



Main Investigation Report

at
**Cinders Nursery, Cinders Lane, Yapton,
Arundel, West Sussex BN18 0JJ**

for
Crayfern Homes

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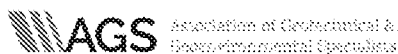
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This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

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

Crayfern Homes commissioned Soils Limited to undertake an intrusive ground investigation and prepare a Main Investigation Report on land at Cinders Nursery, Cinders Lane, Yapton, Arundel, West Sussex BN18 0JJ. The scope of the investigation was outlined in the Soils Limited quotation reference Q22363, dated 20th December 2019.

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: 18115/DS, 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&3:2005+A1:2011 for WS/DP + BH
- BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design
- 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+A1:2013 - Investigation of potentially contaminated sites
- NHBC Standards 2019

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

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

The chemical analyses were undertaken by i2 Analytical Ltd 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.

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Section I Introduction

I.1 Objective of Investigation

Crayfern Homes commissioned Soils Limited to undertake an intrusive ground investigation and to prepare a Main Investigation Report to supply the client and their designers with information regarding ground conditions, to assist in preparing a foundation scheme for development that was appropriate to the settings present on the site.

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

Soil samples were taken for chemical laboratory testing to enable recommendations for the safe redevelopment of the site and the protection of site workers, end-users and the public from any contamination identified as dictated by the Conceptual Site Model (CSM) in the Preliminary Investigation Report undertaken for the site by Soils Limited (Report ref: 18115/DS, February 2020) and the Revised Conceptual Site Model presented in Appendix D.1.

I.2 Location

The site was located at Cinders Nursery, Cinders Lane, Yapton, Arundel, West Sussex BN18 0JJ and had an approximate O.S Land Ranger Grid Reference of SU 980 025.

The site location plan is given in Figure 1.

I.3 Site Description

At the time of reporting, the site comprised an area of land which had been associated with the plant nursery which had been immediately north of the site. There were several storage sheds and two static mobile home trailers on the western half of the site which was covered with tarmac scalpings. The other half of the site, to the east, was covered by grass.

There were semi-mature to mature trees and shrubs present on site, predominantly located to the eastern boundary, with a small area of vegetation including a mature tree midway along the northern boundary. A 30m long grass and shrub covered mound was noted along the southern boundary.

The site sloped gently down from north to south and was slightly undulating along its east-west orientation.

An aerial photograph has been included in Figure 2.

1.4 Proposed Development

At the time of writing, the proposed development was understood to comprise 12No. semi-detached and detached houses plus a two-storey block of 5No. flats. The development was understood to comprise both hard landscaping in the form of access roads, pavements, driveways and parking spaces and soft landscaping in the form of private residential gardens and public open space.

In compiling this report reliance was placed on drawing number 19.14.1 SK01 Rev A, dated April 2019, prepared by Crayfern Homes. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

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

1.5 Anticipated Geology

The 1:50,000 BGS map showed the site to be located upon the bedrock Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated) within this report has been referred to by its parent group name, the White Chalk Subgroup, for simplicity, with overlying superficial River Terrace Deposits.

1.5.1 River Terrace Deposits

The rivers of the south-east of England, including the River Thames and its tributaries, have been subject to at least three changes of level since Pleistocene times. One result has been the formation of a complex series of River Terrace Deposits. These terraces represent ancient floodplain deposits that became isolated as the river cut downwards to lower levels. The composition of the River Terrace Deposits varies greatly, depending on the source material available in the river's catchment. Deposits generally consist of sand and gravel of roughly bedded flint or chert commonly in a matrix of silt and clay. The River Terrace Deposits in the area are anticipated to comprise sand, silt and clay.

1.5.2 White Chalk Subgroup

The White Chalk Subgroup is described by the British Geological Society as "Chalk with flints with discrete marl seams, nodular chalk, sponge-rich and flint seams throughout. Typology of flints and incidence of marl seams is important for correlation."

Chalk is a weak rock and as such it should be noted that the drilling, excavating and sampling process is detrimental to its fabric and structure. Chalk samples that have been machine sampled will therefore appear to be of a lower descriptive grade, as given in CIRIA C574, than the in-situ chalk. Soil sampling and visual

observations from open excavations i.e. trial pits would allow chalk description and classification in accordance with CIRIA 574 including commenting for any aperture and discontinuities in the chalk structure.

Erosional features, such as pipes, swallow holes and solution cavities, usually in-filled with drift deposits, are occasionally found in the chalk, sometimes manifesting themselves at the surface as shallow circular depressions. Solution features may be reactivated by the concentrated ingress of water from leaking drains or soakaways. Reactivation may lead to surface collapse.

1.6 Limitations and Disclaimers

This Main Investigation Report relates to the site located at Cinders Nursery, Cinders Lane, Yapton, Arundel, West Sussex BN18 0JJ and was prepared for the sole benefit of Crayfern Homes (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 or any trees, bushes or shrubs removed prior to or following the site survey.

Where trees are mentioned in the text this means existing trees, substantial bushes or shrubs, recently removed trees (approximately 20 years to full recovery in 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 was 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 and to aid the design of foundations for the proposed residential development. The intended investigation, as outlined within the Soils Limited quotation (Q22363, dated 20th December 2019), was to comprise the following items:

- 4No. up to 4m deep Windowless Sampler Boreholes;
- 4No. up to 6m deep Dynamic Probe Tests;
- Machine Excavated Trial Pits and Infiltration Tests in Line with the Principles of BRE DG365:2016;
- 2No. 15m deep Cable Percussive Boreholes with alternate SPT/U100 Testing at 1m centres for the top 5m and at 1.5m centres thereafter;
- 8No. CBR Tests (DCP-TRL);
- Installation and Monitoring of Dual-Purpose Gas and Groundwater Monitoring Wells;
- Geotechnical Laboratory Testing;
- Contamination Laboratory Testing.

2.1.1 Actual Project Works

The actual project works were undertaken between 6th and 16th January 2020 and comprised:

- 2No. Windowless Sampler Boreholes (WS1 and WS4);
- 2No. Dynamic Probe Tests (DP1 and DP4);
- 4No. Machine Excavated Trial Pits and Infiltration Testing in Line with the Principles of BRE DG35:2016 (TP1 – TP3, 3A);
- 2No. Cable Percussive Boreholes with alternate SPT/U100 Testing (BH1 and BH2);
- 8No. CBR Tests (DCP-TRL) (DCP1 – DCP8);
- Installation of 2No. Dual-Purpose Gas and Groundwater Monitoring Wells;
- Geotechnical Laboratory Testing;
- Contamination Laboratory Testing.

There were issues gaining access to the site due to a large stockpile of gravel blocking the entrance. Following clearing of the stockpile undertaken by the client, the windowless sampler drilling rig subsequently got stuck due to the access road conditions. This lost time resulted in only drilling two of the targeted four locations. Both windowless sampler boreholes (WS1 and WS4) were backfilled with gravel and bentonite following the installation of monitoring wells. Both cable percussive

boreholes and the trial pits were backfilled with arisings following completion.

All trial hole locations have been presented in Figure 3.

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

2.2 Ground Conditions

On 16th January 2020 two windowless sampler boreholes (WS1 and WS4) were drilled, using a Premier Compact drilling rig, to a depth of 4.00m below ground level (bgl) at locations selected by Soils Limited using a development plan provided by the client.

Two dynamic probes, super heavy, (DP1 and DP4) were driven prior and adjacent to their corresponding windowless sampler borehole to a depth of 6.00m bgl.

Two standpipes were installed within the window sample borehole locations (WS1 and WS4) to allow for continued monitoring of both groundwater and soil gas, where present.

On 6th January 2020 four trial pits were machine excavated using a backhoe type excavator to depths of between 1.50 and 2.60m bgl in order to carry out infiltration tests broadly in accordance with the principles of BRE DG365:2016. A deeper pit (TP3A) was excavated in order to identify the groundwater level which was anticipated to be high based on previous site investigation at the site immediately to the north. Groundwater was encountered at 2.00m bgl, influencing the depth of excavation for the infiltration test locations.

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)	Trial Hole	Depth (m bgl)
TP1	1.50	WS4 (w)	4.00
TP2	1.70	DPI	6.00
TP3	1.50	DP4	6.00
TP3A	2.60	BH1	15.00
WS1 (w)	4.00	BH2	17.00

Note: w - well installation

The approximate trial hole locations are shown on Figure 3.

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

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

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

Made Ground/Topsoil (MG/TS)
Cohesive River Terrace Deposits (cRTD)
Granular River Terrace Deposits (gRTD)
White Chalk Subgroup (WHCK)

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

Table 2.2 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Anthropocene	0.00	0.40 - 0.50	0.50	Multicoloured slightly sandy to sandy sub-angular to sub-rounded fine to coarse flint, brick, concrete, cement and plaster GRAVEL
TS	Anthropocene	0.00	0.30 – 0.50	0.50	Very soft to soft greyish brown to dark brown slightly sandy silty CLAY. Frequent rootlets and occasional decomposing organic matter.
cRTD	Holocene	0.30 – 0.50	2.00 – 4.90 ³	2.35	Firm grey mottled yellowish to orangish brown and dark brown slightly sandy silty CLAY. Sand was fine. Occasional to frequent rootlets.
gRTD	Holocene	2.45 – 3.60	3.60 – 4.90 ³	0.40	Yellowish brown slightly gravelly silty SAND. Sand was fine to coarse; gravel was angular to sub-rounded fine to coarse chalk and flint. Occasional clayey/silty pockets and lenses.

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
WHCK	Late Cretaceous	4.90	15.00–17.00	12.10	White chalk recovered as angular to sub-rounded fine to coarse medium weak to strong chalk clasts in a comminuted silty white to light brown or light grey chalk matrix. Rare angular fine to coarse flint nodules with a white cortex.

Note: ¹ Final depth of trial hole. ² Base of strata not encountered. ³ Inferred from Dynamic Probe test results

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 and Topsoil

Soils described as Made Ground were encountered or interpreted in five out of the ten trial holes from ground level to depths ranging between 0.40 (TP3, TP3A) and 0.50m bgl (BH1, WS1 and DP1).

The Made Ground typically comprised multicoloured slightly sandy to sandy sub-angular to sub-rounded fine to coarse flint, brick, concrete, cement and plaster GRAVEL.

Soils described as Topsoil were encountered/interpreted in five of the trial holes from ground level to depths of between 0.25 (TP2) and 0.50m bgl (BH2).

The Topsoil comprised very soft to soft greyish brown to dark brown slightly sandy silty CLAY. Frequent rootlets and occasional decomposing organic matter were noted.

The depth of Made Ground and Topsoil has been included in Table 2.3.

Table 2.3 Final Depth of Made Ground/Topsoil

Trial Hole	Strata	Depth (m bgl)	Trial Hole	Strata	Depth (m bgl)
TP1	TS	0.30	WS4 (w)	TS	0.30
TP2	TS	0.25	DP1 ¹	MG	0.50
TP3	MG	0.40	DP4 ¹	TS	0.30
TP3A	MG	0.40	BH1	MG	0.50
WS1 (w)	MG	0.50	BH2	TS	0.50

Note: ¹ Inferred from information from relevant WS location.

2.3.2 Cohesive River Terrace Deposits

Soils described as cohesive River Terrace Deposits were encountered / inferred within each of the ten trial holes underlying the Made Ground/Topsoil and persisted to depths of between 2.00 and 4.00m bgl, the final depth of WS1 and WS4. The

cohesive River Terrace Deposits were typically encountered overlying granular River Terrace Deposits; in WS1 there were also cohesive River Terrace Deposits encountered underlying granular River Terrace Deposits.

The cohesive River Terrace Deposits typically comprised firm grey mottled yellowish to orangish brown and dark brown slightly sandy silty CLAY. Sand was fine. Occasional to frequent rootlets were present.

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

Table 2.4 Final Depth of cohesive River Terrace Deposits

Trial Hole	Depth (m bgl)	Trial Hole	Depth (m bgl)
TP1	1.50 ¹	WS4	3.60 ¹
TP2	1.70 ¹	DPI	2.45, 4.90 ^{2 3}
TP3	1.50 ¹	DP4	3.60 ³
TP3A	2.60 ¹	BH1	4.90
WS1	2.45, 4.00 ²	BH2	4.90

Note: ¹Base of trial hole. ²Two values presented as stratum was encountered both above and below a granular stratum. ³Inferred from information from relevant WS location.

2.3.1 Granular River Terrace Deposits

Soils described as granular River Terrace Deposits were encountered/inferred within four of the TEN trial holes underlying the cohesive River Terrace Deposits. In WS/DP1, the granular River Terrace Deposits were encountered between two cohesive River Terrace Deposits strata.

The granular River Terrace Deposits were typically encountered as yellowish brown slightly gravelly silty SAND. Sand was fine to coarse; gravel was angular to sub-rounded fine to coarse chalk and flint. Occasional clayey/silty pockets and lenses were noted.

The depth of granular River Terrace Deposits has been included in Table 2.45.

Table 2.5 Final Depth of River Terrace Deposits

Trial Hole	Depth (m bgl)
WS1	3.60
WS4	4.00 ¹
DPI	3.60, 6.00 ^{1 2}
DP4	6.00 ²

Note: ¹ Final depth of trial hole. ²Inferred from information from relevant WS location.

2.3.2 White Chalk Subgroup

Soils described as White Chalk Subgroup were encountered/inferred within four of the ten trial holes underlying the cohesive/granular River Terrace Deposits from 4.90m bgl and persisted to the full depth of the investigation, the final depth of BH2 (17.00m bgl).

The soils of the White Chalk Subgroup were typically encountered as white chalk recovered as angular to sub-rounded fine to coarse medium weak to strong chalk clasts in a comminuted silty white to light brown or light grey chalk matrix. Rare angular fine to coarse flint nodules with a white cortex were present. The quality of the chalk improved with depth.

Chalk is a weak rock and as such it should be noted that the drilling, excavating and sampling process is detrimental to its fabric and structure. Chalk samples that have been machine sampled will therefore appear to be of a lower descriptive grade, as given in CIRIA C574, than the in-situ chalk. Soil sampling and visual observations from open excavations i.e. trial pits would allow chalk description and classification in accordance with CIRIA 574 including commenting for any aperture and discontinuities in the chalk structure.

The depth of White Chalk Subgroup has been included in Table 2.6.

Table 2.6 Final Depth of White Chalk Subgroup

<i>Trial Hole</i>	<i>Depth (m bgl)</i>
DPI	6.00 ¹
DP2	6.00 ¹
BH1	15.00 ¹
BH2	17.00 ¹

Note: ¹ Final depth of exploratory hole.

2.4 Roots

Roots were encountered in six of the trial holes at depths ranging between 1.20 and 2.00m bgl. The depths of root penetration have been included in Table 2.7.

Table 2.7 Depth of Root Penetration

<i>Trial Hole</i>	<i>Depth (m bgl)</i>
TP1	1.50
TP2	1.50
TP3	1.20
WS1	0.75 ¹
WS4	1.80
BH2	2.00

Note: ¹Decomposing roots noted. No live

Trial Hole	Depth (m bgl)
roots noted.	

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, such as those noted to the eastern part of the site and the middle of its northern boundary.

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

2.5 Groundwater

Groundwater was encountered within five trial holes (TP3A, WS1, WS4, BH1 and BH2) and was struck at depths of between 0.80 (BH1) standing at 0.60m bgl after 20 minutes, and 2.00m bgl (TP3A).

Changes in groundwater level occur for reasons including seasonal effects and variations in drainage. The investigation was conducted in January (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.

Further groundwater monitoring was to be conducted within the standpipe installed on site following completion of site works but has not yet been undertaken. The results will be released as an addendum to this report.

Section 3 Discussion of Geotechnical In-Situ and Laboratory Testing

3.1 Standard Penetration Tests

Standard Penetration Tests (SPTs) were undertaken in BH1 and BH2. The results were interpreted based on the classifications outlined in Appendix B.1, Table B.1.1 to Table B.1.3.

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 60%. The energy ratio for each location is presented on the individual logs within Appendix A.1.

The cohesive River Terrace Deposits recorded SPT “N60” values between 7 and 21, classifying the cohesive soils as low to high strength with inferred undrained cohesive strength of 35kPa to 105kPa. Undrained cohesive strength improved with depth.

No SPTs were undertaken within granular River Terrace Deposits due to the testing interval and the depth at which such soils were encountered.

The White Chalk Subgroup recorded SPT “N60” values of between 8 and 25, classifying the chalk as CIRIA Grade Dc (structureless) to Grade C5 – A1 (structured). Chalk grade improved with depth.

A full interpretation of the SPT results are outlined in Appendix B.2, Table B.2.1.

3.2 Dynamic Probe Tests

Dynamic probing (DPSH) was undertaken at two locations (DP1 and DP4) adjacent and prior to the drilling of WS1 and WS4 to a depth of 6.00m bgl. The results were converted to equivalent SPT “N60” values based on dynamic energy using commercial computer software (Geostru). The results were then interpreted based on the classifications outlined in Appendix B.1, Table B.1.1 to Table B.1.3.

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 78.58%. The energy ratio for each location is presented on the individual logs within Appendix A.1.

The cohesive River Terrace Deposits recorded equivalent SPT “N60” values between 0 and 19, classifying the cohesive soils as extremely low to high strength with inferred undrained cohesive strengths of between <10kPa and 90kPa.

The granular River Terrace Deposits recorded equivalent SPT “N60” values between 8 and 26, classifying the granular soils as loose to medium dense relative density. Relative density improved with depth.

The White Chalk Subgroup recorded equivalent SPT “N60” values between 19 and 30. This classifies the chalk as CIRIA Grade C5 – A1 (structured).

A full interpretation of the DPSH tests are outlined in Appendix B.2, Table B.2.2.

3.3 Dynamic Cone Penetrometer Tests

The Transport Research Laboratory (TRL), Dynamic Cone Penetrometer (DCP) was undertaken at eight locations (DCP1 – DCP8). The results were interpreted based on the classification outlined in Appendix B.1.

The results from DCP testing indicated CBR values of between 1% and 58% for the soils encountered in the top 1.00m bgl.

The DCP results are presented in Appendix B.3.

3.4 Infiltration Tests

Infiltration testing was undertaken in TP1 – TP3 within the cohesive River Terrace Deposits following the principles of BRE Digest 365 Soakaway design: 2016. BRE 365 states that for an accurate infiltration rate to be obtained a soakage pit needs to be filled three times in quick succession. Each test can only be ended once 75% of the water present has drained away.

It was not possible to test within deeper, possibly granular soils, due to the presence of groundwater at 2.00m bgl identified within TP3A. TP3A was excavated to try to identify whether testable granular soils were present at a greater depth, however the encountered groundwater limited the test depth for the infiltration pits.

A single test was carried out in TP1 – TP3 over approximately a 24 hour period. Due to the minimal head loss observed, only one test cycle could be undertaken.

Table 3.1 Infiltration Rates

<i>Trial Hole</i>	<i>Test No.</i>	<i>Infiltration Rate (ml/s)</i>
TP1	I	No infiltration rate could be calculated as head loss throughout the test was negligible.
TP2	I	No infiltration rate could be calculated as head loss throughout the test was negligible. Head of water depth increased due to rainfall and runoff into the trial pit during the test.
TP3	I	No infiltration rate could be calculated as head loss throughout the test was negligible.

3.5 Quick Unconsolidated Undrained Triaxial Compression Tests

A single Quick Unconsolidated Undrained Triaxial Compression Test (QUU) was performed on a sample obtained from the cohesive River Terrace Deposits. The strength interpretation was based on the classification outlined in Table B.2.3.

The QUU testing indicated soils of the cohesive River Terrace Deposits were of a medium strength with an undrained cohesion of 40kPa.

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

3.6 Atterberg Limit Tests

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

The cohesive River Terrace Deposits were classified as low to medium volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

A full interpretation of the Atterberg Limit tests is outlined in

Table B.2.4, Appendix B.2 and the laboratory report in Appendix B.3.

3.7 Particle Size Distribution Tests

A single Particle Size Distribution (PSD) test was performed on a sample from the granular River Terrace Deposits.

The PSD tests classified the granular River Terrace Deposits as having a volume change potential in accordance with BRE Digest 240 but not NHBC Standards Chapter 4.2. Note that a cohesive soil is only classified as having a volume change potential if it is also plastic and an Atterberg Limit test can be conducted on the strata. Due to the granular content of the soil, it was not possible to carry out an Atterberg Limit test on the sample.

A full interpretation of the PSD tests is outlined in Table B.2.5, Appendix B.2 and the laboratory report in Appendix B.3.

3.8 Saturated Moisture Content Tests

Saturated Moisture Content (SMC) tests were performed on two samples recovered from the White Chalk Subgroup. The results were classified based on Table 3.2, CIRIA Publication, Engineering in Chalk, C574, 2002.

The SMC tests classified the White Chalk Subgroup as medium density, with dry density ranging between 1.61Mg/m³ and 1.66Mg/m³.

A full interpretation of the SMC tests is outlined in Table B.2.6, Appendix B.2 and the laboratory report in Appendix B.3.

3.9 Sulphate and pH Tests

Two samples were taken from the cohesive River Terrace Deposits (WS4:1.40, BH1:4.00m bgl) for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

The tests recorded water soluble sulphate between 20mg/l and 31mg/l with pH values of 7.9 to 8.3.

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

Section 4 Foundation Design

4.1 General

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

4.1.1 Made Ground and Topsoil

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

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

Peat and organic 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. Based on the anticipated and encountered geology, such soils are not expected to be encountered on site, however should they be encountered during the construction phase, they should be removed.

Soils described as Made Ground were encountered or interpreted in five out of the ten trial holes from ground level to depths ranging between 0.40 (TP3, TP3A) and 0.50m bgl (BH1, WS1 and DP1). The Made Ground typically comprised multicoloured slightly sandy to sandy sub-angular to sub-rounded fine to coarse flint, brick, concrete, cement and plaster GRAVEL. The depths of Made Ground have been included in Table 2.3.

Soils described as Topsoil were encountered/interpreted in five of the trial holes from ground level to depths of between 0.25 (TP2) and 0.50m bgl (BH2). The Topsoil comprised very soft to soft greyish brown to dark brown slightly sandy silty CLAY. Frequent rootlets and occasional decomposing organic matter were noted. The depth of Topsoil has been included in Table 2.3.

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 Cohesive River Terrace Deposits

Soils described as cohesive River Terrace Deposits were encountered/ inferred within each of the ten trial holes underlying the Made Ground/Topsoil and persisted to depths of between 2.00 and 4.90m bgl, identified within BH1 and BH2 and interpreted from DP1. The cohesive River Terrace Deposits were typically encountered overlying granular River Terrace Deposits; in WS1 there were also cohesive River Terrace Deposits encountered underlying granular River Terrace Deposits.

The cohesive River Terrace Deposits typically comprised firm grey mottled yellowish to orangish brown and dark brown slightly sandy silty CLAY. Sand was fine. Occasional to frequent rootlets were present.

The cohesive River Terrace Deposits recorded SPT “N60” values between 7 and 21 and equivalent ST “N60” values of between 0 and 19, classifying the cohesive soils as **extremely low becoming high strength** with inferred undrained cohesive strength of <10kPa to 105kPa. Undrained cohesive strength generally improved with depth, albeit in DP4 low blow counts (0 – 1) were encountered to 2.80m bgl.

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

Soils of the cohesive River Terrace Deposits are normally consolidated cohesive soils and as such are expected to display low to moderate bearing capacities with moderate to high settlement characteristics. The soils of the cohesive River Terrace Deposits were not considered suitable for the proposed development due to likely variations both in composition and deposition thickness, and the low SPT “N60” and equivalent SPT “N60” blow counts within the shallow foundation depth range.

4.1.3 Granular River Terrace Deposits

Soils described as granular River Terrace Deposits were encountered/inferred within four of the ten trial holes underlying the cohesive River Terrace Deposits. In WS/DP1, the granular River Terrace Deposits were encountered between two cohesive River Terrace Deposits strata.

The granular River Terrace Deposits were typically encountered as yellowish brown slightly gravelly silty SAND. Sand was fine to coarse, gravel was angular to sub-rounded fine to coarse chalk and flint. Occasional clayey/silty pockets and lenses were noted.

No SPTs were undertaken within the granular River Terrace Deposits due to the testing interval and the depth at which the stratum was encountered. It was inferred

from the results from DPSH testing that the granular soils of the River Terrace Deposits were of a **loose to medium dense** relative density based on equivalent SPT “N60” blow counts of between 8 and 26. Relative density improved with depth.

The results from the Particle Size Distribution test confirmed that the granular soils of the River Terrace Deposits had **low volume change potential** in accordance with BRE Digest 240, but not NHBC Standards Chapter 4.2 as the sample had too high a granular content to carry out an Atterberg Limit Test.

Soils of the granular River Terrace Deposits are granular soils and as such are expected to display moderate to high bearing capacities with low settlement characteristics. The soils of the River Terrace Deposits were not considered suitable for the proposed development due to likely variations in depth, location, composition and deposition thickness. In addition, granular River Terrace Deposits were not encountered within the shallow foundation depth range.

4.1.4 White Chalk Subgroup

Soils described as White Chalk Subgroup were encountered/inferred within four of the ten trial holes underlying the cohesive/granular River Terrace Deposits from 4.90m bgl and persisted to the full depth of the investigation, the final depth of BH2 (17.00m bgl).

The soils of the White Chalk Subgroup were typically encountered as white chalk recovered as angular to sub-rounded fine to coarse medium weak to strong chalk clasts in a comminuted silty white to light brown or light grey chalk matrix. Rare angular fine to coarse flint nodules with a white cortex were present.

It was inferred from the results from the dynamic probing that the White Chalk Subgroup was typically **structureless (Grade Dc) to structured (C5- A1) chalk** as the White Chalk Subgroup recorded equivalent SPT “N60” values between 19 and 30 from the DPSH testing, and 8 and 25 from SPTs. Chalk grade improved with depth.

Saturated moisture content testing indicated the chalk was of **medium density**, with dry density ranging between 1.61 and 1.66 Mg/m³.

Chalk descriptions from windowless sampler boreholes are not in accordance with CIRIA C574 and are not representative of in-situ chalk. Generally, soils of the White Chalk Subgroup are structureless to weak rock and would possess low to moderate bearing and settlement characteristics. The White Chalk Subgroup would be suitable as a bearing stratum however the depth at which it was encountered/inferred means it would not be suitable for shallow foundations, so piled foundations would have to be utilised.

4.1.5 Roots

Roots were encountered in six of the trial holes to depths ranging between 1.20m bgl and 2.00m 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, such as those towards the eastern boundary of the site, or towards the centre of the northern boundary.

4.1.6 Groundwater

Groundwater was encountered within five trial holes (TP3A, WS1, WS4, BH1 and BH2) and was struck at depths of between 0.80 (BH1) standing at 0.60m bgl after an observation period of 20 minutes, and at 2.0m bgl (TP3A).

Changes in groundwater level occur for reasons including seasonal effects and variations in drainage. The investigation was conducted in January (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.

Further groundwater monitoring was to be conducted within the standpipe installed on site following completion of site works but has not yet been undertaken. The results will be released as an addendum to this report.

4.2 Foundation Scheme General

At the time of writing, the proposed development was understood to comprise 12No. semi-detached and detached houses plus a two-storey block of 5No. flats. The development was understood to comprise both hard landscaping in the form of access roads, pavements, driveways and parking spaces and soft landscaping in the form of private residential gardens and public open space.

In compiling this report reliance was placed on drawing number 19.14.1 SK01 Rev A, dated April 2019, prepared by Crayfern Homes. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation recommendations presented within this report. Soils Limited must be notified about any such changes.

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

4.2.1 Guidance on Shrinkable Soils

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

The results from Atterberg Limits Tests showed that the cohesive River Terrace Deposits had **low to medium volume change potential** in accordance with both

BRE Digest 240 and NHBC Standards Chapter 4.2.

The granular River Terrace Deposits soils were determined to have volume change potential in accordance with BRE Digest 240. As no Atterberg Limit test could be carried out due to the sample's granular nature, it did not have volume change potential in accordance with NHBC Standards Chapter 4.2.

Medium volume change potential must therefore be adopted where foundations pass through the cohesive River Terrace Deposits.

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 and cohesive or granular River Terrace Deposits due to the likely variability and potential for large load induced settlements both total and differential.

Roots were encountered in six of the trial holes to depths ranging between 1.20m bgl and 2.00m 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.

Considering the high groundwater, the low cohesive strengths within cohesive River Terrace Deposits at the shallow foundation depth range and the variability in the presence of absence and thickness of granular River Terrace Deposits, a piled foundation solution was considered most appropriate for the development.

4.3.1 Piled Foundations

If adopted the piled foundations must be taken through any Made Ground and superficial deposits into suitable strength soils of the White Chalk Subgroup.

The construction of a piled foundation is a specialist job with the actual pile working load depending on the particular type of pile and installation method. Prior to finalising the foundation design, the advice from a reputable contractor who is familiar with the ground and groundwater conditions present at the site should be sought.

The load capacities are provided for varying diameters and lengths of bored piles taken into the White Chalk Subgroup, based on SPT "N60" values and must only be used for preliminary design purposes. A factor of safety of 5 was applied to the base and of 2.5 to the shaft depicted by the design line outlined in Appendix C.1.

The bearing values given in Appendix C.1. are applicable to single vertically loaded piles. Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

From ground level the upper 5.00m of the pile shaft has been ignored in the preliminary pile design given.

To prevent necking of the green concrete, temporary casing may be required where the pile passes through the Made Ground or cohesive/granular River Terrace Deposits and below the groundwater table (if encountered). To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

No allowance has been made for negative skin friction that could be generated where piles pass through Made Ground and cohesive/granular River Terrace Deposits underlying the site. The negative skin friction must be applied to the pile working load and must not be factored.

4.4 Subsurface Concrete

Sulphate concentration measured in 2:1 water/soil extracts fell into Class **DS-1** of the BRE Special Digest 1 2005, '*Concrete in Aggressive Ground*'. Table C2 of the Digest indicated ACEC (Aggressive Chemical Environment for Concrete) site classifications of **AC-1**. The pH of the soils tested ranged between 8.5 and 8.8. The classification given was determined using the mobile groundwater case, in the view of groundwater being encountered. The laboratory results are presented in Appendix B.3.

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 River Terrace Deposits are likely to be marginally stable in the short term at best.

Based on the depth to the White Chalk Subgroup, excavations taken into it are unlikely to be stable even in the short term, due to the thickness of overlying cohesive and granular River Terrace Deposits. 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.

4.6 Pavements

The Transport Research Laboratory (TRL) Dynamic Cone Penetrometer (DCP) was undertaken at eight locations on site (DCP1 – DCP8). The results from dynamic cone penetrometer tests indicated **CBR values of between 1% and 58%** for the soils encountered in the top 1.00m bgl.

When removing 500mm of either Made Ground or Topsoil the worst case CBR value was 7% which was considered suitable for design purposes for the majority of the road layout. Within DCP2 and DCP5 – DCP8 low CBR values (1 – 3%) were encountered, however this was not anticipated to be problematic as they were encountered within the Made Ground/Topsoil which would be removed as part of the road/pavement construction process.

As CBR values were highly variable due to changes in moisture content and ground conditions, **in-situ testing must be undertaken** immediately prior to the installation of pavements/roads. Any soft spots at formation level should be dug out and replaced with a suitably compacted granular fill. Prior to construction the formation level should be

proof rolled.

Soils of the cohesive River Terrace Deposits (the formation anticipated to be present beneath the road/pavement layout) are regarded as non-frost susceptible as their plasticity index was >20%.

4.7 Soakaways

Infiltration testing in line with the principles of BRE DG365:2016 was carried out within TP1 – TP3. Based on the negligible infiltration observed throughout the test and the high groundwater encountered within the investigation, it is recommended that the site is not suitable for soakaways as a means of surface water disposal.

It is recommended that alternative surface water disposal techniques such as deep borehole soakaways or discharging into a drain or drainage ditch are utilised. The presence of a shallow groundwater table identified throughout this investigation as well as in the site immediately to the north of the subject site in a previous investigation may render deep borehole soakaways unfeasible.

Due to the expected high groundwater table, the depth of the infiltration pits was limited in order not to test within saturated soils. Traditional soakaways targeting the granular River Terrace Deposits would be susceptible to the same issues as deep borehole soakaways due to the high groundwater table, in addition to the variability in presence/absence, thickness and composition of the granular River Terrace Deposits.

Should soakaways in chalk be utilised, it should be noted that occasional erosional features, such as pipes, swallow holes and solution cavities, usually in-filled with drift deposits, are found in the chalk within this area. These features sometimes manifesting themselves at the surface, as shallow circular depressions.

Dissolution features can form due to manmade features such as deneholes. These features can then be reactivated or caused to collapse by the concentrated ingress of water from leaking drains or soakaways.

In line with current guidance (BRE Digest 365, NHBC and CIRIA C574) soakaways should be located remote from the proposed foundations, ideally greater than 20m away from the face of any existing or proposed footing.

In respect to the control of drainage CIRIA C574, Engineering in Chalk; 2002 states;

- “Concentrated ingress of water into the chalk can initiate new dissolution features, particularly in low-density chalk, and destabilise the loose backfill of existing ones. For this reason, any soakaways should be sited well away from foundations for structures, roads or railways, as indicated below:

- In areas where dissolution features are known to be prevalent, soakaways should be avoided if at all possible but, if unavoidable, should be sited at least 20m away from any foundations;
- Where the chalk is of low density, or its density is not known, soakaways should be sited at least 10m away from any foundations;
- Where the chalk is of medium density (or higher), the closest part of the soakaway should be at least 5m away from any foundations.
- For drainage systems, flexible jointed pipes should be used wherever possible; particular care should be taken for the avoidance of leaks in both water supply and drainage pipework.

As the Chalk is a vitally important aquifer, the Environment Agency and local authority must be consulted when planning soakaway installations where chalk lies below the site even where it is mantled with superficial deposits.

Consultation with the Environment Agency must be sought regarding any use which may have an impact on groundwater resources.

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: 18115/PIR dated February 2020) identified a low to moderate risk of ground contamination from previous usage of the site and offsite sources.

The Main Investigation Report identified Made Ground to depths between 0.40m and 0.50m bgl. The Made Ground typically comprised multicoloured slightly sandy to sandy sub-angular to sub-rounded fine to coarse flint, brick, concrete, cement and plaster GRAVEL.

Superficial deposits of cohesive and granular River Terrace Deposits were encountered underlying the Made Ground. Shallow groundwater was encountered within the cohesive River Terrace Deposits. The conceptual site model was updated to take account of the shallow groundwater encountered at the site and is presented in Appendix D.1.

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 potential sources however the source was located to the north of the site. Most of the northern part of the site lay under a proposed road or was inaccessible to the drilling rig at the time of investigation due to the presence of a static mobile home. A non-targeted sampling pattern was therefore adopted. Table 5.1 outlines the sampling undertaken.

Table 5.1 Sampling Strategy

Sample	Strategy	Proposed Use
WS1:0.50	Hardstanding – Made Ground	Beneath Proposed Building
WS4:0.20	Old Animal Pens Nearby – Confirm no risk	Within Proposed Garden
TP2:0.50	Site coverage	Within Proposed Garden
TP3:0.20	Hardstanding – Made Ground	Within Proposed Garden
BH1:0.30	Hardstanding – Made Ground	Within Proposed Garden

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)				
	WS1:0.50 [§]	WS4:0.20 [§]	TP2:0.50 [§]	TP3:0.20 [§]	SH1:0.30 [§]
Asbestos Screen	✓	✓	✓	✓	✓
Total Phenols	✓	✓	✓	✓	✓
Organic Matter	✓	✓	✓	✓	✓
pH	✓	✓	✓	✓	✓
Metals	✓	✓	✓	✓	✓
Metalloids	✓	✓	✓	✓	✓
Organics	✓	✓	✓	✓	✓

Notes: **Metals:** Cd, Cr, Pb, Hg, Ni, Se, Cu, Zn, Bo, V. **Metalloids:** As. **Organics:** USEPA 16 speciated PAH, TPH-Texas
Asbestos screening was undertaken in accordance with HSG 248. [§] = 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 D.3.

6.2 Representative Contamination Criteria - Soil

At the time of writing, the proposed development was understood to comprise 12No. semi-detached and detached houses plus a two-storey block of 5No. flats. The development was understood to comprise both hard landscaping in the form of access roads, pavements, driveways and parking spaces and soft landscaping in the form of private residential gardens and public open space.

In compiling this report reliance was placed on drawing number 19.14.1 SK01 Rev A, dated April 2019, prepared by Crayfern Homes. Any change or deviation from the scheme outlined in the drawing could invalidate the foundation design and remediation 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 4.2%. 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 D.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
None	

Sample locations where asbestos was found (presence only, there is no asbestos threshold value)

TP3:0.20m bgl. Identified as Chrysotile, Amosite – loose fibres; Chrysotile, Amosite – Loose fibrous debris

The guideline values were 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, none of the samples tested showed concentrations in excess of the relevant C4SL for a residential with home-grown produce land-use scenario.

6.2.1 Asbestos

Asbestos was detected within the sample from TP3 at 0.20m bgl. The material was determined to comprise chrysotile and amosite as both loose fibres and loose fibrous debris.

As asbestos containing material was identified in one of the samples tested from within the area of tarmacadam gravel hardstanding it is possible that asbestos is present in the rest of that area of the site. It is less likely, although still possible, that asbestos may be present within the 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

No groundwater samples were recovered from the standpipe as this did not form part of the scope of works and the groundwater receptor was not anticipated to be at risk, based on the findings of the Soils Limited Preliminary Investigation Report, reference 18115/PIR dated February 2020.

6.4 Tier 1 Quantitative Risk Assessment

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

6.4.1 Soils

None of the samples tested showed concentrations in excess of the relevant C4SL for a residential with home-grown produce land-use scenario. Asbestos was detected within the sample from TP3 at 0.20m bgl. The material was determined to comprise chrysotile and amosite in the form of loose fibres and loose fibrous debris.

The Tier 1 Quantitative risk assessment therefore established that there was **a risk to the human health receptors** of construction workers or future end-users.

6.4.2 Groundwater

The Groundwater Risk Assessment established that the risk to the groundwater receptor was **negligible** as there were no concentrations of determinants in excess of their relevant Environmental Quality Standards (EQS).

6.4.3 Soil Gas

The Preliminary Investigation Report identified no risk of soil gas.

6.5 Remedial Objective

Soil chemical analysis identified asbestos within one of the samples tested. It is considered that the asbestos was present within demolition-based granular material used to create an area of hardstanding for vehicle access.

Therefore, there was a risk to the Human Health, Building Structures and Services and Groundwater receptor, which would require a remediation strategy. It is recommended that this material should be quantified for disposal and health and safety purposes, and specialist advice should be sought as the tests indicated both fibres and loose debris of 2 types of asbestos.

The remedial objective for the site is to ensure site clean-up removes any unacceptable risk to the identified receptors of Human Health, Building Structures and Services and Groundwater receptor.

In essence the remedial objective should sever any source-pathway-receptor pollutant linkages that have been established. Once this has been achieved, by whatever means, there can theoretically be no risk.

6.6 Development of Soil Remediation Strategy

Production of a remediation strategy report was not part of the brief for this Main Investigation Report Intrusive Investigation. A number of examples remedial options are outlined below.

6.6.1 Further Chemical Testing and Human Health Risk Assessment

It is **recommended** that further testing is undertaken once the site strip has been completed.

6.6.2 Adoption of Cover System in Soft Landscaped Areas

The BRE *“Cover Systems For Land Regeneration, Thickness Design of Cover Systems for Contaminated Land, BRE, March 2004”*, allows for the design of cover systems to impacted soils where the concentration of substances within the ground does not exceed any of the respective SGV, C4SL or S4UL by more than six times. In such a situation, a maximum cover thickness of 600mm is given. However, the concentration of substances within the certified clean soil/topsoil, which comprises the cover system, determines the overall thickness of the system and can reduce

the required thickness markedly below 600mm.

Where the concentration of substances within the ground does exceed any of the respective SGV, C4SL or S4UL by more than six then an engineered capping system would be required.

None of the samples tested showed any substances above their respective guideline value.

6.6.3 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.

The initial excavations should be centred on the trial-holes with impacted soil and then extended in all directions, so that the impacted soils can be 'chased' out. Once excavation has been completed validation would be required to prove all impacted soil has been removed. Validation would involve taking a representative number of samples from the sides and base of any excavation and then sent off for appropriate chemical analysis.

The stockpiled soils must be placed on an impermeable liner with raised edges. During periods of rainfall, the stockpile must be covered over to minimise leaching and run-off into the underlying soils. Covering of the stockpile may be required to prevent fumes impacting receptors off-site.

The remedial works must be inspected and independently validated by a suitable person.

On completion of the development, a Validation and Closure Report must be supplied to both the Local Authority and the NHBC detailing the remediation works undertaken on the site.

Any voids resulting from the removal of impacted soil must be backfilled with a suitable certified clean granular soil.

The developer/groundworker must be made aware of the need to address the risk from asbestos identified in this report; former use of the site and for the potential for additional sources of contamination not identified in the Preliminary Investigation Report or the Main Investigation Report Intrusive Investigation to be found within the site both during demolition and the excavation of trenches for services and foundations.

6.6.4 Excavation of All Made Ground

Made Ground was encountered across the site to depths between 0.30m and 0.50m bgl. Given the relatively limited extent of the Made Ground encountered this

option may be feasible.

6.6.5 Hard Landscape Entire Site

Hard landscaping the entire site could eliminate exposure pathways to contaminated soils for:

- Direct soil and dust ingestion,
- Consumption of home-grown produce,
- Dermal contact,
- Inhalation of dust (indoor and outdoor),
- Migration through permeable soils (direct precipitation, overland flow and through flow).

6.6.6 Engineering Capping System

If an engineering capping system was required it should comprise a geotextile and/or mesh underlying a 200mm thick layer of lightly compacted gap graded crushed concrete (5-75mm) or the like, with geotextile upper cover underlying 450mm thickness of clean certified soil.

6.6.7 Asbestos

Asbestos-containing soils (ACSs) were identified at the site, with one out of five soil samples detecting asbestos material. The asbestos matrix identified was described as 'loose fibres' and 'loose fibrous debris'. The asbestos types were chrysotile and amosite.

In collaboration with a licensed asbestos removal contractor consultation must be made with the local authority to determine a remediation strategy. Asbestos-containing soils (ACSs) do not necessarily require removal or treatment but would require a suitable capping layer to remain in-situ. All future works should have suitable health and safety procedures in place to protect workers from airborne asbestos fibres. If ACSs remain in-situ measures should be put in place to ensure the risk of exposures is not increased, such as exposing buried asbestos at the surface. Where ACSs have to be removed from site, quantification of the asbestos would be required. Waste containing asbestos will be hazardous waste if it contains more than 0.1% by weight of asbestos, (CIRIA C733, Asbestos in soil and made ground: a guide to understanding and managing risks).

Asbestos quantification would be recommended on the soil samples where asbestos was identified, so an assessment can be carried out.

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.

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.

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.

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.

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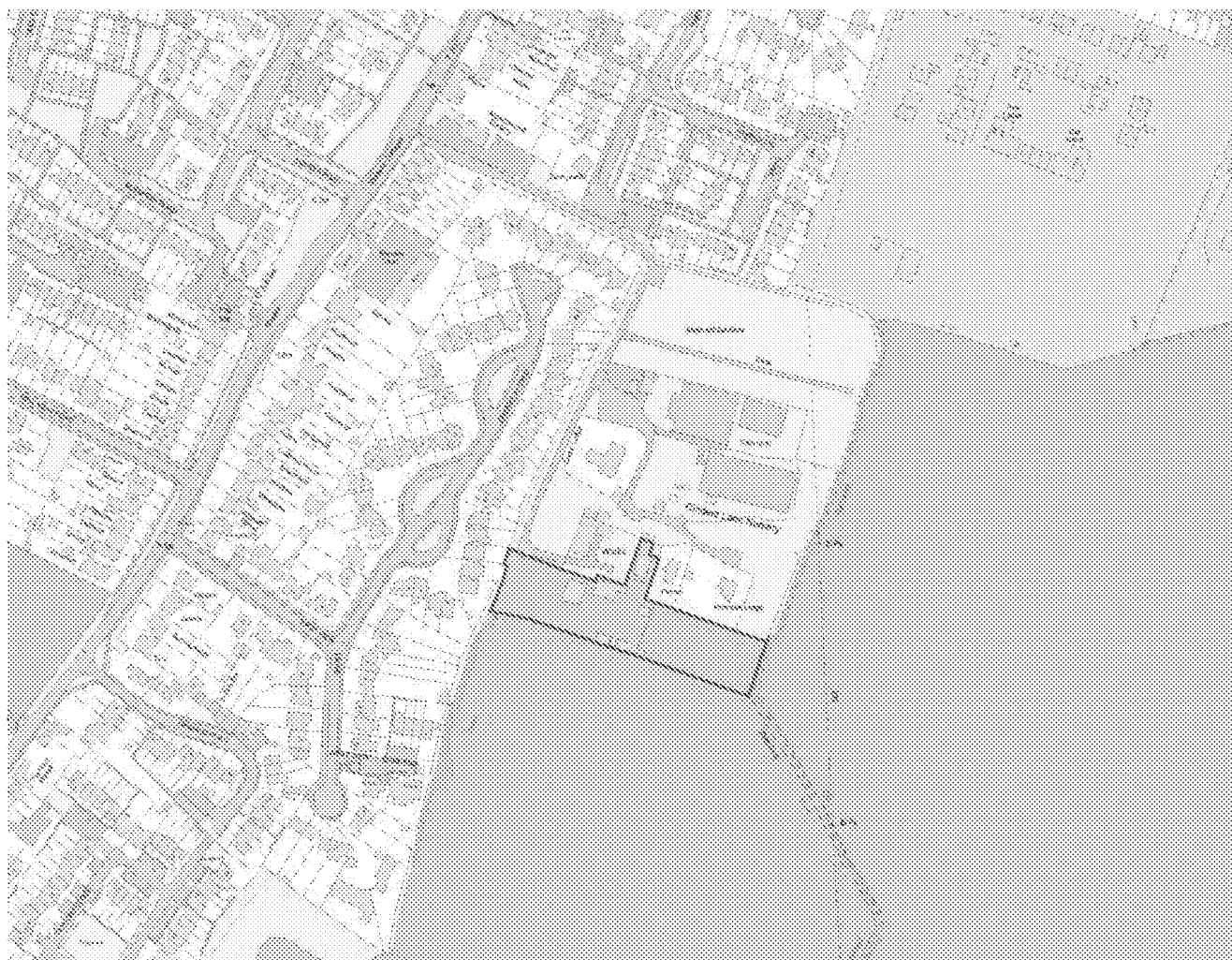
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Figure 1 – Site Location Map



Job Number
18115

Project
Cinders Nursery, Cinders Lane, Yapton, Arundel,
West Sussex BN18 0JJ

Client
Crayfern Homes

Date
February 2020



Figure 2 – Aerial Photograph

Project

Cinders Nursery, Cinders Lane,
Yapton, Arundel, West Sussex
BN18 0JJ

Client

Crayfern Homes

Date

February 2020

Job Number

18115





Figure 3 – Trial Hole Plan

Project
Cinders Nursery, Cinders Lane,
Yapton, Arundel, West Sussex
BN18 0JJ

Client
Crayfern Homes

Date
February 2020

Job Number
18115

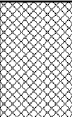
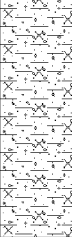


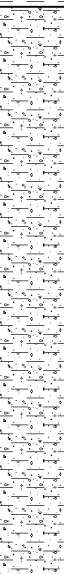
Appendix A Field Work

Appendix A.1 Engineers Logs

		Soils Limited Newton House, Cross Road, Tadworth KT20 5SR 			Trial Pit Log		Trial Pit No. TP1 Sheet 1 of 1	
Project Name: Cinders Lane Nursery				Project No.: 18115		Method:		Hole Type TP
Location: Yapton, Arundel, West Sussex						Plant:		
Client: Crayfern Homes Ltd				Trial Pit Length: m		Trial Pit Width: m		Scale 1:25
Dates: 30/12/1899				Level:		Co-ords:		Logged By
Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES D		0.30			TOPSOIL. Soft brown slightly sandy SILT/CLAY. Sand is fine. Rootlets present.	
	0.50	ES D					Soft orangish brown slight sandy CLAY. Sand is fine. Rare-sub angular to sub rounded fine to medium gravel sized flint and chalk. Occasional rootlets. Gravel content increasing slightly with depth and becoming orangish brown mottled grey towards base. RIVER TERRACE DEPOSITS	
	1.00	ES D						
	1.50	D		1.50			End of Pit at 1.500m	
								1
								2
								3
								4
								5
General Remarks: Roos observed to 1.50m bgl. No groundwater encountered.								Sample Type D: Disturbed B: Bulk J: Jar W: Water
Groundwater Remarks:								

		Soils Limited Newton House, Cross Road, Tadworth KT20 5SR 			Trial Pit Log		Trial Pit No. TP2 Sheet 1 of 1	
Project Name: Cinders Lane Nursery				Project No.: 18115		Method:		Hole Type TP
Location: Yapton, Arundel, West Sussex						Plant:		
Client: Crayfern Homes Ltd				Trial Pit Length: m		Trial Pit Width: m		Scale 1:25
Dates: 30/12/1899				Level:		Co-ords:		Logged By
Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES D		0.25			TOPSOIL. Soft brown slightly sandy SILT/CLAY. Sand is fine. Rootlets present.	
	0.50	ES D					TOPSOIL. Soft orangish brown slightly sandy CLAY. Sand is fine. Occasional rootlets.	
	1.00	ES D						
	1.50	D		1.70				
							End of Pit at 1.700m	
General Remarks: Roos observed to 1.50m bgl. No groundwater encountered.								Sample Type D: Disturbed B: Bulk J: Jar W: Water
Groundwater Remarks:								

 Soils Limited Newton House, Cross Road, Tadworth KT20 5SR				Trial Pit Log		Trial Pit No. TP3 Sheet 1 of 1	
Project Name: Cinders [REDACTED]				Method:		Hole Type TP	
Location: Yapton, Arundel, West Sussex				Plant:		Scale 1:25	
Client: Crayfern Homes Ltd				Trial Pit Length: m		Trial Pit Width: m	
Dates: 30/12/1899				Level:		Co-ords:	
Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	ES D					MADE GROUND: Dark greyish black gravel and macadam top over multicoloured sandy GRAVEL. Gravel is sub-angular to sub-rounded fine to coarse flint brick and macadam.
	0.50	ES D		0.40			MADE GROUND: Firm greyish green silty CLAY with occasional sand. Sand is fine. Rare fine gravel sized flint and brick fragments. Rare rootlets.
	1.00	ES D		0.70			Soft orangish brown mottled grey slightly gravelly silty sandy CLAY. Sand is fine and medium, gravel is sub-angular to sub-rounded fine and medium chalk and rare flint. Rare rootlets. Occasional flint cobbles. RIVER TERRACE DEPOSITS
	1.50	D		1.50			End of Pit at 1.500m
General Remarks: Roots observed to 1.20m bgl. No groundwater encountered.							Sample Type D: Disturbed B: Bulk J: Jar W: Water
Groundwater Remarks:							

		Soils Limited Newton House, Cross Road, Tadworth KT20 5SR		Trial Pit Log		Trial Pit No. TP3A Sheet 1 of 1	
Project Name: Cinders Lane Nursery			Project No.: 18115		Method:		Hole Type TP
Location: Yapton, Arundel, West Sussex					Plant:		
Client: Crayfern Homes Ltd			Trial Pit Length: m		Trial Pit Width: m		Scale 1:25
Dates: 30/12/1899			Level:		Co-ords:		Logged By
Water Strike	Samples & In Situ Testing			Depth (m)	Level (mAOD)	Legend	Stratum Description
	Depth	Type	Results				
				0.20			GRAVEL/MACADAM COVER
				0.40			MADE GROUND: Brownish red sandy subangular to sub-rounded fine to coarse flint, rubble and brick GRAVEL.
				0.70			Firm greyish green CLAY. Occasional fine flint gravel. RIVER TERRACE DEPOSITS
				2.60			Soft light brown mottled grey slightly sandy gravelly CLAY. Gravel is angular to sub rounded fine to coarse chalk and occasional flint. Occasional flint cobbles. RIVER TERRACE DEPOSITS
							End of Pit at 2.600m
General Remarks: No roots observed. Groundwater struck at 2.00m bgl.							Sample Type D: Disturbed B: Bulk J: Jar W: Water
Groundwater Remarks:							

	Contract Name: Cinders Lane Nursery				Client: Crayfern Homes Ltd				Hole ID: WS1										
	Contract Number: 18115		Start and End Date: 16/01/20		Logged By: DW		Checked By:		Status:		Hole Type: WS								
	Easting:		Northing:		Ground Level:		Plant Used: Archway		Print Date: 24/02/2020		Scale: 1:50								
Weather:			Termination:					Sheet 1 of 1											
Samples & In Situ Testing				Strata Details								Groundwater							
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description						Water Strike	Backfill/Installation						
0.30	ES			0.20		MADE GROUND: Blackish brown, slightly sandy GRAVEL. Gravel is angular to sub-rounded, fine to medium tarmac and rare flint.						1							
0.50	ES			0.35										MADE GROUND: Multicoloured mottled brown, slightly silty, sandy GRAVEL. Gravel is angular to sub-angular, fine to coarse flint, brick, concrete, cement and plaster.					
0.60	D			0.50															
0.80	ES			0.75		Firm dark brownish green, slightly sandy, silty CLAY. Occasional decomposing rootlets and organic fragments. Faint odour of decomposition. RIVER TERRACE DEPOSITS													
0.90	D			(0.65)								Firm slightly greenish grey mottled, yellowish brown, slightly sandy, silty CLAY. Occasional sub-rounded, fine to medium marl gravel. RIVER TERRACE DEPOSITS							
1.50	D			1.40		Firm slightly black speckled grey and brown mottled, slightly sandy silty CLAY. Occasional sub-rounded, fine to medium marl gravel. RIVER TERRACE DEPOSITS													
2.10	D			(0.55)								Firm slightly grey mottled, yellowish brown, slightly sandy, slightly gravelly SILT. Gravel is angular to sub-rounded, fine to medium chalk and rare angular flint. Occasional sandy lenses. RIVER TERRACE DEPOSITS							
2.60	D			1.95		Yellowish brown, slightly gravelly, silty SAND. Gravel is angular to sub-rounded, fine to medium chalk. Occasional silty pockets and lenses. RIVER TERRACE DEPOSITS													
3.10	D			(0.50)								Firm, slightly grey mottled yellowish brown, slightly sandy, slightly gravelly SILT. Gravel is angular to sub-rounded, fine to coarse chalk and flint. Occasional sandy lenses. RIVER TERRACE DEPOSITS							
3.50	D			2.45		Firm, slightly grey mottled yellowish brown, slightly sandy, slightly gravelly SILT. Gravel is angular to sub-rounded, fine to coarse chalk and flint. Occasional sandy lenses. RIVER TERRACE DEPOSITS													
3.80	D			(1.15)								Firm, slightly grey mottled yellowish brown, slightly sandy, slightly gravelly SILT. Gravel is angular to sub-rounded, fine to coarse chalk and flint. Occasional sandy lenses. RIVER TERRACE DEPOSITS							
				3.60		Firm, slightly grey mottled yellowish brown, slightly sandy, slightly gravelly SILT. Gravel is angular to sub-rounded, fine to coarse chalk and flint. Occasional sandy lenses. RIVER TERRACE DEPOSITS													
				(0.40)								Firm, slightly grey mottled yellowish brown, slightly sandy, slightly gravelly SILT. Gravel is angular to sub-rounded, fine to coarse chalk and flint. Occasional sandy lenses. RIVER TERRACE DEPOSITS							
				4.00		End of Borehole at 4.00m												4	
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					
					0.00	1.00	PLAIN	19											
					1.00	4.00	SLOTTED	19											
ARUN DISTRICT COUNCIL Y/140/20/DDC																			
Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.																			

	Contract Name: Cinders Lane Nursery				Client: Crayfern Homes Ltd				Hole ID: BH1					
	Contract Number: 18115		Start and End Date: 09/01/20		Logged By: DW		Checked By:		Status:		Hole Type: CP			
	Easting:		Northing:		Ground Level:		Plant Used: Dando150		Print Date: 24/02/2020		Scale: 1:50			
Weather:			Termination:				SPT Hammer: N/R, Energy Ratio: N/R				Sheet 1 of 2			
Samples & In Situ Testing				Strata Details								Groundwater		
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description						Water Strike	Backfill/Installation	
0.20	D			(0.30)		From driller's logs: ROADSTONE. MADE GROUND								
0.30	ES			(0.30)		MADE GROUND: Firm multicoloured mottled, slightly sandy, slightly gravelly silty CLAY. Gravel is angular, fine brick and flint.								
0.50	B			(0.50)		Firm slightly dark brown and orangish brown mottled, yellowish brown, slightly sandy silty CLAY. Sand is fine. RIVER TERRACE DEPOSITS								
0.60	ES			(1.00)										
0.90	ES	N=9 (1,2/2,2,3,2)		(1.00)								1		
1.00	D			(1.50)		Firm, slightly grey mottled, brown, slightly sandy silty CLAY. Sand is fine. Rare angular fine flint gravel. RIVER TERRACE DEPOSITS						2		
1.50 - 1.95	U			(2.00)								3		
2.00	D			(3.50)		Soft, light yellowish brown and light greyish brown mottled, slightly sandy, slightly gravelly, silty calcareous CLAY. Gravel is angular to rounded, fine to coarse chalk and flint. RIVER TERRACE DEPOSITS						4		
2.50	SPT	N=21 (2,4/4,4,5,8)		(2.00)								4		
3.00	D			(1.40)								5		
3.50 - 4.00	B			(4.90)		WEATHERED CHALK. Recovered as angular to sub-rounded, fine to medium weak to moderately strong chalk clasts in as comminuted silty matrix. Matrix is very soft, light brown. Frequent coarse sand sized chalk. WHITE CHALK SUBGROUP						6		
4.00	D			(1.10)								7		
4.50	SPT	N=21 (5,6/5,5,6,5)		(4.90)								8		
5.00	D			(6.00)		WHITE CHALK. Recovered as white, angular to sub-rounded, fine to coarse weak to strong chalk clasts in a comminuted silty matrix. Matrix is light grey. Rare angular, fine to coarse flint nodules with a thin white cortex. WHITE CHALK SUBGROUP						9		
5.50	D			(5.00)								10		
6.00	SPT			(5.00)										
6.50	D	N=18 (3,3/4,4,5,5)		(5.00)										
7.00	D			(5.00)										
7.50	SPT			(5.00)										
8.00	D			(5.00)										
8.50	D	N=21 (3,2/4,5,6,6)		(5.00)										
9.00	SPT			(5.00)										
9.50	D			(5.00)										
10.00	D			(5.00)										
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 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
												0	0.00	Water added to assist drilling. Water at 5.50m bgl at end of borehole.
									0.80		1.50	20	0.60	
Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.														

	Contract Name: Cinders Lane Nursery			Client: Crayfern Homes Ltd			Hole ID: BH2								
	Contract Number: 18115		Start and End Date: 08/01/20		Logged By: DW		Checked By:		Status:		Hole Type: CP				
	Easting:		Northing:		Ground Level:		Plant Used: Dando150		Print Date: 24/02/2020		Scale: 1:50				
Weather:			Termination:				SPT Hammer: N/R, Energy Ratio: N/R					Sheet 1 of 2			
Samples & In Situ Testing				Strata Details								Groundwater			
Depth	Type	Results	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description						Water Strike	Backfill/Installation		
0.20	D			(0.50)		TOPSOIL: Very soft, greyish brown silty CLAY. Frequent rootlets.						1			
0.50	D			0.50		Firm slightly grey and brown mottled yellowish brown, slightly sandy silty CLAY. Sand is fine. Occasional rootlets. Occasional coarse sand to fine gravel sized purplish brown ferruginous mottling. RIVER TERRACE DEPOSITS									
0.50 - 1.00	ES			(1.50)											
0.80	B														
1.00	ES														
1.50	SPT	N=7 (1,1/2,2,1,2)		2.00		Soft, light yellowish brown and light greyish brown mottled, slight sandy, slightly gravelly, silty calcareous CLAY. Gravel is angular to rounded, fine to coarse chalk and flint. RIVER TERRACE DEPOSITS						2			
2.50 - 3.00	B			(1.00)											
3.00	D			3.00		Very soft yellowish brown slightly sandy, slightly gravelly, silty calcareous CLAY. Gravel is angular to rounded, fine to medium chalk. RIVER TERRACE DEPOSITS								3	
3.50	SPT			N=6 (1,0/1,1,2,2)	(1.00)									4	
4.00	D			4.00		Soft light yellowish brown and light greyish brown mottled, slightly sandy, slightly gravelly, silty calcareous CLAY. Gravel is angular to rounded, fine to coarse chalk and flint. RIVER TERRACE DEPOSITS								5	
4.50	SPT			N=15 (1,1/3,3,4,5)	(0.90)		WEATHERED CHALK. Recovered as occasional angular to sub-rounded, fine to medium weak to moderately strong chalk clasts in as comminuted silty matrix. Matrix is very soft, light brown. Frequent coarse sand sized chalk. WEATHERED WHITE CHALK SUBGROUP							6	
4.90	D			4.90											
5.50	D			(1.60)										7	
6.00	SPT			N=8 (1,1/2,2,2,2)	6.50		WHITE CHALK. Recovered as white, angular to sub-rounded, fine to coarse weak to strong chalk clasts in a comminuted silty matrix. Matrix is light grey. Rare angular, fine to coarse flint nodules with a thin white cortex. WHITE CHALK SUBGROUP							8	
6.50	D													9	
7.00	D													10	
7.50	SPT	N=8 (1,2/2,2,2,2)		(4.50)											
8.00	D														
8.50	D														
9.00	SPT	N=13 (2,2/3,3,3,4)													
9.50	D														
10.00	D														
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 2.00m bgl.						
Chiselling				Installation		Water Strikes									
From (m)	To (m)	Duration	Remarks		Top (m)	Base (m)	Type	Dia (mm)	Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	
												0	0.00	Water added to assist drilling. Water at 5.00m bgl at end of borehole.	
									1.50		1.80	20	1.40		
Hand vane (HV), Hand penetrometer (HP) reported in kPa. PID reported in ppm.															
ARUN DISTRICT COUNCIL Y/140/20/DDC															

Appendix B Geotechnical In-Situ and Laboratory Testing

Appendix B.1 Classification

Classification based on SPT “N” values:

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

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

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

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

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

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

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

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

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

Chalk samples recovered are disturbed by the sampling process. Therefore, it is difficult to assess an accurate chalk grade for in accordance with CIRIA C574 ‘Engineering in

Chalk'. In the absence of a standardised correlation between SPT "N" values and chalk grade for the most recent chalk classification (CIRIA C574) a broad indication of the in-situ chalk grade can be assessed using a paper by T.R.M. Wakeling from a site in Mundford, Norfolk, which compares SPT "N" values to the old Spink & Norbury chalk classification. From the Spink & Norbury classification it is possible to infer a basic CIRIA Grade (structureless or structured), as outlined in Table B.1.3.

Table B.1.3 Interpretation of SPT "N" Blow Counts in Chalk

SPT "N" Value Range	Spink & Norbury Grade	Inferred CIRIA Grade
<8	VI	Structureless (Dm)
8 – 15	V	Structureless (Dc)
15 – 20	IV	Structured chalk (C5 – A1)
20 - 25	III	Structured chalk (C5 – A1)
25 - 35	II	Structured chalk (C5 – A1)
>35	I	Structured chalk (C5 – A1)

Note:

Classification of DCP results to CBR:

The DCP consists of a cone fixed to the bottom of a 575mm vertical rod. An 8kg weight is repeatedly lifted and dropped onto an anvil at the mid-height of the rod to deliver a 'blow'. A vertical scale alongside the rod is used to measure the depth of penetration of the cone. These measurements are then converted to CBR values using the following equation derived from the DTP Interim Advice Note 73/06 – Design Guidance for Road Pavement Foundations:

Appendix B.2 Interpretation

Table B.2.1 Interpretation of SPT Tests

BH	Strata	SPT N60 Blow Counts	Inferred Cohesive Strength/Approximate CIRIA Chalk Grade
BH1	cRTD 0.50 – 3.50 Slightly sandy silty CLAY	9	Medium (Cu = 45kPa)
	cRTD 3.50 – 4.90 Slightly sandy slightly gravelly silty CLAY	21	High (Cu = 105kPa)
	WHCK 4.90 – 6.00 Weathered CHALK	No data	
	WHCK 6.00 – 17.00 CHALK	15 – 28	Structured (C5 – A1) Chalk
	cRTD 0.50 – 2.00 Slightly sandy silty CLAY	7	Low (Cu = 35kPa)
BH2	cRTD 2.00 – 4.90 Slightly sandy slightly gravelly silty CLAY	6 - 15	Low to Medium (Cu = 30 – 75kPa)
	WHCK 4.90 – 10.50 Weathered CHALK	8 - 13	Structureless (Dc) Chalk
	WHCK 10.50 – 15.00 CHALK	17 – 25	Structured (C5 – A1) Chalk

Table B.2.2 Interpretation of DPSH Blow Counts

DP	Strata	Equivalent SPT N60 Blow Counts	Inferred Cohesive Strength/Granular Density/Approximate CIRIA Chalk Grade
DPI	cRTD 0.50 – 1.90 Slightly sandy silty CLAY	4 – 15	Low to medium (20 – 75kPa)
	cRTD 1.90 – 2.50 Slightly sandy slightly gravelly SILT	11 – 19	Medium to high (55 – 90kPa)
	gRTD 2.50 – 3.60 Slightly gravelly silty SAND	15 – 26	Medium dense

DP	Strata	Equivalent SPT N60 Blow Counts	Inferred Cohesive Strength/Granular Density/Approximate CIRIA Chalk Grade
	cRTD 3.60 – 4.90 Slightly sandy slightly gravelly SILT	11 – 19	Medium to high strength (Cu = 55 – 90kPa)
	WHCK 4.90 – 6.00 CHALK	23 – 30	Structured (C5 – A1) Chalk
DP4	cRTD 0.30 – 1.10 Slightly sandy silty CLAY	0 – 8	Extremely low to low strength (Cu = <10 – 40kPa)
	cRTD 1.10 – 2.00 Slightly sandy silty CLAY	4	Very low strength (Cu = 20kPa)
	cRTD 2.00 – 2.40 Slightly sandy SILT/CLAY	0 – 4	Extremely low to very low strength (Cu = <10 – 20kPa)
	cRTD 2.40 – 3.30 Slightly sandy SILT/CLAY	4 – 8	Very low to low strength (Cu = 20 – 40kPa)
	cRTD 3.30 – 3.60 Slightly sandy slightly gravelly SILT	8 – 11	Medium strength (Cu = 40 – 55kPa)
	gRTD 3.60 – 3.90 Slightly gravelly silty SAND	8 – 11	Loose to medium dense
	gRTD ¹ 3.90 – 4.90 Granular ¹	15 – 23	Medium dense
	WHCK 4.90 – 6.00 CHALK	19 – 30	Structured (C5 – A1) Chalk

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

Table B.2.3 Interpretation of QUU Tests

Location	Stratum	Sample Depth (m bgl)	Moisture Content (%)	Soil Strength	Shear Strength (kPa)
BHI	cRTD	1.50	21	Medium	40

Table B.2.4 Interpretation of Atterberg Limit Tests

Stratum	Moisture Content (%)	Plasticity Index (%)	Passing 425µm Sieve (%)	Modified Plasticity Index (%)	Soil Classification	Volume Change Potential	
						BRE	NHBC
cRTD	16 - 28	7 - 40	78 - 90	6 - 36	CL - CH	Low – Medium	Low – Medium

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

NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2

Soils Classification based on British Soil Classification System

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

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

Table B.2.5 Interpretation of PSD Tests

Location	Depth (m bgl)	Soil Description	Volume Change Potential		Passing 63µm Sieve (%)
			BRE	NHBC	
WS4	3.70	Off-white/brown silty/clayey fine to coarse sandy fine to medium GRAVEL	Yes	No	29

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

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

Table B.2.6 Interpretation of SMC Tests

Location	Depth (m bgl)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Moisture Content (%)	Saturation Moisture Content (%)	Density Classification (CIRIA)
BH1	13.00	2.06	1.66	23	23	Medium
BH2	16.00	2.02	1.61	25	25	Medium

Note: (The Determination of Saturation Moisture Content of Chalk Tests were made in accordance with BS 1377: Part 2: 1990 Clauses 3.3)

Appendix B.3 Geotechnical In-Situ and Laboratory Results



Soils Limited

Newton House, Cross Road, Tadworth KT20 5SR

Probe Log

Probe No.

DP1

Sheet 1 of 1

Project Name:	Cinders Lane Nursery	Project No.	18115	Co-ords:		Hole Type	DP
Location:	Yapton, Arundel, West Sussex	Level:	m AOD			Scale	1:50
Client:	Crayfern Homes Ltd	Dates:	16/01/2020			Logged By	

Depth (m)	Blows/100mm				Torque (Nm)
	10	20	30	40	
0	16 11 7 4 3 2 1 0				0
1	1 1 2 1 2 2 2 3 4 3 3 4 4 5 5 6 6 6 7 7				25
2	5 6 6 7 6 6 4 4 4 4 4 5 4 4 3				40
3	4 4 4 4 4 5 4 4 3				60
4	4 4 5 4 5 5 5 4 5 5 6 7				80
5	6 7 8 8 7 8 7 7				80
6					
7					
8					
9					
10					
Remarks		Fall Height 750mm	Cone Base Diameter 33mm		
		Hammer Weight 63.5kg	Final Depth 6m		
		Probe Type DPSH	Energy Ratio (Er) %		



Soils Limited

Newton House, Cross Road, Tadworth KT20 5SR

Probe Log

Probe No.

DP4

Sheet 1 of 1

Project Name:	Cinders Lane Nursery	Project No.	18115	Co-ords:		Hole Type	DP
Location:	Yapton, Arundel, West Sussex	Level:	m AOD			Scale	1:50
Client:	Crayfern Homes Ltd	Dates:	16/01/2020			Logged By	

Depth (m)	Blows/100mm					Torque (Nm)
	10	20	30	40		
0					0	
1						
2					15	
3					30	
4					60	
5					80	
6					85	
7						
8						
9						
10						
Remarks	Fall Height 750mm		Cone Base Diameter 33mm			
	Hammer Weight 63.5kg		Final Depth 6m			
	Probe Type DPSH		Energy Ratio (Er) %			



Laboratory Report



Contract Number: 47551

Client Ref: **18115**

Report Date: **07-02-2020**

Client PO: **18115**

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

Contract Title: **Cinders Nursery**
For the attention of: **Tom Rees-Blanchard**

Date Received: **29-01-2020**

Date Completed: **07-02-2020**

Test Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	4
Saturated Moisture Content of chalk (SMC) BS 1377:1990 - Part 2 : 3.3 - * UKAS	2
4 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.3 & 5.3 - * UKAS	4
PSD Wet Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	1
Quick Undrained Triaxial Compression test - single specimen at one confining pressure (100mm or 38mm diameter) BS 1377:1990 - Part 7 : 8 - * UKAS	1
Disposal of samples for job	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
* - denotes test included in laboratory scope of accreditation
- denotes test carried out by approved contractor
@ - denotes non accredited tests

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

Approved Signatories:

Emma Sharp (Office Manager) - Paul Evans (Quality/Technical Manager) - Richard John (Advanced Testing Manager)
Sean Penn (Administrative/Accounts Assistant) - Shaun Jones (Laboratory manager) - Wayne Honey (Administrative/Quality Assistant)

GEO Site & Testing Services Ltd

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



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

Contract Number **47551**

Borehole/Pit No. **WS4**

Site Name **Cinders Nursery**

Sample No.

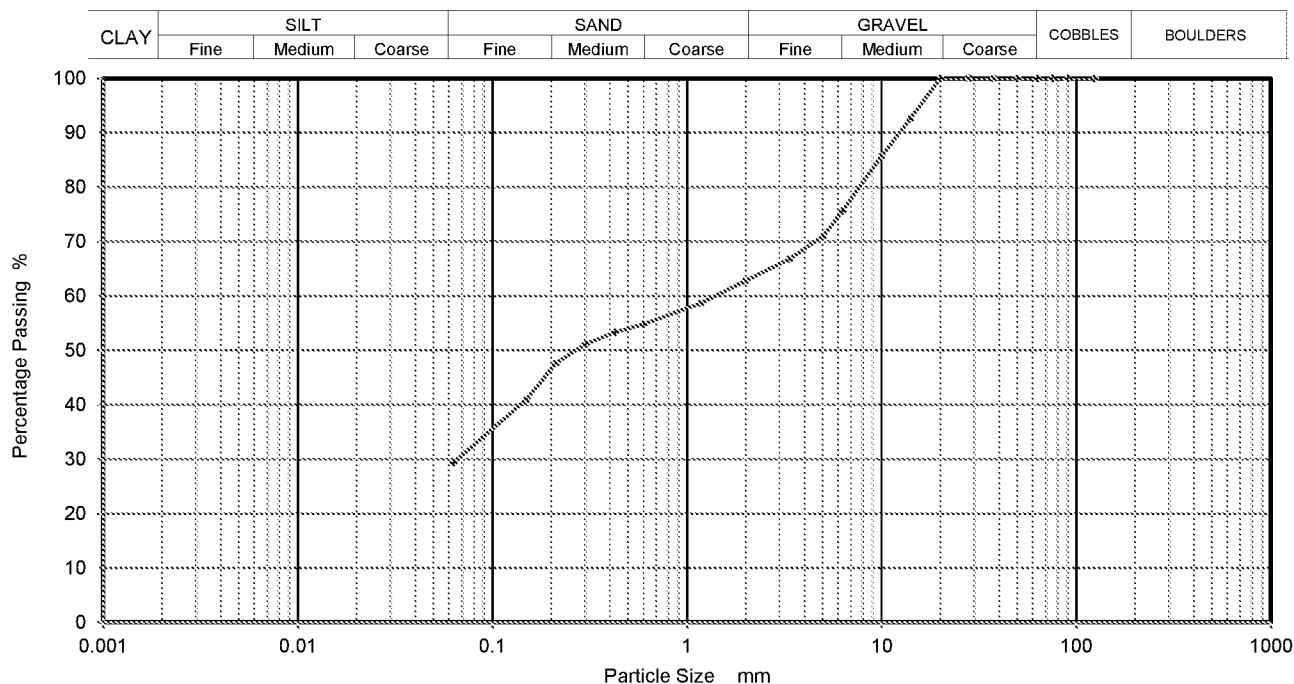
Soil Description **Off white/ brown silty/ clayey fine to coarse sandy fine to medium GRAVEL**

Depth Top **3.70**

Depth Base

Date Tested **05/02/2020**

Sample Type **D**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	93		
10	86		
6.3	76		
5	71		
3.35	67		
2	63		
1.18	59		
0.6	55		
0.425	53		
0.3	51		
0.212	48		
0.15	41		
0.063	29		

Sample Proportions	% dry mass
Cobbles	0
Gravel	37
Sand	34
Silt and Clay	29

Remarks

Preparation and testing in accordance with BS1377 unless noted below



Operators	Checked	06/02/2020	Wayne Honey
RO/MH	Approved	07/02/2020	Paul Evans



**Single Stage Unconsolidated-Undrained Triaxial
Test
BS 1377 : 1990 Part 7 : 8**

Contract Number

47551

Borehole/Pit No.

BH1

Site Name

Cinders Nursery

Sample No.

Soil Description

Brown sandy silty CLAY

Depth Top (m)

1.50

Depth Base (m)

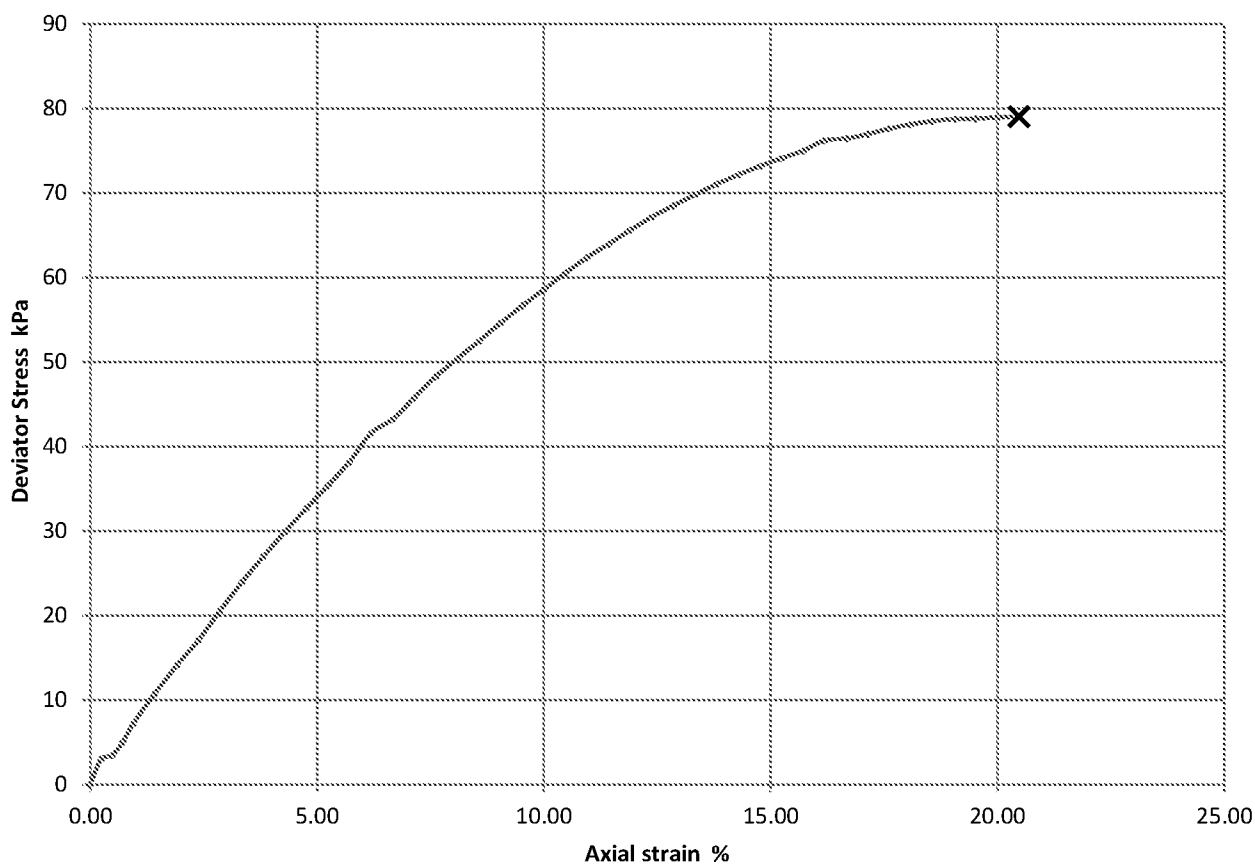
1.95

Date Tested

04/02/2020

Sample Type

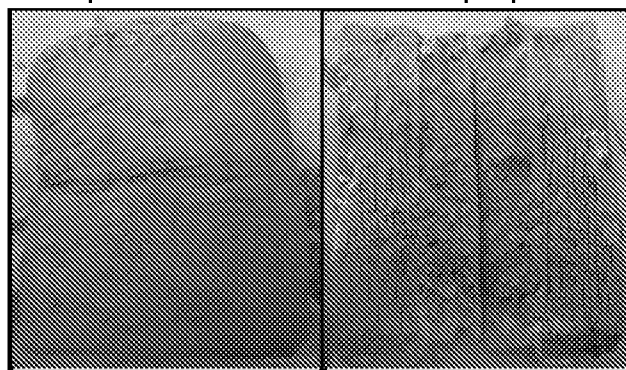
U



Moisture Content (%)	21
Bulk Density (Mg/m ³)	2.10
Dry Density (Mg/m ³)	1.74
Specimen Length (mm)	210
Specimen Diameter (mm)	105
Cell Pressure (kPa)	30
Deviator Stress (kPa)	79
Undrained Shear Strength (kPa)	40
Failure Strain (%)	20
Mode Of Failure	Plastic
Membrane Used/Thickness	Rubber/0.3mm
Rate of Strain (%/min)	1.43

Specimen Post Test

Sample Split



Checked	06/02/2020	Emma Sharp
Approved	07/02/2020	Paul Evans

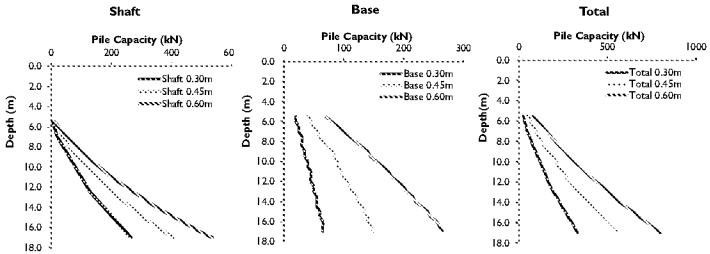


Appendix C Foundation Design

Appendix C.1 Preliminary Pile Design

Preliminary Pile Working Loads						
Single Vertically Loaded Piles (kN)						
Notes:	LP	Shaft Depth	16	Pile Base Depth	5	Pile
					Depth	Base
File No:	18115	Depth at GW (m)	0.6	Pile Point Depth	17	Below GWL
Date:	11.2.20			Pile Diameter	0.5	2.5
						5

Notes:



Pile Capacity Table									
Pile Depth (m)	0.30	0.45	0.60	0.30	0.45	0.60	0.30	0.45	0.60
Capacity (kN)	Shaft	Base	Total	Shaft	Base	Total	Shaft	Base	Total
5.0	5	20	25	10	40	50	10	70	80
5.5	5	20	25	10	40	50	10	70	80
6.0	10	20	30	20	45	65	25	80	105
6.5	15	25	40	30	50	80	40	90	130
7.0	20	25	45	40	55	95	55	100	155
7.5	30	30	60	50	60	110	70	110	180
8.0	40	30	70	60	65	125	85	120	205
8.5	50	30	80	75	70	145	100	130	230
9.0	60	35	95	90	80	170	120	140	260
9.5	70	35	105	105	85	190	140	145	285
10.0	80	40	120	120	90	210	160	155	315
10.5	90	40	130	135	90	225	180	165	345
11.0	100	45	145	150	95	245	200	175	375
11.5	110	45	155	165	100	265	225	180	405
12.0	120	45	165	185	105	290	250	190	440
12.5	130	50	180	205	110	315	275	200	475
13.0	145	50	195	225	115	340	300	205	505
13.5	160	55	215	245	120	365	325	215	540
14.0	175	55	230	265	125	390	350	220	570
14.5	190	55	245	285	130	415	380	230	610
15.0	205	60	265	305	135	440	410	240	650
15.5	220	60	280	330	140	470	440	245	685
16.0	235	65	300	355	140	495	470	255	725
16.5	250	65	315	380	145	525	500	260	760
17.0	265	65	330	405	150	555	535	265	800

Appendix D Chemical Laboratory Testing

Appendix D.1 Conceptual Site Model

Table D.I.I CSM Revised Pre Testing

Source	Potential Contaminant	Exposure Pathway	Receptor	Initial Assessment from Preliminary Investigation Report Information			Comments	Proposed Investigation
				Severity	Probability	Risk		
Works Off site, historical usage. Unspecified activities. One of the works was active between 1984 - 1994.	Metals, Semi-metals and non-metals, PAHs,TPHs, asbestos	Inhalation of dust	Site Workers/Site Maintenance	Medium	Low	Moderate/Low	Asbestos may have been present in the building fabric and may have gotten into the soils during demolition. Other contaminants may have been present as part of the works.	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	Minor	Low	Very Low		
			End Users					
			Off-site Users	Minor	Unlikely	Very low		
	Metals, Semi-metals and non-metals, PAHs, TPHs	Ingestion and absorption via direct contact	Site Workers/Site Maintenance	Minor	Low	Very Low		
			End Users	Minor	Low	Very Low		
	Metals, Semi-metals and non-metals, PAHs, TPHs	Migration via surface runoff	Surface Water	Minor	Low	Very Low	Due to age of source – any contaminants likely to migrate via surface runoff are likely to have done so.	Secondary A Aquifer where granular deposits are present however age of source means that it is unlikely for any contaminants to remain in soils in damaging quantities. Superficial deposits are anticipated to be primarily cohesive based on previous investigation immediately north of the site.
		Migration in solution via groundwater	Surface Water	Minor	Low	Very Low		
			Shallow Aquifer	Minor	Low	Very Low		
			Deep Aquifer	-	-	-	Principal Aquifer present however it is unlikely for any contaminants to be able to migrate into the deep aquifer in damaging quantities. The superficial deposits are anticipated to be predominantly cohesive based on previous investigation immediately north of the site.	
		Direct contact with construction material	Buried structures	Mild	Low	Very Low	Superficial soils on site anticipated to comprise predominantly cohesive soils. No sources of soil gas present.	
-	Migration of gases via permeable soils	Buried Services						
		Site Workers/Site Maintenance	-	-	-			
		End Users						
		Off-site Users	-	-	-			
		Building and confined spaces						

Table D.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		
Works Off site, historical usage. Unspecified activities. One of the works was active between 1984 - 1994.	Asbestos	Inhalation of dust	Site Workers/Site Maintenance	Medium	Likely	Moderate	Chrysotile and amosite determined from contamination laboratory testing within TP3 and 0.20m bgl as loose fibres and loose fibrous debris. It was present within the gravel hardstanding that formed part of the site which may have been construction debris from demolition of the works, reused on site. Although asbestos was only detected within one sample, as it was found within the gravel hardstanding on site, it is possible that such materials may be encountered elsewhere.	Preparation of a Remediation Method Statement in collaboration with a licensed asbestos removal contractor and the Local Authority.
			End Users	Medium	Low	Moderate/low		
			Off-site Users	Medium	Unlikely	Low		
	-	Inhalation of Vapour/gases (including Radon)	Site Workers/Site Maintenance					
			End Users					
			Off-site Users					
	-	Ingestion and absorption via direct contact	Site Workers/Site Maintenance					
			End Users					
	-	Migration via surface runoff	Surface Water					
	-	Migration in solution via groundwater	Surface Water					
			Shallow Aquifer					
			Deep Aquifer					
	-	Direct contact with construction material	Buried structures					
			Buried Services					
	-	Migration of gases via permeable soils	Site Workers/Site Maintenance					
			End Users					
			Off-site Users					
			Building and confined spaces					

Appendix D.2 Chemical Laboratory Results



Lucy Philip
Soils Ltd
Unit 11
Sun Valley Business Park
Winnall Close
Winchester
Hampshire
SO23 0LB



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

e: lp@soilslimited.co.uk

Analytical Report Number : 20-81594

Project / Site name:	Cinders Lane Nursery	Samples received on:	17/01/2020
Your job number:	18115	Samples instructed on:	17/01/2020
Your order number:	18115	Analysis completed by:	22/01/2020
Report Issue Number:	1	Report issued on:	22/01/2020
Samples Analysed:	2 soil samples		

Signed:

Agnieszka Czerwińska

Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

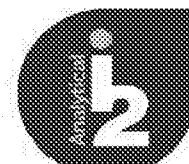
soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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



4841



Environmental Science

Analytical Report Number: 20-81594

Project / Site name: Cinders Lane Nursery

Your Order No: 18115

Lab Sample Number				1414767	1414768			
Sample Reference				WS1	WS4			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.50	0.20			
Date Sampled				17/01/2020	17/01/2020			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1			
Moisture Content	%	N/A	NONE	18	21			
Total mass of sample received	kg	0.001	NONE	0.91	1.1			

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected			
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.7	8.2			
Organic Matter	%	0.1	MCERTS	2.3	4.2			

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0			
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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	< 0.05	< 0.05			
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05			
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 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	< 0.80	< 0.80			
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.2	7.6			
Boron (water soluble)	mg/kg	0.2	MCERTS	2.1	1.2			
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	24			
Copper (aqua regia extractable)	mg/kg	1	MCERTS	30	15			
Lead (aqua regia extractable)	mg/kg	1	MCERTS	48	60			
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3			
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20	17			
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0			
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	39	33			
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	300	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	< 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			



Analytical Report Number : 20-81594

Project / Site name: Cinders Lane Nursery

* 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 *
1414767	WS1	None Supplied	0.50	Brown clay.
1414768	WS4	None Supplied	0.20	Brown clay with vegetation.

Analytical Report Number : 20-81594

Project / Site name: Cinders Lane Nursery

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 disperion 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 based on BS1377 Part 2, 1990, Classification tests	L019-UK/PL	W	NONE
Monohydric 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.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	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 based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	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.



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Analytical Report Number : 20-83725

Project / Site name:	Cinders Lane Nursery	Samples received on:	29/01/2020
Your job number:	18115	Samples instructed on:	29/01/2020
Your order number:	18115	Analysis completed by:	05/02/2020
Report Issue Number:	1	Report issued on:	05/02/2020
Samples Analysed:	2 soil samples		

Signed: Karolina Marek

Karolina Marek
Technical Reviewer (Reporting Team)

For & on behalf of i2 Analytical Ltd.

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

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

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Analytical Report Number: 20-83725

Project / Site name: Cinders Lane Nursery

Your Order No: 18115

Lab Sample Number				1425636	1425637			
Sample Reference				WS4	BH1			
Sample Number				None Supplied	None Supplied			
Depth (m)				1.40	4.00			
Date Sampled				Deviating	Deviating			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1			
Moisture Content	%	N/A	NONE	16	17			
Total mass of sample received	kg	0.001	NONE	0.86	0.99			

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.9	8.3			
Total Sulphate as SO ₄	%	0.005	MCERTS	0.014	0.039			
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.020	0.031			
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	20.3	31.3			
Water Soluble Chloride (2:1) (leachate equivalent)	mg/l	0.5	MCERTS	4.4	2.0			
Total Sulphur	%	0.005	MCERTS	0.009	0.015			
Ammonium as NH ₄	mg/kg	0.5	MCERTS	< 0.5	< 0.5			
Ammonium as NH ₄ (10:1 leachate equivalent)	mg/l	0.05	MCERTS	< 0.05	< 0.05			
Water Soluble Nitrate (2:1) as N (leachate equivalent)	mg/l	2	NONE	< 2.0	< 2.0			

Heavy Metals / Metalloids

Magnesium (water soluble)	mg/kg	5	NONE	8.5	17			
Magnesium (leachate equivalent)	mg/l	2.5	NONE	4.2	8.4			



Analytical Report Number : 20-83725

Project / Site name: Cinders Lane Nursery

* 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 *
1425636	WS4	None Supplied	1.40	Brown clay and sand with gravel.
1425637	BH1	None Supplied	4.00	Brown clay and sand with gravel.

Analytical Report Number : 20-83725

Project / Site name: Cinders Lane Nursery

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
Ammonium as NH ₄ in soil	Determination of Ammonium/Ammonia/ Ammoniacal Nitrogen by the colorimetric salicylate/nitroprusside method, 10:1 water extraction.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L082-PL	W	MCERTS
Chloride, water soluble, in soil	Determination of Chloride colorimetrically by discrete analyser.	In house method.	L082-PL	D	MCERTS
Magnesium, water soluble, in soil	Determination of water soluble magnesium by extraction with water followed by ICP-OES.	In-house method based on TRL 447	L038-PL	D	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
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
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
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Water Soluble Nitrate (2:1) as N in soil	Determination of nitrate by reaction with sodium salicylate and colorimetry.	In-house method based on Examination of Water and Wastewater & Polish Standard Method PN-82/C-04579.08, 2:1 extraction.	L078-PL	W	NONE

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.

Sample Deviation Report

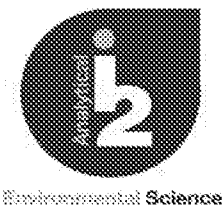


Sample ID	Other ID	Sample Type	Job	Sample Number	Sample Deviation Code	test name	test ref	Test Deviation code
BH1		S	20-83725	1425637	a			
WS4		S	20-83725	1425636	a			



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Analytical Report Number : 20-80810

Project / Site name:	Cinders Lane Nursery	Samples received on:	14/01/2020
Your job number:	18115	Samples instructed on:	14/01/2020
Your order number:		Analysis completed by:	17/01/2020
Report Issue Number:	1	Report issued on:	17/01/2020
Samples Analysed:	3 soil samples		

Signed:

Rachel Bradley

Deputy Quality Manager
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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Analytical Report Number: 20-80810

Project / Site name: Cinders Lane Nursery

Lab Sample Number				1410692	1410693	1410694		
Sample Reference				TP2	TP3	BH1		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				0.50	0.20	0.30		
Date Sampled				06/01/2020	06/01/2020	06/01/2020		
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	11	7.8		
Moisture Content	%	N/A	NONE	20	18	16		
Total mass of sample received	kg	0.001	NONE	1.2	1.1	1.4		

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	Chrysotile, Amosite - Loose Fibres; Chrysotile, Amosite - Loose Fibrous Debris	-		
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Detected	Not-detected		

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.5	7.4	7.7		
Organic Matter	%	0.1	MCERTS	2.5	0.8	2.8		

Total Phenols

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

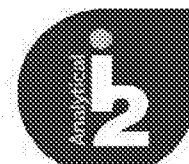
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.39		
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.10		
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.0		
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.90		
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.71		
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.61		
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.78		
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.42		
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.57		
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.43		
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.55		

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	6.49		
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4841



Environmental Science

Analytical Report Number: 20-80810

Project / Site name: Cinders Lane Nursery

Lab Sample Number				1410692	1410693	1410694		
Sample Reference				TP2	TP3	BH1		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				0.50	0.20	0.30		
Date Sampled				06/01/2020	06/01/2020	06/01/2020		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.8	13	14		
Boron (water soluble)	mg/kg	0.2	MCERTS	0.9	0.7	2.0		
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2		
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0		
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	27	41	26		
Copper (aqua regia extractable)	mg/kg	1	MCERTS	9.9	12	25		
Lead (aqua regia extractable)	mg/kg	1	MCERTS	31	18	50		
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3		
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	18	43	25		
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	37	51	55		
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	76	52	68		

Petroleum Hydrocarbons

TPH Texas (C6 - C8)	mg/kg	0.1	ISO 17025	< 0.1	< 0.1	< 0.1		
TPH Texas (C8 - C10)	mg/kg	10	MCERTS	< 10	< 10	< 10		
TPH Texas (C10 - C12)	mg/kg	1	MCERTS	< 1.0	< 1.0	1.1		
TPH Texas (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0		
TPH Texas (C16 - C21)	mg/kg	10	MCERTS	< 10	< 10	14		
TPH Texas (C21 - C40)	mg/kg	10	MCERTS	< 10	< 10	150		
TPH Texas (C6 - C40)	mg/kg	10	NONE	< 10	< 10	170		



Analytical Report Number : 20-80810

Project / Site name: Cinders Lane Nursery

* 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 *
1410692	TP2	None Supplied	0.50	Brown clay.
1410693	TP3	None Supplied	0.20	Brown clay with stones.
1410694	BH1	None Supplied	0.30	Brown silt with stones.**

**Non MCERTS matrix.

Analytical Report Number : 20-80810

Project / Site name: Cinders Lane Nursery

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 disperion 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 based on BS1377 Part 2, 1990, Classification tests	L019-UK/PL	W	NONE
Monohydric 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.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	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 based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	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 D.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.

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Land Use			Residential With or Without Plant Uptake									Allotments			Commercial			Public Open Space (POS)						Name	Authority	Date
			With home-grown produce			Without home-grown produce			Residential									Park								
			SOM	1.0	2.5	5	1	2.5	5	1	2.5	5	1	2.5	5	1	2.5	5	1	2.5	5					
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			16		21	C481	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 & alkanes	1,2 Dichloroethane		2015	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28	S4UL	LQM/CIEH	2015		
	1,1,1 Trichloroethane		2015	8.8	18	39	9	18	40	48	110	240	660	1300	3000	140000	140000	140000	57000	76000	100000	S4UL	LQM/CIEH	2015		
	1,1,2,2 Tetrachloroethane		2015	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	270	550	1100	1400	1400	1400	1800	2100	2300	S4UL	LQM/CIEH	2015		
	1,1,1,2 Tetrachloroethane		2015	1.2	2.8	6.4	1.5	3.5	8.2	0.79	1.9	4.4	110	250	560	1400	1400	1400	1500	1800	2100	S4UL	LQM/CIEH	2015		
	Tetrachloroethene		2015	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	19	42	95	1400	1400	1400	810	1100	1500	S4UL	LQM/CIEH	2015		
	Tetrachloromethane (Carbon Tetrachloride)		2015	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400	S4UL	LQM/CIEH	2015		
	Trichloroethene		2015	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120	S4UL	LQM/CIEH	2015		
	Trichloromethane		2015	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100	S4UL	LQM/CIEH	2015		
	Vinyl Chloride (chloroethene)		2015	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	S4UL	LQM/CIEH	2015		
Explosives	2,4,6 Trinitrotoluene		2015	1.6	3.7	8.1	65	66	66	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270	S4UL	LQM/CIEH	2015		
	RDX (Hexogen/Cyclonite/1,3,5-trinitro-1,3,5-triazacyclohexane)		2015	120	250	540	13000	13000	13000	17	38	85	210000	210000	210000	26000	26000	27000	49000	51000	53000	S4UL	LQM/CIEH	2015		
	HMX (Octogen/1,3,5,7-tetrenitro-1,3,5,7-tetrazacyclo-octane)		2015	5.7	13	26	6700	6700	6700	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	23000	23000	24000	S4UL	LQM/CIEH	2015		
Pesticides	Aldrin		2015	5.7	6.6	7.1	7.3	7.4	7.5	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31	S4UL	LQM/CIEH	2015		
	Dieldrin		2015	0.97	2	3.5	7	7.3	7.4	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31	S4UL	LQM/CIEH	2015		
	Atrazine		2015	3.3	7.6	17.4	610	620	620	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	2400	S4UL	LQM/CIEH	2015		
	Dichlorvos		2015	0.032	0.066	0.14	6.4	6.5	6.6	0.0049	0.01	0.022	140	140	140	16	16	16	26	26	27	S4UL	LQM/CIEH	2015		
	Alpha - Endosulfan		2015	7.4	18	41	160	280	410	1.2	2.9	6.8	5600	7400	8400	1200	1200	1200	2400	2400	2500	S4UL	LQM/CIEH	2015		
	Beta - Endosulfan		2015	7	17	39	190	320	440	1.1	2.7	6.4	6300	7800	8700	1200	1200	1200	2400	2400	2500	S4UL	LQM/CIEH	2015		
	Alpha -Hexachlorocyclohexanes		2015	0.23	0.55	1.2	6.9	9.2	11	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48	S4UL	LQM/CIEH	2015		
	Beta -Hexachlorocyclohexanes		2015	0.085	0.2	0.46	3.7	3.8	3.8	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	1							

Land Use			Residential With or Without Plant Uptake												Public Open Space (POS)									Name	Authority	Date
			Allotments						Commercial																	
			With home-grown produce			Without home-grown produce									Residential			Park								
Type	Contaminants	Species	Year	SQM	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 E Information Provided by the Client



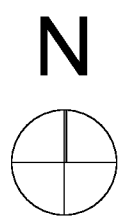
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**SITE LAYOUT | PROPOSED
DEVELOPMENT AT:
CINDERS LANE (ADDITIONAL LAND))
YAPTON
BN18 0JJ**

**FOR
CRAYFERN HOMES LIMITED**

Scale : 1:500 Date : 25.04.2019
Drawing No : 19.14.1 SK01 Rev A



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