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SUB SURFACE
Site Investigation Specialists,
Geotechnical & Environmental Consultants

GROUND INVESTIGATION REPORT

FOR
33 THE CRESCENT,
BRIMINGTON,
CHESTERFIELD

PREPARED FOR
CHESTERFIELD BOROUGH COUNCIL

REPORT NO. NE4037A
JUNE 2021

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GROUND INVESTIGATION AT 33 THE CRESCENT, BRIMINGTON, CHESTERFIELD, S43 1AZ

CLIENT: CHESTERFIELD BOROUGH COUNCIL

ENGINEER: PROPERTY AND TECHNICAL SERVICES

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1. INTRODUCTION

This report has been prepared in accordance with Purchase Order No. DES/51669 dated 23rd March 2021, from the Client.

The brief was set out in our estimate, ref. E7036 and dated 17th March 2021, with amendments as the investigation proceeded and includes:

- 1 No. mini borehole
- Insitu testing
- Geotechnical laboratory testing
- Contamination analysis
- Provision of an interpretative report on the above.

It should be noted that we have previously issued a Phase I Desk Study Report for this site, ref. NE4037 and dated May 2021 which should be read in conjunction with this Phase II Ground Investigation Report.

1.1 Site Location and Description

The site is located at 33 The Crescent, Brimington, Chesterfield, Derbyshire, S43 1AZ, as indicated on Figure 1. The approximate National Grid Reference of the centre of the site is 439476, 373343.

As shown on Figure 2, the site forms a roughly rectangular area of 0.02ha comprising an existing end terrace house with garden. The site is bound by The Crescent to the south east, 31 The Crescent adjoining to the south west, 35 The Crescent to the north east, and woodland to the north west.

At the time of the investigation the site comprised a brick-built two-storey end terrace house with a rear garden to the west and small front garden to the east. Some evidence of structural distress was observed in the northern corner of the property with cracking in the wall.

The generally level garden areas were mainly grassed with occasional concrete surfaced paths and concrete flags adjacent to the building. A shared brick outbuilding was located in the north east of the site. A hedge delineated the western boundary at the rear of the property, with an overgrown wooded area beyond, with mature trees noted several metres from the site.

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1.2 Proposed Development and Purpose of the Ground Investigation

We understand that the existing property is showing signs of subsidence in the northern corner with cracking occurring both internally and externally, and consequently an investigation into potential causes and remedial measures is required.

The purpose of the investigation was to determine the ground conditions and soil properties at the position of the exploratory hole and to establish the load bearing characteristics of the strata deriving, if possible, an assessment of the suitability of appropriate founding techniques for a proposed remedial scheme.

In addition contamination analysis and assessment was required in order to determine necessary precautions and/or remedial measures required for the proposed development and to ascertain the need for any further sampling and analysis.

2. INVESTIGATION

2.1 Investigation Details

One mini borehole was put down to a depth of 6.45m using a Dart Mini Sampling Rig fitted with windowless sample tubes of varying diameters at the positions determined by the Client and set out by Sub Surface North East Ltd, as shown on Figure 3. The samples were subsequently logged in accordance with BS EN ISO 14688-1: 2018 and BS EN ISO 14689-1: 2018 and the resulting Mini Borehole Record is appended. On completion the borehole was backfilled with arisings.

2.2 Sub Surface Detail

Details of the strata encountered in the ground investigation are given on the appended Mini Borehole. The exploratory hole found made ground and possible made ground, comprising reworked natural material, overlying residual clays underlain by Coal Measures strata bedrock. A general summary of the strata found is as follows:

2.2.1 Made Ground/ Possible Made Ground

M1 encountered made ground to a depth of 1.60m, initially comprising dark brown slightly gravelly slightly sandy silty clay with occasional stone gravels to 0.40m overlying soft grey and orangish brown mottled slightly gravelly slightly sandy silty clay with occasional cobble sized fragments of concrete. Gravel sized fragments consisted of fine to coarse stone, brick and concrete.

At 0.90m, M1 found reworked highly weathered mudstone recovered as dark grey and occasional orangish brown clayey fine to coarse gravel sized fragments of extremely weak mudstone, completely weathered to soft silty clay in many places.

From 1.60m to 2.40m, M1 encountered possible made ground comprising grey and occasional yellowish brown mottled slightly gravelly slightly sandy silty clay with gravel consisting of subangular to angular siltstone, mudstone and coal. The strata was initially found to be firm to stiff becoming soft below 2.00m.

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2.2.2 Residual Clays

At 2.40m depth, M1 encountered residual clays derived from completely weathered mudstone bedrock and comprising firm medium strength dark grey and occasional orangish brown mottled slightly gravelly silty clay. Gravel consisted of angular fine to coarse mudstone lithorelicts.

2.2.3 Bedrock

Below 3.40m, M1 encountered extremely weak thinly laminated brown and occasional orangish brown highly weathered mudstone, completely weathered to clay in places, and underlain at 4.00m by extremely weak grey and occasional greyish brown moderately weathered mudstone.

2.2.4 Groundwater

No groundwater was encountered in the borehole although it should be noted that it was only left open for a short period of time and groundwater levels and rates of inflow and may be subject to seasonal and/ or climatic variations.

3. SAMPLING AND TESTING

3.1 Sampling

Continuous core, small disturbed and bulk disturbed samples were obtained for the strata encountered and were subjected to careful examination and hand shear vane tests, where appropriate.

The samples will be retained for a period of one month after the issue of this report, for reference purposes, and then disposed of unless otherwise instructed.

3.2 Field Testing

Six Standard Penetration Tests (SPTs) were performed in the borehole, the results of which are recorded on the appended Standard Penetration Test Results Sheet with 'N' values and indicative relative density and shear strength, where appropriate, given on the appended Mini Borehole Record.

3.3 Laboratory Testing

The following laboratory tests were carried out in accordance with BS.1377: 1990, where applicable, and the results are appended.

- Moisture content, plastic limit and liquid limit tests
- Soluble sulphate content and pH value tests (including pyritic ground testing).

Contamination analyses have been performed on two soil samples to determine: pH and concentrations of sulphate, sulphide, cyanide, arsenic, boron (soluble), cadmium, chromium, hexavalent chromium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, speciated total petroleum hydrocarbons (TPHs), the speciated polynuclear aromatic hydrocarbons (PAHs) suite, the benzene/ ethylbenzene/ toluene/ xylene (BTEX) suite and phenols. In addition one soil sample was subjected to an asbestos screen. The results of the above analyses are appended.

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4. APPRAISAL AND RECOMMENDATIONS

4.1 Comments on the Profile

At the outset it should be appreciated that only a small proportion of the area to be developed has been investigated and consequently the recommendations made and opinions expressed in this report can only be applied to such conditions as were encountered in the exploratory holes.

In our opinion a single exploratory hole cannot be interpreted to give an indication of the profile over the site and the immediately adjacent area unless there is a likelihood that there is a consistent geological formation over the area. In this instance the previous report indicated the site to be underlain by Coal Measures strata weathered to residual clays in the uppermost horizons. Given the above there is an indication that the geological formation will be similar beneath the site and the immediate surrounding area and hence some continuity might be assumed, but not guaranteed.

Due to the site having been previously developed, and the nature of made ground, localised variations in thickness and composition should be anticipated and hence interpolation or extrapolation from the exploratory holes to adjoining areas should only be undertaken with caution.

Details of the findings of the investigation are given on the appended Borehole Record and a summary of the ground conditions is given in Section 2.2.

4.2 Foundations

We understand that the existing property is showing signs of subsidence to the northern corner with cracking occurring both internally and externally, and consequently an investigation with assessment of ground conditions was required to assist in the design of remedial measures.

The ground investigation found made ground to 1.60m overlying possible made ground to 2.40m underlain by medium strength residual clays to 3.40m overlying extremely weak mudstone bedrock.

Although no investigation was undertaken to determine the nature of the existing foundations, a trial pit records supplied by the Client indicates shallow concrete foundations within made ground at less than 0.75m.

In addition, the previous report identified a potential risk from potentially worked coal seams outcropping on site and/ or at shallow depth beneath the site. No detailed coal mining risk assessment or ground investigation has been undertaken into the presence of shallow mine workings and as a potential cause of instability, as this was outside our brief. As detailed in the previous report, we recommend a detailed geological and mining risk assessment is carried out to determine the likely presence and/ or depth of potentially worked coal seams outcropping on site and at shallow depth beneath the site.

We would not recommend the founding of any underpinning scheme in the made ground or possible made ground because of its inherent variability in consistency and compaction, and in parts the nature of its constituents.

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Based on the findings of the ground investigation and the insitu strength testing, the firm medium strength clays encountered at 2.40m depth in M1, would provide a safe bearing pressure of 95kN/m^2 for traditional mass concrete underpinning foundations.

Atterberg limit tests on the natural cohesive strata encountered below 2.40m indicate the cohesive strata underlying the building to be of intermediate to high plasticity which are considered to have a medium susceptibility to shrinkage and swelling with varying moisture content. Several large mature deciduous trees are located to the west of the site, including adjacent to the site boundary, approximately 5m from the building. As the property is within the zone of influence of these mature trees foundation depths for proposed foundations at shallow depth should be determined in line with the guidelines given in the National House Building Council (NHBC) Standards Chapter 4.2, 'Building Near Trees'. Consequently for proposed shallow foundations we would recommend that a detailed tree survey is carried out by an arboriculturalist to determine the type of trees present, and the height and distance of the trees from the property. From the information obtained it would be possible to determine the required foundation depth for the soils of medium shrinkage and swelling potential, encountered on site.

All formation levels should be carefully inspected by an experienced and qualified engineer to confirm the appropriateness of the design figures used with any soft or rubbly zones removed and replaced with lean mix concrete. The formation should then be blinded with lean mix concrete as soon as possible after exposure, if there is to be a delay before construction, to prevent water softening or disturbance.

It should be noted that the safe bearing pressures given for the cohesive strata do not take into consideration settlement. Settlement is dependent upon loading intensity, the width of the foundation and the coefficient of volume compressibility (Mv) of the compressible strata. When details of the foundations are formulated we recommend that total and differential settlements are assessed to ensure that they are within acceptable limits.

It should be noted that if a partial underpinning scheme is undertaken then care must be taken to ensure that there is not excessive differential settlement between the underpinned and the non-underpinned sections including the adjoining property.

Given the depth of made ground/ possible made ground and/ or the potential requirement for deeper foundations due to trees (depending on species and distance from the building), consideration might be given to underpinning the property with mini piles, with associated cantilever or bridge beams to support the existing walls, transferring the structural loads down to the bedrock strata, encountered below 3.40m in M1. Due to the potential presence of shallow mine workings which may affect the required depth or feasibility of a mini piling scheme, further investigation into the presence of shallow mine workings will be required before a mini piling scheme can be considered.

In addition to the above, given the risk of ground instability associated with the depth of made ground and potential shallow mine workings we recommend that drains, and other services that may be affected, located on site are inspected, checked for any leaks and are replaced where necessary with appropriate material and flexible joints to allow for potential movement.

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4.3 Excavations and Groundwater

There should be no particular difficulties in excavating the strata indicated in the exploratory holes utilising an appropriate and suitably sized mechanical excavator.

It is recommended that all excavations to greater than 1.20m depth, or for shallower excavations where groundwater is encountered above this level, are closely supported, especially where man entry is required. Alternatively, where space permits, the excavations might be battered back to an appropriate angle.

The borehole did not encounter groundwater entries, although it should be noted that it was only left open for a relatively short period of time and groundwater levels and rates of inflow may be subject to seasonal and/ or climatic variations.

Given the limited information, groundwater seepages or inflows are not anticipated in shallow excavations. However, should groundwater seepages occur and water accumulate in the excavation it should be able to be removed by pumping from a filtered sump.

4.5 Buried Concrete

For the design of buried concrete the recommendations given in Building Research Establishment (BRE) Special Digest 1 (February 2017 revision), “Concrete in Aggressive Ground”, should be followed.

Determination of pH on the soil samples gave values in the range of 8.4 to 8.7. Soluble sulphate concentrations were also determined for the soil samples with all results found to be <0.01g/l.

In view of the natural strata being potentially pyritic ground, total sulphate, total sulphur and magnesium have been determined for one sample and the results were <0.01%, 0.01% and <0.01g/l respectively. Our calculations have determined that pyrite (sulphides), which might weather and produce higher levels of sulphates, are not present.

The results indicate that the Design Sulphate Class for the site should be DS-1.

Our knowledge of the site and ground conditions indicates that the site is “brownfield” with potentially mobile groundwater. Consequently, in accordance with the Design Sulphate Class for the site together with the site and groundwater conditions an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-1 should be used as detailed on the appended extract.

4.5 Contamination Considerations

We have previously undertaken a Phase I Report, ref. NE4037 and dated May 2021 and this Phase II ground investigation has been undertaken to provide an initial contamination risk assessment in accordance with the Phase I Conceptual Ground Model. Based upon the findings of the above additional sampling, analysis and assessment may be required.

It should be appreciated that the suite of determinants analysed for consists of a range of contaminants identified in the Conceptual Ground Model. However, the absence of any other specific contaminants cannot be guaranteed.

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4.5.1 Assessment

In order to provide an assessment of the presence of contamination two soil samples have been analysed for a suite of determinants and the results are appended.

Levels of the determinants have been compared against the most recently published guideline values. Contaminated Land: Applications in Real Environments (CL:AIRE) published guideline values in December 2009 to supplement previous guideline values. The Department for Environment, Food and Rural Affairs (DEFRA) published in March 2014 Category 4 Screening Levels (C4SLs) for arsenic, cadmium, lead, hexavalent chromium, benzo(a)pyrene and benzene. Land Quality Management Limited (LQM)/ Chartered Institute of Environmental Health (CIEH) then published Suitable for Use Levels (S4ULs) in November 2014, which largely superseded the previous guideline values. Updated S4ULs values for cadmium and phenols were published in July 2015 and for nickel in August 2015. The guideline values (S4ULs and occasionally C4SLs and CL:AIRE) are derived using the Environment Agency's CLEA Model and vary dependent upon the land use; allotment and residential use being the most sensitive and commercial/ industrial use being the least sensitive.

For the purposes of assessment, as the site comprises an existing house with garden, contamination analyses have been compared with the guideline values for a standard land use of residential with plant uptake (with homegrown produce).

The contamination analysis determined no elevated levels of the determinants analysed for when compared with the guideline values for a standard land use of residential with plant uptake (with homegrown produce). Guideline values for the assessment can be supplied directly to the Regulator, if requested.

An asbestos screen was undertaken on one soil sample and no asbestos was detected.

In addition to the above, an assessment of risk to personnel who will come into contact with on-site materials throughout the site has been undertaken.

4.5.2 Conclusions and Recommendations

Section 78a(2) of the Environmental Protection Act: 1990 as amended by the Contaminated Land (England) (Amendment) regulations 2012, and Section 86 of the Water Act 2003, defines CONTAMINATED LAND for the purposes of Part IIA as:

"any 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) SIGNIFICANT POLLUTION OF CONTROLLED WATERS is being, or is likely to be, caused"

Before a LOCAL AUTHORITY can make the judgement that land appears to be CONTAMINATED LAND on the basis that SIGNIFICANT HARM is being caused, or that there is a SIGNIFICANT POSSIBILITY of such harm being caused, the LOCAL AUTHORITY must identify a SIGNIFICANT POLLUTANT LINKAGE. This means that each of the following has to be identified:

(a) a CONTAMINANT;

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(b) a relevant RECEPTOR (defined as living organisms, ecological systems, controlled waters or property); and
(c) a PATHWAY by means of which either:
  (i) the CONTAMINANT is causing SIGNIFICANT HARM to that RECEPTOR, or
  (ii) there is a SIGNIFICANT POSSIBILITY of such harm being caused by that CONTAMINANT to that RECEPTOR

It should be noted that the words in capitals have a legal definition within the legislation.

Without a clear identification of all three elements of the pollutant linkage, land cannot be identified as contaminated under the regime.

The National Planning Policy Framework states that, "after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990". Therefore, the general principles detailed above apply to this assessment.

Our assessment, based on the results of the contamination analyses, indicates that there are no contaminants requiring remediation and/or precautions to be taken for the proposed development.

If waste materials are to be removed from the site, classification of the waste should be undertaken to determine the most appropriate tip to use and the associated costs. It should be noted that significant cost savings can sometimes be made on waste disposal by correct classification of the waste, a service that we can provide.

It should be noted that all vehicles carrying contaminated material should be securely sheeted and the wheels and undercarriages cleaned before leaving site to ensure that hazardous materials are not dropped onto public roads.

S4ULs, C4SLs and CL:AIRE assume long term contact with contamination and assess chronic health risk. The risk of short term acute exposure to site personnel is dealt with in the remit of the Health and Safety Executive under the Health and Safety at Work Act: 1974 and Regulations made under the Act, including the Control of Substances Hazardous to Health (COSHH) Regulations. The levels of contamination and risk to site personnel should be considered under the Construction Design and Management (CDM) Regulations at the planning stage and in the development of the designers and contractors Health and Safety Plans and Method Statements. The risk of contact with on-site soils should be minimised and as standard good practice site personnel involved in earthworks and excavations should wear gloves, overalls, and boots and smoking should be prohibited.

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4.6 General

As detailed in the previous report, we recommend a detailed geological and mining risk assessment is carried out to determine the likely presence and/ or depth of potentially worked coal seams outcropping on site and at shallow depth beneath the site. If there is a significant risk of worked coal seams being present at shallow depth that might affect the current stability and / or impact the stability of any proposed remediation scheme, a rotary borehole investigation is recommended to allow further assessment.

In addition, if the detailed geological and mining risk assessment indicates the site is likely to be underlain by potentially worked coal seams at shallow depth there is a risk of mine gases being present. Consequently, in this scenario we recommend gas standpipes are installed and monitored over an extended period of time to allow for an assessment to be made.

We trust that this report fulfils your present requirements but if you have any queries or we can be of further assistance please contact the undersigned or Mr David Simpson at our Ossett office.

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REPORT No. NE4037A
JUNE 2021

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INSITU TEST RESULTS

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Standard Penetration Test Results

Site : 33 THE CRESCENT, BRIMINGTON, CHESTERFIELD

Client : CHESTERFIELD BOROUGH COUNCIL

Engineer : PROPERTY AND TECHNICAL SERVICES

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Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
M1	1.00	1.15	1.45	SPT	2	2	2	2	2	3	N=9	
M1	2.00	2.15	2.45	SPT	1	1	1	1	2	2	N=6	
M1	3.00	3.15	3.45	SPT	2	2	2	3	4	4	N=13	
M1	4.00	4.15	4.45	SPT	10	12	10	8	2	6	N=26	
M1	5.00	5.15	5.45	SPT	7	7	9	9	10	11	N=39	
M1	6.00	6.15	6.45	SPT	8	10	18	20	13	17	N=68	

LABORATORY TEST RESULTS

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Laboratory Test Results

Site : 33 THE CRESCENT, BRIMINGTON, CHESTERFIELD

Client : CHESTERFIELD BOROUGH COUNCIL

Engineer : PROPERTY AND TECHNICAL SERVICES

Job Number NE4037A

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DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY AND LIQUIDITY INDEX

Borehole/ Trial Pit	Depth (m)	Sample	Natural Moisture Content %	Sample Passing 425µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Group Symbol	Laboratory Description
				Percentage %	Moisture Content %						
M1	1.00	D	15	57	26	49	25	24	0.04	CI	MADE GROUND: dark grey and occasional orangish brown clayey fine to coarse gravel sized fragments of mudstone.
M1	2.00	D	24	69	35	44	23	21	0.57	CI	Grey and occasional yellowish brown mottled slightly gravelly slightly sandy silty CLAY. Gravel is subangular fine siltstone and mudstone (possible made ground).
M1	3.00	D	20	56	36	56	25	31	0.35	CH	Dark grey and occasional orangish brown mottled slightly gravelly silty CLAY. Gravel sized fragments are angular fine to coarse mudstone lithorelicts (completely weathered bedrock).
M1	5.00	D	11	71	15	53	25	28	-0.36	CH	Grey and occasional greyish brown moderately weathered MUDSTONE.

Method of Preparation : BS 1377:PART 1:1990:7.4 Preparation of samples for classification tests BS 1377:PART 2:1990:4.2 & 5.2 Sample preparations

Method of Test : BS 1377:PART 2:1990:3 Determination of moisture content 1990:4 Determination of the liquid limit BS 1377:PART 2:1990:5 Determination of the plastic limit and plasticity index

Remarks : NP = Non Plastic

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Laboratory Test Results

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DETERMINATION OF pH, SULPHATE CONTENT AND TOTAL SULPHUR OF SOIL AND GROUNDWATER AND MAGNESIUM, CHLORIDE, AMMONIA AND NITRATE CONTENT

Borehole/ Trial Pit	Depth (m)	Sample	Concentration of Sulphate			Total Sulphur %	Magnesium mg/l	Ammonium NH4 mg/l	Water Soluble Chloride mg/l	Water Soluble Nitrate mg/l	pH	Design Class	Laboratory Description
			Soil		Ground Water g /l								
			Total S03 %	S04 in 2:1 water:soil g /l									
M1	1.00	D		<0.01							8.4	DS-1	MADE GROUND: dark grey and occasional orangish brown clayey fine to coarse gravel sized fragments of mudstone.
M1	4.00	D		<0.01							8.5	DS-1	Grey and occasional greyish brown moderately weathered MUDSTONE.
M1	5.80	C	<0.01	<0.01		0.10	<0.01				8.7	DS-1	Grey and occasional greyish brown moderately weathered MUDSTONE.

Method of Preparation : BS 1377:PART 1:1990:7.5 Preparation of soil for chemical tests BS 1377:PART 3:1990:5.2, 5.3, 5.4 & 9.4

Method of Test : Lab in-house methods based on BS1377: Part 3 for contents of water sol sulphate, pH, chloride and magnesium. Lab in-house method based on MEWAM (EA, 2006) for total sulphur

Remarks : Classification relates to Design Sulphate Class of BRE Special Digest 1 (2005)

AGGRESSIVE CHEMICAL ENVIRONMENT FOR CONCRETE (ACEC) SITE CLASSIFICATION.

Table C1 Aggressive Chemical Environment for Concrete (ACEC) classification for natural ground locations [a]

Sulfate				Groundwater		
Design Sulfate Class for location	2:1 water/soil extract [b]	Groundwater	Total potential sulfate [c]	Static water	Mobile water	ACEC Class for location
1	2 (SO_4 mg/l)	3 (SO_4 mg/l)	4 (SO_4 %)	5 (pH)	6 (pH)	7
DS-1	< 500	< 400	< 0.24	≥ 2.5		AC-1s
					> 5.5 [d]	AC-1 [d]
					2.5–5.5	AC-2z
DS-2	500–1500	400–1400	0.24–0.6	> 3.5		AC-1s
					> 5.5	AC-2
				2.5–3.5		AC-2s
					2.5–5.5	AC-3z
DS-3	1600–3000	1500–3000	0.7–1.2	> 3.5		AC-2s
					> 5.5	AC-3
				2.5–3.5		AC-3s
					2.5–5.5	AC-4
DS-4	3100–6000	3100–6000	1.3–2.4	> 3.5		AC-3s
					> 5.5	AC-4
				2.5–3.5		AC-4s
					2.5–5.5	AC-5
DS-5	> 6000	> 6000	> 2.4	> 3.5		AC-4s
				2.5–3.5	≥ 2.5	AC-5

Notes
a Applies to locations on sites that comprise either undisturbed ground that is in its natural state (ie is not brownfield – Table C2) or clean fill derived from such ground.
b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered relative to previous Digests (Box C7).
c Applies only to locations where concrete will be exposed to sulfate ions (SO_4) which may result from the oxidation of sulfides (eg pyrite) following ground disturbance (Appendix A1 and Box C8).
d For flowing water that is potentially aggressive to concrete owing to high purity or an aggressive carbon dioxide level greater than 15 mg/l (Section C2.2.3), increase the ACEC Class to AC-2z.

Explanation of suffix symbols to ACEC Class
- Suffix 's' indicates that the water has been classified as static.
- Concrete placed in ACEC Classes that include the suffix 'z' primarily have to resist acid conditions and may be made with any of the cements or combinations listed in Table D2 on page 42.

Table C2 Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations [a]

Sulfate and magnesium						Groundwater		ACEC
Design Sulfate Class for location	2:1 water/soil extract [b]		Groundwater		Total potential sulfate [c]	Static water	Mobile water	Class for location
1	2 (SO_4 mg/l)	3 (Mg mg/l)	4 (SO_4 mg/l)	5 (Mg mg/l)	6 (SO_4 %)	7 (pH) [d]	8 (pH) [d]	9
DS-1	< 500		< 400		< 0.24	≥ 2.5		AC-1s
							> 6.5 [d]	AC-1
							5.5–6.5	AC-2z
							4.5–5.5	AC-3z
							2.5–4.5	AC-4z
DS-2	500–1500		400–1400		0.24–0.6	> 5.5		AC-1s
							> 6.5	AC-2
						2.5–5.5		AC-2s
							5.5–6.5	AC-3z
							4.5–5.5	AC-4z
							2.5-4.5	AC-5z
DS-3	1600–3000		1500–3000		0.7–1.2	> 5.5		AC-2s
							> 6.5	AC-3
						2.5–5.5		AC-3s
							5.5–6.5	AC-4
							2.5–5.5	AC-5
DS-4	3100–6000	≤ 1200	3100–6000	≤ 1000	1.3–2.4	> 5.5		AC-3s
							> 6.5	AC-4
						2.5–5.5		AC-4s
							2.5–6.5	AC-5
DS-4m	3100–6000	> 1200 [e]	3100–6000	> 1000 [e]	1.3–2.4	> 5.5		AC-3s
							> 6.5	AC-4m
						2.5–5.5		AC-4ms
							2.5–6.5	AC-5m
DS-5	> 6000	≤ 1200	> 6000	≤ 1000	> 2.4	> 5.5		AC-4s
						2.5–5.5	≥ 2.5	AC-5
DS-5m	> 6000	> 1200 [e]	> 6000	> 1000 [e]	> 2.4	> 5.5		AC-4ms
						2.5–5.5	≥ 2.5	AC-5m

Notes
a Brownfield locations are those sites, or parts of sites, that might contain chemical residues produced by or associated with industrial production (Section C5.1.3).
b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered from previous Digests (Box C7).
c Applies only to locations where concrete will be exposed to sulfate ions (SO_4), which may result from the oxidation of sulfides such as pyrite, following ground disturbance (Appendix A1 and Box C8).
d An additional account is taken of hydrochloric and nitric acids by adjustment to sulfate content (Section C5.1.3).
e The limit on water-soluble magnesium does not apply to brackish groundwater (chloride content between 12 000 mg/l and 17 000 mg/l). This allows 'm' to be omitted from the relevant ACEC classification. Seawater (chloride content about 18 000 mg/l) and stronger brines are not covered by this table.

Explanation of suffix symbols to ACEC Class
- Suffix 's' indicates that the water has been classified as static.
- Concrete placed in ACEC Classes that include the suffix 'z' have primarily to resist acid conditions and may be made with any of the cements in Table D2 on page 42.
- Suffix 'm' relates to the higher levels of magnesium in Design Sulfate Classes 4 and 5.

CONTAMINATION ANALYSIS RESULTS

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

Final Report

Report No.:	21-13653-1
Initial Date of Issue:	05-May-2021
Client	Sub Surface
Client Address:	3 Peel Street Preston Lancashire PR2 2QS
Contact(s):	Simon Gabbatt
Project	NE4037A 33 THE CRESCENT , BRIMINGTON

Quotation No.:		**Date Received:**	27-Apr-2021
Order No.:		**Date Instructed:**	27-Apr-2021
No. of Samples:	5		
Turnaround (Wkdays):	7	**Results Due:**	06-May-2021
Date Approved:	05-May-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: NE4037A 33 THE CRESCENT , BRIMINGTON

Client: Sub Surface			**Chemtest Job No.:**		21-13653	21-13653	21-13653	21-13653	21-13653
Quotation No.:			**Chemtest Sample ID.:**		1187704	1187705	1187706	1187707	1187708
			Client Sample ID.:		639	641	642	648	651
			Sample Location:		M1	M1	M1	M1	M1
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.2	0.9	1.00	4.00	5.80
			Bottom Depth (m):		0.4	1.00	1.45	4.45	
			Date Sampled:		14-Apr-2021	14-Apr-2021	14-Apr-2021	14-Apr-2021	14-Apr-2021
			Asbestos Lab:		COVENTRY				
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
ACM Type	U	2192		N/A	-				
Asbestos Identification	U	2192		N/A	No Asbestos Detected				
ACM Detection Stage	U	2192		N/A	-				
Moisture	N	2030	%	0.020	13	16	13	6.4	7.2
Stones and Removed Materials	N	2030	%	0.020					< 0.020
pH	U	2010		4.0	7.8	8.5	8.4	8.5	8.7
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40			
Magnesium (Water Soluble)	N	2120	g/l	0.010					< 0.010
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010			< 0.010	< 0.010	< 0.010
Total Sulphur	U	2175	%	0.010					0.10
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50			
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	2.0	8.3			
Sulphate (Total)	U	2430	%	0.010	0.043	0.065			
Sulphate (Acid Soluble)	U	2430	%	0.010					< 0.010
Arsenic	U	2450	mg/kg	1.0	7.8	12			
Cadmium	U	2450	mg/kg	0.10	0.10	0.25			
Chromium	U	2450	mg/kg	1.0	11	22			
Molybdenum	U	2450	mg/kg	2.0	< 2.0	< 2.0			
Copper	U	2450	mg/kg	0.50	22	39			
Mercury	U	2450	mg/kg	0.10	< 0.10	0.42			
Nickel	U	2450	mg/kg	0.50	15	33			
Lead	U	2450	mg/kg	0.50	17	61			
Selenium	U	2450	mg/kg	0.20	0.25	0.27			
Zinc	U	2450	mg/kg	0.50	35	120			
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50			
TPH >C6-C10	N	2670	mg/kg	1.0	< 1.0	< 1.0			
TPH >C10-C21	N	2670	mg/kg	1.0	< 1.0	< 1.0			
TPH >C21-C40	N	2670	mg/kg	1.0	< 1.0	< 1.0			
Total TPH >C6-C40	U	2670	mg/kg	10	< 10	< 10			
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	0.43			

Results - Soil

Project: NE4037A 33 THE CRESCENT , BRIMINGTON

Client: Sub Surface			**Chemtest Job No.:**		21-13653	21-13653	21-13653	21-13653	21-13653
Quotation No.:			**Chemtest Sample ID.:**		1187704	1187705	1187706	1187707	1187708
			Client Sample ID.:		639	641	642	648	651
			Sample Location:		M1	M1	M1	M1	M1
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.2	0.9	1.00	4.00	5.80
			Bottom Depth (m):		0.4	1.00	1.45	4.45	
			Date Sampled:		14-Apr-2021	14-Apr-2021	14-Apr-2021	14-Apr-2021	14-Apr-2021
			Asbestos Lab:		COVENTRY				
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Pyrene	U	2700	mg/kg	0.10	< 0.10	0.43			
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	0.54			
Chrysene	U	2700	mg/kg	0.10	< 0.10	0.64			
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10			
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	2.0			
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0			
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0			
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0			
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0			
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0			
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0			
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10			

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

MINI BOREHOLE RECORD SHEETS

SUB SURFACE

SITE INVESTIGATION SPECIALISTS, GEOTECHNICAL & ENVIRONMENTAL CONSULTANTS
3 Peel Street, Preston, Lancashire, PR2 2QS. Tel: (01772) 561135 Fax: (01772) 204907

Site	Borehole Number
33 THE CRESCENT, BRIMINGTON, CHESTERFIELD	M1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
MINI PERCUSSIVE			CHESTERFIELD BOROUGH COUNCIL	NE4037A
	Location	**Dates**	**Engineer**	**Sheet**
	AS PLAN	14/04/2021	PROPERTY AND TECHNICAL SERVICES	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.20	B						MADE GROUND: friable dark brown slightly gravelly slightly sandy silty clay with occasional roots and rootlets and occasional cobble sized fragments of stone, Gravel sized fragments are fine to coarse stone, brick and concrete. (Topsoil).		
0.20-0.40	B					(0.40)			
						0.40	MADE GROUND: soft grey and orangish brown mottled slightly gravelly slightly sandy silty clay with occasional cobble sized fragments of concrete. Gravel sized fragments are fine to coarse stone, concrete and brick.		
0.60-0.80	B					(0.50)			
0.90-1.00	B					0.90	MADE GROUND: dark grey and occasional orangish brown clayey fine to coarse gravel sized fragments of mudstone (reworked natural).		
1.00-1.45 1.00-2.00 1.00-1.45	D C SPT N=9			1.00m to 2.00m - 100% recovery 2,2/2,2,2,3		(0.70)			
				HV@1.65m, c=102kPa		1.60	Firm to stiff medium to high strength becoming soft low strength grey and occasional yellowish brown mottled slightly gravelly slightly sandy silty CLAY with occasional rootlets. Gravel is subangular to angular fine siltstone, mudstone and coal. (Possible made ground).		
				HV@1.90m, c=72kPa					
2.00-2.45 2.00-3.00 2.00-2.45	D C SPT N=6			2.00m to 3.00m - 90% recovery 1,1/1,1,2,2		(0.80)	.... below 2.00m : soft low strength		
						2.40	Firm medium strength dark grey and occasional orangish brown mottled slightly gravelly silty CLAY. Gravel sized fragments are angular fine to coarse mudstone lithorelicts. (Completely weathered bedrock).		
				HP@2.60m, c=50kPa					
						(1.00)			
3.00-3.45 3.00-4.00 3.00-3.45	D C SPT N=13			3.00m to 4.00m - 100% recovery 2,2/2,3,4,4					
						3.40	Extremely weak thinly laminated brown and occasional orangish brown highly weathered MUDSTONE, completely weathered to clay in places.		
						(0.60)			
4.00-4.45 4.00-5.00 4.00-4.45	D C SPT N=26			4.00m to 5.00m - 50% recovery 10,12/10,8,2,6		4.00	Extremely weak grey and occasional greyish brown moderately weathered MUDSTONE.		
5.00-5.45	SPT N=39			7,7/9,9,10,11					

Remarks
Hand dug inspection pit from GL to 1.00m to check for services.
C = Plastic lined core sample
Core diameter : 84mm to 2.00m, 74mm to 3.00m, 64mm to 4.00m and 54mm to 5.70m
HV = Hand Shear Vane test
HP = Hand Penetrometer test
On completion backfilled with grout and spoil.

Scale (approx)	Logged By
1:25	MSB/SJ

Figure No. NE4037A.M1

SUB SURFACE

SITE INVESTIGATION SPECIALISTS, GEOTECHNICAL & ENVIRONMENTAL CONSULTANTS
3 Peel Street, Preston, Lancashire, PR2 2QS. Tel: (01772) 561135 Fax: (01772) 204907

Site	Borehole Number
33 THE CRESCENT, BRIMINGTON, CHESTERFIELD	M1

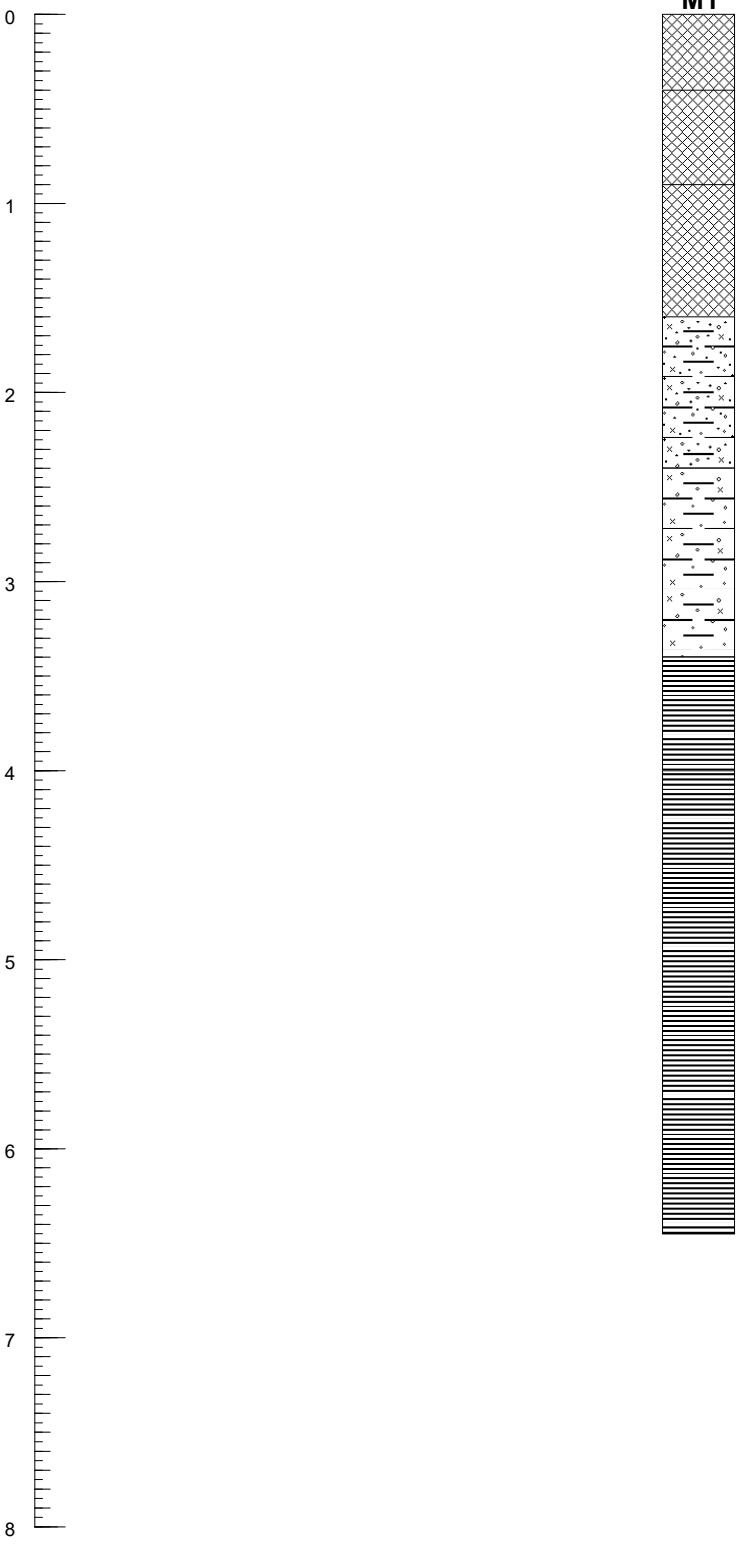
Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
MINI PERCUSSIVE			CHESTERFIELD BOROUGH COUNCIL	NE4037A
	Location AS PLAN	**Dates** 14/04/2021	**Engineer** PROPERTY AND TECHNICAL SERVICES	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
5.00-5.45 5.00-6.00	D C			5.00m to 6.00m - 90% recovery		(2.45)	Extremely weak grey and occasional greyish brown moderately weathered MUDSTONE.		
6.00-6.45 6.00-6.45	SPT N=68 D			8,10/18,20,13,17					
				14/04/2021:DRY		6.45	Complete at 6.45m		

Remarks

Scale (approx)	Logged By
1:25	MSB/SJ

Figure No. NE4037A.M1



Key

- Groundwater Strike
- Strike Rise Level
- MADE GROUND
- Silty gravelly CLAY
- Silty sandy gravelly CLAY
- MUDSTONE

SUB SURFACE
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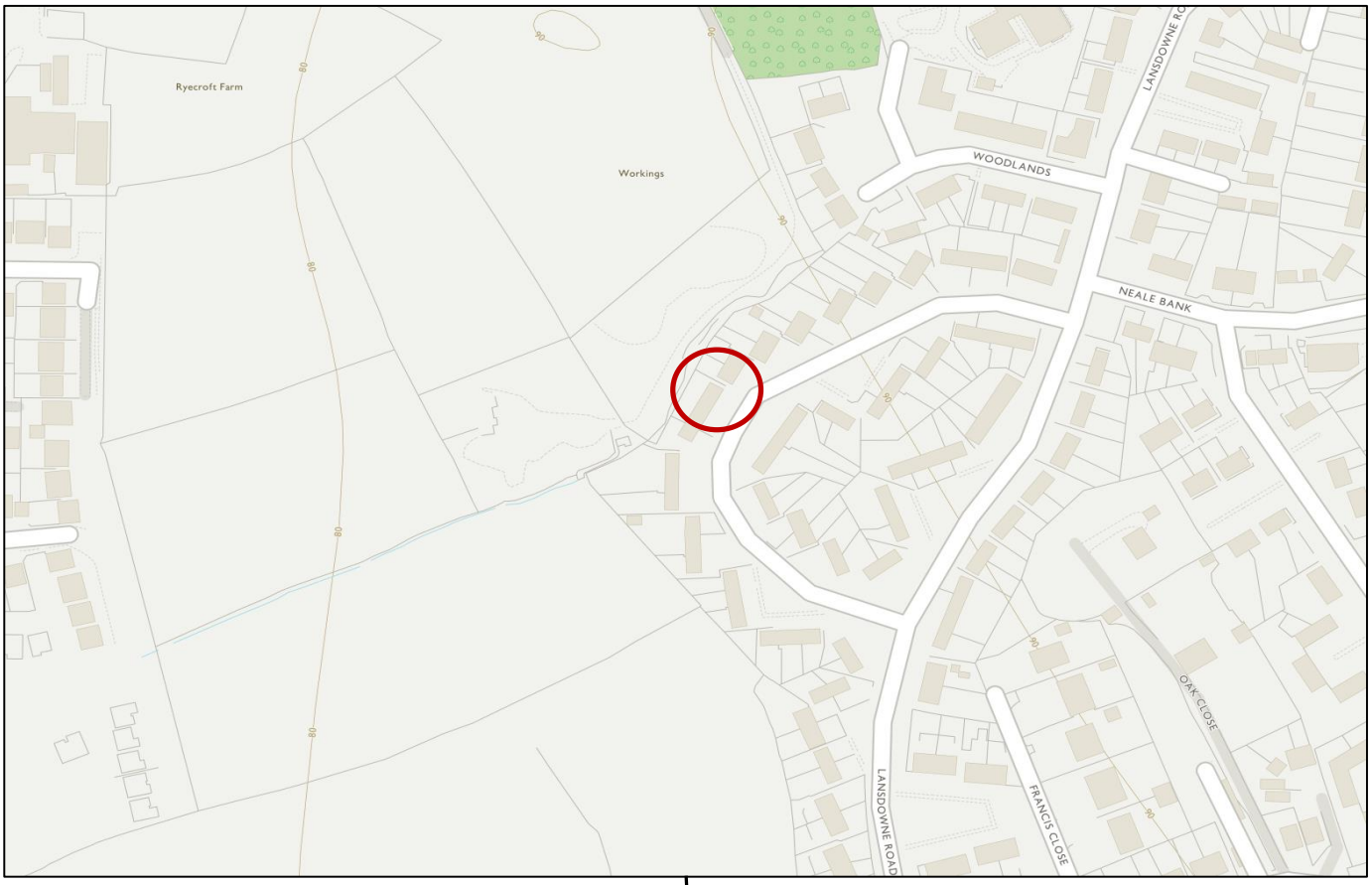
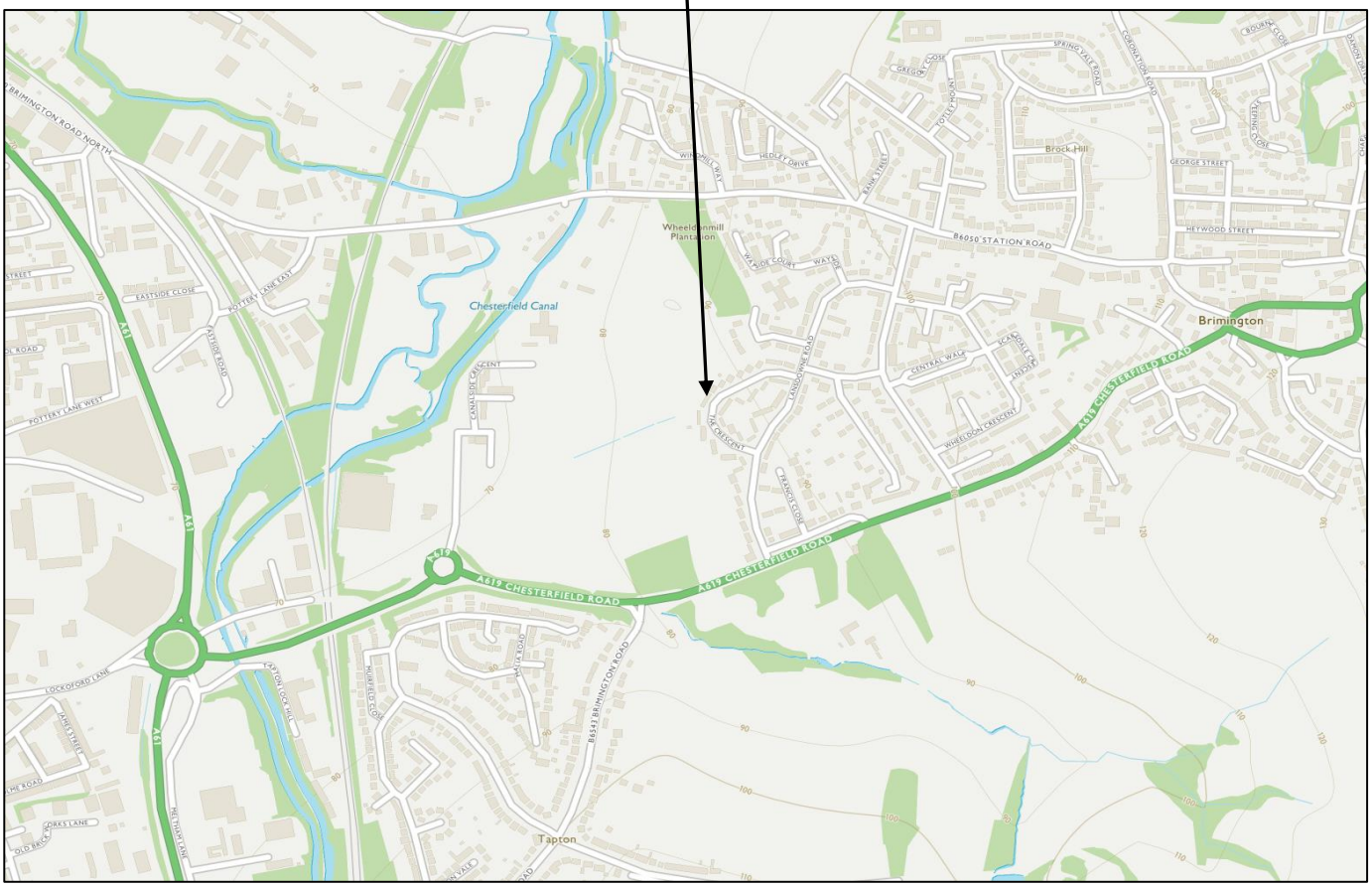
Nominal Section

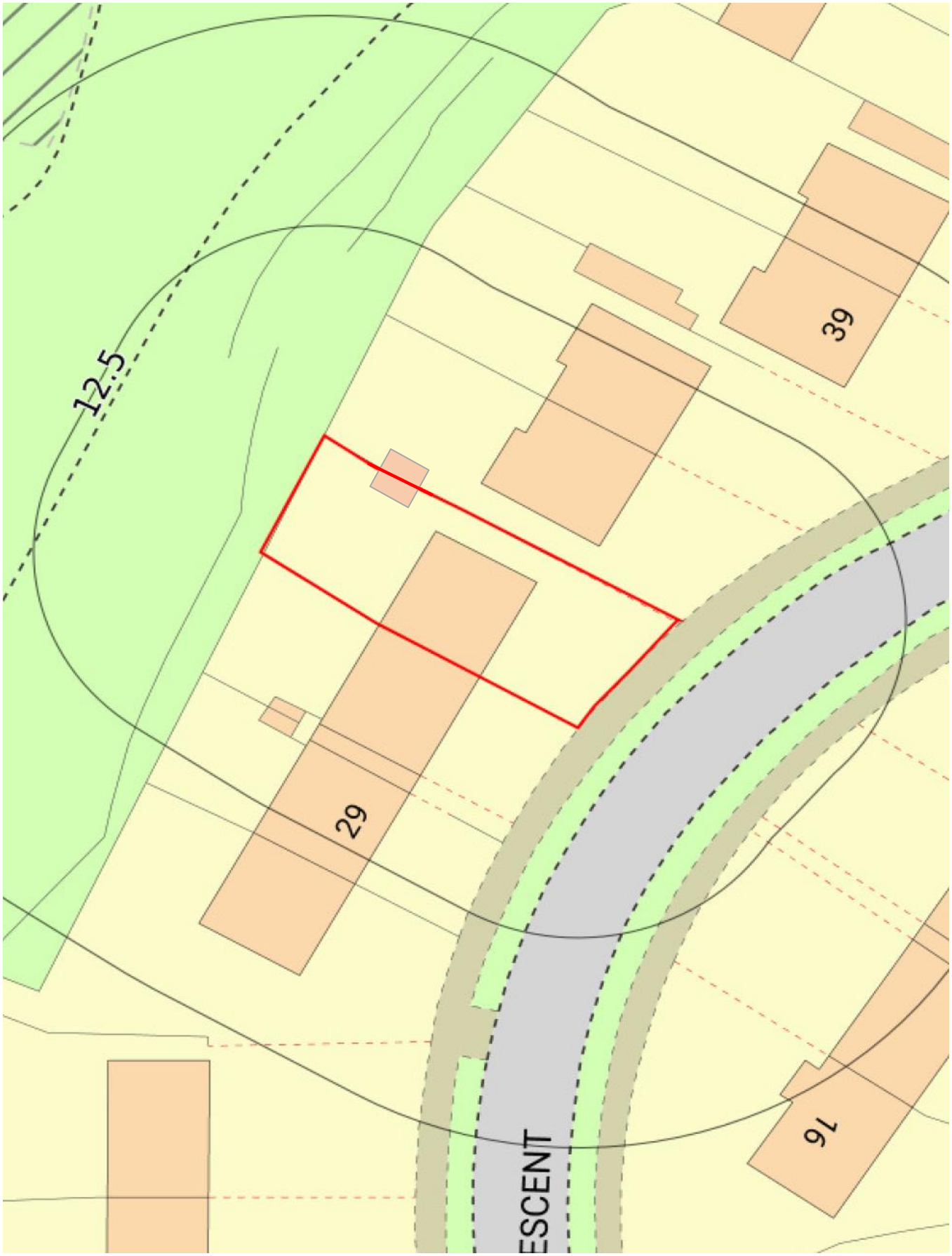
Site	Date Drawn	Date Checked	Sheet	Job Number
33 THE CRESCENT, BRIMINGTON, CHESTERFIELD	22/06/2021		1/1	NE4037A
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
CHESTERFIELD BOROUGH COUNCIL			1:40[V]	NE4047A.1

FIGURES





SUB SURFACE SITE INVESTIGATION AND SPECIALIST GEOTECHNICAL CONSULTANTS 3 Peel Street, Preston, PR2 2QS. Tel. (01772) 561135 Fax (01772) 204907	General Site Location			
Site 33 THE CRESCENT, BRIMINGTON, CHESTERFIELD	Date Drawn 09-Jun-21	Date Checked	Orientation N	Job No. NE4037
Client CHESTERFIELD BOROUGH COUNCIL	Drawn By TP	Checked By	Scale –	Figure No. 1



SUB SURFACE

SITE INVESTIGATION AND SPECIALIST GEOTECHNICAL CONSULTANTS

3 Peel Street, Preston, PR2 2QS. Tel. (01772) 561135 Fax (01772) 204907

Location Plan

Site	Date Drawn	Date Checked	Orientation	Job No.
33 THE CRESCENT, BRIMINGTON, CHESTERFIELD	09-Jun-21		N	NE4037
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
CHESTERFIELD BOROUGH COUNCIL	TP		_	2

SUB SURFACE

SITE INVESTIGATION AND SPECIALIST GEOTECHNICAL CONSULTANTS

3 Peel Street, Preston, PR2 2QS. Tel. (01772) 561135 Fax (01772) 204907

Borehole Location Plan

Site	Date Drawn	Date Checked	Orientation	Job No.
33 THE CRESCENT, BRIMINGTON, CHESTERFIELD	09-Jun-21		N	NE4037
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
CHESTERFIELD BOROUGH COUNCIL	TP		_	3