site which may have a total area of up to 1 hectare. The tenants are assumed to be adults and that young children make occasional accompanied visits.

Although some allotment holders may choose to keep animals including rabbits, hens, and ducks, potential exposure to contaminated meat and eggs is not considered.

-
- Critical receptor is a young female child (zero to six years old)
 - Exposure duration is six years.
 - Exposure pathways include direct soil ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and inhalation of outdoor dust and vapours.
 - There is no building.
-

Commercial

The generic scenario assumes a typical commercial or light industrial property comprising a three-storey building at which employees spend most time indoors and are involved in office-based or relatively light physical work.

-
- Critical receptor is a working female adult (aged 16 to 65 years old).
 - Exposure duration is a working lifetime of 49 years.
 - Exposure pathways include direct soil and indoor dust ingestion, skin contact with soils and dusts and inhalation of dust and vapours.
 - Building type is a three-storey office (pre 1970).
-

Public Open Space within Residential Area

The generic scenario refers to any grassed area 0.05 ha and that is close to Housing.

-
- Grassed area of up to 0.05 ha and a considerable proportion of this (up to 50%) may be bare soil
 - Predominantly used by children for playing and may be used for activities such as a football kick about
 - Sufficiently close proximity to home for tracking back of soil to occur, thus indoor exposure pathways apply
 - older children as the critical receptor on basis that they will use site most frequently (Age class 4-9)
 - ingestion rate 75 mg.day^{-1}
-

Public Open Space Park

This generic scenario refers to any public park that is more than 0.5ha in area:

-
- Public park (>0.5 ha), predominantly grassed and may also contain children's play equipment and border areas of soil containing flowers or shrubs (75% cover)
 - Female child age classes 1-6
 - Soil ingestion rate of 50 mg.day^{-1}
 - Occupancy period outdoors = 2 hours.day^{-1}
 - Exposure frequency of 170 days.year⁻¹ for age classes 2-18 and 85
 - days.year⁻¹ for age class 1
 - Outdoor exposure pathways only (no tracking back).
-

Human Health Generic Quantitative Risk Assessment (GQRA) involves the comparison of contaminant concentrations measured in soil at the site with Generic Assessment Criteria (GAC).

GAC are conservative values adopted to ensure that they are applicable to the majority of possible contaminated site. These values may be published Contaminated Land Exposure Assessment Model (CLEA) derived GAC derived by a third party or the Environment Agency/ DEFRA. It is imperative to the risk assessor to understand the uncertainties and limitations associated with these GAC to ensure that they are used appropriately. Where the adoption of a GAC is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses, then a Detailed Quantitative Risk Assessment (DQRA) may be undertaken to develop site specific values for relevant soil contaminants based on the site specific conditions.

In 2014, the publication of Category 4 Screening Levels (C4SL) ref 1.15, 1.16, as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3) ref 1.5 used in the generation of SGVs. C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010 ref 1.16. Where a C4SL has been published, Soils Limited has adopted them as GAC for these six substances.

For all other substances the soils will be compared to Suitable 4 Use Levels (S4ULs) published by LQM ref. 1.12, which were developed for around 85 substances and are intended to enable a screening assessment of the risks posed by soil quality on development sites. The updated LQM/CIEH GAC publication was developed to accommodate recent developments in the understanding of chemical, toxicological and routine exposure to soil-based contaminants.

Where no S4UL or C4SL is available, the assessment criteria (AC) may be generated using the Contaminated Land Exposure Assessment (CLEA) Software Version 1.07, ref. 1.13. Toxicological and physico-chemical/fate and transport data used to generate the AC has been derived from a hierarchy of data sources as follows:

1. Environment Agency or Department of Environment Food and Rural Affairs (DEFRA) documents;
2. Other documents produced by UK Government or state organisations;
3. European institution documents;
4. International organisation documents;
5. Foreign government institutions.

In the case of the majority of contaminants considered, the toxicological data has been drawn from the relevant CLR 9 TOX report, or updated toxicological data published by the Environment Agency (2009), ref. 1.6, where available. Where no TOX report is available reference has been made to the health criteria values, derived for use in Land Quality Press (2006), ref. 1.17, as this is considered to represent a peer reviewed data source. Similarly, fate and transport data has been derived in the first instance from Environment Agency (2003), ref. 1.18 and for contaminants not considered in this document the fate and transport data used in previous versions of the CLEA model has been used.

Chemical laboratory test results are processed as follows. A statistical analysis of the results is conducted, as detailed in CIEH and CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', ref. 1.14. Individual concentrations are compared to the selected guideline values to identify concentrations of contaminants that are above the selected screening criteria.

Where the risk estimation identifies significant concentrations of one or more contaminants, a further risk evaluation needs to be undertaken.

References

- 1.1 The Environmental Protection Act, Part IIA, Section 78, DoE 1990.
- 1.2 Environment Act 1995, Section 57, DoE 1995.
- 1.3 CLR 11, '*Model Procedures for the Management of Contaminated Land*', DEFRA and Environment Agency, 2004.
- 1.4 Environment Agency Science Report SC050021/SR2 'Human health toxicological assessment of contaminants in soil'.
- 1.5 Science Report SC050021/SR3 '*Updated technical background to the CLEA model*', Environment Agency, 2008
- 1.6 CLR 2, '*Guidance on preliminary site inspection of contaminated land*', Report by Applied Environmental, DoE 1994.
- 1.7 CLR 3 '*Documentary Research on Industrial Sites*', Report by RPS Consultants Ltd., DOE, 1994
- 1.8 CLR 4, '*Sampling strategies for contaminated land*', Report by The Centre for Research into the Built Environment, the Nottingham Trent University, DoE, 1994
- 1.9 BS 10175: 2011 '*Investigation of potentially contaminated sites. Code of practice*', British Standards Institute, 2011
- 1.10 BS 5930: 2015 '*Code of practice for ground investigations*', British Standards Institute, 2015
- 1.11 Science Report SC050021 '*Contaminants in Soil: Updated Collation of Toxicological Data and Intake Values for Humans*', Environment Agency, 2009
- 1.12 The LQM/S4ULs for Human Health Risk Assessment, Nathanail P, McCaffery C, Gillett A, Ogden R, and Nathanail J, Land Quality Press, Nottingham, published 2015.
- 1.13 CLEA '*Software Version 1.071*' (downloaded from the Environment Agency website, <http://www.environment-agency.gov.uk>)
- 1.14 CIEH '*Guidance on Comparing Soil Contamination Data with a Critical Concentration*', Chartered Institute of Environmental Health (CIEH) and Contaminated Land: Applications in Real Environments (CL:AIRE), May 2008.
- 1.15 DEFRA SP1010: Development of Category 4 Screening Levels for the Assessment of Land Affected by Contamination, published March 2014.
- 1.16 Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). '*Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination*', Revision 2, DEFRA research project SP1010.
- 1.17 Generic Assessment Criteria for Human Health Risk Assessment, Nathanail CP, McCaffery C, Ashmore M, Cheng Y, Gillett A, Hooker P and Ogden RC
- 1.18 CLR 2, '*Guidance on preliminary site inspection of contaminated land*', Report by Applied Environmental, DoE 1994.

			Residential with home-grown produce			Residential without home-grown produce			Allotments			Commercial			Public Open Space - Resi			Public Open Space -Park						
			SOM	1.0	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6			
Type	Contaminants	Species	Year																					
Metals	Antimony		2010				550						7500									EIC/AGS/	CL:AIRE	2010
	Arsenic		2014	37			40			49			640			79			168			C4SL	DEFRA	2014
			2015	37			40			40			640			79			170			S4UL	LQM/CIEH	2015
	Beryllium		2015	1.7			1.7			35			12			2.2			63			S4UL	LQM/CIEH	2015
	Boron		2015	290			11000			45			240000			21000			46000			S4UL	LQM/CIEH	2015
	Cadmium		2015	11			85			1.9			190			120			532			S4UL	LQM/CIEH	2015
			2014	26			149			4.9			410			220			880			C4SL	DEFRA	2014
	Chromium	III	2015	910			910			18000			8600			1500			33000			S4UL	LQM/CIEH	2015
		VI	2014	21			21			170			49			23			250			C4SL	DEFRA	2014
		VI	2015	6			6			1.8			33			7.7			220			S4UL	LQM/CIEH	2015
	Copper		2015	2400			7100			520			68000			12000			44000			S4UL	LQM/CIEH	2015
	Lead		2014	200			310			80			2330			630			1300			C4SL	DEFRA	2014
	Mercury	Elemental	2015	1.2			1.2			21			58			16			30			S4UL	LQM/CIEH	2015
		Inorganic	2015	40			56			19			1100			120			240			S4UL	LQM/CIEH	2015
		Methyl	2015	11			15			6			320			40			68			S4UL	LQM/CIEH	2015
	Nickel		2015	130			180			53			980			230			800			S4UL	LQM/CIEH	2015
	Selenium		2015	250			430			88			12000			1100			1800			S4UL	LQM/CIEH	2015
	Vanadium		2015	410			1200			91			9000			2000			5000			S4UL	LQM/CIEH	2015
	Zinc		2015	3700			40000			620			730000			81000			170000			S4UL	LQM/CIEH	2015
	Benzene		2014	0.87			3.3			0.18			98			140			230			C4SL	DEFRA	2014
			2015	0.087	0.17	0.37	0.38	0.7	1.4	0.017	0.034	0.075	27	47	90	72	72	73	90	100	110	S4UL	LQM/CIEH	2015
	Toluene		2015	130	290	660	880	1900	3900	22	51	120	65000	110000	180000	56000	56000	56000	87000	95000	100000	S4UL	LQM/CIEH	2015
	Ethylbenzene		2015	47	110	260	83	190	440	16	39	91	4700	13000	27000	24000	24000	25000	17000	22000	27000	S4UL	LQM/CIEH	2015
	Xylenes	o-xylene	2015	60	140	330	88	210	480	28	67	160	6600	15000	33000	41000	42000	43000	17000	24000	33000	S4UL	LQM/CIEH	2015
		m-xylene	2015	59	140	320	82	190	450	31	74	170	6200	14000	31000	41000	42000	43000	17000	24000	32000	S4UL	LQM/CIEH	2015
		p-xylene	2015	56	130	310	79	180	310	29	69	160	5900	14000	30000	41000	42000	43000	17000	23000	31000	S4UL	LQM/CIEH	2015
Petroleum Hydrocarbons Fractions	Aliphatic >C5 - C6		2015	42	78	160	42	78	160	730	1700	3900	3200	5900	12000	570000	590000	600000	95000	130000	180000	S4UL	LQM/CIEH	2015
	Aliphatic >C6 - C8		2015	100	230	530	100	230	530	2300	5600	13000	7800	17000	40000	600000	610000	620000	150000	220000	320000	S4UL	LQM/CIEH	2015
	Aliphatic >C8 - C10		2015	27	65	150	27	65	150	320	770	1700	2000	4800	11000	13000	13000	13000	14000	18000	21000	S4UL	LQM/CIEH	2015
	Aliphatic >C10 - C12		2015	130	330	760	130	330	770	2200	4400	7300	9700	23000	47000	13000	13000	13000	21000	23000	24000	S4UL	LQM/CIEH	2015
	Aliphatic >C12 - C16		2015	1100	2400	4300	1100	2400	4400	11000	13000	13000	59000	82000	90000	13000	13000	13000	25000	25000	26000	S4UL	LQM/CIEH	2015
	Aliphatic >C16 - C35		2015	65000	92000	110000	65000	92000	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	S4UL	LQM/CIEH	2015
	Aliphatic >C35 - C44		2015	65000	92000	140000	65000	92000	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	S4UL	LQM/CIEH	2015
	Aromatic >C5 - C7		2015	70	140	300	370	690	1400	13	27	57	26000	46000	86000	56000	56000	56000	76000	84000	92000	S4UL	LQM/CIEH	2015
	Aromatic >C7 - C8		2015	130	290	660	860	1800	3900	22	51	120	56000	110000	180000	56000	56000	56000	87000	95000	100000	S4UL	LQM/CIEH	2015
	Aromatic >C8 - C10		2015	34	83	190	47	110	270	8.6	21	51	3500	8100	17000	5000	5000	5000	7200	8500	9300	S4UL	LQM/CIEH	2015
	Aromatic >C10 - C12		2015	74	180	380	250	590	1200	13	31	74	16000	28000	34000	5000	5000	5000	9200	9700	10000	S4UL	LQM/CIEH	2015
	Aromatic >C12 - C16		2015	140	330	660	1800	2300	2500	23	57	130	36000	37000	38000	5100	5100	5000	10000	10000	10000	S4UL	LQM/CIEH	2015
	Aromatic >C16 - C21		2015	260	540	930	1900	1900	1900	46	110	260	28000	28000	28000	3800	3800	3800	7600	7700	7800	S4UL	LQM/CIEH	2015
	Aromatic >C21 - C35		2015	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	S4UL	LQM/CIEH	2015
	Aromatic >C34 - C44		2015	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	S4UL	LQM/CIEH	2015
	Aliphatic + Aromatic >C44 - C70		2015	1600	1800	1900	1900	1900	1900	1200	2100	3000	28000	28000	28000	3800	3800	3800	7800	7800	7900	S4UL	LQM/CIEH	2015
Polycyclic Aromatic Hydrocarbons (PAH' s) (mg/kg)	Acenaphthene		2015	210	510	1100	3000	4700	6000	34	85	200	84000	97000	100000	15000	15000	15000	29000	30000	30000	S4UL	LQM/CIEH	2015
	Acenaphthylene		2015	170	420	920	2900	4600	6000	28	69	160	83000	97000	100000	15000	15000	15000	29000	30000	30000	S4UL	LQM/CIEH	2015
	Anthracene		2015	2400	5400	11000	31000	35000	37000	380	950	2200	520000	54000	540000	74000	74000	74000	150000	150000	150000	S4UL	LQM/CIEH	2015
	Benzo(a)anthracene		2015	7.2	11	13	11	14	15	2.9	6.5	13	170	170	180	29	29	29	49	56	62	S4UL	LQM/CIEH	2015
	Benzo(a)pyrene		2014			5			5.3			5.7			76			10			21	C4SL	DEFRA	2014
			2015	2.2	2.7	3	3.2	3.2	3.2	0.97	2	3.5	35	35	36	5.7	5.7	5.7	11	12	13	S4UL	LQM/CIEH	2015
	Benzo(b)fluoranthene		2015	2.6	3.3	3.7	3.9	4.0	4.0	0.99	2.1	3.9	44	44	45	7.1	7.2	7.2	13	15	16	S4UL	LQM/CIEH	2015
	Benzo(ghi)perylene		2015	320	340	350	360	360	360	290	470	640	3900	4000	4000	640	640	640	1400	1500	1600	S4UL	LQM/CIEH	2015
	Benzo(k)fluoranthene		2015	77	93	100	110	110	110	37	75	130	1200	1200	1200	190	190	190	370	410	440	S4UL	LQM/CIEH	2015
	Chrysene		2015	15	22	27	30	31	32	4.1	9.4	19	350	350	350	57	57	57	93	110	120	S4UL	LQM/CIEH	2015
	Dibenz(a,h)anthracene		2015	0.24																				

			Residential with home-grown produce			Residential without home-grown produce			Allotments			Commercial			Public Open Space - Resi			Public Open Space -Park						
			SOM	1.0	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6			
Type	Contaminants	Species	Year																					
	Fluoranthene		2015	280	560	890	1500	1600	1600	52	130	290	23000	23000	23000	3100	3100	3100	6300	6300	6400	S4UL	LQM/CIEH	2015
	Fluorene		2015	170	400	860	2800	3800	4500	27	67	160	63000	68000	71000	9900	9900	9900	20000	20000	20000	S4UL	LQM/CIEH	2015
	Indeno(1,2,3-cd)pyrene		2015	27	36	41	45	46	46	9.5	21	39	500	510	510	82	82	82	150	170	180	S4UL	LQM/CIEH	2015
	Naphthalene		2015	2.3	5.6	13	2.3	5.6	13	4.1	10	24	190	460	1100	4900	4900	4900	1200	1900	3000	S4UL	LQM/CIEH	2015
	Phenanthrene		2015	95	220	440	1300	1500	1500	15	38	90	22000	22000	23000	3100	3100	3100	6200	6200	6300	S4UL	LQM/CIEH	2015
	Pyrene		2015	620	1200	2000	3700	3800	3800	110	270	620	54000	54000	54000	7400	7400	7400	15000	15000	15000	S4UL	LQM/CIEH	2015
	Coal Tar(Bap as surrogate matter)		2015	0.79	0.98	1.1	1.2	1.2	1.2	0.32	0.67	1.2	15	15	15	2.2	2.2	2.2	4.4	4.7	4.8	S4UL	LQM/CIEH	2015
Chloroalkanes & alkenes	1,2 Dichloroethane		2015	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28	S4UL	LQM/CIEH	2015
	1,1,1 Trichloroethane		2015	8.8	18	39	9	18	40	48	110	240	660	1300	3000	140000	140000	140000	57000	76000	100000	S4UL	LQM/CIEH	2015
	1,1,2,2 Tetrachloroethane		2015	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	270	550	1100	1400	1400	1400	1800	2100	2300	S4UL	LQM/CIEH	2015
	1,1,1,2 Tetrachloroethane		2015	1.2	2.8	6.4	1.5	3.5	8.2	0.79	1.9	4.4	110	250	560	1400	1400	1400	1500	1800	2100	S4UL	LQM/CIEH	2015
	Tetrachloroethene		2015	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	19	42	95	1400	1400	1400	810	1100	1500	S4UL	LQM/CIEH	2015
	Tetrachloromethane (Carbon Tetrachloride)		2015	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400	S4UL	LQM/CIEH	2015
	Trichloroethene		2015	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120	S4UL	LQM/CIEH	2015
	Trichloromethane		2015	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100	S4UL	LQM/CIEH	2015
	Vinyl Chloride (chloroethene)		2015	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	S4UL	LQM/CIEH	2015
Explosives	2,4,6 Trinitrotoluene		2015	1.6	3.7	8.1	65	66	66	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270	S4UL	LQM/CIEH	2015
	RDX (Hexogen/Cyclonite/1,3,5-trinitro-1,3,5-triazacyclohexane)		2015	120	250	540	13000	13000	13000	17	38	85	210000	210000	210000	26000	26000	27000	49000	51000	53000	S4UL	LQM/CIEH	2015
	HMX (Octogen/1,3,5,7-tetrenitro-1,3,5,7-tetrazacyclo-octane)		2015	5.7	13	26	6700	6700	6700	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	23000	23000	24000	S4UL	LQM/CIEH	2015
Pesticides	Aldrin		2015	5.7	6.6	7.1	7.3	7.4	7.5	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31	S4UL	LQM/CIEH	2015
	Dieldrin		2015	0.97	2	3.5	7	7.3	7.4	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31	S4UL	LQM/CIEH	2015
	Atrazine		2015	3.3	7.6	17.4	610	620	620	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	2400	S4UL	LQM/CIEH	2015
	Dichlorvos		2015	0.032	0.066	0.14	6.4	6.5	6.6	0.0049	0.01	0.022	140	140	140	16	16	16	26	26	27	S4UL	LQM/CIEH	2015
	Alpha - Endosulfan		2015	7.4	18	41	160	280	410	1.2	2.9	6.8	5600	7400	8400	1200	1200	1200	2400	2400	2500	S4UL	LQM/CIEH	2015
	Beta - Endosulfan		2015	7	17	39	190	320	440	1.1	2.7	6.4	6300	7800	8700	1200	1200	1200	2400	2400	2500	S4UL	LQM/CIEH	2015
	Alpha -Hexachlorocyclohexanes		2015	0.23	0.55	1.2	6.9	9.2	11	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48	S4UL	LQM/CIEH	2015
	Beta -Hexachlorocyclohexanes		2015	0.085	0.2	0.46	3.7	3.8	3.8	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	15	15	16	S4UL	LQM/CIEH	2015
	Gamma -Hexachlorocyclohexanes		2015	0.06	0.14	0.33	2.9	3.3	3.5	0.0092	0.023	0.054	67	69	70	8.2	8.2	8.2	14	15	15	S4UL	LQM/CIEH	2015
Chlorobenzenes	Chlorobenzene		2015	0.46	1	2.4	0.46	1	2.4	5.9	14	32	56	130	290	11000	13000	14000	1300	2000	2900	S4UL	LQM/CIEH	2015
	1,2-Dichlorobenzene		2015	23	55	130	24	57	130	94	230	540	2000	4800	11000	90000	95000	98000	24000	36000	51000	S4UL	LQM/CIEH	2015
	1,3-Dichlorobenzene		2015	0.4	1	2.3	0.44	1.1	2.5	0.25	0.6	1.5	30	73	170	300	300	300	390	440	470	S4UL	LQM/CIEH	2015
	1,4-Dichlorobenzene		2015	61	150	350	61	150	350	15	37	88	4400	10000	25000	17000	17000	1700	36000	36000	36000	S4UL	LQM/CIEH	2015
	1,2,3,-Trichlorobenzene		2015	1.5	3.6	8.6	1.5	3.7	8.8	4.7	12	28	102	250	590	1800	1800	1800	770	1100	1600	S4UL	LQM/CIEH	2015
	1,2,4,-Trichlorobenzene		2015	2.6	6.4	15	2.6	6.4	15	55	140	320	220	530	1300	15000	17000	19000	1700	2600	4000	S4UL	LQM/CIEH	2015
	1,3,5,-Trichlorobenzene		2015	0.33	0.81	1.9	0.33	0.81	1.9	4.7	12	28	23	55	130	1700	1700	1800	380	580	860	S4UL	LQM/CIEH	2015
	1,2,3,4,-Tetrachlorobenzene		2015	15	36	78	24	56	120	4.4	11	26	1700	3080	4400	830	830	830	1500	1600	1600	S4UL	LQM/CIEH	2015
	1,2,3,5,- Tetrachlobenzene		2015	0.66	1.6	3.7	0.75	1.9	4.3	0.38	0.9	2.2	49	120	240	78	79	79	110	120	130	S4UL	LQM/CIEH	2015
	1,2,4, 5,- Tetrachlobenzene		2015	0.33	0.77	1.6	0.73	1.7	3.5	0.06	0.16	0.37	42	72	96	13	13	13	25	26	26	S4UL	LQM/CIEH	2015
	Pentachlorobenzene		2015	5.8	12	22	19	30	38	1.2	3.1	7	640	770	830	100	100	100	190	190	190	S4UL	LQM/CIEH	2015
	Hexachlorobenzene		2015	1.8	3.3	4.9	4.1	5.7	6.7	0.47	1.1	2.5	110	120	120	16	16	16	30	30	30	S4UL	LQM/CIEH	2015
Phenols & Chlorophenols																								
	Phenols		2015	120	200	380	440	690	1200	23	42	83	440	690	1300	440	690	1300	440	690	1300	S4UL	LQM/CIEH	2015
	Chlorophenols (4 Congeners)		2015	0.87	2	4.5	94	150	210	0.13	0.3	0.7	3500	4000	4300	620	620	620	1100	1100	1100	S4UL	LQM/CIEH	2015
	Pentachlorophenols		2015	0.22	0.52	1.2	27	29	31	0.03	0.08	0.19	400	400	400	60	60	60	110	120	120	S4UL	LQM/CIEH	2015
Others																								
	Carbon Disulphide		2015	0.14	0.29	0.62	0.14	0.29	0.62	4.8	10	23	11	22	47	11000	11000	12000	1300	1900	2700	S4UL	LQM/CIEH	2015
	Hexachloro-1,3-Butadiene		2015	0.29	0.7	1.6	0.32	0.78	1.8	0.25	0.61	1.4	31	66	120	25	25	25	48	50	51	S4UL	LQM/CIEH	2015

NOTE

Priority	Guideline (mg kg ⁻¹)
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				Residential with home-grown produce			Residential without home-grown produce			Allotments			Commercial			Public Open Space - Resi			Public Open Space -Park				
SOM				1.0	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6		
Type	Contaminants	Species	Year																				
	1	Site Specific Assessment Criteria (SSAC) (Soils Limited)																					
	2	2014: Category 4 Screening Level (C4SL) (Contaminated Land: Application in Real Environment (CL:ARE), 2014)																					
	3	2012: Soil Guideline Value (SGV) (Environment Agency, 2009)																					
	4	2015: Suitable 4 Use Level (S4UL) (Nathanail <i>et al</i> , 2015)																					
For Generic Risk Assessment, the values in Bold have priority																							
Table reviewed February 2020																							

Appendix D Information Provided by the Client

Soils Limited
Geotechnical & Environmental Consultants

Newton House
Cross Road, Tadworth
Surrey KT20 5SR

T 01737 814221
W soilslimited.co.uk