



Main Investigation Report

at

Willowdene Close, Havant, Hampshire PO9 3QP

for

Wildern Architecture Ltd

Reference: 18189/MIR
March 2020

Control Document

Project

Willowdene Close, Havant, Hampshire PO9 3QP

Document Type

Main Investigation Report

Document Reference

18189/MIR

Document Status

Final

Date

March 2020

Prepared by

C G Swainston BSc, PGCE, CGeol, FGS



First check by

T Rees-Blanchard BEng (Hons), ProfGradIMMM, FGS.



Second check by

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



This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

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 was commissioned by Wildern Architecture Ltd to undertake an intrusive ground investigation and prepare a Main Investigation Report on land at Willowdene Close, Havant, Hampshire PO9 3QP. The scope of the investigation was outlined in the Soils Limited quotation reference Q22367/Rev.01 dated 31st January 2020.

This document comprises the Main Investigation Report and incorporates the results, discussion and conclusions to this intrusive works.

This Main Investigation Report must be read in conjunction with the Preliminary Investigation Report undertaken on the above site by Soils Limited, Report ref: 18189/PIR_26, dated February 2020.

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 EN ISO 14688-1:2002+A1:2013 - Geotechnical investigation and testing - Identification and description
- BS EN ISO 14688-2:2004+A1:2013 - Geotechnical investigation and testing - Principles for a classification
- BS 10175:2011+A2:2017 - Investigation of potentially contaminated sites
- NHBC Standards 2019

The chemical analyses were undertaken by i2 Analytical 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.

Contents

Section I	Introduction	I
1.1	Objective of Investigation	1
1.2	Location	1
1.3	Site Description	1
1.4	Proposed Development	1
1.5	Anticipated Geology	2
1.5.1	Alluvium	2
1.5.2	Head	2
1.5.3	London Clay Formation	2
1.6	Limitations and Disclaimers	2
Section 2	Site Works	5
2.1	Proposed Project Works	5
2.1.1	Actual Project Works	5
2.2	Ground Conditions	5
2.3	Ground Conditions Encountered in Trial Holes	7
2.3.1	Made Ground	7
2.3.2	Alluvium	7
2.3.3	Head	8
2.3.4	Weathered London Clay Formation	8
2.4	Roots	8
2.5	Groundwater	9
Section 3	Discussion of Geotechnical In-Situ Testing	10
3.1	Dynamic Probe Tests	10
Section 4	Foundation Design	11
4.1	General	11
4.1.1	Made Ground and Topsoil	11
4.1.2	Alluvium	11
4.1.3	Weathered London Clay Formation	12
4.1.4	Roots	12
4.1.5	Groundwater	12
4.2	Foundation Scheme General	13
4.2.1	Guidance on Shrinkable Soils	13

4.3	Foundation Scheme.....	14
4.3.1	Ground Floor Slab	15
4.4	Subsurface Concrete	15
4.5	Excavations	15
Section 5	Determination of Chemical Analysis	17
5.1	Site Characterisation and Revised Conceptual Site Model	17
5.2	Soil Sampling.....	17
5.3	Determination of Chemical Analysis	18
Section 6	Qualitative Risk Assessment.....	19
6.1	Assessment Criteria.....	19
6.2	Representative Contamination Criteria - Soil	19
6.2.1	Asbestos	20
6.3	Risk to Groundwater	20
6.4	Tier 1 Quantitative Risk Assessment	20
6.4.1	Soils.....	20
6.4.2	Groundwater	21
6.4.3	Soil Gas	21
6.5	Remedial Objective.....	21
6.6	Development of Soil Remediation Strategy.....	22
6.6.1	Further Chemical Testing and Human Health Risk Assessment.....	22
6.6.2	Excavation of Impacted Soil.....	22
6.6.3	Excavation of All Made Ground.....	22
6.6.4	Asbestos	22
6.7	Duty of Care.....	23
6.8	Excavated Material	23
6.9	Re-use of Excavated Material On-site	24
6.10	Imported Material	25
6.11	Discovery Strategy.....	25

List of Figures

Figure 1 – Site Location Map	27
Figure 2 – Aerial Photograph	28
Figure 3 – Trial Hole Plan	29

List of Tables

Table 2.1 Final Depth of Trial Holes	6
Table 2.2 Ground Conditions	7
Table 2.3 Final Depth of Made Ground	7
Table 2.4 Final Depth of Alluvium	8
Table 2.5 Final Depth of Weathered London Clay Formation.....	8
Table 2.6 Groundwater Strikes	9
Table 5.1 Sampling Strategy	18
Table 5.2 Chemical Analysis Specification	18
Table 6.1 Summary of Chemical Analysis of Soils Sample Exceedance.....	19
Table B.1.1 SPT "N" Blow Count Cohesive Classification	
Table B.2.1 Interpretation of DPSH Blow Counts	
Table C.1.1 CSM Revised Pre-Testing	
Table C.1.2 CSM Revised Post Testing	

List of Appendices

Appendix A Field Work

Appendix A.1 Engineers Logs

Appendix B Geotechnical In-Situ and Laboratory Testing

Appendix B.1 Classification

Appendix B.2 Interpretation

Appendix B.3 Geotechnical In-Situ and Laboratory Results

Appendix C Chemical Laboratory Testing

Appendix C.1 Conceptual Site Model

Appendix C.2 Chemical Laboratory Results

Appendix C.3 General Assessment Criteria

Appendix D Information Provided by the Client

Section I Introduction

I.1 Objective of Investigation

Soils Limited was commissioned by Wildern Architecture Ltd 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 and to assist in preparing a foundation scheme for development that was appropriate to the settings present on the site.

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, though this latter element was not undertaken at this time for reasons outlined below following consultation with the Client.

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: 18189/PIR_26, dated February 2020) and/or the Revised Conceptual Site Model presented in Appendix C.1.

I.2 Location

The site was located at Willowdene Close, Havant, Hampshire PO9 3QP and had an approximate O.S Land Ranger Grid Reference of SU 698 076.

The site location plan is given in Figure 1.

I.3 Site Description

The site was generally flat with a slight southerly dip and comprised two single storey private garage sets, one to the north and one to the south of an open concrete covered area adjacent to and with access from Willowdene Close.

An aerial photograph has been included in Figure 2.

I.4 Proposed Development

The proposal comprised demolition of the existing garages and the erection of either 1 or two 2 storey residential properties with gardens.

In compiling this report reliance was placed on drawing W19-009 prepared by Wildern Architecture Ltd. Any change or deviation from the scheme outlined in the drawing could

invalidate the recommendations presented within this report. Soils Limited must be notified about any such changes.

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

1.5 Anticipated Geology

The 1:50,000 BGS Geology map showed the site to be situated on the London Clay Formation bedrock, with overlying superficial deposits of Head. Alluvium was not mapped by the BGS however was anticipated due to the presence of an historical stream crossing the center of the site and associated "marsh" area present on the historical maps.

1.5.1 Alluvium

Alluvium is the most recent river or estuarine deposit and generally comprises silty clays usually with an appreciable organic content. Lenses of sand and gravel are also commonly found, as are pockets of peat.

The BSI Code of Practice for Foundations, BS8004: 1986, Clause 2.2.2.3.4 Peat and organic soils, includes the caveat that 'all these soils are highly compressible, and even lightly loaded foundations will be subject to considerable settlements over a long period if placed on them. For this reason, these soils are not suitable for carrying the loads for important structures'.

1.5.2 Head

Head deposit are drifts produced by solifluxion, the downslope movement of debris outwash during the periglacial period, and characteristically comprise poorly sorted sands gravels and chalk of local derivation

1.5.3 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).

1.6 Limitations and Disclaimers

This Main Investigation Report relates to the site located at Willowdene Close, Havant, Hampshire, PO9 3QP and was prepared for the sole benefit of Wildern Architecture Ltd (The "Client"). The report was prepared solely for the brief described in Section 1.1 of this report.

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.

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 on 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).

It should 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, particularly given that the site walkover has been undertaken in winter, when invasive species would not be significantly notable due to dieback.

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:

"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".

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.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets remains with Soils Limited. License is for the sole use of the client and may not be assigned, transferred or given to a third party.

Section 2 Site Works

2.1 Proposed Project Works

The proposed intrusive investigation was designed to provide information on the ground conditions, to aid the design of foundations for the proposed residential development and determine if potential risks and unknowns identified in the PIR were present and could present potential risks to receptors identified in the initial conceptual site model (CSM).

The intended investigation, as outlined within the Soils Limited quotation (Q22367/Rev.01 dated 31st January 2020), was to comprise the following items:

- 4No up to 4m deep windowless sampler boreholes
- 4No up to 6m deep dynamic probes
- Geotechnical laboratory testing
- Contamination laboratory testing.

2.1.1 Actual Project Works

The actual project works were undertaken on 6th February 2020 and comprised:

- 4No up to 4m deep windowless sampler boreholes
- 4No up to 6m deep dynamic probes
- Contamination laboratory testing.

All windowless sampler boreholes were backfilled with gravel. 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 testing. An initial review of the windowless sampler logs, dynamic probe results and subsequent discussion with the client suggested that a shallow foundation was unlikely to be viable and therefore the geotechnical laboratory testing was delayed until more appropriate samples can be obtained.

2.2 Ground Conditions

On 6th February 2020 four windowless sampler boreholes (WS1 – WS4) were drilled, using a Premier type tracked windowless sampler drilling rig, to depths ranging between 1.50 and 4.00m below ground level (bgl) at locations selected by Soils Limited using a development plan provided by the client.

Four dynamic probes, super heavy, (DP1 – DP4) were driven prior and adjacent to their corresponding windowless sampler borehole to depths ranging between 2.00 and 6.00m bgl. DP4 was attempted three times due to obstructions being encountered at 0.30 and

0.50m bgl on the first and second attempts.

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	1.50	DP1	2.00
WS2	4.00	DP2	6.00
WS3	4.00	DP3	6.00
WS4	4.00	DP4	6.00

Note:

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. No Topsoil was encountered during this investigation.

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)
Alluvium (ALV)
Head (H) – not encountered
Weathered London Clay Formation (WLCF)

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	Recent	GL	1.50 ¹ -2.00	1.90	Firm, black, greenish brown and greyish brown mottled, slightly sandy, slightly gravelly CLAY. Gravel is angular to sub-angular, fine to coarse flint, brick, clinker and concrete.
ALL	Quaternary	1.90	2.00-3.10	0.65	Very soft brown mottled black blueish grey slightly sandy silty CLAY with decomposing rootlets and faint odour of decomposition.
WLCF	Eocene	2.00	>4.00 ¹	Not proven ²	Firm, blueish grey and brown mottled, slightly sandy silty CLAY.

Note: ¹ Final depth of trial hole. ² Base of strata not encountered

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 locations from ground level to depths of ranging between 1.50m (WS1 – final base of hole) and 2.00m bgl (WS4).

The Made Ground typically comprised firm, black, greenish brown and greyish brown mottled, slightly sandy, slightly gravelly CLAY. Gravel is angular to sub-angular, fine to coarse flint, brick, clinker and concrete.

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	1.50 ¹
WS2	1.90
WS3	1.70
WS4	2.00

Note: ¹ Final depth of trial hole.

2.3.2 Alluvium

Soils described as Alluvium were encountered in three out of the four trial holes immediately underlying the Made Ground to depths of between 2.00 and 3.10m.

Where encountered the Alluvium was described as very soft brown mottled black blueish grey slightly sandy silty CLAY with decomposing rootlets and faint odour of decomposition.

The final depth of the Alluvium is presented in Table 2.4.

Table 2.4 Final Depth of Alluvium

Trial Hole	Depth (m bgl)
WS1	Not encountered
WS2	2.00
WS3	2.65
WS4	3.10
Note:	

2.3.3 Head

Soils matching the typical description of the Head deposits were not encountered during drilling. The site lies on the edge of the BGS mapped position of Head deposits and it is likely that these deposits have been removed by the stream and replaced with Alluvium.

2.3.4 Weathered London Clay Formation

Material described as Weathered London Clay Formation encountered within three out of the four trial hole locations from immediately underlying the Alluvium and was present to the base of the investigation, 6.00m bgl.

The soils of the Weathered London Clay Formation typically comprised firm, blueish grey and brown mottled, slightly sandy silty CLAY.

The depth of Weathered London Clay Formation has been included in Table 2.5.

Table 2.5 Final Depth of Weathered London Clay Formation

Trial Hole	Depth (m bgl)
WS1	Not encountered
WS2	4.00 ¹
WS3	4.00 ¹
WS4	4.00 ¹
Note: ¹ Final depth of trial hole.	

2.4 Roots

Live roots were encountered in only one location (WS4) to a depth of 3.60m bgl. It is extremely difficult to determine the maximum depth of root penetration from a narrow diameter borehole, should this information be crucial to the proposed design then

supplementary investigation by means of machine excavated trial pit and careful inspection of the arisings will be required. It should also be noted that it is very hard to prove whether a root fragment recovered in a sampler tube is “live” or “dead”, particularly in the case of ancient soils.

2.5 Groundwater

Groundwater was encountered at all locations during the investigation but at variable depths. WS1 and WS2 encountered potentially perched water at 1.00m. WS3 and WS4 encountered groundwater at 2.30m bgl, within the Alluvium.

All levels encountered rose within 30 minutes of observation as presented in Table 2.6.

Table 2.6 Groundwater Strikes

Trial Hole	Depth to Water (m bgl)	
	Strike	Rose To
WS1	1.00	0.50
WS2	1.00	0.50
WS3	2.30	1.83
WS4	2.30	1.15

Note: Time rose = 20 minutes

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in February (2020), when groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September to the annual maximum (highest) which typically occurs around March.

Groundwater equilibrium conditions may only be conclusively established, if a series of observations are made via groundwater monitoring wells.

Section 3 Discussion of Geotechnical In-Situ Testing

3.1 Dynamic Probe Tests

Dynamic probing (DPSH) was undertaken at four locations (DP1 to DP4) adjacent and prior to the drilling of their respective windowless sampler boreholes to depths ranging between 2.00 and 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, Table B.1.1 to **Error! Reference source not found..**

The SPT "N60" values presented have been corrected in accordance with BS EN 22476 Part 3, to account for the rig 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 87.96%. The energy ratio for each location is presented on the individual logs within Appendix A.1.

The Alluvium recorded equivalent SPT "N60" values between ≤ 4 and 8. Classifying the cohesive soils as very low to low strength and inferred undrained cohesive strength of $\leq 20\text{kPa}$ to 40kPa .

The Weathered London Clay Formation recorded equivalent SPT "N60" values between 4 and 21 within cohesive beds. The cohesive beds were classified as low to high, typically low to medium strength with an inferred undrained cohesive strength of between 20 and 105kPa typically between 20 and 85kPa and improving with depth.

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

In light of the results obtained in this investigation, and its obvious implications for shallow foundation solutions (i.e. largely impractical) and following consultation with the Client, no geotechnical analysis was scheduled on existing samples as they would have been inappropriate for the analysis required to advise on piling solutions and not to sufficient depth.

Additional investigation utilising cable percussive or similar methods to greater depths will be required to obtain appropriate class samples for further analysis in line with current guidance.

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.'*

Peat and organic soils highly compressible, and even lightly loaded foundations will be subject to considerable settlements over a long period if placed on them. For this reason, these soils are not suitable for carrying the loads for important structures.

Soils described as Made Ground were encountered in all locations from ground level to depths of ranging between 1.50m (WS1 – final base of hole) and 2.00m bgl (WS4). The Made Ground typically comprised firm, black, greenish brown and greyish brown mottled, slightly sandy, slightly gravelly CLAY. Gravel is angular to sub-angular, fine to coarse flint, brick, clinker and concrete.

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 Alluvium

Soils described as Alluvium were encountered in three out of the four trial holes from immediately underlying the Made Ground to depths of between 2.00 and 3.10m bgl. Where encountered the Alluvium was described as very soft brown mottled black blueish grey slightly sandy silty CLAY with decomposing rootlets and faint odour of decomposition.

The Alluvium recorded equivalent SPT "N60" values between ≤ 4 and 8. Classifying the cohesive soils as very low to low strength and inferred undrained cohesive strength of $\leq 20\text{kPa}$ to 40kPa .

Soils of the Alluvium are normally consolidated, predominantly soft cohesive or loose granular soils with a high organic content and as such are expected to display very low bearing capacities with high and variable settlement characteristics. The soils of the Alluvium were not considered suitable for the proposed development due to their low strength, high degree of variability and likely uncontrolled settlement.

4.1.3 Weathered London Clay Formation

Soil described as Weathered London Clay Formation encountered within three out of the four trial hole locations from immediately underlying the Alluvium and was present to the base of the investigation, 6.00m bgl. The soils of the Weathered London Clay Formation typically comprised firm, blueish grey and brown mottled, slightly sandy silty CLAY.

The Weathered London Clay Formation recorded equivalent SPT "N60" values between 4 and 21 within cohesive beds. The cohesive beds were classified as low to high, typically low to medium strength with an inferred undrained cohesive strength of between 20 and 105kPa typically between 20 and 85kPa and improving with depth.

The soils of the London Clay Formation are heavily overconsolidated and would typically be expected to display moderate to high bearing capacities and low to moderate settlement characteristics. The soils encountered were heavily weathered and should therefore be expected to behave as a normally consolidated soil. The Weathered London Clay Formation is therefore anticipated to provide low to moderate bearing capacities and moderate to high settlement characteristics.

The Weathered London Clay Formation is therefore not considered suitable for the proposed development.

4.1.4 Roots

Live roots were encountered in only one location (WS4) to a depth of 3.60m 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.

4.1.5 Groundwater

Groundwater was encountered at all locations during the investigation but at variable depths. WS1 and WS2 encountered potentially perched water at 1.00m. WS3 and WS4 encountered groundwater at 2.30m bgl, within the Alluvium. All levels encountered rose within 30 minutes of observation as presented in Table 2.6.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was conducted in February (2020), when groundwater levels should be rising from their annual minimum (lowest) elevation, which typically occurs around September to the annual maximum (highest) which typically occurs around March.

Groundwater equilibrium conditions may only be conclusively established, if a series of observations are made via groundwater monitoring wells.

4.2 Foundation Scheme General

The proposal comprised demolition of the existing garages and the erection of either 1 or two 2 storey residential properties with gardens.

In compiling this report reliance was placed on drawing W19-009 prepared by Wildern Architecture Ltd. Any change or deviation from the scheme outlined in the drawing could invalidate the recommendations presented within this report. Soils Limited must be notified about any such changes.

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.

Due to the encountered ground conditions being unsuitable for the proposed development no laboratory testing was commissioned following consultation with the client and therefore it should be assumed that precautions in line with **high volume change** potential soils, in accordance with the NHBC Standards and the BRE240, will be required until proven otherwise.

The BRE Digest 241 states: "An increasingly common, potentially damaging situation is where trees or hedges have been cut down prior to building. The subsequent long-term swelling of the zone of clay desiccated by the roots, as moisture slowly returns to the ground, can be substantial. The rate at which the ground recovers is very difficult to predict and if there is any doubt that recovery is complete then bored pile foundations with suspended beams and floors should be used".

The stated intention of the NHBC is to ensure that shrinkage and swelling of plastic soils does not adversely affect the structural integrity of foundations to such a degree that remedial works would be required to restore the serviceability of the building. It must be borne in mind that adherence to the NHBC tables and design recommendations may not, in all cases, totally prevent foundation movement and

cracking of brickwork might occur.

The BRE Digest 240 suggests: *“Two courses of action are open:*

Estimate the potential for swelling or shrinkage and try to avoid large changes in the water content, for example by not planting trees near the foundations.

Accept that swelling or shrinkage will occur and take account of it. The foundations can be designed to resist resulting ground movements or the superstructure can be designed to accommodate movement without damage.”

The design of foundations suitable to withstand movements is presented in BRE Digest 241 “Low-rise buildings on shrinkable clay soils: Part 2”

4.3 Foundation Scheme

Foundations **must not** be constructed within any Made Ground/Topsoil, Alluvium or Weathered London Clay Formation due to the likely variability and potential for large load induced settlements both total and differential.

Roots were encountered in four out of the five trial holes to a maximum depth of 3.60m 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 suitable person prior to concrete being poured.

The below factors were taken into account when recommending a foundation solution;

- The presence of Made Ground to depths of between 1.70 and 2.00m bgl requiring that foundations be placed below a depth of 2.30m bgl and therefore ruling out the effective use of a raft foundation;
- The presence of Alluvium of variable thickness immediately underlying the Made Ground typically to a depth of 2.65m bgl;
- The highly compressible and variable nature of Alluvium ruling out the possibility of founding within this stratum;
- The presence of soft Weathered London Clay Formation to a depth of between 3.50 and 4.00m bgl, well below 2.50m bgl which is typically considered to be the maximum depth to which traditional strip footings can be economically viable and reasonably practicable to construct;
- The presence of very dense obstructions within the Made Ground;
- The presence of perched groundwater at circa 1.00m bgl and another layer of water under pressure within the Alluvium.

Based on the above factors it is recommended that a piled foundation solution is adopted to bypass the soft and variable soils of the Made Ground, Alluvium and Weathered London Clay Formation to bear within the (unweathered) London Clay Formation.

Additional investigation by means of Cable Percussive Borehole or CPTu is recommended to inform the design of a piled foundation solution. Additional samples should be taken for a range of geotechnical classification and strength tests.

4.3.1 Ground Floor Slab

NHBC Standards 2019 states ground floors should be constructed as suspended floors where:

- *“the foundation depth dictated by the NHBC Standards 2019, 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.”*

Based on up to 2.00m thickness of Made Ground (fill) a suspended floor construction should be adopted.

4.4 Subsurface Concrete

Geotechnical laboratory testing was not commissioned at this stage and therefore it was not possible to recommend a concrete classification. Samples should be sent to the laboratory for BRE-SD1 concrete classification testing during the subsequent round of investigation.

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 excavations in the Made Ground/Topsoil and Alluvium are likely to rapidly become unstable, especially if progressed below the groundwater table.

Deeper excavations taken into the Weathered London Clay Formation are likely to be stable in the short term, depending on the thickness of overlying Alluvium and Made Ground. 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 before excavations are entered by personnel.

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

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: 18189/PIR dated February 2020) identified a very low to moderate risk of ground contamination from previous development of the site and the off-site source of the adjacent garage facility.

The Main Investigation Report identified Made Ground to depths of 2.00m reflecting the findings of the initial CSM whereby it appeared that the area was historically landfilled probably to locally raise and consolidate levels for the development of the garages and adjacent properties, involving the diversion of the historical stream passing west to east across the site. The Made Ground comprised a mixture of firm, black, greenish brown and greyish brown mottled, slightly sandy, slightly gravelly CLAY. Gravel is angular to sub-angular, fine to coarse flint, brick, clinker and concrete.

Potential hydrocarbon staining and odours were identified in both WS2 and WS4 at depth.

Superficial deposits of Alluvium were encountered underlying the Made Ground at depth and may have been reworked in places. Shallow groundwater, probably perched, was encountered within the Made Ground and at depth in the Alluvium and rose on all occasions suggesting underlying waters are under pressure. The conceptual site model was updated to take account of the shallow groundwater encountered at the site and presented in Appendix C.1.

The groundwater flow direction, if not confined by the variable Made Ground and Alluvium deposits is still anticipated to be generally eastwards following the local topography and the former historical stream direction. It was interesting to note the contrast between the depth of water encountered on the southern side of the assumed former course of the historical stream at 1.00m (WS1 and WS2) in the Made Ground and on the northern side (WS3 and WS4) at 2.30m in the Alluvium.

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.

The CSM identified only one potentially significant external source (the adjacent garage facility to the east containing historical tanks) and internally the fill materials potentially historically used to raise and consolidate levels on site prior to development and the potentially imported material associated with the development of the garages themselves, which do contain asbestos roofing, fixtures and fittings. A targeted sampling pattern based on site access with a bias towards the adjacent external source and presumed centre of the historical filling was adopted and a general screen for asbestos only in more recent demolition-based granular materials. Table 5.1 outlines the sampling undertaken.

Table 5.1 Sampling Strategy

Sample	Strategy	Proposed Use
WS1:0.30	Garage Area – Made Ground Demolition	Garden adjacent to house
WS1:0.70	Garage Area – Made Ground	Garden adjacent to house
WS2:0.80	Garage Area – Made Ground Demolition	Garden adjacent to house
WS2:1.90	Garage Area – Potentially hydrocarbon impacted soil	Garden adjacent to house
WS3:1.10	Garage Area – Made Ground	Garden area
WS3:2.20	Garage Area – Alluvium	Garden area
WS4:0.10	Garage Area – Made Ground Demolition	Garden area
WS4:1.90	Garage Area – Potentially hydrocarbon impacted soil	Garden area

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	Locations: Depths (m bgl)					
	WS1:0.70 ^s	WS2:1.90 ^s	WS3:2.20 ^s	WS4:1.90 ^s	WS1:0.30 ^s WS2:0.80 ^s	WS3:1.10 ^s WS4:0.10 ^s
Asbestos Screen	✓	✓	✓	✓	✓	✓
Total Phenols	✓	✓	✓	✓		
Organic Matter	✓	✓	✓	✓		
pH	✓	✓	✓	✓		
Metals	✓	✓	✓	✓		
Metalloids	✓	✓	✓	✓		
Organics	✓	✓	✓	✓		
PAHs	✓	✓	✓	✓		
TPH-Texas	✓	✓	✓	✓		
BTEX	✓	✓	✓	✓		

Notes: **Metals:** Cd, CrVI, Cr, Cu, Pb, Hg, Ni, Se, V, Zn. **metalloids:** As, Bo. **Organics:** USEPA 16 speciated PAH, TPH-Texas (Banded TPH) **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 proposal comprised demolition of the existing garages and the erection of either 1 or two 2 storey residential properties with gardens.

In compiling this report reliance was placed on drawing W19-009 prepared by Wildern Architecture Ltd. Any change or deviation from the scheme outlined in the drawing could invalidate the recommendations presented within this report. Soils Limited must be notified about any such changes.

Based on the proposed development, 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 0.8% and 3.8%. 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
PAHs	Benzo(b)fluoranthene 4.0mg/kg against 3.3mg/kg – WS4:1.90m (S4UL) Di-benzo(a,h)anthracene 0.56mg/kg against 0.28mg/kg – WS4:1.90m (S4UL)
TPH	C16-C21 890mg/kg against 540mg/kg - WS4:1.90m (S4UL)
Asbestos locations where material found (no threshold just presence)	
Chrysotile Loose Fibres – WS3 1.10m	

The guideline values are assessed against the "Residential" with home grown produce land-use scenario, which was considered the most appropriate land-use scenario, given the type of the proposed redevelopment.

In summary, one of the samples tested (WS4:1.90m) showed concentrations of PAH Benzo(b)fluoranthene of 4.0mg/kg against 3.3mg/kg and Di-benzo(a,h)anthracene of 0.56mg/kg against 0.28mg/kg and TPH (C16-C21) of 890mg/kg against 540mg/kg in excess of the relevant S4UL for a residential land-use scenario. A PAH ratio analysis indicates that this material is probably coal rather than oil based. This was slightly unexpected given the adjacent potential source, but does explain the clear bias in the banding analysis towards the higher carbon fractions and total lack of any noted lesser fractions above the detection limits of the method in the C6-C12 (VOC-Fuel oils) range. None of the other substances tested recorded concentrations above the residential end-use screening values.

6.2.1 Asbestos

Asbestos (Chrysotile as fibres) was detected within the sample from WS3 at 1.10m bgl. As asbestos containing material was identified in one of the samples tested 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 Risk to Groundwater

Groundwater was not considered to be at risk from the site in the PIR and was therefore beyond the scope of this investigation and not sampled during this investigation.

6.4 Tier I Quantitative Risk Assessment

Quantitative risk assessments are undertaken for the soil, groundwater and soil 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.

6.4.1 Soils

One of the samples tested (WS4:1.90m) showed concentrations of PAH and TPH in excess of the relevant S4UL's for a residential land-use scenario. Furthermore, Asbestos as Chrysotile fibre was detected within the sample from WS3 at 1.10m bgl.

Given the depth to these samples in relation to the proposed ground levels (1.90m and 1.10m below current ground levels respectively), neither the PAH/TPH exceedance nor the presence of asbestos as fibre is considered likely to significantly affect the development as currently proposed. Most pathway linkages associated with garden areas are considered likely to be significant only in the top 0.60m (2 spade depths).

It is considered likely, given the nature of the immediately underlying material as noted in the logs, that such materials will not be suitable for use as garden soil and would probably not comply with the current BS definition of Topsoil for use in gardens in compliance with NHBC requirements and therefore replacement and importation of suitable materials will probably be required.

The Tier 1 Quantitative risk assessment screening therefore established that there was **a risk to the human health receptors** of construction workers or future end-users, but that in the context of the proposed development, it cannot be considered significant and risk is considered low to negligible as no pathway is likely to be present from this depth to a human receptor.

6.4.2 Groundwater

Groundwater is not considered to be at risk from this site and does not appear to have been significantly influenced below the site by the adjacent identified potential garage source. However, given the slightly unusual and possibly perched water levels noted on site during this investigation, and the contention that the area has been historically reworked, a potential does remain for oily materials to be encountered during the works which cannot be completely discounted.

6.4.3 Soil Gas

No significant sources of soil gas or vapour were identified in the preliminary assessment CSM and the logs would appear to indicate that the underlying material in general is either waterlogged and/or cohesive, both of which considerations would significantly reduce the potential for both generation and transmission of gas. The lack of any materials in the C6-C10 TPH range (even in "oily" samples) as well as the PAH ratio indication of a coal rather than oil-based source, also strongly suggests that there can be only minimal to negligible risk from vapours

6.5 Remedial Objective

Soil chemical analysis recorded one sample (WS4:1.90m) with PAH and TPH substance levels in excess of their representative guideline values and one positively identified asbestos containing soil (ACS). Therefore, there was a potential risk to the Human Health of future receptors. However, this is not considered significant in context of the proposed development and whilst such observation may require appropriate caution during the development, would not necessarily require a remediation strategy to resolve.

The remedial objective for any site is to ensure that its application removes any unacceptable risk to identified receptors. In essence the remedial objective should sever any potentially significant source-pathway-receptor pollutant linkages that may have been established. Once this has been achieved, by whatever means, there can theoretically be no risk. As noted above, no realistic theoretical pathway has been established or confirmed in the context of the proposed development by this investigation.

6.6 Development of Soil Remediation Strategy

Production of a remediation strategy report was not considered part of the brief for this Main Investigation Report Intrusive Investigation. However, a number of considerations, concerns and potential issues in relation to the proposed development are outlined below.

6.6.1 Further Chemical Testing and Human Health Risk Assessment

It is **recommended** that further testing and analysis is undertaken once the site strip has been completed, as further sources of potential contamination could be present in other areas of the site given the mixed nature of the underlying materials encountered and the potential presence of asbestos in some parts.

Such analysis may also be advised for waste determination and characterisation as it is considered likely that removal of materials will be required at this site i.e. to provide suitable growing media in garden areas.

6.6.2 Excavation of Impacted Soil

It could be proposed to excavate and stockpile the impacted material on the site in preparation for classification and subsequent disposal off-site to a suitable licensed facility. However, as the only materials identified as being of potential risk lie at depth below the proposed levels of the development, such activities would probably be neither cost-effective, sustainable nor reasonable.

6.6.3 Excavation of All Made Ground

Made Ground was encountered across the site to depths between 1.70m and 2.00m bgl, but may be deeper in places and include underlying historically reworked Alluvial materials to even greater depth. Given the extent of the Made Ground encountered, this option would be very expensive, require excavations to be supported and is probably not justifiable in the circumstances and context of the proposed development. However, the removal of limited amounts of material is anticipated during demolition and clearance and should be considered for garden areas where such material would probably not be suitable for re-use as Topsoil.

6.6.4 Asbestos

Asbestos-containing soils (ACSs) were identified at the site in one sample at 1.10m bgl at WS3 associated with imported demolition-based materials. The asbestos matrix identified was described as loose fibres of Chrysotile.

Asbestos-containing soils (ACSs) do not necessarily require removal or treatment, and at this depth are unlikely to significantly mix with overlying materials or present any risk to future users. However, all future works should have suitable health and safety procedures in place to protect workers from airborne asbestos fibres if any similar materials are encountered during the development.

6.7 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.

6.8 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).

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.

In this case excavated material is considered unlikely to be considered hazardous on the basis of the results of this investigation, but may require additional analysis prior to

disposal especially if to landfill where the organic material concentrations (if >3%) may affect the potential disposal routes available.

6.9 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.

In this case the materials identified on site should technically be fit for purpose in a purely environmental human health future user sense in context, but may not be geotechnically or otherwise suitable for re-use, i.e. as Topsoil or growing media and additional consideration, investigation and analysis may be required to confirm such suitability

depending on the precise nature of the final development proposal.

6.10 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. In this case it is considered likely that Topsoil will be required in garden areas to replace local Made Ground, which will probably not be suitable for re-use as such.

6.11 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.

List of Figures

Figure 1 – Site Location Map	27
Figure 2 – Aerial Photograph	28
Figure 3 – Trial Hole Plan	29

List of Appendices

Appendix A Field Work

Appendix A.1 Engineers Logs

Appendix B Geotechnical In-Situ and Laboratory Testing

Appendix B.1 Classification

Appendix B.2 Interpretation

Appendix B.3 Geotechnical In-Situ and Laboratory Results

Appendix C Chemical Laboratory Testing

Appendix C.1 Conceptual Site Model

Appendix C.2 Chemical Laboratory Results

Appendix C.3 General Assessment Criteria

Appendix D Information Provided by the Client

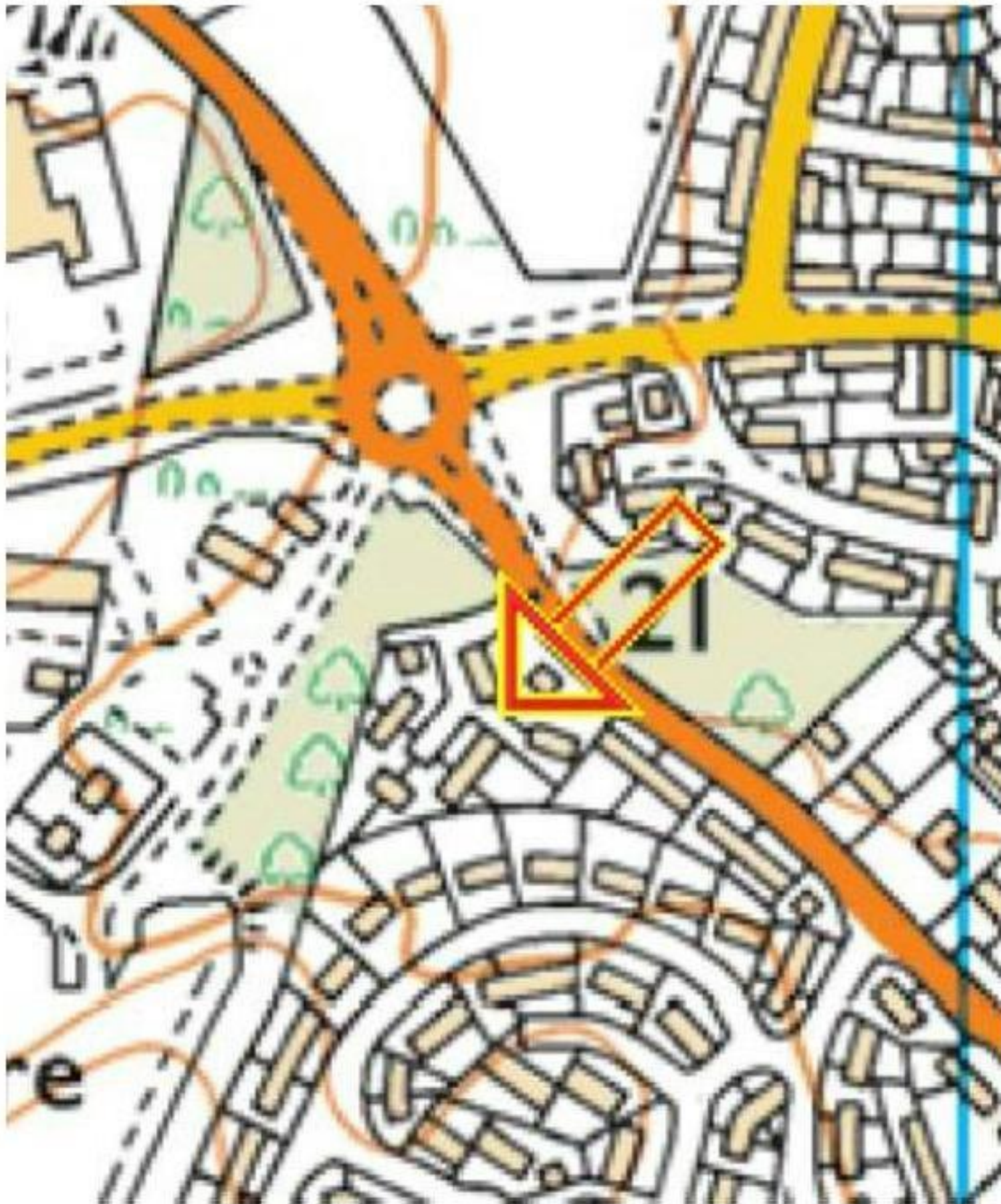


Figure 1 – Site Location Map

Job Number

18189

Project

Willowdene Close, Havant, Hampshire, PO9 3QP

Client

Wildern Architecture Ltd

Date

March 2020



Figure 2 – Aerial Photograph

Project

Willowdene Close, Havant,
Hampshire, PO9 3QP

Client

Wildern Architecture Ltd

Date

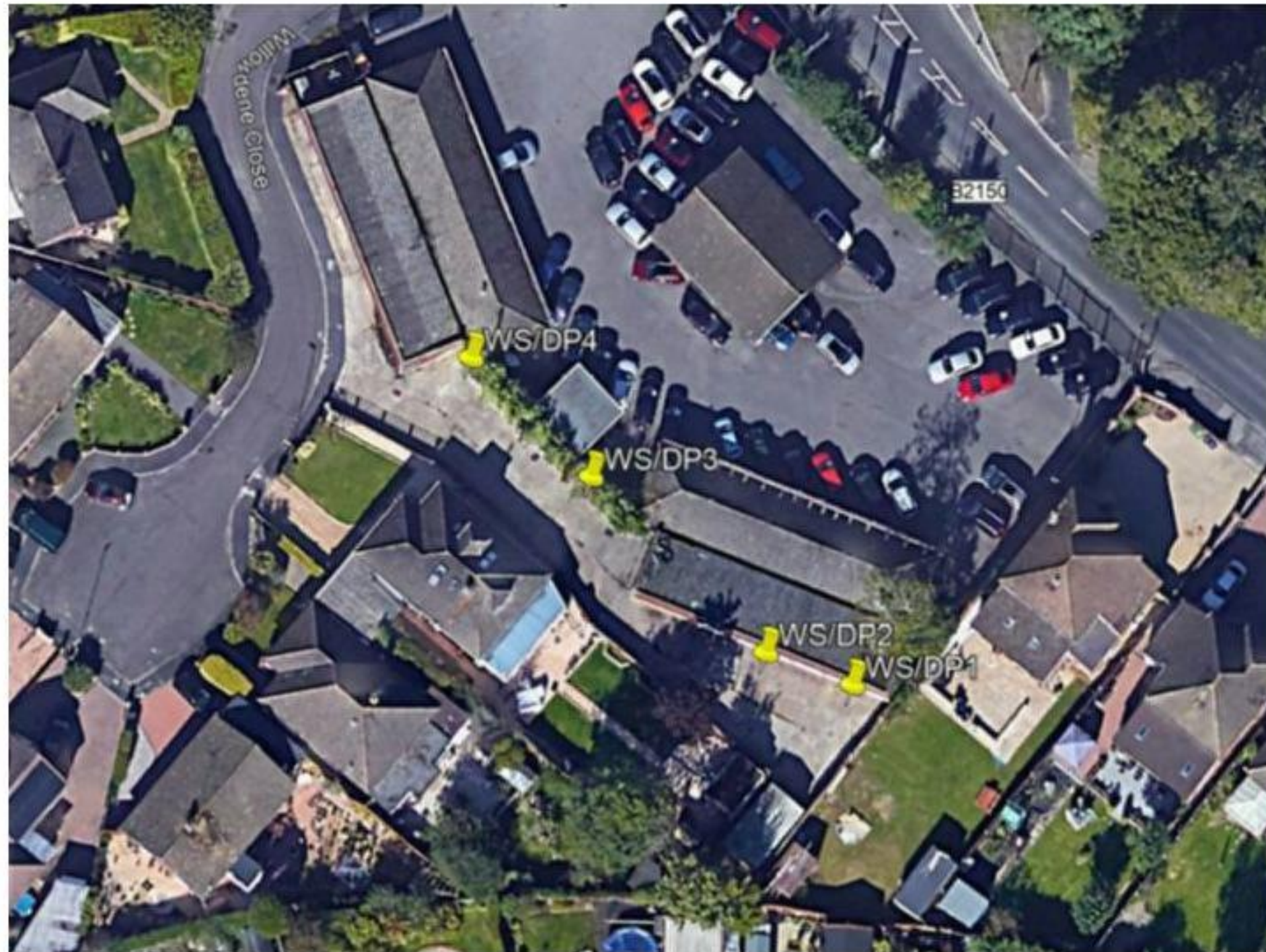
March 2020

Job Number

18189



Figure 3 – Trial Hole Plan



Project

Willowdene Close, Havant,
Hampshire, PO9 3QP

Client

Wildern Architecture Ltd

Date

March 2020

Job Number

18189



Appendix A Field Work

Appendix A.1 Engineers Logs

	Contract Name: Willowdene Close				Client: Wildern Architecture Ltd				Hole ID: WS1		
	Contract Number: 18189		Start and End Date: 06/02/20		Logged By: DW		Checked By:		Status:		
	Easting:		Northing:		Ground Level:		Plant Used:		Print Date: 05/03/2020		
Weather:				Termination:				Sheet 1 of 1			
Samples & In Situ Testing				Strata Details						Groundwater	
Depth	Type	Results	Level (mAOO)	Depth (m) (Thickness)	Legend	Strata Description				Water	Backfill/Installation
0.30	D ES			0.15 (0.35)		CONCRETE.					
0.70	D ES			0.50 (0.50)		Firm, brown and greyish brown mottled, slightly sandy, slightly gravelly CLAY. Gravel is angular, fine to coarse flint, brick, clinker and concrete. MADE GROUND.					
1.20	D ES			1.00 (0.50)		Firm, slightly black mottled, greyish brown, slightly sandy, slightly gravelly SILT. Gravel is angular fine to coarse flint, brick, and clinker. Occasional wood fragments. MADE GROUND.					
				1.50 (0.50)		Soft, slightly black and blueish grey mottled, greyish brown, slightly gravelly silty CLAY. Gravel is angular, fine to medium flint. Rare angular fine brick gravel at 1.4m bgl. Black staining around decomposing wood fragment from 1.3 - 1.5m bgl, with faint odour of decomposition. MADE GROUND.					
						End of Borehole at 1.50m					
10 9 8 7 6 5 4 3 2											
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)	No live rootlets observed.		
Chiselling				Installation		Water Strikes					
From (m)	To (m)	Duration	Remarks	Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	
								1.00			
								Time (mins)	Rose to (m)	Remarks	
								0	0.00		
Hand vane (HV), Hand penetrometer (HP) reported in kPa. PiD reported in ppm.											

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)	No live rootlets observed.																	
									Water Strikes <table border="1" style="width: 100%;"> <thead> <tr> <th>Strike (m)</th> <th>Casing (m)</th> <th>Sealed (m)</th> <th>Time (mins)</th> <th>Rose to (m)</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td>1.00</td> <td></td> <td></td> <td>0</td> <td>0.00</td> <td></td> </tr> </tbody> </table>						Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	1.00			0	0.00	
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks																					
1.00			0	0.00																						
Chiselling					Installation																					
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)																		
									Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.																	

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)	No live rootlets observed.					
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
									2.30			0	0.00	
									Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.					

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)	Rootlets observed to 3.6m bgl.																	
									Water Strikes <table border="1" style="width: 100%;"> <thead> <tr> <th>Strike (m)</th> <th>Casing (m)</th> <th>Sealed (m)</th> <th>Time (mins)</th> <th>Rose to (m)</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td>2.30</td> <td></td> <td></td> <td>0</td> <td>0.00</td> <td></td> </tr> </tbody> </table>						Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	2.30			0	0.00	
Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks																					
2.30			0	0.00																						
Chiselling					Installation																					
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)																		
									Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.																	

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.)

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/Approximate CIRIA Chalk Grade
DP2	ALV 1.90 – 2.10 CLAY	≤4	Very low ($C_u = \leq 20\text{kPa}$)
	WLCF 2.10 – 3.40 CLAY	4 – 8	Low ($C_u = 20 - 40\text{kPa}$)
	WLCF ¹ 3.40 – 6.00 CLAY	13 – 21	Medium to high ($C_u = 65 - 105\text{kPa}$)
DP3	ALV 1.70 – 2.80 CLAY	≤4 – 8	Very low to low ($C_u = \leq 20 - 40\text{kPa}$)
	WLCF 2.80 – 3.80 CLAY	8 – 13	Low to medium ($C_u = 40 - 65\text{kPa}$)
	WLCF ¹ 3.80 – 6.00 CLAY	13 – 17	Medium to high ($C_u = 65 - 85\text{kPa}$)
DP4	ALV 2.00 – 3.10 CLAY	≤4 – 8	Very low to low ($C_u = \leq 20 - 40\text{kPa}$)
	WLCF 3.10 – 3.90 CLAY	4 – 8	Low ($C_u = 20 - 40\text{kPa}$)
	WLCF ¹ 3.90 – 6.00 CLAY	8 – 17	Medium to high ($C_u = 40 - 85\text{kPa}$)

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

Appendix B.3 Geotechnical In-Situ and Laboratory Results

Project Name:	Willowdene Close	Project No.	18189	Co-ords:		Hole Type	DP
Location:	Havant, PO9 3QP	Level:	m AOD	Scale	1:50	Logged By	SW
Client:	Wildern Architecture Ltd	Dates:	06/02/2020				

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0					
0.1					
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1	1				
1.1					
1.2					
1.3					
1.4					
1.5	1				
1.6	2				
1.7	1				
1.8	1				
2					
2.1					
2.2					
2.3					
2.4					
2.5					
2.6					
2.7					
2.8					
2.9					
3					
3.1					
3.2					
3.3					
3.4					
3.5					
3.6					
3.7					
3.8					
3.9					
4					
4.1					
4.2					
4.3					
4.4					
4.5					
4.6					
4.7					
4.8					
4.9					
5					
5.1					
5.2					
5.3					
5.4					
5.5					
5.6					
5.7					
5.8					
5.9					
6					
6.1					
6.2					
6.3					
6.4					
6.5					
6.6					
6.7					
6.8					
6.9					
7					
7.1					
7.2					
7.3					
7.4					
7.5					
7.6					
7.7					
7.8					
7.9					
8					
8.1					
8.2					
8.3					
8.4					
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 Core removed to 1mb/gl. Rod kicked over.	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Weight	64.5kg	Final Depth	2m
	Probe Type	DPSH	Energy Ratio (Er)	%

Project Name:	Willowdene Close	Project No.	18189	Co-ords:		Hole Type	DP
Location:	Havant, PO9 3QP	Level:	m AOD	Scale	1:50	Logged By	SW
Client:	Wildern Architecture Ltd	Dates:	06/02/2020				

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0					
1					
1.5					
2					10
2.5					
3					40
3.5					
4					65
4.5					
5					85
5.5					
6					
6.5					
7					
7.5					
8					
8.5					
9					
9.5					
10					

Remarks Core removed to 1mb/gl. Then fell under hammer weight to 1.5mb/gl.	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Weight	64.5kg	Final Depth	6m
	Probe Type	DPSH	Energy Ratio (Er)	%

Project Name:	Willowdene Close	Project No.	18189	Co-ords:		Hole Type	DP
Location:	Havant, PO9 3QP	Level:	m AOD	Scale	1:50	Logged By	SW
Client:	Wildern Architecture Ltd	Dates:	06/02/2020				

Depth (m)	Blows/100mm	Torque (Nm)
0	0	
0.1	2	
0.2	2	
0.3	4	
0.4	2	
0.5	9	
0.6	2	
1.0		50
2.0		50
3.0		65
4.0		110
5.0		115
6.0		
7.0		
8.0		
9.0		
10.0		

Remarks Fell under hammer weight	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Weight	64.5kg	Final Depth	6m
	Probe Type	DPSH	Energy Ratio (Er)	%

Project Name:	Willowdene Close	Project No.	18189	Co-ords:		Hole Type	DP
Location:	Havant, PO9 3QP	Level:	m AOD	Scale	1:50	Logged By	SW
Client:	Wildern Architecture Ltd	Dates:	06/02/2020				

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0					
0.1					
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
2.3					
2.4					
2.5					
2.6					
2.7					
2.8					
2.9					
3.0					
3.1					
3.2					
3.3					
3.4					
3.5					
3.6					
3.7					
3.8					
3.9					
4.0					
4.1					
4.2					
4.3					
4.4					
4.5					
4.6					
4.7					
4.8					
4.9					
5.0					
5.1					
5.2					
5.3					
5.4					
5.5					
5.6					
5.7					
5.8					
5.9					
6.0					
6.1					
6.2					
6.3					
6.4					
6.5					
6.6					
6.7					
6.8					
6.9					
7.0					
7.1					
7.2					
7.3					
7.4					
7.5					
7.6					
7.7					
7.8					
7.9					
8.0					
8.1					
8.2					
8.3					
8.4					
8.5					
8.6					
8.7					
8.8					
8.9					
9.0					
9.1					
9.2					
9.3					
9.4					
9.5					
9.6					
9.7					
9.8					
9.9					
10.0					

Remarks Fell under hammer weight. Obstruction, hole stopped.	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Weight	64.5kg	Final Depth	0.5m
	Probe Type	DPSH	Energy Ratio (Er)	%

Project Name:	Willowdene Close	Project No.	18189	Co-ords:		Hole Type	DP
Location:	Havant, PO9 3QP	Level:	m AOD	Scale	1:50	Logged By	SW
Client:	Wildern Architecture Ltd	Dates:	06/02/2020				

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0					
0.1					
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0					
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					
2.1					
2.2					
2.3					
2.4					
2.5					
2.6					
2.7					
2.8					
2.9					
3.0					
3.1					
3.2					
3.3					
3.4					
3.5					
3.6					
3.7					
3.8					
3.9					
4.0					
4.1					
4.2					
4.3					
4.4					
4.5					
4.6					
4.7					
4.8					
4.9					
5.0					
5.1					
5.2					
5.3					
5.4					
5.5					
5.6					
5.7					
5.8					
5.9					
6.0					
6.1					
6.2					
6.3					
6.4					
6.5					
6.6					
6.7					
6.8					
6.9					
7.0					
7.1					
7.2					
7.3					
7.4					
7.5					
7.6					
7.7					
7.8					
7.9					
8.0					
8.1					
8.2					
8.3					
8.4					
8.5					
8.6					
8.7					
8.8					
8.9					
9.0					
9.1					
9.2					
9.3					
9.4					
9.5					
9.6					
9.7					
9.8					
9.9					
10.0					

Remarks Fell under hammer weight. Obstruction, hole stopped.	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Weight	64.5kg	Final Depth	0.3m
	Probe Type	DPSH	Energy Ratio (Er)	%

Project Name:	Willowdene Close	Project No.	18189	Co-ords:		Hole Type	DP
Location:	Havant, PO9 3QP	Level:	m AOD	Scale	1:50	Logged By	SW
Client:	Wildern Architecture Ltd	Dates:	06/02/2020				

Depth (m)	Blows/100mm				Torque (Nm)
0					
0.1					
0.2					
0.3					
0.4					
0.5					
0.6					
0.7					
0.8					
0.9					
1.0					25
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
1.7					
1.8					
1.9					
2.0					25
2.1					
2.2					
2.3					
2.4					
2.5					
2.6					
2.7					
2.8					
2.9					
3.0					30
3.1					
3.2					
3.3					
3.4					
3.5					
3.6					
3.7					
3.8					
3.9					
4.0					75
4.1					
4.2					
4.3					
4.4					
4.5					
4.6					
4.7					
4.8					
4.9					
5.0					100
5.1					
5.2					
5.3					
5.4					
5.5					
5.6					
5.7					
5.8					
5.9					
6.0					
6.1					
6.2					
6.3					
6.4					
6.5					
6.6					
6.7					
6.8					
6.9					
7.0					
7.1					
7.2					
7.3					
7.4					
7.5					
7.6					
7.7					
7.8					
7.9					
8.0					
8.1					
8.2					
8.3					
8.4					
8.5					
8.6					
8.7					
8.8					
8.9					
9.0					
9.1					
9.2					
9.3					
9.4					
9.5					
9.6					
9.7					
9.8					
9.9					
10.0					

Remarks Fell under hammer weight. Third attempt.	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Weight	64.5kg	Final Depth	6m
	Probe Type	DPSH	Energy Ratio (Er)	%

Appendix C Chemical Laboratory Testing

Appendix C.1 Conceptual Site Model

Table C.I.1 CSM Revised Pre-Testing

Source	Potential Contaminant	Exposure Pathway	Receptor	Initial Assessment from Desk Study and Main Investigation Report Information			Comments	Proposed Investigation
				Severity	Probability	Risk		
Domestic Garages And Made Ground On-site historic and current site usage.	Metals, Semi-metals and non-metals, PAHs, Asbestos	Inhalation of dust	Site Workers/Site Maintenance	Medium	Unlikely	Low	Site located on bedrock of the London Clay Formation, which was classified as unproductive strata and would act as an aquiclude to any deeper groundwater receptors.	Phase II ground investigation to confirm the ground conditions present and chemical testing prior to undertaking a generic quantitative risk assessment.
			End Users	Medium	Low	Moderate/Low		
			Off-site Users	Medium	Unlikely	Low		
	PAHs, TPHs	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Mild	Low	Low	Surface waters will be drained from site hardstanding or pass into underlying Alluvium shallow aquifer.	
			End Users	Mild	Low	Low		
			Off-site Users	Minor	Unlikely	Very low		
	Metals, Semi-metals and non-metals, PAHs, TPHs, Asbestos, pH	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Medium	Unlikely	Low		
			End Users	Medium	Low	Moderate/Low		
	Metals, Semi-metals and non-metals, PAHs, TPHs, pH	Migration via surface runoff	Surface Water	-	-	-		
		Migration in solution via groundwater	Surface Water	-	-	-		
			Shallow Aquifer	Medium	Low	Moderate/Low		
			Deep Aquifer	-	-	-		
		Direct contact with construction material	Buried structures	Mild	Low	Low		
			Buried Services	Minor	Unlikely	Very low		
	PAHs, TPHs	Migration of gases via permeable soils	Site Workers/Site Maintenance	Medium	Unlikely	Low		
			End Users	Medium	Unlikely	Low		
			Off-site Users	Minor	Unlikely	Very low		
			Building and confined spaces	Minor	Unlikely	Very low		
Garage including underground fuel and oil storage Off-site sources from which potential contamination would have migrated onto the site.	Metals, Semi-metals and non-metals, PAHs, Asbestos	Inhalation of dust	Site Workers/Site Maintenance	Medium	Unlikely	Low	Site located on bedrock of the London Clay Formation, which was classified as unproductive strata and would act as an aquiclude to any deeper groundwater receptors.	Phase II ground investigation to confirm the ground conditions present and chemical testing prior to undertaking a generic quantitative risk assessment.
			End Users	Medium	Low	Moderate/Low		
			Off-site Users	Medium	Unlikely	Low		
	PAHs, TPHs	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Mild	Low	Low	Surface waters will be drained from site hardstanding or pass into underlying Alluvium shallow aquifer.	
			End Users	Mild	Low	Low		
			Off-site Users	Minor	Unlikely	Very low		
	Metals, Semi-metals and non-metals, PAHs, TPHs, Asbestos, pH	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Medium	Unlikely	Low		
			End Users	Medium	Low	Moderate/Low		
	Metals, Semi-metals and non-metals, PAHs, TPHs, pH	Migration via surface runoff	Surface Water	-	-	-		
		Migration in solution via groundwater	Surface Water	-	-	-		
			Shallow Aquifer	Medium	Low	Moderate/Low		
			Deep Aquifer	-	-	-		
		Direct contact with construction material	Buried structures	Mild	Low	Low		
			Buried Services	Minor	Unlikely	Very low		
	PAHs, TPHs	Migration of gases via permeable soils	Site Workers/Site Maintenance	Medium	Unlikely	Low		
			End Users	Medium	Unlikely	Low		
			Off-site Users	Minor	Unlikely	Very low		
			Building and confined spaces	Minor	Unlikely	Very low		

Table C.I.2 CSM Revised Post Testing

Source	Potential Contaminant	Exposure Pathway	Receptor	Initial Assessment from Desk Study and Main Investigation Report Information			Comments	Proposed Investigation
				Severity	Probability	Risk		
Domestic Garages And Made Ground On-site historic and current site usage.	Metals, Semi-metals and non-metals, PAHs, Asbestos	Inhalation of dust	Site Workers/Site Maintenance	Minor	Unlikely	Very low	No significant levels of contaminants noted, severity defaults to minor.	No additional investigation considered necessary in this context, although additional analysis may be required if further materials are discovered or additional data is required for off-site disposal or suitability for use confirmation.
			End Users	Minor	Unlikely	Very low		
			Off-site Users	Minor	Unlikely	Very low		
	PAHs, TPHs	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Minor	Unlikely	Very low	Elevated levels of PAH and TPH identified lie at depth, unlikely to be in contact with potential receptors.	
			End Users	Minor	Unlikely	Very low		
			Off-site Users	Minor	Unlikely	Very low		
	Metals, Semi-metals and non-metals, PAHs, TPHs, Asbestos, pH	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Minor	Unlikely	Very low		
			End Users	Minor	Unlikely	Very low		
	Metals, Semi-metals and non-metals, PAHs, TPHs, pH	Migration via surface runoff	Surface Water	-	-	-		
		Migration in solution via groundwater	Surface Water	-	-	-		
			Shallow Aquifer	Minor	Unlikely	Very low		
			Deep Aquifer	-	-	-		
		Direct contact with construction material	Buried structures	Minor	Unlikely	Very low		
			Buried Services	Minor	Unlikely	Very low		
	PAHs, TPHs	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		
			Building and confined spaces	Minor	Unlikely	Very low		
Garage including underground fuel and oil storage Off-site sources from which potential contamination would have migrated onto the site.	Metals, Semi-metals and non-metals, PAHs, Asbestos	Inhalation of dust	Site Workers/Site Maintenance	Minor	Unlikely	Very low	No significant levels of contaminants noted, severity defaults to minor.	No additional investigation considered necessary in this context, although additional analysis may be required if further materials are discovered or additional data is required for off-site disposal or suitability for use confirmation.
			End Users	Minor	Unlikely	Very low		
			Off-site Users	Minor	Unlikely	Very low		
	PAHs, TPHs	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance	Minor	Unlikely	Very low	Elevated levels of PAH and TPH identified lie at depth, unlikely to be in contact with potential receptors.	
			End Users	Minor	Unlikely	Very low		
			Off-site Users	Minor	Unlikely	Very low		
	Metals, Semi-metals and non-metals, PAHs, TPHs, Asbestos, pH	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Minor	Unlikely	Very low		
			End Users	Minor	Unlikely	Very low		
	Metals, Semi-metals and non-metals, PAHs, TPHs, pH	Migration via surface runoff	Surface Water	-	-	-		
		Migration in solution via groundwater	Surface Water	-	-	-		
			Shallow Aquifer	Minor	Unlikely	Very low		
			Deep Aquifer	-	-	-		
		Direct contact with construction material	Buried structures	Minor	Unlikely	Very low		
			Buried Services	Minor	Unlikely	Very low		
	PAHs, TPHs	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		
			Building and confined spaces	Minor	Unlikely	Very low		

Appendix C.2 Chemical Laboratory Results



4041



Environmental Science

Chris Swainston
 Soils Ltd
 Unit 11
 Sun Valley Business Park
 Winnall Close
 Winchester
 Hampshire
 SO23 0LB

e: cs@soilslimited.co.uk

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

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

Analytical Report Number : 20-86133

Project / Site name:	Willowdene Close	Samples received on:	11/02/2020
Your job number:	18189	Samples instructed on:	11/02/2020
Your order number:	18198	Analysis completed by:	18/02/2020
Report Issue Number:	1	Report issued on:	18/02/2020
Samples Analysed:	8 soil samples		

Signed:

Zina Abdul Razzak
 Senior Quality Specialist

For & on behalf of i2 Analytical Ltd.

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

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

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

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

Excel copies of reports are only valid when accompanied by this PDF certificate.

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

Iss No 20-86133-1 Willowdene Close 18189

This certificate should not be reproduced, except in full, without the express permission of the laboratory.

The results included within the report are representative of the samples submitted for analysis.

Page 1 of 7



4041



Environmental Science

Analytical Report Number: 20-86133

Project / Site name: Willowdene Close

Your Order No: 18198

Lab Sample Number	1438585	1438586	1438587	1438588	1438589
Sample Reference	WS1	WS1	WS2	WS2	WS3
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.30	0.70	0.80	1.90	1.10
Date Sampled	06/02/2020	06/02/2020	06/02/2020	06/02/2020	06/02/2020
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	-	< 0.1
Moisture Content	%	N/A	NONE	-	14
Total mass of sample received	kg	0.001	NONE	-	0.80

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	Chrysotile- Loose Fibres
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Detected

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	7.8	-	6.9	-
Organic Matter	%	0.1	MCERTS	-	1.6	-	3.8	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
----------------------------	-------	---	--------	---	-------	---	-------	---

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	< 0.05	-	< 0.05	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	< 0.05	-	< 0.05	-
Acenaphthene	mg/kg	0.05	MCERTS	-	< 0.05	-	< 0.05	-
Fluorene	mg/kg	0.05	MCERTS	-	< 0.05	-	< 0.05	-
Phenanthrene	mg/kg	0.05	MCERTS	-	0.28	-	< 0.05	-
Anthracene	mg/kg	0.05	MCERTS	-	< 0.05	-	< 0.05	-
Fluoranthene	mg/kg	0.05	MCERTS	-	0.66	-	0.39	-
Pyrene	mg/kg	0.05	MCERTS	-	0.65	-	0.35	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	0.38	-	< 0.05	-
Chrysene	mg/kg	0.05	MCERTS	-	0.35	-	< 0.05	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	0.45	-	< 0.05	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	0.21	-	< 0.05	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	0.41	-	< 0.05	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	< 0.05	-	< 0.05	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	< 0.05	-	< 0.05	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	< 0.05	-	< 0.05	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	3.39	-	< 0.80	-
-----------------------------	-------	-----	--------	---	------	---	--------	---

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	9.8	-	5.1	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	1.3	-	1.6	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	< 0.2	-	< 0.2	-
Chromium (hexavalent)	mg/kg	4	MCERTS	-	< 4.0	-	< 4.0	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	29	-	22	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	18	-	4.4	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	52	-	30	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	< 0.3	-	< 0.3	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	20	-	9.1	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	41	-	30	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	73	-	34	-

Petroleum Hydrocarbons

TPH Texas (C6 - C8)	mg/kg	0.1	ISO 17025	-	< 0.1	-	< 0.1	-
TPH Texas (C8 - C10)	mg/kg	10	MCERTS	-	< 10	-	< 10	-
TPH Texas (C10 - C12)	mg/kg	1	MCERTS	-	< 1.0	-	< 1.0	-
TPH Texas (C12 - C16)	mg/kg	4	MCERTS	-	< 4.0	-	< 4.0	-
TPH Texas (C16 - C21)	mg/kg	10	MCERTS	-	< 10	-	< 10	-
TPH Texas (C21 - C40)	mg/kg	10	MCERTS	-	< 10	-	< 10	-
TPH Texas (C6 - C40)	mg/kg	10	NONE	-	< 10	-	< 10	-

Iss No 20-86133-1 Willowdene Close 18198

This certificate should not be reproduced, except in full, without the express permission of the laboratory.

The results included within the report are representative of the samples submitted for analysis.

Page 2 of 7



4041



Analytical Report Number: 20-86133

Project / Site name: Willowdene Close

Your Order No: 18198

Lab Sample Number				1438585	1438586	1438587	1438588	1438589
Sample Reference				WS1	WS1	WS2	WS2	WS3
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.70	0.80	1.90	1.10
Date Sampled				06/02/2020	06/02/2020	06/02/2020	05/02/2020	06/02/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					



4041



Environmental Science

Analytical Report Number: 20-86133

Project / Site name: Willowdene Close

Your Order No: 18198

Lab Sample Number	1438590	1438591	1438592		
Sample Reference	WS3	WS4	WS4		
Sample Number	None Supplied	None Supplied	None Supplied		
Depth (m)	2.20	0.10	1.90		
Date Sampled	06/02/2020	06/02/2020	06/02/2020		
Time Taken	None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	-
Moisture Content	%	N/A	NONE	20	-
Total mass of sample received	kg	0.001	NONE	1.0	-

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-		
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected		

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.3	-	8.3		
Organic Matter	%	0.1	MCERTS	0.8	-	2.5		

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	-	< 1.0		
----------------------------	-------	---	--------	-------	---	-------	--	--

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	-	< 0.05		
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	-	0.34		
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	-	0.68		
Fluorene	mg/kg	0.05	MCERTS	< 0.05	-	0.78		
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	-	6.5		
Anthracene	mg/kg	0.05	MCERTS	< 0.05	-	2.3		
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	-	8.9		
Pyrene	mg/kg	0.05	MCERTS	< 0.05	-	7.5		
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	-	4.7		
Chrysene	mg/kg	0.05	MCERTS	< 0.05	-	2.8		
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	-	4.0		
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	-	2.4		
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	-	4.0		
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	-	2.5		
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	-	0.56		
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	-	3.2		

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	-	51.1		
-----------------------------	-------	-----	--------	--------	---	------	--	--

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	-	11		
Boron (water soluble)	mg/kg	0.2	MCERTS	0.6	-	0.8		
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	-	< 0.2		
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	-	< 4.0		
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	30	-	26		
Copper (aqua regia extractable)	mg/kg	1	MCERTS	3.4	-	36		
Lead (aqua regia extractable)	mg/kg	1	MCERTS	12	-	130		
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	-	< 0.3		
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	32	-	19		
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	-	< 1.0		
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	43	-	42		
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	58	-	120		

Petroleum Hydrocarbons

TPH Texas (C6 - C8)	mg/kg	0.1	ISO 17025	< 0.1	-	< 0.1		
TPH Texas (C8 - C10)	mg/kg	10	MCERTS	< 10	-	< 10		
TPH Texas (C10 - C12)	mg/kg	1	MCERTS	< 1.0	-	< 1.0		
TPH Texas (C12 - C16)	mg/kg	4	MCERTS	< 4.0	-	150		
TPH Texas (C16 - C21)	mg/kg	10	MCERTS	< 10	-	890		
TPH Texas (C21 - C40)	mg/kg	10	MCERTS	< 10	-	490		
TPH Texas (C6 - C40)	mg/kg	10	NONE	< 10	-	1500		



4041



Analytical Report Number: 20-86133

Project / Site name: Willowdene Close

Your Order No: 18198

Lab Sample Number				1438590	1438591	1438592		
Sample Reference				WS3	WS4	WS4		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				2.20	0.10	1.90		
Date Sampled				06/02/2020	06/02/2020	06/02/2020		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		



4041

**Analytical Report Number : 20-86133****Project / Site name: Willowdene Close**

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1438585	WS1	None Supplied	0.30	-
1438586	WS1	None Supplied	0.70	Brown clay and sand with gravel.
1438587	WS2	None Supplied	0.80	-
1438588	WS2	None Supplied	1.90	Brown loam and clay with gravel.
1438589	WS3	None Supplied	1.10	-
1438590	WS3	None Supplied	2.20	Brown clay and sand with gravel.
1438591	WS4	None Supplied	0.10	-
1438592	WS4	None Supplied	1.90	Brown loam and clay with gravel and vegetation.



4041



Environmental Science

Analytical Report Number : 20-86133

Project / Site name: Willowdene Close

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monochydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270.	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
TPH Texas (Soil)	Determination of dichloromethane/hexane extractable hydrocarbons in soil by GC-MS.	In-house method	L064-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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.

Land Use			Residential With or Without Plant Uptake									Public Open Space (POS)									Name	Authority	Date		
			With			Without			Allotments			Commercial			Residential			Park							
			home-grown produce			home-grown produce																			
Type	Contaminants	Species	Year	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			
Metals	Antimony		2010							550						7500						EIC/AGS/CL:AIRE	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						200			310			80			2330			630		1300	C4SL	DEFRA	2014	
	Mercury	Elemental	2012				1.0			1.0			26			26						SGV	DEFRA	2012	
			2015				1.2			1.2			21			58			16		30	S4UL	LQM/CIEH	2015	
		Inorganic	2012				170			170			80			36000						SGV	DEFRA	2012	
			2015				40			56			19			1100			120		240	S4UL	LQM/CIEH	2015	
		Methyl	2012				11			11			8			410						SGV	DEFRA	2012	
			2015				11			15			6			320			40		68	S4UL	LQM/CIEH	2015	
	Nickel		2012				130			130			230			1800						SGV	DEFRA	2012	
			2015				130			180			53			980			230		800	S4UL	LQM/CIEH	2015	
	Selenium		2012				350			350			120			13000						SGV	DEFRA	2012	
			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	
BTEX & MTBE	Benzene		2012				0.33			0.33			0.07			95						SGV	DEFRA	2012	
			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		2012				610			610			120			4400						SGV	DEFRA	2012	
			2015	130	290	660	880	1900	3900	22	51	120	65000	110000	180000	56000	56000	56000	87000	95000	100000	S4UL	LQM/CIEH	2015	
	Ethylbenzene		2012				350			350			90			2800						SGV	DEFRA	2012	
			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	2012				250			250			160			2600						SGV	DEFRA	2012	
			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	2012				240			240			180			3500						SGV	DEFRA	2012	
			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	2012				230			230			160			3200						SGV	DEFRA	2012	
			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	

Land Use			Residential With or Without Plant Uptake									Public Open Space (POS)									Name	Authority	Date	
			With			Without			Allotments			Commercial			Residential			Park						
			SOM	1.0	2.5	6	1	2.5							6	1	2.5	6	1	2.5				6
Type	Contaminants	Species	Year																					
	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			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	0.28	0.3	0.31	0.32	0.32	0.14	0.27	0.43	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4	S4UL	LQM/CIEH	2015
	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
Explosives	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
	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
Chlorobenzenes	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
	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		

Land Use			Residential With or Without Plant Uptake									Public Open Space (POS)									Name	Authority	Date	
			With			Without			Allotments			Commercial			Residential			Park						
			SOM	home-grown produce	2.5	6	home-grown produce	1																2.5
Type	Contaminants	Species	Year	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			
Phenols & Chlorophenols	1,2,3,5,- Tetrachlorobenzene		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,- Tetrachlorobenzene		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		2012			420			420			280			3200							SGV	DEFRA	2012
			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
	Sum of PCDDs, PCDFs and dioxin-like PCB's.		2012			8			8			8			240							SGV	DEFRA	2012

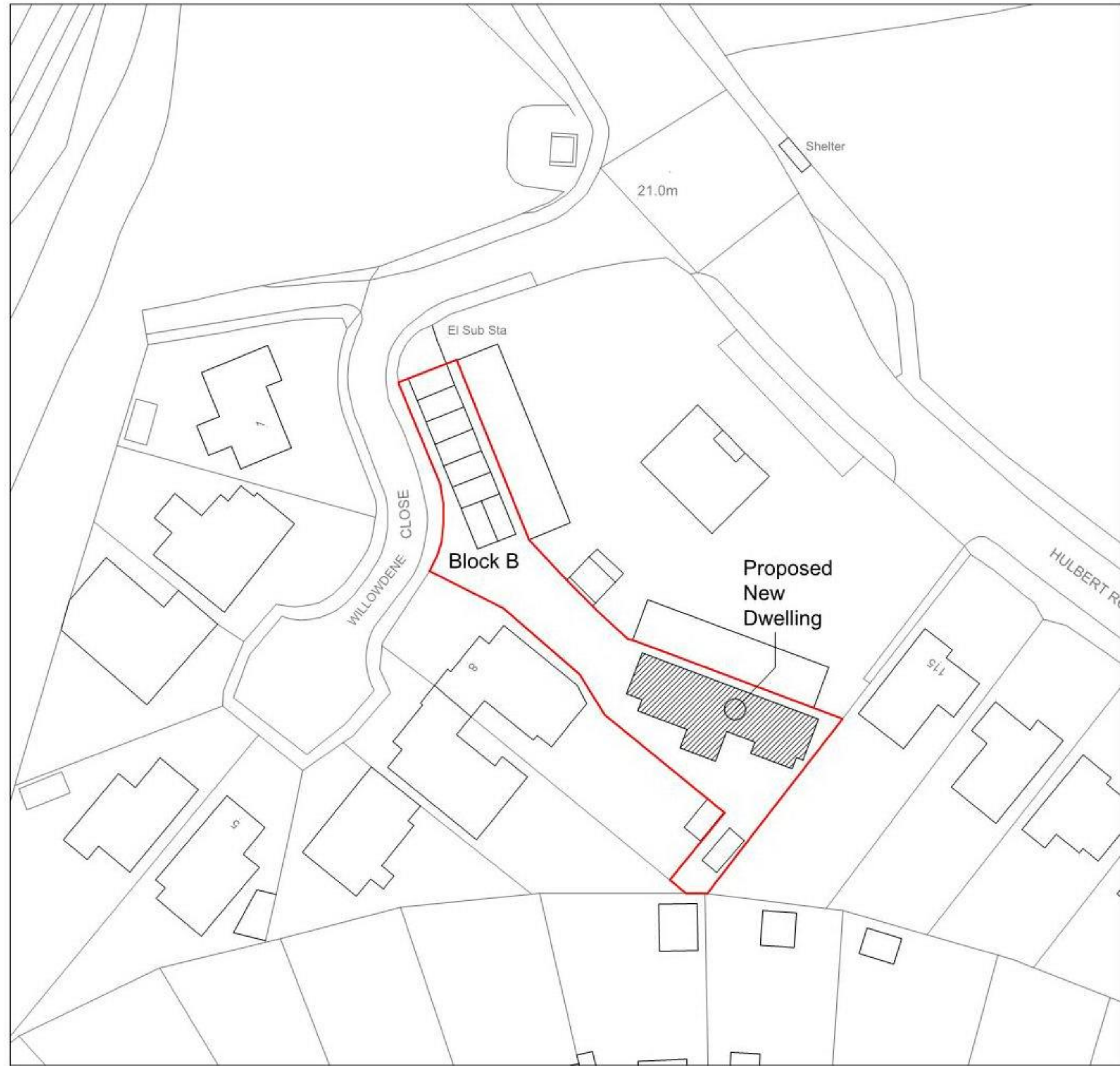
NOTE

Priority	Guideline (mg kg ⁻¹)
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



Block Plan - As Existing 1:500



Block Plan - As Proposed 1:500

-	Issued for Planning Application	NJ	23-09-19
Rev.		By	Date
Wildern Architecture Ltd Middle House, 3 Sampan Close, Warsash, Southampton, SO31 9BU 07920 260758 Project Garages at Willowdene Close, Bedhampton, Havant, PO9 3QP Client Mr and Mrs A Shaw			
Title Block Plan - As Existing and Proposed			
Date	Sept 19	Drawn By	NJ
Job No.	Drawing No.	Scale	Revision
W19-009	101	1:500@A1	-

Soils Limited
Geotechnical & Environmental Consultants

Newton House
Cross Road, Tadworth
Surrey KT20 5SR

T 01737 814221
W soilslimited.co.uk