LITHOS

Land at North Moor View, Brimington

For Vistry Yorkshire

Report no: 3569/1

Date: March 2020

SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	3569	Site area/ha	6.7ha (16.5 acres))
Client:	Vistry Yorkshire	NGR:	SK 403 731
Site:	North Moor View, Brimington	Nearest postcode:	S43 1PL

The site is located off North Moor View, approximately 2.7km northeast of Chesterfield. The site can be considered as two distinct areas:

- Area A: a large cropped field (c. 6.5 ha).
- Area B: a car sales garage in the far north-west (c. 0.17ha).

Lithos were commissioned by Vistry to provide a geoenvironmental appraisal of the site, which it is understood is to be redeveloped with housing. Lithos' investigation included a review of the site's history and environmental setting, and a ground investigation comprising 32 trial pits and 7 window sample boreholes.

A summary of salient geoenvironmental issues is provided in the table below.

Issue	Remarks
Made ground	Only encountered within Riverside Motor Company (Area B) to a maximum depth of 0.7m (average 0.4m). Typically comprised a sandy Gravel of clinker, brick, burnt shale, sandstone and mudstone in the south, and macadam hardstand in the north underlain by a firm gravelly clay.
Natural ground	Natural strata comprise Residual Soils - slightly sandy slightly gravelly Clay) and slightly clayey slightly sandy Gravel. Bedrock was encountered within every exploratory hole from depths of between 0.4m and 3.2m (average 1.3m). Sandstone was encountered beneath almost all of Area A, other than in the far east (TPs 1 to 3), where mudstone was encountered
Contamination	A hot-spot of fuel contaminated soil has been identified in the area surrounding the waste oil tank within Area B. An elevated concentration of B(a)P was also recorded within WS03. Elsewhere, the made ground is essentially "clean", but contains materials (e.g. concrete, clinker and brick), which would generally be considered undesirable as a near-surface material in garden areas. If made ground is retained in Area B no cover is required, other than a nominal 300mm topsoil to support plant growth. If made ground is relocated to Area A it can only be redistributed below hardstanding and plots and cannot be placed in garden areas. Topsoil in Area A is considered suitable for re-use.
Mining & quarrying	The site lies within a Coal Authority Low Risk Area. There are no known quarries at or adjacent to the site.
Hazardous gas	Radon protection is not required, but the Developer might consider providing new dwellings with basic measures in light of Public Health England advice.
Preparatory works	Area A: Topsoil Strip and stockpile Area B: Demolition of existing building & grubbing up of surface hardstand Decommissioning and removal of waste oil tank.
Foundations	All plots at the site will be founded on traditional strip and trench fill foundations at a minimum depth of 0.9m within firm to stiff Clays or bedrock.
Groundwater & excavations	Groundwater seepages were recorded within 3 exploratory holes between 0.6m and 0.9m depth. Excavations should remain stable in the short term. Excavation greater than 1.5m is likely to prove difficult across about 50% of the site due to the presence of sandstone bedrock.
Flooding & drainage	The EA indicate that the site is not located within an indicative floodplain. Sandstone was encountered beneath almost all of Area A and soakaways may provide a suitable drainage solution for surface water run-off at the site. However, no testing has been undertaken to date.
Highways	Both natural and made ground across the site should give a CBR value of at least 3%, although this should be confirmed prior to, or during, redevelopment.

Significant developer abnormals relating to geoenvironmental issues at the site are:

- Demolition of existing buildings/foundations and grubbing up of hardstand within Area B.
- Ground improvement – turnover of the full thickness of made ground within Area B, in order to deal with contamination and remove buried obstructions

CONTENTS

APPENDICES

Appendix A - General notes

01	Environmental setting
02	Ground investigation fieldwork
03	Geotechnical testing
04	Contamination laboratory analysis & interpretation

Appendix B - Drawings

Drawing	Revision	Title
3569/1	-	Site location plan
3569/2	-	Proposed site layout
3569/3	-	Site features
3569/4	-	Site photographs
3569/5	-	Preliminary conceptual site model
3569/6	-	Exploratory hole locations (Area A)
3569/6A	-	Exploratory hole locations (Area B)
3569/7	-	Revised conceptual site model
3569/8	-	Geological Fault

Appendix C - Commission

Appendix D - Historical OS plans#

Appendix E - Search responses#

From	Date	Content
Landmark	03 12 2019	Environmental search data
Coal Authority	03 12 2019	Mining report

Appendix F & G - Exploratory records

Appendix F	TP01 to TP32
Appendix G	WS01 to WS07

Appendix H - Contaminated land assessment for selection of water supply pipes

Appendix I - Chemical test results

Appendix J - Geotechnical test results

Some of this data is not included within the paper or PDF copies of this report; by request, it can be provided on a CD.

FOREWORD (geoenvironmental appraisal report)

This report has been prepared for the sole internal use and reliance of the Client named on page 1. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Lithos Consulting Limited (Lithos); such authorisation not to be unreasonably withheld. If any unauthorised third party comes into possession of this report, they rely on it at their peril and the authors owe them no duty of care and skill.

This report has been reviewed by a Competent Person, as defined in the National Planning Policy Framework. We ensure that all projects are managed by individuals with necessary experience, relevant qualifications, and current membership of a relevant professional organisation. Records of engineers, project managers and reviewers involved in this project are maintained by us. Lithos QA/QC procedures for all our work forms an integral part of our ISO9001 accreditation and as such is regularly audited.

The report presents observations and factual data obtained during our site investigation and provides an assessment of geoenvironmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from Lithos prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. Lithos cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context. However, it should be noted that in order to keep the number of sheets of paper in the hard copy to a minimum, some information (e.g. full copy of the Landmark/Groundsure Report) is not included in the pdf, by request, it can be provided on a CD.

The findings and opinions conveyed in this report (including review of any third-party reports) are based on information obtained from a variety of sources as detailed within this report, and which Lithos believes are reliable. Reasonable care and skill has been applied in examining the information obtained. Nevertheless, Lithos cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

The report represents the findings and opinions of experienced geoenvironmental consultants. Lithos does not provide legal advice and the advice of lawyers may also be required.

Intrusive investigation can only investigate shallow ground beneath a small proportion of the total site area. It is possible therefore that the intrusive investigation undertaken by Lithos, whilst fully appropriate, may not have encountered all significant subsurface conditions. Consequently, no liability can be accepted for conditions not revealed by the exploratory holes. Any opinion expressed as to the possible configuration of strata between or below exploratory holes is for guidance only and no responsibility is accepted as to its accuracy

It should be borne in mind that the timescale over which the investigation was undertaken may not allow the establishment of equilibrium groundwater levels. Particularly relevant in this context is that groundwater levels are susceptible to seasonal and other variations and may be higher during wetter periods than those encountered during this commission.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

This report assumes that ground levels will not change significantly from those existing at present and that houses will be of two storey construction. If this is not to be the case, then some modification to this report may be required.

Lithos cannot be responsible for the consequences of changing practices, revisions to waste management legislation etc that may affect the viability of proposed remediation options.

Lithos reserve the right to amend their conclusions and recommendations in the light of further information that may become available.

GEOENVIRONMENTAL APPRAISAL

of land at

NORTH MOOR VIEW, BRIMINGTON

1 INTRODUCTION

1.1 The commission and brief

1.1.1 Lithos Consulting Limited were commissioned by Vistry Yorkshire to carry out a geoenvironmental appraisal of land at North Moor View, Brimington.

1.1.2 Correspondence regarding Lithos' appointment, including the brief for this investigation, is included in Appendix C. The agreed scope of works included:

- A site walkover and inspection
- An assessment of the land use history
- Determination of the site's environmental setting
- A mining risk assessment in accordance with Coal Authority guidance.
- An intrusive ground investigation comprising 32 trial pits and 7 window sample boreholes
- Assessment of the geotechnical properties of the near surface deposits to enable provision of foundation and highway recommendations
- A qualitative assessment of contamination risks
- Recommendations for the necessary site preparatory and remediation works

1.1.3 Primary aims of this of investigation were to identify salient geoenvironmental issues affecting the site to support the submission of a planning application, and also to enable Vistry to obtain budget costs for: foundations; gas protection measures; and site preparatory and remediation works.

1.2 The proposed development

1.2.1 It is understood that consideration is being given to redevelopment of the site with 150 domestic dwellings, associated gardens, POS and adoptable roads and sewers. A site layout has been provided by Whittam Cox Architects (Drawing reference SK-007, dated October 2019) which is reproduced as Drawing 3569/2 in Appendix B to this report.

1.3 Report format and limitations

1.3.1 All standard definitions, procedures and guidance are contained within Appendix A, which includes background, generic information on:

- Assessment of the site's environmental setting
- Ground investigation fieldwork
- Geotechnical testing
- Contamination testing

1.3.2 General notes and limitations relevant to all Lithos geoenvironmental investigations are described in the Foreword and should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

1.3.3 In accordance with the agreed scope of works, the ground investigation reported here is not fully compliant with Eurocode 7 (EC7) and this report does not purport to be a Ground Investigation Report, nor a Geotechnical Design Report as defined by EC7. The ground appraisal, parametric assessment and preliminary design guidance presented are intended to assist others as they prepare the design of the proposed works.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site's location is shown on Drawing 3569/1 presented in Appendix B to this report. Site details are summarised in the table below.

Detail	Remarks
Location	2.4 km northeast of Chesterfield town centre
NGR	SK 403 731
Approximate area	6.7ha (16.5 acres)
Known services	Overhead and below ground electric in the far northwest

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on the 12th December 2019.

2.2.2 Existing salient features, at the time of the walkover are presented on Drawing 3569/3 in Appendix B to this report and summarised in the table below.

Feature	Remarks
Current Access	Off Chesterfield Road in the north to access Riverside Motor Company, off North Moor view in the east to access the fields.
Topography	Gentle slope of 1 in 23 to the west
Approximate areas	200m² buildings 1,000m² tarmac hardstand 65,750m² grass
Nature of boundaries	North, east and west – miscellany of garden fences South- no physical boundary
Surrounding land uses	North, northwest & northeast - housing, Riverside Motor Company and A1 Viaduct Auto Salvage Southeast, south & southwest – open fields

2.2.3 The site can be divided into two distinct areas based on current land use, shown on Drawing 3569/3:

- Area A: Cropped agricultural field (6.5 ha)
- Area B: Car sales garage in the far north (0.17 ha)

2.2.4 A selection of site photographs is included on Drawing 3569/4.

Area A

2.2.5 Area A can be accessed in the east via a metal gate off North Moor View.

2.2.6 Area A currently comprises a single cropped field. Two public footpaths cross the site; the first footpath runs northeast to southwest, the second footpath runs east to west. The two footpaths meet in the west of site where the field can be accessed via a single tracked road off Briar View in the northwest.

2.2.7 The topography of the site slopes gently to the west (average slope of 1 in 23 west).

2.2.8 The majority of boundaries to Area A comprise a miscellany of fences from adjacent houses and businesses. There is no boundary along the south of the site.

Area B

2.2.9 Area B can be accessed off Chesterfield Road in the north and currently comprises 'Riverside Motor Company'- a car sales garage.

2.2.10 The south of Area B lies around 2m topographically higher than the north. The southern area is level with the adjacent fields (Area A). The north of Area B is level with Chesterfield Road. A sloped embankment with a tarmacked road links the two.

2.2.11 The southern half of Area B is surfaced with a macadam gravel, the north of the area is surfaced with a macadam hardstand.

2.2.12 A building (c. 200m^2) exists in the centre west and can be divided into three separate areas based on construction materials and current use.

2.2.13 The southern area of the building is labelled as a 'valeting bay', however, according to the current tenant, this area has been utilised for storage in the last 10 years.

2.2.14 The central area of the building is used as a workshop for vehicles to be sold at the site. This includes the repairing of body work, changing oil filters etc. A waste oil heater was noted in the northeast corner of this area. Some spillages were evident around the base of the burner, where cardboard was laid to soak up some of the fuel. A ramp to lift the cars up is present in the southern half of this area.

2.2.15 The northern area of the building is currently used for sales, comprising an office and a waiting area.

2.2.16 To the south of the building is an above ground waste oil tank. It is understood after talking with the tenant, the tank has not been in use for the last 9 years, however, is known to contain fuel. The tank appeared sealed, however, some spillage to the south was noted.

2.2.17 Elsewhere across Area B, the site is used as a forecourt for the parking and selling of cars.

2.2.18 Palisade fencing divides Area A & B in the south and southwest, a decorative metal fence borders Area B elsewhere.

3 SITE HISTORY

3.1 Site centred extracts from Ordnance Survey (OS) plans dating back to 1877 have been examined. Some of these plans are presented in Appendix D to this report.

3.2 The table below provides a summary of the salient points relating to the history of the site. It is not the intention of this report to describe in detail all the changes that have occurred on or adjacent to the site. Significant former uses/operations are highlighted in bold text for ease of reference.

Date	Site	Surrounding land
1877	Open fields	Open fields with some buildings to the east Ivy Cottage 70m southwest Almond Place 80m northwest
1898	Public footpath running northeast to southwest then forking from Cotterill Lane to Ivy Cottage and Cotterill Lane to Almond Place	No significant changes
1916	No significant changes	Below ground tank in the northwest corner, adjacent to Area B Pump 20m west of tank
1938	Building labelled garage constructed in the northwest	Housing developed in the east on Manor Road
1962	No significant changes	Housing developed in the northwest, works 60m northwest
1984		Tank no longer shown, addition of houses in replacement
1992	Additional footpath running east to west linking Cotterill Lane, Top Pringle Close and North Moor View	Housing build along northern boundary

3.3 No significant changes have occurred on the site or within surrounding land since 1992.

4 ENVIRONMENTAL SETTING

4.1 General

4.1.1 Notes describing how the site's environmental setting has been assessed are included in Appendix A to this report. Extracts from the response received from Landmark, and responses from the Coal Authority, the BGS and the Environment Agency are presented in Appendix E. These responses are summarised below, together with the findings of our own "desk study" investigation.

Issue	Data reviewed	Summary
Geology	1:50,000 BGS map (Sheet 112) 1:10,000 BGS map (Sheet SK47SW) BGS Memoir/Technical Report	Drift – none recorded. Solid – Pennine Lower Coal Measures. Shallowest coal seam – Mickley Thin (Upper Brampton) Thin Coal at about outcrops approx. 220m south of site depth beneath site unknown. Strata dip – 1.2 degrees northwest. Faults – Fault running northeast to southwest through centre of site, dipping east.
Mining	Coal Authority	This site is located within a Coal Mining Development Low Risk Area (within the defined coalfield, but no known defined risks have been recorded by the Coal Authority; there may still be unrecorded issues) Past and present workings – none recorded. Opencast – unlicensed opencast 440m southwest. Mine entries – none recorded.
Quarrying	Historical OS plans	None within 1km
Landfills	Envirocheck Report	No known landfills within 250m.
Radon	Public Health England	The site lies in an area where 1-3% of homes are estimated to be above the action level.
Hydrogeology	Environment Agency	Groundwater Source Protection Zone? none. Aquifer - Secondary A Aquifer (Solid). Groundwater abstractions? None of significance to site. Soil leaching potential - High. Pollution incidents? None of significance to site.
Hydrology	Environment Agency Envirocheck Report	Nearest watercourse(s) – Tinker Sick 130m south, part of the Rother, Spittal Brook to Doe Lea catchment Water quality - moderate. Pollution incidents? None of significance to site (only if relate or significant to site). Abstractions? None of significance to site. Discharge consents? None of significance to site.
Flood risk	Environment Agency	The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency)

5 GROUND INVESTIGATION DESIGN

5.1 Anticipated ground conditions & potential issues

5.1.1 Based on the data reviewed in Section 4 (Environmental Setting) anticipated ground conditions are expected to comprise:

Anticipated condition	Remarks
Made ground	Thin veneer anticipated in the vicinity of Riverside Motor Company.
Natural soils	Likely residual soils (gravelly Clay) to a shallow depth (c.2.0m)
Bedrock	Pennine Lower Coal Measures Bedrock anticipated from a shallow depth c.2.0m
Groundwater	Likely perched in shallow residual soils and deep in bedrock (Secondary A aquifer)

5.1.2 Based on the data above and that in Sections 2 (Site Description) and 3 (History), potential ground-related issues associated with this site are likely to include:

Type of issue	Specific issue	Remarks
Potential on-site contamination sources	1. Made ground 2. tanks	1. Veneer of made ground in Area B 2. Waste oil tank with noted spillages, organics (hydrocarbons)
Potential off-site contamination sources	1. Former fuel tank	1. organics (hydrocarbons)
Potential geotechnical hazards	1. None	1. None
Other potential constraints	1. Overhead and underground Electric utility	1. Will need rerouting and/or easement

5.2 Preliminary conceptual site model

5.2.1 A preliminary conceptual site model, presented as Drawing 3569/5 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 5.1 inclusive of this report.

5.2.2 Historical plans show that the majority of the site (Area A) has been occupied by arable farmland which is not considered likely to have caused significant ground contamination. Nonetheless, activities such as slurry spreading, the discharge of chemicals to ground, and unregulated burial have all occurred on farmland. Potential pollutants associated with farming activity might include any of the following:

Agricultural activity	Potential contaminant
Plant & animal protection	Pesticides & herbicides
Soil conditioners	Metals, sulphates, PAH
Naturally occurring contaminants	Arsenic, metals

5.2.3 Whilst it is likely that pesticides have been applied during arable use of the land, these are not likely to include the persistent organochloride pesticides such as Dieldrin, Aldrin, DDT etc. Pesticides routinely used on arable crops in the UK (Phenoxy Acetic acid herbicide or PAAH) rapidly degrade in soils or leach via rainwater infiltration to groundwater. It is highly unlikely these would be detected by soil sampling and therefore these have not been included within the proposed sampling suite.

5.2.4 Use by the Riverside Motor Company in the north (Area B) may have given rise to some contamination. An assessment of potential contaminants associated with the former uses has been undertaken. As a consequence of this assessment, anticipated potential contaminants, within soil and/or groundwater include:

- Inorganics (metals, asbestos)
- Organics (fuels/oils, PAH)

5.2.5 Potential pollutant linkages are shown on the preliminary conceptual site model.

5.3 Ground investigation design & strategy

5.3.1 The preliminary conceptual site model was used as a basis for design of an appropriate ground investigation, the scope of which is summarised below.

Exploratory holes	Purpose
TPs 1 to 28	To determine the general nature of soils underlying the site, including the: • Nature, distribution and thickness of shallow soils, including any made ground • Suitability of the ground for founding structures and highways
WSs 1 to 7	To determine the general nature of soils underlying the Riverside Motor Company, including the: • Nature, distribution and thickness of made ground • Nature, degree and extent of contamination • Proportion of undesirable elements e.g. biodegradable matter, foundations etc • Suitability of the ground for founding structures and highways

5.3.2 Proposed exploratory hole locations were selected to provide a representative view of the strata beneath the site. A nominal 50m grid spacing was proposed across Area A, with a tighter (20m) spacing in Area B. Additional exploratory locations might be scheduled by the site engineer in light of the ground conditions actually encountered.

5.3.3 The number of representative samples taken will be reflective of the geological complexity actually encountered. However, in general about 3 samples will be taken from most pits.

6 FIELDWORK

6.1 Objectives

6.1.1 The original investigation strategy is outlined in Section 5.3 above.

6.1.2 The additional exploratory holes listed below were advanced in light of ground conditions actually encountered.

Exploratory holes	Purpose
Trial Pits 29 to 32	To enable better delineation of the depth and lateral extent of poor ground in the vicinity of TP22
Surface samples 1 to 3	To enable chemical assessment of tarmac hardstand within Riverside Motor Company (sample taken at less than 0.1m)
Surface samples 4 to 6	To enable an assessment of possible organic contamination in the vicinity of the fuel tank within Riverside Motor Company (sample taken at less than 0.1m)

6.2 Exploratory hole location constraints

6.2.1 Window sampling, with localised surface sampling) was the only practical investigation in Area B. It should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material). Furthermore, assessment of the strength of cohesive soils, via hand vane tests, is difficult due to disturbance caused by drilling.

6.3 Scope of works

6.3.1 Fieldwork was supervised by Lithos between the 27th and 29th January 2020 and comprised the exploratory holes listed below.

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs 01 to 32	0.7m to 3.3m	Vane tests in cohesive soils
Window sample boreholes	WSs 01 to 07	0.4m to 1.3m	
Sample pits	SPs 01 to 06	0.1m to 0.2m	Samples for chemical testing.

6.3.2 Notes describing ground investigation techniques, in-situ testing and sampling are included in Appendix A to this report.

6.3.3 Exploratory hole logs are presented in Appendices F & G to this Report. These logs include details of the:

- Samples taken
- Descriptions of the solid strata, and any groundwater encountered.
- Results of the in-situ testing
- The monitoring wells installed

6.3.4 Exploratory hole locations are shown on Drawing 3569/6 presented in Appendix B; hole positions are based on data from a hand-held GPS (typically +/- 3m accuracy) and have not been surveyed in.

7 GROUND CONDITIONS

7.1 General

7.1.1 A complete record of strata encountered beneath the proposed development site is given on the various exploratory hole records, presented in Appendices F & G.

7.1.2 The site can be divided into two areas based on ground conditions. These areas are shown on Drawing 3569/3 and are summarised below:

Site area	General location	Area (m^2)
A	Open fields	65,300
B	Car sales garage in the far north	1,700

7.1.3 Typical ground conditions encountered at the site are described below in Sections 7.2 (made ground) and 7.4 (natural ground), with a summary provided in the table on pages 11 & 12.

7.2 Made ground

7.2.1 Made ground was only encountered within Area B. The bulk of the made ground can be categorised as one of 4 broad types:

- Granular Made Ground: Encountered in 3 of 7 window sample holes in the south of area B to maximum depths between 0.2m and 0.4m. Typically comprises a sandy Gravel of mixed lithologies including sandstone, mudstone clinker and burnt shale.
- Cohesive Made Ground: Encountered in WS07 between 0.2m and 0.4m depth and comprised a dark grey Clay with gravel of brick, sandstone and mudstone.
- Reworked Natural Soils: Encountered within WS01 and WS02 in the south of Area B at between 0.3m and 0.7m depth. Typically comprised a firm dark brown slightly sandy Clay with gravel of included glass, brick, coal, burnt shale, sandstone and mudstone.
- Made Ground Topsoil: Encountered within WS04 to 0.2m depth comprising dark greyish brown Clay with gravel of plastic and sandstone.

7.3 Obstructions

7.3.1 Constraints associated with the existing building within Area B, and ongoing operations (car sales) have prevented trenching to identify and assess the nature/extent of buried obstructions. However, the existing buildings will have foundations (likely strip footings), and other below ground structures should be anticipated.

7.4 Natural ground

7.4.1 Natural ground was encountered in the majority of the exploratory holes, and typically comprised the following:

- Topsoil: Dark brown slightly gravelly Clay identified across Area A to an average depth of 300mm.
- Cohesive Residual Soils (firm to stiff Clay): Encountered within the majority of exploratory holes between depths of 0.3m and 2.8m and typically comprised a firm to stiff light orange and grey mottled slightly sandy slightly gravelly Clay with gravels of sandstone and mudstone.
- Granular Residual Soils (clayey Gravel): Encountered within the majority of exploratory holes beneath Cohesive Residual Soils and occasionally Weathered Coal Measures to depths between 0.9m and 3.2m. Typically comprised a light grey slightly clayey slightly

sandy Gravel of mudstone, or at further depths as a light brown slightly sandy Gravel of sandstone.

- Weathered Coal Measures (sandy Gravel): Encountered within 8 of 39 exploratory holes between cohesive and granular residual soils or less frequently directly above Coal Measures bedrock. Typically comprised a dark grey Mudstone, recovered as a slightly sandy angular fine to coarse gravel to a maximum depth of 2.2m. Within TP10, encountered between 0.5m and 1.0m depth as Sandstone, recovered as an angular tabular fine to coarse gravel with a high cobble content.

7.4.2 Coal Measures bedrock was encountered at the base of all exploratory holes across the site to depths between 0.4m and 3.3m (average depth to top 1.3m). Sandstone was encountered beneath almost all of Area A, other than in the far east (TPs 1 to 3), where mudstone was encountered.

7.5 Visual & olfactory evidence of organic contamination

7.5.1 Exploratory locations where evidence of significant organic contamination was noted are summarised below:

Area	Hole ID	Material	Depth (m)	Observation
B	SP04 to 06	Cohesive Made Ground (SP04 & 05), Made Ground Topsoil (SP06)	0.1m	Located adjacent to waste oil tank where visual and olfactory evidence of spillages were evident.

7.5.2 Selected samples of potentially contaminated materials were scheduled for chemical testing to determine the nature and extent of the identified contamination.

7.6 Groundwater

7.6.1 Groundwater seepages were encountered within WS06, TP24 and TP32 between 0.6m and 0.9m depth.

7.7 Stability

7.7.1 Stability of excavations was generally good.

7.8 Revised conceptual ground model (ground conditions)

7.8.1 The Preliminary Conceptual Site Model has been revised in light of data obtained during the ground investigation, most notably with respect to:

- The nature and distribution of made ground, including the presence of significant buried obstructions
- The strength, nature and depth of underlying natural strata
- The nature and distribution of contamination (based on visual/olfactory evidence only)

7.8.2 Further refinement of the Conceptual Site Model is presented in Sections 9.3, where the results of laboratory testing for contaminants have been considered.

Summary of Ground Conditions (Trial Pits, Area A)

Hole	Final depth	Made Ground Topsoil	Natural Soils (depth to base)				Depth to Top	Remarks
			Topsoil	Cohesive Residual Soil	Weathered Coal Measures	Granular Residual Soil	Coal Measures Bedrock	
TP01	2.4	-	0.4	1.7	2.1	2.3	2.3	Unable to excavate beyond 2.4m depth due to mudstone bedrock.
TP02	3.3	-	0.3	1.3, 2.8	-	2.5, 3.2	3.2	Unable to excavate beyond 3.3m depth due to mudstone bedrock.
TP03	2.3	-	0.3	2.2	-	-	2.2	Unable to excavate beyond 2.3m depth due to mudstone bedrock.
TP04	1.4	-	0.3	0.70	1.10	1.4	>1.4	Unable to excavate beyond 1.4m depth due to sandstone bedrock.
TP05	2.2	-	0.3	1.6	2.0	2.2	>2.2	Unable to excavate beyond 2.2m depth due to sandstone bedrock.
TP06	1.6	-	0.4	1.2	1.5	1.6	>1.6	Unable to excavate beyond1.6m depth due to sandstone bedrock.
TP07	2.5	-	0.3	1.8	-	2.5	>2.5	Unable to excavate beyond 2.5m depth due to sandstone bedrock.
TP08	2.1	-	0.3	1.8	-	2.1	>2.1	Unable to excavate beyond 2.1m depth due to sandstone bedrock.
TP09	1.3	-	0.4	1.3	-	-	>1.3	Unable to excavate beyond 1.3m depth due to sandstone bedrock.
TP10	2.0	-	0.3	0.5	1.0	2.0	>2.0	Unable to excavate beyond 2.0m depth due to sandstone bedrock.
TP11	2.1	-	0.3	1.0	-	2.1	>2.1	Unable to excavate beyond 2.1m depth due to sandstone bedrock.
TP12	1.6	-	0.4	1.0	-	1.6	>1.6	Unable to excavate beyond 1.6m depth due to sandstone bedrock.
TP13	2.0	-	0.4	1.6	-	2.0	>2	Unable to excavate beyond 2.0m depth due to sandstone bedrock.
TP14	2.2	-	0.3	2.0	-	2.2	>2.2	Unable to excavate beyond 2.2m depth due to sandstone bedrock.
TP15	1.9	-	0.3	1.6	-	1.9	>1.9	Unable to excavate beyond 1.9m depth due to sandstone bedrock.
TP16	2.7	-	0.4	2.1	-	2.0	>2.7	Unable to excavate beyond 2.7m depth due to sandstone bedrock.
TP17	2.4	-	0.4	2.2	-	2.7	>2.4	Unable to excavate beyond2.4m depth due to sandstone bedrock.
TP18	2.5	-	0.4	2.0	-	2.4	>2.5	Unable to excavate beyond 2.5m depth due to sandstone bedrock.
TP19	2.5	-	0.4	2.1	-	2.5	>2.5	Unable to excavate beyond 2.5m depth due to sandstone bedrock.
TP20	2.0	-	0.3	1.3	-	2.5	>2	Unable to excavate beyond 2.0m depth due to sandstone bedrock.
TP21	2.5	-	0.3	1.7	-	2.0	>2.5	Unable to excavate beyond 2.5m depth due to sandstone bedrock.
TP22	2.8	-	0.3	1.1	-	2.5	>2.8	Unable to excavate beyond 2.8m depth due to sandstone bedrock.
TP23	1.4	-	0.4	1.1	-	2.8	1.1	Unable to excavate beyond 1.4m depth due to sandstone bedrock.
TP24	0.9	-	0.3	0.9	-	-	>0.9	At 0.9m, groundwater seepage. Unable to excavate beyond 0.9m depth due to sandstone bedrock.
TP25	1.3	-	0.3	1.2	-	-	1.2	Unable to excavate beyond 1.3m depth due to sandstone bedrock.

Hole	Final depth	Made Ground Topsoil	Natural Soils (depth to base)				Depth to Top	Remarks
			Topsoil	Cohesive Residual Soil	Weathered Coal Measures	Granular Residual Soil	Coal Measures Bedrock	
TP26	1.4	-	0.3	0.4, 1.3	0.8	-	1.3	Unable to excavate beyond 1.4m depth due to sandstone bedrock.
TP27	1.5	-	0.4	0.8, 1.4	1.1	-	1.4	Unable to excavate beyond 1.5m depth due to sandstone bedrock.
TP28	2.2	-	0.4	1.4	2.2	2.1	>2.2	Unable to excavate beyond 2.2m depth due to sandstone bedrock.
TP29	0.9	-	0.3	-	-	0.9	>0.9	Unable to excavate beyond 0.9m depth due to sandstone bedrock.
TP30	0.7	-	0.3	-	-	-	0.3	Unable to excavate beyond 0.7m depth due to sandstone bedrock.
TP31	0.7	-	0.4	-	-	-	0.4	Unable to excavate beyond 0.7m depth due to sandstone bedrock.
TP32	1.3	-	0.3	1.1	-	1.3	>1.3	At 0.6m, groundwater seepage. Unable to excavate beyond 1.3m depth due to sandstone bedrock.

Summary of Ground Conditions (Window Samples, Area B)

Hole	Final depth	Depth to Base of Made Ground	Depth to Base of Made Ground					Natural Soils	Depth to Top	Remarks
			Tarmac Hardstand	Granular Made Ground	Cohesive Made Ground	Reworked Natural Soils	Made Ground Topsoil	Cohesive Residual Soil	Coal Measures Bedrock	
WS01	1.3	0.7	-	0.4	-	0.7	-	1.3	>1.3	Refusal at 1.3m depth on possible sandstone bedrock.
WS02	1.0	0.5	-	0.3	-	0.5	-	1.0	>1.0	Refusal at 1.0m depth on possible sandstone bedrock.
WS03	1.0	0.2	-	0.2	-	-	-	1.0	>1.0	Refusal at 1.0m depth on possible sandstone bedrock.
WS04	0.9	0.2	-	-	-	-	0.2	0.6	0.6	Refusal at 0.9m depth on possible sandstone bedrock.
WS05	0.4	0.2	0.2	-	-	-	-	0.3	0.4	Refusal at 0.4m depth on possible sandstone bedrock.
WS06	1.0	0.3	0.3	-	-	-	-	1.0	>1.0	At 0.6m, groundwater seepage. Refusal at 1.0m depth on possible sandstone bedrock.
WS07	0.9	0.4	0.2	-	0.4	-	-	0.9	>0.9	Refusal at 0.9m depth on possible sandstone bedrock.

8 CONTAMINATION (ANALYSIS)

8.1 General

8.1.1 The far north of the site (Area B) has formerly been used as a car sales garage, including a valeting bay and workshop, a waste oil tank is located to the south of the buildings. This previous land use is likely to have given rise to some (likely localised) contamination, particularly within the servicing area.

8.1.2 An assessment of potential contaminants associated with the former uses has been undertaken; see Section 5.2.

8.1.3 In the context of risks to human health associated with residential redevelopment, the Tier 1 Soil Screening Values referenced in this report have been derived via the CLEA default conceptual site model (CSM) used for generating SGVs, but amended, where appropriate, to be more specific to redevelopment within the planning process.

8.1.4 Screening values assume a residential with gardens end use, this is appropriate in Area A, however this is highly conservative in Area B, since the development plan indicates and access road and landscaping in Area B; further discussion in provided below.

8.1.5 Where available, Category 4 Screening Levels (C4SL) have also been referenced.

8.1.6 Generic Note 04 in Appendix A provides further details with respect to current guidance and the interpretation of analytical data.

8.2 Testing scheduled

8.2.1 Based on the above assessment, Lithos submitted a test schedule (summarised in the table below) to a UKAS accredited laboratory. Account has also been taken of visual and olfactory evidence recorded during the ground investigation.

Type of sample	No. of samples	Determinands
Made ground	12	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID TOC, Speciated Polycyclic Aromatic Hydrocarbons (PAH), Banded Total Petroleum Hydrocarbons (TPH)
Topsoil	9 5	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID Speciated Polycyclic Aromatic Hydrocarbons (PAH) Clay/sand/silt content and visible contaminants, sharps (glass etc) to check compliance with BS3882:2015
Natural soil	2	Banded Total TPH

8.2.2 Account was taken of previous uses in specific areas, with TPH analysis concentrated on samples recovered from the vicinity of the fuel storage tank within Area B.

8.3 Soil contamination results

8.3.1 The soil contamination test results are summarised in the tables on pages 14 to 17.

8.3.2 Laboratory test certificates as received from the laboratory are presented in Appendix I to this report.

Summary of degree of soils contamination (Area A inorganics and organics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in BLUE and assume a residential with gardens end-use.													
			pH	As ∞	B ~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg *	Ni	Se	Zn $	% TOC	PAH		Asbestos I.D.
															B(a)P ∞	Naphthalene	
				37	5	26	3000	200	200	169	127	350	200		5	8	
TP01	0.20	Topsoil	6.9	20	1.0	0.3	24	37	83	0.07	23	1.0	120	4.9	< 0.03	< 0.03	N.D.
TP03	0.10	Topsoil	6.5	22	1.5	0.4	25	52	99	0.12	27	1.3	140	7.2	< 0.03	< 0.03	N.D.
TP07	0.20	Topsoil	6.2	18	0.7	0.3	24	31	68	0.07	18	1.7	110	3.5	< 0.03	< 0.03	N.D.
TP09	0.10	Topsoil	6.5	19	0.8	0.5	22	41	80	0.08	19	2.6	140	6.3	< 0.03	< 0.03	N.D.
TP12	0.20	Topsoil	6.6	17	0.8	0.3	21	31	87	0.08	19	1.3	110	4.0	< 0.03	< 0.03	N.D.
TP16	0.30	Topsoil	6.6	18	1.0	0.3	23	38	80	0.11	19	1.0	110	4.1	< 0.03	< 0.03	N.D.
TP17	0.20	Topsoil	6.6	18	1.0	0.3	27	43	84	0.10	22	1.2	130	4.5	< 0.03	< 0.03	N.D.
TP21	0.20	Topsoil	6.9	19	0.9	0.3	29	42	95	0.14	21	0.9	130	5.3	< 0.03	< 0.03	N.D.
TP25	0.20	Topsoil	7.6	14	0.9	0.3	24	53	73	0.08	16	1.8	120	3.5	< 0.03	< 0.03	N.D.

Summary of degree of soils contamination (Area B inorganics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in BLUE and assume a residential with gardens end-use.										
			pH	As ∞	B~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg*	Ni	Se	Zn$	Asbestos
				37	5	26	3000	200	200	169	127	350	200	
WS01	0.20	Granular Made Ground	10.4	9.6	0.3	< 0.1	200	29	25	< 0.05	14	1.7	32	N.D.
WS03	0.10	Granular Made Ground	10.8	4.9	0.5	0.4	420	44	61	< 0.05	56	3.2	76	Chrysotile bundle
WS07	0.30	Cohesive Made Ground	10.4	7.9	1.3	< 0.1	12	81	33	< 0.05	14	0.6	46	N.D.
WS01	0.60	Reworked Natural	7.6	19	1.0	1.0	26	64	220	0.09	30	1.4	270	N.D.
WS02	0.40	Reworked Natural	7.1	18	1.4	0.7	18	63	170	0.07	21	0.9	190	N.D.
WS04	0.10	Made Ground Topsoil	7.4	14	0.4	0.6	17	32	100	< 0.05	22	1.9	240	N.D.

Key	
36	Parameter tested for and found to be in excess of Tier 1 value.
179	Parameter tested for and found to be > 5 x Tier 1 value.
12	Parameter tested for but not found to be in excess of Tier 1 value.
	Parameter not tested for.
♣	Tier 1 Value is pH dependent.
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI Tier 1 would be 21mg/kg.
ND	No fibres detected (asbestos screen)

Source of guidance trigger level	
With the exception of those annotated with one of the symbols below (∞, $, ~), all Soil Screening Values in brackets above have been derived using CLEA v1.06.	
∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).
$	MAFF. Code of Practice for Agricultural Practice for the Protection of Soil, 1998.
~	Engineering judgement (Lithos). Boron is a phytotoxic, although most phytotoxic compounds can pose a risk to human health if sufficient concentrations are present. However, plants represent the most sensitive receptor, and a Tier 1 value which is protective of flora is therefore also protective of human health.
*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.

Summary of degree of soils contamination (Area B organics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in BLUE and assume a residential without gardens end use.					
			% TOC	PAH		TPH - C6 to C40		
				B(α)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				5.3	9	34	154	2000
WS01	0.20	Granular Made Ground	0.8	0.87	< 0.03	-	-	-
WS03	0.10	Granular Made Ground	1.9	17	0.46	-	-	-
SP04	0.10	Granular Made Ground *	7.3	<0.03	<0.03	< 0.1	685	15400
SP05	0.10	Granular Made Ground *	6.5	<0.03	<0.03	< 0.1	813	14980
WS07	0.30	Cohesive Made Ground	9.8	0.37	< 0.03	-	-	-
WS01	0.60	Reworked Natural	5.6	0.04	< 0.03	-	-	-
WS02	0.40	Reworked Natural	4.5	0.07	< 0.03	< 0.1	48	480
WS04	0.10	Made Ground Topsoil	3.4	< 0.03	< 0.03	-	-	-
SP06	0.10	Made Ground Topsoil	-	-	-	< 0.1	47	322
WS06	0.10	Macadam Hardstand	-	6.2	< 0.03	-	-	-
WS07	0.10	Macadam Hardstand	-	6.1	< 0.03	-	-	-
SP01	0.10	Macadam Hardstand	-	5.4	4.1	-	-	-
SP05	0.20	Cohesive Residual Soil	-	-	-	< 0.1	69	971
SP04	0.2	Cohesive Residual Soil	-	-	-	<0.1	<30	<20

Key		Source of guidance trigger level	
60	Parameter tested for and in excess of Tier 1 concentration.	All Soil Screening Values in brackets above have been derived using CLEA v1.06. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
0.3	Parameter tested for but not in excess of Tier 1 concentration.	~	Assumes all GRO is aromatic fraction C7 to C8.
	Contaminant not tested for.	◊	Assumes all DRO is aliphatic fraction C10 to C12.
*	Spot sample for hydrocarbon contamination near fuel tank	∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).

Summary of degree of soils contamination (Area B organics) – revised screening values for low TOC

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in BLUE and assume a residential with gardens (and no cover) end use					
			% TOC	PAH		TPH - C6 to C40		
				B(a)P ∞	Naphthalene	GRO~ C_6 to C_{10}	DRO◊ C_{10} to C_{21}	LRO C_{21} to C_{40}
				4	4	15	67	1000
WS01	0.20	Granular Made Ground	0.8	0.87	< 0.03	-	-	-
WS03	0.10	Granular Made Ground	1.9	17	0.46	-	-	-
SP04	0.10	Granular Made Ground *	7.3	<0.03	<0.03	< 0.1	685	15400
SP05	0.10	Granular Made Ground *	6.5	<0.03	<0.03	< 0.1	813	14980

Key		Source of guidance trigger level	
60	Parameter tested for and in excess of Tier 1 concentration.	All Soil Screening Values in brackets above have been derived using CLEA v1.06. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
0.3	Parameter tested for but not in excess of Tier 1 concentration.	~	Assumes all GRO is aromatic fraction C7 to C8.
	Contaminant not tested for.	◊	Assumes all DRO is aliphatic fraction C10 to C12.
*	Spot sample for hydrocarbon contamination near fuel tank	∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).

Area A (Cropped field)

8.3.3 Of the 9 samples of topsoil analyses for organic and inorganic parameters, all can be classified as uncontaminated.

8.3.4 No asbestos fibres were identified within any of the 9 samples screened within Area A.

Area B (Garage)

Inorganic determinands

8.3.5 Of the 6 samples of made ground analysed for inorganic parameters, 4 can be classified as uncontaminated and 2 could be classified as contaminated.

8.3.6 These samples have been classified by comparison with Tier 1 Soil Screening Values for an end use including domestic gardens and any area where plants are to be grown (the most sensitive of the proposed end-uses).

8.3.7 The most common contaminants are Lead (220mg/kg in WS01) and Zinc (240mg/kg and 270mg/kg in WS04 and WS01).

8.3.8 Given the limited amount of made ground type(s) encountered, it was not possible to collect a sufficient number of soil samples from each ground type to enable meaningful statistical analysis. However, the elevated concentrations are only marginally above the residential with gardens screening value.

8.3.9 Furthermore, Zinc is a phytotoxic metal; phytotoxicity describes the inhibitive and toxic effect high concentrations of some substances can have on plant growth.

8.3.10 Most substances are harmful to human health at lower concentrations than would be detrimental to plant growth. However, there are three notable exceptions - boron, copper and zinc. Plants are the more sensitive receptor to these elements i.e. detrimental effects are seen in plants at concentrations which do not present a risk to human health. Consequently, for zinc, consideration and protection of flora would also be protective of human health.

8.3.11 Allowable concentrations of heavy metals in arable soils are set out in Defra's Code of Good Agricultural Practice 2009[1]. The value for zinc is 200mg/kg, and is based on a continued annual application of heavy metal rich fertiliser (sludge); as such it is not representative of activity in a standard UK garden.

8.3.12 Lithos have also derived a value for zinc in relation to risks to human health, using the CLEA model, assuming a residential end use with consumption of home grown produce in a sandy loam soil with 6% SOM. The reported value is 2,170mg/kg, ten times greater than the potential phytotoxic concentration.

8.3.13 Zinc is not considered to present a risk to human health nor it is considered likely, at the recorded concentration, to inhibit plant growth in gardens or landscaped areas.

8.3.14 Elevated lead was recorded in WS01 in made ground, however this was only marginally above Lithos' Tier 1 screening value of 200mg/kg.

[1] *Defra – Protecting our Water, Soil & Air – A Code of Good Agricultural Practice for farmers, growers and land managers. 2009*

Asbestos

8.3.15 Screening for asbestos identified fibres in 1 of the 6 samples tested within Area B. Supplementary analysis (asbestos quantification) of the sample was undertaken and confirmed that only trace amounts (<0.01%) of asbestos is present.

Organic determinands

8.3.16 Organic contamination was only detected in made ground. There is the possibility that made ground could be moved around site during development, as such organic determinants have been assessed against a residential setting, but without gardens (i.e. made ground could be redistributed below hardstanding, plots or in landscaped areas, but not placed in garden areas).

8.3.17 Lithos have used the CLEA model to derive risk-based screening values for hydrocarbons, in accordance with the methodology detailed by the TPHCWG, and reviewed by a UK workshop of experts with respect to UK adoption of the method.

8.3.18 However, these screening values assume a Soil Organic Matter (SOM) of 6% (equivalent to a TOC of 3.5%). Many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with lower screening values may be required.

8.3.19 In order to check the validity of Lithos' Tier 1 Soil Screening Values, the average TOC for each common fill type (beyond any areas of obvious hydrocarbon impact) have been determined.

Fill type	Typical TOC (%)	Comparison of soil results with revised screening value necessary?
Topsoil	4.8%	No
Made Ground Topsoil	3.4%	No
Cohesive Made Ground	9.8%	No
Granular Made Ground	1.4%	Yes, revised screening values adopted.
Reworked Natural	5%	No

Hydrocarbons (TPH & PAH)

8.3.20 Petroleum sources were identified within the preliminary conceptual model in Area B, and olfactory evidence of hydrocarbon contamination was noted surrounding the waste oil tank (SP04 & SP05, 0.1m depth).

8.3.21 Hydrocarbon contamination encountered here is likely due to leakage or spillage of fuel. Such contamination can be mobile and as such may pose a risk to the environment and human health.

8.3.22 A simple banded TPH was initially scheduled on 5 samples, including 2 samples of Granular Made Ground from the area surrounding the waste oil tank. Both samples of Granular Made Ground surrounding the tank yielded elevated concentrations of DRO and LRO, therefore supplementary full speciation was scheduled on these two samples.

8.3.23 Assessment of TPH has been undertaken in accordance with a 3-step approach, (outlined in Generic Note 04 in Appendix A). The first two steps involve review of speciated results. The third step assesses cumulative effects.

8.3.24 Step 1 – Consideration of Indicator Compounds, (BTEX, naphthalene & BaP). None of the Indicator Compounds exceed their respective Tier 1 criteria, therefore the more toxic / prevalent compounds are below their representative screening value and the next step can be undertaken to consider mixtures within the fractions.

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in BLUE and assume a residential with no gardens (currently proposed as an access road) with 6% SOM.					
			GRO				DRO	LRO
			Benzene	Toluene	Ethyl Benzene	Xylenes	Naphthalene	Benzo(a)pyrene
			3.3	2,700	843	321	9.0	5.3
SP04	0.1	Granular Made Ground	< 0.1	< 0.1	< 0.1	< 0.1	< 0.03	<0.03
SP05	0.1	Granular Made Ground	<0.1	<0.1	<0.1	<0.1	< 0.03	<0.03

8.3.25 Step 2 – TPH Fractions, does any individual fraction exceed Tier 1?. The DRO and LRO fractions do not exceed their respective Tier 1 criteria in either sample. The cumulative effects from fractions should therefore be considered.

8.3.26 Step 3 – Assessing Cumulative Effects. The third step of the assessment assesses the cumulative risk from all of the fractions identified. This is because each TPH fraction comprises a range of different substances, and a number of these can affect the same 'target organ' (i.e. cause skin irritation or affect the liver), resulting in cumulative effects.

8.3.27 The cumulative effect, associated with each source material, has been assessed via calculation of a Hazard Index (HI): HI < 1 indicates no cumulative effects; HI > 1, cumulative risk requires further consideration.

8.3.28 HI calculation results are presented in the table on page 21.

8.3.29 The results of this 3-step assessment are summarised in table below.

Sample	Made ground type	Initial TPH result	1 BTEX, etc	2 individual fraction	3 Cumulative effects	Remarks
SP04, 0.1m	Granular MG	Significantly elevated DRO & LRO	No	Yes, aliphatic C16-21, C21-35 and aromatic C21-35	HI = 2	'Hot-Spot'
SP05, 0.1m					HI = 2	

8.3.30 The HI is > 1 for both samples. Therefore, some remediation will be required.

8.3.31 In this case it is considered unlikely that dQRA will negate the need for remediation, or significantly reduce the volume of soil requiring treatment (likely a small isolated volume around the base of the tank). Visual observation of material below the surface samples indicated this was clean, supporting the likelihood of a localised surface hotspot.

TPH Cumulative Effects Assessment (Steps 2 &3)

Site Area/Hot -Spot	Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in BLUE and assume a residential with no gardens (currently shown as a proposed access road) end use.														Hazard Index
				Aliphatic							Aromatic							
				C5-C6	C6-C8	C8-C10	C10-C12	C12-C16	C16-C21	C21-C35	C5-C7	C7-C8	C8-C10	C10-C12	C12-C16	C16-C21	C21-C35	
				42	125	32	154	697	1.00E+05	1.00E+05	122	34	50	266	1.00E+03	2.00E+03	2.00E+03	
Fuel Tank	SP04	0.1	Granular Made Ground	< 0.01	< 0.01	< 0.01	2.1	19	210	7200	< 0.01	< 0.01	< 0.01	< 0.9	6.9	120	2800	2
	SP05	0.1	Granular Made Ground	< 0.01	< 0.01	< 0.01	2.4	20	210	6000	< 0.01	< 0.01	< 0.01	< 0.9	8.8	120	3000	2

Polycyclic Aromatic Hydrocarbons (PAH)

8.3.32 There are numerous PAH compounds. The USEPA identified 16 PAHs that are considered to represent the most problematic in terms of toxicology, fate and behaviour. The UK have also focused on these 16 and these are included in the laboratory report where speciated PAH analysis has been scheduled.

8.3.33 Speciated PAH analysis has been undertaken in order to determine concentrations of the key "marker" compounds: benzo(a)pyrene (considered the most toxic of the PAHs); and naphthalene (the most mobile and volatile of the PAHs).

8.3.34 Speciated analysis has confirmed the presence of elevated benzo(a)pyrene in one sample of made ground in Area B (17mg/kg cf 4mg./kg).

8.3.35 Other elevated B(a)P results are associated with the macadam hardstanding.

9 CONTAMINATION (QUALITATIVE RISK ASSESSMENT & REMEDIATION)

9.1 Topsoil (Area A)

9.1.1 Topsoil, typically 300mm thick underlies the entire site. Testing suggests this material is chemically suitable for re-use.

9.1.2 Given the nature of the topsoil present on this site it would be expected to be suitable to support plant growth.

Topsoil grading

9.1.3 The clay/sand/silt content and visible contaminants, sharps (glass etc) of 5 topsoil samples have been determined to check compliance with BS3882:2015[2] requirements. BS3882 considers visual contaminants to comprise 'undesirable potentially injurious foreign object(s) visible to the naked eye'.

9.1.4 It should be noted that this is a reduced suite of analysis, and no N-P-K etc. testing has been undertaken.

9.1.5 The results are summarised below:

Parameter	BS3882 Specification	TP01, 0.2m	TP09, 0.1m	TP12, 0.2m	TP17, 0.2m	TP25, 0.2m
Retained on 2mm sieve	< 30%	2.0	6.0	18	4.0	3.0
Retained on 20mm sieve	< 10%	<1.0	<1.0	<1.0	<1.0	<1.0
Retained on 50mm sieve	0%	<1.0	<1.0	<1.0	<1.0	<1.0
Clay content	5 to 35%	29	20	17	26	23
Silt content	0 to 65%	60	60	58	70	66
Sand content	0 to 90%	11	20	25	4	11
Visible contaminants	< 0.5%	<0.1	<0.1	<0.1	<0.1	<0.1

Notes
Values in bold type fail the required specification for multipurpose topsoil

[2] *BS3882:2015. Specification for topsoil. Published by BSI Standards Limited.*
[4] *CL:AIRE SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination (September 2014)*

9.1.6 The above results suggest that the majority of the topsoil at this site complies to the standards set out in BS3882. In terms of textural classification, the topsoil falls into the 'Silty Clay Loam' to 'Clay Loam' class, with the exception of TP17, 0.2m and TP25, 0.2m that marginally exceeds the permissible level of silt. However, the average silt content from the 5 samples is within the specified range.

9.2 Summary of significant contamination (Area B)

9.2.1 A veneer of made ground underlies Area B (Riverside Motor Company), which is typically less than 0.7m thick and typically comprises macadam hardstand underlain by a gravel or gravelly Clay. The gravel is of mixed lithologies including sandstone, mudstone and clinker.

9.2.2 A localised area of organic (hydrocarbon) contamination was located at the base of the waste oil tank (max TPH of 15,400 mg/kg) at 0.1m depth within Granular Made Ground. Speciated analysis confirms this comprises heavy, non-volatile aliphatic and aromatic fractions, indicative of highly weathered diesel and engine oil.

9.2.3 A slightly elevated lead concentration was also recorded in one sample of made ground.

9.3 Revised conceptual ground model (contamination)

9.3.1 The Preliminary Conceptual Site Model has been amended in light of data obtained during the ground investigation, most notably with respect to the distribution of made ground and contaminants.

9.3.2 A revised Conceptual Site Model is presented as Drawing 3569/7 in Appendix B. The Model includes the contaminants described in Section 9.2 above, and potential pollutant linkages (summarised below in Section 0) to receptors.

9.4 Environmental setting & end use

9.4.1 As discussed in Section 9.2 above, contamination exists in made ground beneath Area B. In order to assess the significance of this contamination, consideration must be given to the site's environmental setting and the proposed end use.

9.4.2 The underlying Pennine Lower Coal Measures bedrock is classified as a Secondary A aquifer. The nearest surface watercourse is the Tinker Sick 130m beyond the site's southern boundary. Therefore, the site's environmental setting is considered to be moderate to low sensitivity.

9.4.3 With respect to human health, the proposed end use (residential) is considered sensitive.

9.4.4 Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures, see Section 13.6.

9.5 Pollutant linkages

9.5.1 In terms of a proposed redevelopment of this site, plausible pollutant linkages can be summarised as follows.

Contaminants

9.5.2 Contaminants have been summarised in Section 9.2 above.

Pathways

9.5.3 Potential contaminant pathways include:

- Ingestion
- Dermal contact
- Migration of leachable components to groundwater

Receptors

9.5.4 Potential contaminant receptors include:

- The environment – Secondary A aquifer
- End users of the site (residents)

9.5.5 It can be concluded that there are plausible pathways between the soil contaminants summarised in Section 9.2 above and potential receptors. Consequently, some remediation will be required; either treatment/removal of the contaminant, or "breakage" of the pathway.

9.6 Potential remediation options

General

9.6.1 Given the constraints discussed in Section 6.2 (existing buildings across the majority of Area B), a simple post-demolition trial pit investigation will be required in this area before definitive recommendations are provided. However, at this stage it is considered unlikely that anything more than localised excavation of limited hydrocarbon impacted material and placement of made ground beneath areas of landscaping and hardstanding would be required.

9.6.2 Approval of the recommendations given below should be sought from the appropriate regulatory authorities prior to commencement of site redevelopment.

Asbestos

9.6.3 CL:AIRE has published a Joint Industry Working Group (JIWG) guidance[3] document with the support of the Health & Safety Executive which provides an explanation of how legal requirements of the Control of Asbestos Regulations 2012 have been interpreted to be more directly applicable to the risks associated with asbestos contaminated soil and construction & demolition materials.

9.6.4 Chrysotile fibres were identified in 1 of 15 samples of made ground screened for asbestos. Asbestos quantification has confirmed the positive result is associated with the presence of trace amounts of fibre (<0.001%) and is therefore of limited significance. Risks associated with trace amounts of asbestos are considered negligible providing made ground is retained in landscaped corridors along the highway in Area B or distributed below hardstanding.

9.6.5 Whilst not identified during the ground investigation, any fragments of asbestos cement sheeting encountered during the excavation works, should be gathered by hand and placed in double sealed bags. Personnel involved in this activity must be equipped with an appropriate respirator (i.e. a FFP3 or better), in addition to their "standard" PPE. The bags of asbestos waste should be placed in a sealed skip for off-site disposal at a suitably licensed landfill site; such material will be classified as hazardous waste.

9.6.6 It should be noted that ACMs were commonly used as shuttering beneath concrete slabs, and to form ducts, and it is important that this is kept in mind when breaking through concrete slabs.

9.6.7 Consequently, in line with the principles of sustainable development, there should be no need to export any soil from site.

9.6.8 See also comments in the 'Waste Classification' Section below.

Organic contamination

9.6.9 As discussed in Section 9.2 above, localised hydrocarbon contamination has been encountered, this did not include volatile fractions and is mostly consistent with engine oil. However, oils can be mobile and could pose a risk to the environment and human health.

9.6.10 Based on a qualitative review of the data obtained to date and site observations, it is considered that a relatively localised area of grossly contaminated soil will require excavation and disposal from site.

9.6.11 The made ground in Area B also contains materials (e.g. concrete, brick and glass) which would generally be undesirable as a near-surface material in garden areas. Therefore, made ground should only be placed in landscaped areas along the highway corridor in Area B and below hardstanding and plots.

[3] *Control of Asbestos Regulations 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction & Demolition materials: Industry Guidance*

9.7 Summary of potential pollutant linkages & mitigation

9.7.1 In terms of the proposed redevelopment plausible pollutant linkages, and feasible remediation options, can be summarised as follows:

Receptors	Pathways	Contaminants	Plausible pollutant linkage? (and remediation options where required)
Human health (Future residents) ◊	Consumption of contaminated vegetables	Low levels of metals and hydrocarbons in the made ground	Yes. Localised excavation of hydrocarbon impacts soils for disposal off site Isolation of made ground beneath hardstand or plots, also in landscaped areas long landscaped corridors. No made ground in garden areas.
	Ingestion		
	Dermal contact		
	Inhalation (dust)		
	Infiltration of water supply pipes		
Groundwater	Migration of dissolved and/or free phase organics	Hydrocarbons (leaking from tanks, and/or spills)	

◊ transient risks to construction workers will be addressed by the adoption of appropriate health and safety measures in accordance with the Health and Safety at Work Act 1974 and regulations made under the Act including for example the COSHH Regulations.

9.8 Waste classification

Area A

9.8.1 Some excess arisings (topsoil & subsoil) may be generated by excavations for foundations, sewers etc. If these are intended for retention and reuse on the site, they would be classed as clean naturally occurring soils and would not be considered waste, under the Waste Framework Directive.

9.8.2 Off-site disposal of surplus clean naturally occurring soils to landfill is not recommended. In accordance with the CL:AIRE Code of Practice[4] any excess natural soil arisings should be suitable for Direct Transfer to another development site, for use either as clean cover material, or bulk fill for use, without the need for waste legislation to be applied.

Area B

9.8.3 Disposal of the made ground off site is generally not considered appropriate, economically viable, nor in line with current Government philosophy regarding sustainable development. However, some excess arisings may be generated by excavations for foundations, sewers etc.

9.8.4 Following excavation and stockpiling, sampling will be required prior to disposal.

9.8.5 As there is no WRAP protocol for soils, the characterisation, sampling and classification of soils arising from brownfield sites has been incorporated within the Environment Agency's Technical Guidance WM3[5]. Classification of soils as non-hazardous or hazardous in accordance with WM3 is quite a complex process, although it ultimately results in a simple classification as hazardous or non-hazardous. Note: inert is not a class under WM3; WAC testing is required to determine whether a waste soil can be considered inert.

[4] The Definition of Waste: Development Industry Code of Practice. CL:AIRE, 2011.
[5] Technical Guidance WM3 – Guidance on the classification and assessment of waste. Environment Agency 2015

9.8.6 If waste soil is classed as hazardous following classification under WM3, and destined for landfill, waste acceptance criteria (WAC) leachate testing will need to be undertaken. Similarly, if waste soil destined for landfill is classed as non-hazardous under WM3, and suspected to be inert, WAC leachate testing will need to be undertaken. However, non-hazardous soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required.

9.8.7 WAC analysis is different to the 'routine' laboratory testing (such as that included earlier in this Section) undertaken in order to determine hazardous properties. Lithos typically only include WAC analysis if significant off-site disposal (of soil classified as hazardous waste) is anticipated.

9.8.8 It is critical if material is to be exported from site that this is allocated an appropriate waste code, following the steps within WM3. Waste carriers transporting, and sites accepting, this material should have a corresponding code within their permits. It is the responsibility of those generating the waste (i.e. the site), to ensure that the waste is handled and disposed of appropriately.

9.8.9 Soil treatment facilities (STFs) provide an alternative to landfill. STFs are regulated by the Environment Agency and allow soils to be treated and screened (effectively recycled to be used at other sites). Export to an STF does not require WAC testing and suitability of various soil types will be dependent on material waste codes, which may be allocated after consideration of the data in Section 8 but will often need supplementing with further testing after soils have been stockpiled (see also advice in Section 13.3).

9.8.10 Most STFs are permitted to accept soils with waste code 17 05 04 (i.e. soils which do not exhibit hazardous properties). Lithos has a list of permitted STFs and can help identify one local to this development site.

9.8.11 With respect to asbestos, waste soils will be classed hazardous if the soil mass contains more than 0.1% asbestos fibres that are free and dispersed. However, WM3 states that where the waste contains identifiable pieces of asbestos (i.e. any particle of a size that can be identified as potentially being asbestos by a competent person if examined by the naked eye), then the waste is hazardous if the concentration of asbestos in the pieces alone is 0.1%. If a stockpile of soil contained rare fragments of broken asbestos-cement sheeting, the whole stockpile would be classed as hazardous unless all the fragments could be picked-out (even though the concentration of asbestos in the soil mass might be orders of magnitude less than 0.1%).

9.8.12 As discussed in Section 7.2, tarmac hardstand is present.

9.8.13 This tarmac could be recycled and crushed to yield a 6F3 selected granular material, provided the recovered bitumen content is less than 10% (determined in accordance with BS598-1:2011). Crushed tarmac could also be blended with crushed concrete etc to generate 6F2 graded material. 6F2 can contain up to 50% recycled tarmac/asphalt (provided it does not pose a contamination risk to controlled waters and, if the proportion of asphalt is greater than 20%, the recovered bitumen content is less than 2%).

9.8.14 However, if off-site disposal is anticipated, tarmac assessment is based on the amount of coal tar present, this will vary depending on the age of the tarmac. The assessment is based on the amount of benzo(a)pyrene and has a concentration limit of 50mg/kg.

9.8.15 Speciated PAH analysis has been undertaken on 3 samples of tarmac and BaP concentrations were all < 50mg/kg. Consequently, tarmac is likely to fall within waste code 17 03 02:

- 17 - Construction and Demolition wastes,
- 03 – bituminous mixtures, coal tar and tarred products
- 02 – bituminous mixtures other than those mentioned in 17 03 01

9.8.16 This is a mirror non-hazardous entry. This code along with this supporting report, in particular the laboratory results, should be used to complete a paper trail documenting disposal routes for tarmac.

9.8.17 Contractors exporting waste from the site should review the site investigation data and make their own assessment. Alternatively, Lithos could undertake this assessment once exported waste streams have been identified.

10 HAZARDOUS GAS

10.1 Methane & carbon dioxide

10.1.1 The site is not believed to be affected by sources of hazardous gas generation as it is:

- Not located within 250m of a known former or current landfill site or backfilled feature (e.g. quarry, pond, canal etc)
- Neither underlain by shallow mineworkings nor located in an area considered susceptible to mines gas emissions
- Not underlain by a significant thickness of made ground
- Not underlain by peat or shallow chalk deposits

10.2 Radon

10.2.1 Requirements with respect radon measures are set out in Building Regulations Approved Document C. Probability bandings (based on the proportion of properties in a given area that exceed the Action Level; currently 200 $Bq.m^{-3}$) are used to determine whether a property requires no, basic or full measures.

10.2.2 At present Approved Document C advocates basic measures for the probability banding 3% to 10% (full measures if >10%). However, Public Health England would like to see all new build include basic measures.

10.2.3 The Public Health England UK radon map and the Landmark report indicate that the site is in an area where between 1% and 3% of homes are estimated to be above the action level.

10.2.4 Consequently, basic radon protection measures are not required. However, in light of Public Health England advice, the Developer might consider providing all new dwellings with basic radon protection measures.

11 GEOTECHNICAL TESTING

11.1 General

11.1.1 A total of 21 samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.

11.1.2 The geotechnical laboratory test results are presented in Appendix J to this report.

11.2 Atterberg limits

11.2.1 The plasticity indices of 15 samples of cohesive soil have been determined; results are summarised below.

Soil type	No. samples tested	Moisture content range (average)	Range of Plasticity Indices* (average)	Shrinkability
Cohesive Residual Soils	15	14-34 (22)	10-44 (25)	Low to high (medium on average)

* Modified where appropriate in accordance with Chapter 4.2 of the NHBC Standards

Note. The term Shrinkability is equivalent to the term Volume Change Potential used in Chapter 4.2.

11.2.2 Two of 15 samples tested yielded plasticity indices >40% (high shrinkability) and 4 of 15 samples tested yielded plasticity indices <20% (low shrinkability). The majority of the samples tested yielded plasticity indices between 20% and 40% (medium shrinkability). Therefore, for the purposes of foundation design, it is recommended that all cohesive soils be regarded as being of medium shrinkability.

11.3 Soluble sulphate and pH

11.3.1 In accordance with BRE Special Digest 1:2005, this site has been classified as predominantly greenfield with a mobile groundwater regime (Area A), the far north of the site is classified as brownfield with a mobile groundwater regime (Area B).

11.3.2 It is envisaged foundations will extend to depths of about 0.9m through made ground and natural strata and samples taken from this depth range have been submitted for pH and water-soluble sulphate (2:1 soil/water extract).

11.3.3 The concentrations of sulphate in the aqueous natural soil extracts of 21 samples were determined. In addition, 6 samples of made ground and 9 samples of topsoil were tested as part of the contamination suite. The pH value of each sample has also been determined.

11.3.4 The highest water-soluble sulphate concentration and the lowest pH value for each soil type analysed are shown in the table below.

Soil type	No. samples tested	Lowest pH values	Highest soluble sulphate concentration (mg/l)
Topsoil	9	6.2	-
Made Ground Topsoil	1	7.4	-
Granular Made Ground	2	10.4	-
Cohesive Made Ground	1	10.4	-
Reworked Natural	2	7.1	-
Cohesive Residual Soils	15	5.3	40
Granular Residual Soils	6	5.3	130

11.3.5 Two samples of Cohesive Residual Soils and one sample of Granular Residuals Soil yielded pH values below 5.5, therefore supplementary analysis to determine the concentrations of magnesium, chloride and nitrate was scheduled.

11.3.1 The equivalent sulphate concentrations of chloride and nitrate have been calculated (SO_4 equivalent of Cl = Cl x 1.35mg/l; SO_4 equivalent of NO_3 = NO_3 x 0.77mg/l). Given that the sulphate concentrations are all <3,000 mg/l, consideration of magnesium is not required.

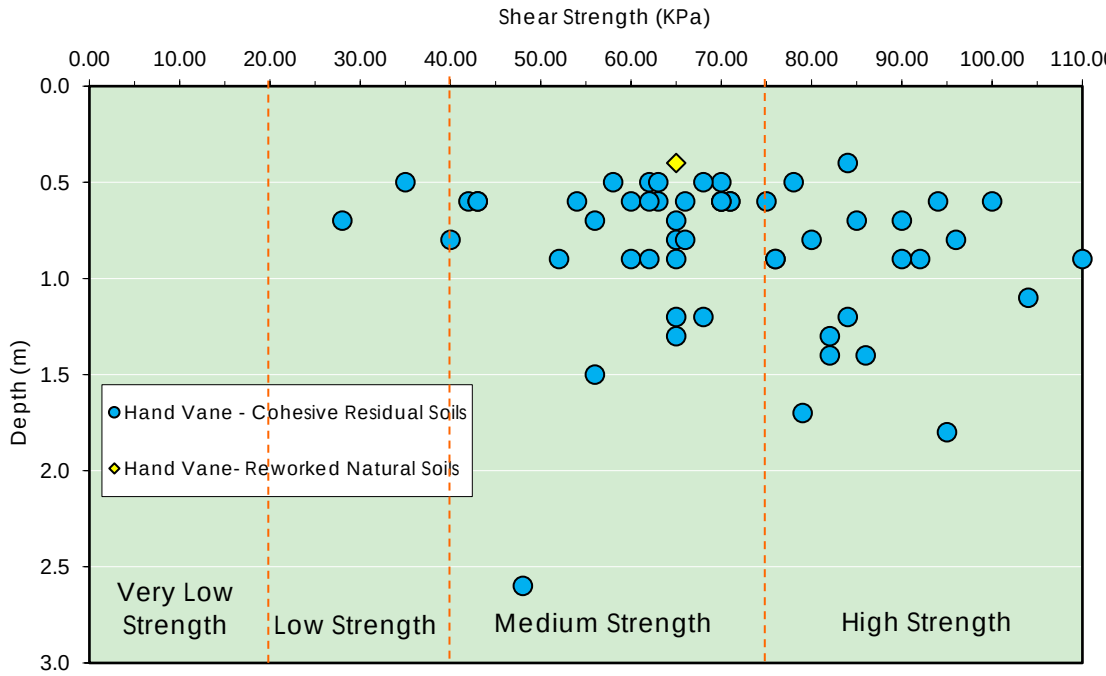
11.3.2 In accordance with Tables C1 and C2 of SD1, sub-surface concrete should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-2z.

Hand shear vane testing

11.3.3 Hand shear vane testing was undertaken within trial pits in-situ to around 1.2m depth and from larger blocks of excavated clay below that depth.

11.3.4 The results are summarised within the plot below and illustrate the Cohesive Residual Soils have a shear strength within the medium and high strength ranges (40kPa to >75kPa), with the exception of two readings taken within TP22 at 0.5m and 0.7m depth.

11.3.5 The plot below provides a summary of undrained shear strengths.



12 GEOTECHNICAL ISSUES

12.1 Conceptual site model

12.1.1 Within Area B, made ground was encountered within all exploratory holes and predominantly comprised a clayey gravel of sandstone, mudstone and clinker. Macadam hardstand is present between 0.2m and 0.3m depth across this area.

12.1.2 Natural strata comprise Residual Soils, slightly sandy slightly gravelly Clay and slightly clayey slightly sandy Gravel. Weathered bedrock (dark grey mudstone) was also found interbedded within the cohesive and granular residual soils.

12.1.3 Bedrock was encountered within every exploratory hole from depths of between 0.4m and 3.2m (average 1.3m). Sandstone was encountered beneath almost all of Area A, other than in the far east (TPs 1 to 3), where mudstone was encountered.

12.1.4 A geological fault runs northeast to southwest across the western half of the site.

12.2 Mining & quarrying

12.2.1 This site is located within a Coal Mining Development Low Risk Area.

12.2.2 There are no known quarries on, or within 50m of the site.

12.3 Site regrade and/or ground improvement

12.3.1 Made ground currently underlies Area B in the far north of site, to an average depth of 0.4m; maximum of 0.7m. This made ground contains materials (e.g. clinker, coal, etc), which would generally be considered undesirable as a near-surface material in garden areas.

12.3.2 Consideration should be given to turnover (excavation, screening and replacement in engineered layers) of the full thickness of made ground beneath Area B. Turnover is considered an appropriate ground improvement solution since significant excavation of the made ground will be required in any case to remove the soil/fill grossly contaminated with hydrocarbons (and relict foundations) in order to enable highway construction.

12.3.3 Screened and engineered fill should yield CBR values in excess of 3%, thereby reducing abnormals associated with the construction of estate roads and car parking areas. Excavations through the engineered fill, for drainage etc and foundations will not encounter significant obstructions or grossly contaminated ground and should be stable with little overbreak.

12.4 Foundation recommendations

General

12.4.1 Foundation recommendations assume that development will be two or three storey construction and that line loads will not exceed 90kN/m. If this is not the case significant alteration to these recommendations will be required.

12.4.2 We have assumed that final development levels will not differ significantly from ground levels existing at the time of investigation. Any digital terrain modelling undertaken, or commissioned, by Vistry should consider implications for the foundation recommendations outlined below.

12.4.3 Made ground is not considered a suitable foundation material and foundations should therefore be taken through these materials into underlying natural strata of adequate bearing capacity.

12.4.4 Sub-surface concrete in contact with the made and natural ground should be Design Sulphate Class DS-1, with the site allocated an ACEC Classification of AC-2z.

Strip/trench fill footings

12.4.5 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for all of the two or three storey houses constructed at the site. Footings will be founded in residual soils or competent rock

12.4.6 Reinforcement, as a precaution against differential settlement, is recommended only where foundation excavations encounter significant lateral and vertical variations in strata. One layer of B385 mesh placed 75mm above the base of the footing is likely to provide suitable reinforcement, but further advice should be sought from the Structural Engineer.

12.4.7 In order to minimise softening and swelling of cohesive soils or loosening of granular soils, it is recommended that footings are cast as soon as formation level is reached (or alternatively formation could be blinded using concrete with as low a water:cement ratio as possible).

12.4.8 Vistry or their groundworker should seek further advice from Lithos if unexpected ground conditions are encountered in foundation or sewer excavations, including any conflict between soft ground associated with a backfilled trial pit excavation and the line of a proposed footing.

Granular soils (sand & gravel)

12.4.9 The granular soils are assumed to have a relative density of at least medium dense (in accordance with BS5930:2015).

12.4.10 A safe bearing capacity of at least 150kPa, allowing a maximum foundation line load of 90kN/m run, can be assumed if the following are true:

- A foundation length of 10m
- A foundation breadth of 0.6m
- A foundation thickness of 225mm
- A foundation depth of 0.6m
- An angle of shearing resistance of ϕ=32° for the granular deposits

12.4.11 Assuming the foundation geometry detailed above, minimal settlements would be anticipated. This is considered likely to be acceptable, however, further advice should be sought from the Structural Engineer responsible for foundation design.

12.4.12 In accordance with NHBC Standards, a minimum founding depth of 450mm is required in the granular soil (due to potential frost susceptibility). This depth should be taken from finished ground level to the underside of the footing. If finished ground level is to be above existing ground level then the foundation excavation simply needs to ensure that there is sufficient depth of excavation to allow casting of the footing entirely within natural ground (not made ground or topsoil).

12.4.13 However, if the excavation is dug from original ground level in cold conditions when freezing is expected, then foundation depth should be taken from the existing, not finished, ground level.

12.4.14 It should be noted that founding at shallow depth (450mm), whilst desirable from an excavation stability viewpoint, may not provide sufficient bearing capacity due to the lesser depth of (resisting) overburden. Consequently, a minimum founding depth of 600mm is recommended.

12.4.15 It should also be noted that the footing may require deepening or stepping in order to allow plot drainage to exit the plot footprint (either over or under the footing).

Weathered Coal Measures (Granular Soils)

12.4.16 The weathered in-situ mudstone and sandstone (sand, gravel and cobbles) is assumed to have a relative density of at least medium dense (in accordance with BS5930:2015).

12.4.17 A safe bearing capacity of around 150kPa, allowing a maximum foundation line load of 90kN/m run, can be assumed if the following are true:

- A foundation length of 10m
- A foundation breadth of 0.6m
- A foundation thickness of 225mm
- A foundation depth of 0.45m depth
- An angle of shearing resistance of ϕ=34° for the granular deposits

12.4.18 Assuming the foundation geometry detailed above, minimal settlements would be anticipated. This is considered likely to be acceptable. However, further advice should be sought from the Structural Engineer responsible for foundation design.

Cohesive Residual Soils

12.4.19 Clay classification tests suggest that natural cohesive soils at the site should be regarded as being of medium shrinkability. A minimum founding depth of 900mm is therefore recommended for all soils on the site where strip footings are proposed.

12.4.20 In accordance with NHBC Standards, founding depths in cohesive soils should be taken from original or finished ground level, whichever is the lower, to the underside of the footing.

12.4.21 A safe bearing capacity of around 150kPa, allowing a maximum foundation line load of 90kN/m run, can be assumed if the following are true

- A foundation length of 8m
- A foundation breadth of 0.6m
- A foundation thickness of 225mm
- A foundation depth of 0.9m depth
- An undrained shear strength of 50kPa for the firm clay (typical minimum recorded on site)

12.4.22 Assuming the foundation geometry detailed above, minimal settlements would be anticipated. This is considered likely to be acceptable. However, further advice should be sought from the Structural Engineer responsible for foundation design.

Coal Measures Bedrock

12.4.23 The bedrock is generally considered to have a safe bearing capacity of at least 300kPa and minimal settlements would be anticipated.

12.4.24 Where rock is encountered at shallow depth foundations should be placed entirely on rock and not partially on rock and partially on soil. This may, depending on surface gradient, necessitate significant overdeepening of foundations.

Geological fault

12.4.25 Drawing 3569/3 shows the approximate line of the fault superimposed on the proposed housing layout; the fault crosses through the centre of site running northeast to southwest.

12.4.26 It should be noted that the line of a fault on a geological map is often very approximate, and it may be inaccurate by 10m or more. Furthermore, the presence of a fault is usually 'masked' by overlying residual soils; they can only be seen where long trenches are excavated into bedrock.

12.4.27 At this site, no movement associated with past, present or future mining is anticipated, therefore building can take place over the fault, without the need to search for the fault, and without the need to adopt special precautions in the footings of those plots suspected to lie in the vicinity of the fault.

12.4.28 However, NHBC like to see reinforcement of footings with one layer of B385 mesh placed 75mm above the base of the footing. Given the uncertainty regarding the precise line of the fault, it would be prudent to reinforce the footings of all plots within 25m of its assumed line; i.e. Plots 03 to 08, 83, 140 and 150.

12.4.29 Further advice should be sought if a significant weak zone is encountered (e.g. ground comprising loose, broken or soft 'gouge' material) during the excavation of footings. If associated with a fault, the weak zone is likely to form a fairly continuous "linear belt", rather than a localised "pocket", and be anything from a few centimetres to a few metres in width.

12.5 Floor slabs

12.5.1 Suspended floor slabs should be utilised where the depth of made ground or engineered stone exceeds 600mm in accordance with NHBC Standards Chapter 5.1 (to negate potential settlement problems).

12.5.2 It is considered that the natural ground is generally suitable for the use of ground bearing floors. However, ground bearing slabs should not be cast on topsoil. Where plots are elevated for design reasons, the depth of engineered stone below a ground bearing slab should not exceed 600mm, in accordance with NHBC guidance.

12.5.3 The natural ground beneath this site includes cohesive soils and is therefore subject to seasonal variation in moisture content. If ground slabs were constructed on desiccated soil, heave of the slab would occur on re-hydration of the ground. If any significantly desiccated soil is present, a suspended floor slab, with sub-floor void will be required.

12.5.4 It should be noted that NHBC have suffered a significant number of claims resulting from the use of ground bearing floor slabs. Consequently, if ground bearing slabs are proposed, care should be taken to ensure correct and careful construction. For example, if fill to the internal face of the foundation excavation is not properly compacted, subsequent settlement can result in cracking of the slab.

12.6 Designated concrete mixes

12.6.1 Designated mixes are considered in BRE Special Digest SD1 and BS 8500 -1:2015+A1:2016. However, in addition to soil chemistry (sulphate class), there are a number of other considerations relating to structural design that need to be taken into account when determining an appropriate concrete mix.

12.6.2 Consequently, Vistry should seek advice from their appointed Structural Engineer.

12.7 Excavations

12.7.1 Groundwater should be controlled in accordance with CIRIA report 113 "Control of Groundwater for Temporary Works".

12.7.2 Based on the results of the investigation it is considered *unlikely that major groundwater flows will be encountered in shallow excavations.

12.7.3 Excavations should remain stable in the short term but if left open for any significant period of time may require shoring.

12.7.4 Bedrock was encountered in all exploratory holes. Based on the exploratory hole logs, excavation greater than 1.5m is likely to prove difficult across about 50% of the site. It would therefore be prudent to allow for excavation of hard rock in any deep excavations such as those that may be required for drainage etc.

12.8 Drainage

12.8.1 Sandstone was encountered beneath almost all of Area A, from depths of between 0.4m and 3.2m (average 1.3m). Consequently, soakaways may provide a suitable drainage solution for surface water run-off at the site. However no testing has been undertaken to date.

12.8.2 It may be necessary to consider alternative sustainable drainage systems (SUDS), and there may be a need for surface water balancing.

12.8.3 Alternative SUDS options (see CIRIA C753:2015 for further details) include:

- Swales – linear grassed features in which surface water can be stored or conveyed. Where suitable, swales can be designed to allow infiltration.
- Infiltration basins – vegetated depressions designed to store runoff and infiltrate it gradually into the ground.
- Pervious Pavements – provide a surface suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate into subsurface storage, with subsequent infiltration or controlled discharge. Pavement could be porous (water able to infiltrate across entire surface material; e.g. reinforced grass), or permeable (water infiltrates via joints between concrete blocks).
- Ponds – designed to have permanent pool of water, but with capacity to provide temporary storage-controlled discharge.

12.8.4 Yorkshire Water have published a guide[6] for developers and designers outlining their design requirements for surface water attenuation assets.

12.8.5 With respect to detention basins, which should normally be dry, water table levels should be taken from borehole monitoring wells over 4 consecutive seasons, for at least 3 points in the basin area. The detention basin should be designed to ensure that there is a minimum of 1m of unsaturated soil between the maximum groundwater level and the lowest part of the structure.

12.8.6 Ground conditions must be suitable to allow free drainage from the detention basin all year round by having regard to groundwater levels, and impermeable liners are not to be used.

[6] *Design Requirements for Surface Water Attenuation Assets, February 2017.*

12.8.7 It is Lithos' understanding that ground does not have to be free-draining (i.e. sands/gravels), but where clay is present the basin needs to be designed to prevent waterlogging - because this renders maintenance (grass cutting) difficult. It would be prudent to seek confirmation of this from Yorkshire Water and/or the appointed drainage designer.

12.8.8 Appropriate design usually comprises a fall across the short axis (to centre of basin), and then along the long axis (possibly inclusive of a pipe in gravel trench) to the outfall.

12.8.9 The guide also discusses required access to flow control chambers, large diameter (i.e. >900mm) surface water storage pipes, and surface water storage tanks.

12.9 Highways

12.9.1 The natural soils present at shallow depth (anticipated formation) are predominantly cohesive. Based on visual inspection of the natural materials and the recorded plasticity indices at the site, published tables[7] indicate that the Residual soil deposits would be expected to provide a CBR value of at least 3%. This value should be verified prior to or during construction.

12.9.2 Whilst the CBRs estimated above should be achievable, significant deterioration during/after periods of significant rainfall and/or site trafficking is likely. Consequently, it would be prudent to consider flexibility in the groundworks programme to enable highway construction during prolonged dry/warm weather (typically between May and September) when formation will be least vulnerable to deterioration. Alternatively, a minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) could be placed along the line of proposed highways to protect formation during the construction phase.

12.10 External works

12.10.1 Any digital terrain modelling undertaken, or commissioned, by Vistry should be made available to their Engineering Designer prior to issue of an External Works Drawing.

13 REDEVELOPMENT ISSUES

13.1 General

13.1.1 This report has presented options with respect to foundation solutions, treatment of contamination, re-use of topsoil etc that are considered technically feasible and in line with current good practice. Consequently, we would expect to obtain regulatory approval for whichever option is adopted, although this cannot be guaranteed. Copies of this report should be forwarded to the relevant regulatory authorities (Warranty Provider & Local Authority) for their comment/approval.

13.1.2 Even after an appropriate preliminary investigation and ground investigation, with exploratory holes on a closely spaced grid (say trial pits at 30m centres), a geoenvironmental appraisal is typically based on inspection of the ground underlying less than 0.5% of the total site area (and much less at depths in excess of about 3.5m). Consequently, there is always a possibility that unanticipated ground conditions will be encountered during the construction phase.

13.1.3 If unanticipated ground is encountered during the construction phase, the Contractor should immediately seek further advice from the Engineer.

[7] *Interim Advice Note 73/06 Revision 1 (2009), Chapter 5. Characterisation of Materials Design Guidance for Road Pavement Foundations - Draft HD25*

13.2 Remediation strategy

13.2.1 Whilst a detailed remediation strategy report is unlikely to be required, preparation of a Remediation Statement would be prudent and should include:

- Demolition of the existing buildings within Area B
- General site clearance of surface materials and vegetation
- Topsoil strip & stockpile (Area A)
- Break-up of hardstand (Area B)
- Simple post demo SI (Area B only)
- Excavation of the hot-spot of fuel-contaminated soil (Area B)
- Turnover full thickness of made ground in Area B
- Redistribute made ground below hardstanding, plots or landscape corridors or replace below highway in engineered layers

13.2.2 Whilst this site does not require large-scale remediation works, it is strongly recommended that, in advance of the anticipated infrastructure groundworks, the hot-spot of fuel-contaminated soil is delineated, 'chased-out' by excavation, and placed in a designated stockpile. This work should be supervised by a suitably qualified geoenvironmental engineer such as Lithos. Given the site's relatively small size, failure to complete such works before groundworks begin is likely to result in the generation of excessive volumes of material that are unsuitable for retention on site.

13.2.3 Stockpiles of fuel-contaminated soil should be located in an area where they will not constrain subsequent works before the material's fate has been determined, agreed and actioned.

13.2.4 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed. See also comments in Section 9.8 regarding asbestos.

13.2.5 Immediately prior to demolition of the garage buildings in Area B, current legislation (as outlined in HSG 264) requires a pre-demolition (formerly Type 3) asbestos survey to be undertaken. The Contractor should request a copy of the survey report from Vistry.

13.2.6 It is strongly recommended that the demolition contractor should chase-out all significant buried structures, and survey-in the resultant excavations before making them safe by backfilling. At the very least, relevant features should be surveyed-in before "hiding" them beneath a veneer of rubble. Similarly, it would be prudent to complete a drainage survey prior to blading rubble across the site to leave it safe and secure.

13.2.7 A minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) could be placed along the line of proposed haul roads to provide a firm and stable running layer for the subsequent construction works.

13.3 Control of excavation arisings

13.3.1 Made ground in Area B should not be mixed with any natural soil arisings. The groundworker should carefully segregate (and stockpile separately) made ground from arisings of "clean" natural soils, in order that an excessive volume of unsuitable material is not generated.

13.3.2 It should be ensured that the groundworker understands the need for good materials management. Most notably the importance of not mixing different materials within a given stockpile; i.e. there should be separate stockpiles of: topsoil; grubbed-up concrete hardstand; tarmac; fuel-contaminated soil; excess clean, natural soil arisings; general construction waste etc.

13.3.3 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed. See also comments in Section 9.8 regarding asbestos.

13.3.4 Made ground arisings could be:

- redistributed beneath concrete oversite, or areas of hardstanding, where they would be satisfactorily isolated from end users
- Isolated beneath the 300mm thick cover layer in landscaped corridors (with the exception of fuel contaminated soil)
- Exported from site to a suitably licensed landfill facility

13.3.5 Natural ground arisings should be suitable for use as subsoil.

13.4 Good practice guidance

13.4.1 The construction phase groundworker should follow good environmental practice to minimise the risks of spillage, leakage etc with reference, but not limited, to the following documents:

- CIRIA C502 'Environmental Good Practice on Site'
- EA Pollution Prevention Guidelines[8]:
  - PPG6 - Working at construction and demolition sites
  - PPG2 - Above ground oil storage tank
  - PPG7 – The safe operation of refuelling facilities.
  - PPG21 – Incident Response Planning

13.4.2 Site preparatory works associated with this project are likely to involve the re-use of both natural and made ground soils on site. Therefore, the Contractor should prepare a Materials Management Plan (MMP) in accordance with the CL:AIRE Code of Practice (v2, March 2011).

13.4.3 The MMP will document how all of the materials to be excavated during the proposed site preparatory and remediation earthworks are to be dealt with.

13.5 New utilities

13.5.1 It is strongly recommended that all statutory service bodies are consulted at an early stage with respect to the ground conditions within which they will lay services in order to enable them to assess at an early stage any potential abnormal costs.

13.5.2 It is recommended that trenches for services including site drainage and water supply are cut over size in order to isolate pipe materials from potential contaminants and to enable maintenance to be conducted in "clean" material.

13.5.3 Water Companies have a statutory duty to supply wholesome water, which could be compromised by the selection of an inappropriate pipe material. For example, compounds such as petroleum hydrocarbons and solvents can permeate commonly used plastics pipes, and/or corrosive chemicals can reduce the service life of metallic pipes. Guidance has been developed for the selection of pipes in brownfield sites and is contained in a UKWIR Report[9].

[8] *Whilst this has formally been withdrawn it can still be accessed via the EA archives and provides useful information on managing risks.*
[9] *UKWIR Report 10/WM/03/21 – 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'.*

13.5.4 Area A is essentially greenfield, and no previous or current usage of this area of the site or its immediate surroundings is likely to have resulted in ground contamination. Furthermore, no significant made ground was encountered in any of the exploratory holes during the ground investigation.

13.5.5 Made ground in Area B did include slighted elevated inorganic determinants and localised hydrocarbon contamination (which is most likely to be excavated and removed from site)

13.5.6 Consequently, the use of 'standard' polyethylene water supply pipes is likely to be acceptable for the majority of the site, with the adoption of protective pipes which pass though made ground.

13.5.7 However, Vistry should consult Yorkshire Water at the earliest opportunity to confirm this.

13.5.8 This site investigation has enabled completion of Yorkshire Water's Contaminated Land Assessment Form, a copy of which is included in Appendix I.

13.6 Health & safety issues - construction workers

13.6.1 Access into excavations etc. must be controlled and undertaken in accordance with the CDM Regulations 2015, most notably Regulation 22, to mitigate risk of collapse or asphyxiation.

13.6.2 Before site operations are started, the necessary COSHH statements and Health & Safety Plan should be drafted in accordance with the CDM regulations.

13.6.3 The bulk of the made ground will be retained on site. This made ground contains contaminants at concentrations marginally above the guidance threshold values for an end use that includes domestic gardens. Workers involved in excavations for foundations, drainage, utilities etc are likely to come into direct contact with the made ground.

13.6.4 Although workers will only be exposed to the contaminated soil for a relatively short time, the contaminants represent a risk, and simple precautionary measures are required, i.e. good personal hygiene and basic personnel protective equipment. See also comments in Section 9.8 regarding asbestos.

13.6.5 Consequently, during the remediation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. General guidance on these matters is given in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land".

13.7 Potential development constraints

13.7.1 Some deterioration of the surface is likely to be caused by trafficking, especially after topsoil has been stripped and during/after periods of significant rainfall. Consequently, it would be prudent to consider placement of a minimum 200mm thickness of suitable granular fill (i.e. a "blanket" of 6F2) along the line of proposed highways and any temporary haul roads to protect formation during the construction phase.

13.7.2 It would be prudent to allow flexibility in the groundworks programme to take advantage of any prolonged dry\warm weather (typically between May and September) to enable footings to be cast and blockwork brought up to DPC level well in advance of the build programme (i.e. so it is never necessary to dig deep footings in winter/early spring, when the groundwater table is likely to be higher).

13.7.3 The electric utilities present a potential development constraint unless they can be relocated. Additional enquiries are required to ascertain the feasibility of such diversionary works and the particular easement required by each service undertaker if they remain in-situ.

14 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

14.1 General

14.1.1 The site is located off North Moor View, Brimington, approximately 2.4km northeast of Chesterfield town centre and comprises a single cropped field (Area A), with Riverside Motor Company car sales and garage in the north west (Area B). Two public footpaths cross the site running northeast to southwest and east to west.

14.1.2 It is understood that considerations is being given to redevelopment of the site with 150 traditional 2 & 3 storey domestic dwellings, with associated gardens and adoptable roads and sewers. A site layout has been provided by Wittam Cox Architects (Drawing reference SK-007, 19-266, dated October 2019).

14.1.3 Within Area B, made ground was encountered to an average depth of 0.4m within all exploratory holes and comprised predominantly a clayey gravel of sandstone, mudstone and clinker. Macadam hardstand is present between 0.2m and 0.3m depth across this area.

14.1.4 Natural strata within Area A (open fields) comprises Topsoil (typically 300mm thick) underlain by Residual Soils, slightly sandy slightly gravelly Clay and slightly clayey slightly gravelly Gravel.

14.1.5 Bedrock was encountered within every exploratory hole from depths of between 0.4m and 3.2m (average depth to rock of 1.3m). Sandstone was encountered beneath almost all of Area A, other than in the far east (TPs 1 to 3), where mudstone was encountered.

14.1.6 A geological fault runs northeast to southwest across the western half of the site.

14.1.7 Land falls at about 1 in 23 to the west.

14.2 Mining

14.2.1 This site is located within a Coal Mining Development Low Risk Area and no significant risks have been identified, therefore an intrusive mining investigation will not be required.

14.3 Hazardous gas

14.3.1 The site is in an area where 1-3% of homes are estimated to be above the radon action level. Therefore, radon protection is not required, but the Developer might consider providing new dwellings with basic measures in light of Public Health England advice.

14.3.2 There are no known or suspected areas of landfilling within 250m, and the site is not in area considered susceptible to mines gas, nor is it underlain by shallow mineworkings. As such, no special precautions against methane / carbon dioxide gas are required.

14.4 Contamination & remediation

14.4.1 A hotspot of fuel contaminated soil surrounding a fuel tank within Area B has been identified. The hotspot presents a potential risk to future end users and the Secondary A aquifer and should be excavated and removed from site.

14.4.2 Whilst this site does not require large-scale remediation works, it is strongly recommended that, in advance of the anticipated infrastructure groundworks, the hot-spot of fuel-contaminated soil etc is delineated, 'chased-out' by excavation, and placed in a designated stockpile. This work should be supervised by a suitably qualified geoenvironmental engineer such as Lithos.

14.4.3 Slightly elevated inorganic determinants were identified in made ground as well as anthropogenic material that would be unsuitable at near surface in garden areas. Made ground should be isolated below hardstanding and plots or within landscaped corridors along the main access road. Made ground should not be placed in garden areas.

14.5 Foundations

14.5.1 All plots will be founded on traditional strip/trench-fill foundations, founding within Residual soils at a minimum of 0.9m depth.

14.6 Flooding

14.6.1 The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low.

14.7 Drainage

14.7.1 Sandstone was encountered beneath almost all of Area A, from depths of between 0.4m and 3.2m (average 1.3m). Consequently, soakaways may provide a suitable drainage solution for surface water run-off at the site. However, no testing has been undertaken to date.

14.8 Highways

14.8.1 Based on visual inspection of the shallow natural materials and published guidance, the Residual Soils should provide a CBR value of at least 3%. This value should be verified prior to or during construction.

14.8.2 However, made ground is present within Area B, typically to depths of around 0.4m, and consultation with the adopting authority, regarding the specification of the highways, is strongly recommended if the made ground remains *insitu*

14.8.3 Where made ground is present it should be excavated and either replaced with suitable aggregate, or screened, to allow selection of suitable material, before being replaced in engineered layers. Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.

Appendix A

General Notes

01 - Environmental setting
Generic notes – geoenvironmental Investigations

General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the "Search Responses" Appendix of this Geoenvironmental Report.

Geology, mining & quarrying

In order to establish the geological setting of a site, Lithos refer to BGS maps for the area, and the relevant geological memoir. Further information is sourced by reference to current and historical OS plans.

In July 2011, the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology. The CA, using its extensive records has prepared plans for all coalfield Local Planning Authorities, which effectively refines the defined coalfield areas into High Risk and Low Risk areas. High Risk areas are likely to be affected by a range of legacy issues that pose a risk to surface stability, including: mine entries; shallow coal workings; workable coal seam outcrops; mines gas; and previous surface mining sites. Low Risk areas comprise the remainder of the defined coalfield, and are areas where no known defined risks have been recorded; although there may still be unrecorded issues. Where a site lies within either a High or Low Risk area, a mining report is obtained from the CA.

Landfills

Lithos obtain data from Landmark or Groundsure, the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site. Historical OS plans are also inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Radon

Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite), and can move though fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, Lithos refer to BRE Report BR211[1], and the Public Health England website. Advice on the limitation of exposure of the population to radon in buildings was originally published in 1990 by the National Radiological Protection Board (NRPB), which joined the Health Protection Agency (HPA) in 2005; the HPA updated NRPB advice in July 2010[2]. The HPA became part of Public Health England in 2013.

The HPA recommended that the NRPB radon Action Level for homes be retained, and a new Target Level for radon in homes be introduced. The values of the Action Level and Target Level, expressed as the annual average radon concentration in the home, are 200 Bqm^{-3} and 100 Bqm^{-3} respectively. The Target Level was to provide an objective for remedial action in existing homes and preventive action in new homes.

The term 'radon Affected Area' is defined as those parts of the country with >1% of homes estimated to be above the Action Levels. The NRPB first indicated which parts of the country should be regarded as radon Affected Areas in 1990. A more detailed mapping method was developed by the HPA in conjunction with the British Geological Survey in 2007[3]. The level of protection needed is site-specific and can be determined by reference to this mapping on the Public Health England website, which indicates the highest radon potential within each 1km grid square. Each 1km grid square is classified on the basis of the percentage of existing homes within that grid square estimated to have radon concentrations above the Action Level. There are 6 'bands': <1%; 1 to 3%; 3 to 5%; 5 to 10%; 10 to 30%; and >30%.

The NRPB advised that action should be taken to reduce radon concentrations in existing homes if the radon concentration exceeded the Action Level of 200 Bqm^{-3} in room air averaged over a year; ten times the average UK domestic radon concentration. NRPB advice informed changes in the requirements for radon protection in new buildings.

- **Basic** preventive measures are required in new buildings, extensions, conversions and refurbishments if the probability of exceeding the Action Level is **>3%** in England and Wales, and >1% in Scotland and Northern Ireland.
- Provision for further preventive (**Full**) measures is required in new buildings if the probability of exceeding the Action Level is **>10%**.

At present Building Regulations Approved Document C advocates basic measures for the probability banding 3% to 10%, and full measures if >10%. However, Public Health England would like to see all new build include basic measures.

Action and Target Levels should also be applied to non-domestic buildings with public occupancy exceeding 2,000 hours per year and to all schools.

Hydrogeology

Lithos obtain information from the Environment Agency (EA), and Landmark or Groundsure with respect to:

- Groundwater quality
- Recorded pollution incidents
- Licensed groundwater abstractions

From April 2010 the EA's Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply), but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. The maps are split into two different types of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels
- Bedrock - solid permeable formations e.g. sandstone, chalk and limestone

The maps display the following aquifer designations:

Principal aquifers: These are layers of rock or superficial deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary aquifers: These include a wide range of rock layers or superficial deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into three types:

- Secondary A - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
- Secondary B - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers
- Secondary undifferentiated - In most cases, this is because the rock type in question has previously been designated as both a minor and non-aquifer in different locations due to the variable characteristics.

[1] BRE Report BR211, 2015: "Radon: guidance on protective measures for new buildings.

[2] Limitation of Human Exposure to Radon, Documents of the Health Protection Agency - Radiation, Chemical and Environmental Hazards, RCE-15. July 2010.

[3] Miles JCH, Appleton JD, Rees DM, Green BMR, Adlam KAM and Myers AH (2007). Indicative Atlas of Radon in England and Wales. Chilton, HPA-RPD-033.

Unproductive strata: These are rock layers or superficial deposits with low permeability that have negligible significance for water supply or river base flow.

The EA maps only display the principal and secondary aquifers as coloured areas. All uncoloured areas on the map will be unproductive strata. However, for uncoloured areas on the superficial (drift) designation map it is not possible to distinguish between areas of unproductive strata and areas where no superficial deposits are present; to do this, it is necessary to consult the published geological survey maps.

For the purposes of the EA's Groundwater Protection Policy the following default position applies, unless there is site specific information to the contrary:

- If no superficial (drift) aquifers are shown, the bedrock designation is adopted
- In areas where the bedrock designation shows unproductive strata (the uncoloured areas) the superficial designation is adopted
- In all other areas, the more sensitive of the two designations is used (e.g. If secondary superficial overlies principal bedrock, an overall designation of principal is assumed)

The EA have also designated groundwater Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone is a function of the aquifer, volume of groundwater abstracted and the effective rainfall, and may vary from tens to several thousand hectares.

Hydrology

Lithos obtain information from the Environment Agency and Landmark or Groundsure with respect to:

- Surface water quality
- Recorded pollution incidents
- Licensed abstractions (groundwater & surface waters)
- Licensed discharge consents
- Site susceptibility to flooding

The EA have set water quality targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality classification scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are 6 GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to flooding is assessed by reference to a Flood Map on the Environment Agency's website. These maps show natural floodplains - areas potentially at risk of flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas. There are two different kinds of area shown on the Flood Map:

1. Dark blue areas (Flood Zone 3) could be flooded by the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or by a river by a flood that has a 1% (1 in 100) or greater chance of happening each year
2. Light blue areas (Flood Zone 2) show the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Where there is no blue shading (Flood Zone 1), there is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

The maps also show all flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, or floods from the sea with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, older defences and defences which protect against smaller floods.

The Agency's assessment of the likelihood of flooding from rivers and the sea at any location is based on the presence and effect of all flood defences, predicted flood levels, and ground levels.

It should also be noted that as the floodplain shown is the 1 in 100 year, areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley, the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within a floodplain, it is recommended that a flood survey be undertaken by a specialist who can advise on appropriate mitigating measures; i.e. raising slab levels, provision of storage etc. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for: proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and any new development in Flood Zones 2 and 3.

COMAH & explosive sites

Lithos obtain information from Landmark or Groundsure with respect to Control of Major Accident Hazards (COMAH) or explosive sites within 1km of the proposed development site. Lithos' report refers to any that are present, and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise its emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH site may object to a proposed development (although it is the Local Authority who have final say, and they are likely to place more weight on advice from the HSE).

Preliminary conceptual site model

The site's environmental setting (and proposed end use) is used by Lithos to assess the significance of any contamination encountered during the subsequent ground investigation.

Assessment of contaminated land is based on an evaluation of pollutant linkages (source-pathway-receptor). Contaminants within the near surface strata represent a potential source of pollution. The environment (most notably groundwater), site workers and end users are potential receptors.

Potential pollutant linkages are shown on a preliminary conceptual site model (pCSM). A CSM is essentially a cross-section through a site that reflects both the surface topography and underlying geology, and shows surface features of interest. The most significant sources of contamination are then superimposed onto this cross-section together with potential receptors (human health & controlled waters), and plausible pathways between the two. In addition to environmental issues, the CSM should also highlight geotechnical issues.

A pCSM is prepared after consideration of all available "desk study" data, and before design of the ground investigation. Data reviewed should include historical plans (with superimposition on a current-day plan), previous SI reports, geological maps etc. The pCSM, in conjunction with knowledge of site constraints (buildings, services, slopes etc) is used to design the ground investigation.

The revised CSM takes account of data obtained during the ground investigation, including the distribution of made ground, the nature and distribution of contamination etc.

02 - Ground investigation fieldwork
Generic notes – geoenvironmental investigations

General

Lithos Ground Investigations are undertaken in accordance with current UK guidance including:

- BS5930:2015 "Code of practice for site investigation"
- Eurocode 7: BS EN 1997-1:2004. Geotechnical design - Part 1: General rules
- Eurocode 7: BS EN 1997-2:2007. Geotechnical design - Part 2: Ground investigation and testing
- BS10175:2013 "Code of practice for the identification of potentially contaminated sites"
- "Technical Aspects of Site Investigation" – EA R&D Technical Report P5-065/TR (2000)
- "Development of appropriate soil sampling strategies for land contamination" – EA R&D Technical Report P5-066/TR (2001)
- Contaminated Land Reports 1 to 6, most notably CLR Report No. 4 "Sampling strategies for contaminated land"
- "Guidance on the protection of housing on contaminated land" – NHBC & EA R&D Publication 66 (2000)
- AGS: 1996 "Guide to the selection of Geotechnical Soil Laboratory Testing"

Exploratory hole locations

Exploratory hole locations are selected by Lithos, prior to commencement of fieldwork, to provide a representative view of the strata beneath the site and to target potential contaminant sources identified during the preliminary investigation (desk study). Additional exploratory locations are often determined by the site engineer in light of the ground conditions actually encountered; this enables better delineation of the depth and lateral extent of organic contamination, poor ground, relict structures etc.

Investigation techniques

Ground conditions can be investigated by a number of techniques; the procedures used are in general accordance with BS5930: 2015 and BS1377: 1990. Techniques most commonly used by Lithos include:

- Machine excavated trial pits, usually equipped with a backactor and a 0.6m wide bucket.
- Cable percussive (Shell & Auger) boreholes, typically using 150mm diameter tools and casing.
- Window or windowless sampling boreholes (dynamic sampling). Constraints associated with existing buildings, operations and underground service runs can render some sites partly or wholly inaccessible to a mechanical excavator. In such circumstances, window sampling is often the most appropriate technique. A window sampling drilling rig can be manoeuvred in areas of restricted access and results in minimal disturbance of the ground (a 150mm diameter tarmac/concrete core can be lifted and put to one side). However, it should be noted that window sampling allows only a limited inspection of the ground (especially made ground with a significant proportion of coarse material).
- Rotary percussive open-hole probeholes are typically drilled using a tri-cone rock roller or polycrystalline diamond compact (PDC) bit with air as the flushing medium. Probeholes are generally lined through made ground with temporary steel casing to prevent hole collapse.

Where installed, gas\groundwater monitoring wells typically comprise a lower slotted section, surrounded by a filter pack of 10 mm non-calcareous gravel and an upper plain section surrounded in part by a bentonite seal and in part by gravel or arisings. The top of the plain pipe is cut off below ground level and the monitoring well protected by a square, stopcock type manhole cover set in concrete, or the plain pipe is cut off just above ground level and the well protected by 100mm diameter steel borehole helmet set in concrete. Monitoring well details, including the location of the response zone and bentonite seal are presented on the relevant exploratory hole logs.

In-situ testing

Relative densities of granular materials given on the trial pit logs are based on visual inspection only, they do not relate to any specific bearing capacities.

The relative densities of granular materials encountered in cable percussive boreholes are based on Standard Penetration Test (SPT) results. SPTs are carried out boreholes, in accordance with BS 1377 1990, Part 9 Section 3.3. Where full penetration (600mm) is not possible, N values are calculated by linear extrapolation and are shown on the logs as N* = x. The strength of cohesive deposits is determined using a hand shear vane.

Shear strength test results (hand vane readings) reported on trial pit logs are considered to be more reliable than those reported on window sample logs. Significant sample disturbance occurs during window sampling and consequently shear strength results on disturbed window samples are generally lower than results obtained during trial pitting, in-situ or in large excavated blocks.

Sampling

Typically Lithos collect at least three soil samples from each exploratory hole, although in practice a greater number are often taken. The collection of a sufficient number of samples provides a sound basis upon which to schedule laboratory analysis, ensuring:

- A sufficient number of samples from each (common) site material are tested
- Horizontal and vertical coverage of the site is adequate, thereby providing a robust data set for use in the conceptual ground model
- Any localised, significant, but non-pervasive conditions are considered

Made ground and natural soils encountered in the field during a ground investigation often contain a significant proportion of coarse grained material (e.g. brick etc). Soil samples obtained during most investigations are often only truly representative of the in-situ soil mass where there is an absence of particles coarser than medium gravel; i.e the entire soil mass would pass a 20mm sieve.

Representative bulk samples of the **soil mass** are retrieved from coarse soils for specific geotechnical tests (most notably grading and compaction); this typically requires the collection of at least 10kg of soil, and occasionally >50kg. However, in the context of assessing land contamination, it is generally accepted that samples should be representative of the **soil matrix** of the stratum from which they are taken. Consequently, truly representative samples of coarse soils for subsequent contaminant analysis are not obtained - only the finer fraction is placed in sample containers. Coarse constituents not sampled would typically comprise any 'particles' with an average diameter greater than about 20mm (i.e. coarse gravel, cobble and boulder).

At present, neither ISO/IEC 17025 nor MCERTS specify sample pre-treatment with respect to stone removal. Unsurprisingly therefore UKAS accredited testing laboratories do not adopt the same approach to stones[1] – some crush and test the "as received" soil, whilst others sieve out stones and analyse only the residual soil (the sieve size used varies depending on the laboratory).

[1] *Mark Perrin. Stoned – Sample Preparation for Soils Analysis. Ground Engineering, April 2007.*

In essence, samples taken from coarser soils for contaminant analysis are "screened" by the geoenvironmental engineer in the field, and often sieved again by the laboratory during sample preparation. Geoenvironmental engineers do not typically re-calculate soil mass contaminant concentrations by taking account of the unsampled coarse fraction. Likewise, laboratories that remove stones typically report contaminant concentrations based on the dry weight of soil passing the sieve. In the context of land contamination and human health risk assessment, this is considered reasonable, because it is the soil matrix which is of greatest concern. Stones are unlikely to:

- Provide a significant source for plant uptake (consumption of vegetables)
- Remain on vegetables after washing (consumption of vegetables)
- Be eaten (accidentally by an adult, or deliberately by a child)
- Be whipped-up by the wind for dust generation (inhalation)
- Stick to the skin for any length of time (dermal contact)
- Yield toxic vapour (inhalation)

Consequently, Lithos instruct labs to remove all stones >10mm, and to report the results as dry-weight based on the mass of matrix tested. However, the laboratory are given site-specific instruction where coarse stones are coated in say oil, or impregnated with mobile contaminants such as diesel. Where the stones are predominantly natural, or inert (e.g. brick, concrete etc), removal will clearly result in higher reported concentrations, than if the stones were crushed and added to the matrix.

Where the stones include a significant proportion of contaminant-rich material (e.g. slag, fragments of galvanised metal etc) an argument could be made for crushing and analysing. However, provided the stones are stable (i.e. unlikely to disintegrate or degrade) they should not pose a significant risk to human health for the reasons stated above.

Sometimes it is necessary to obtain samples that are not representative of the wider soil matrix, for example when investigating localised, significant, but non-pervasive conditions. Any such unrepresentative samples are annotated with the suffix '*' (eg 2D*, or 4G*). Lithos' site engineer describes both the unrepresentative sample, and the soil mass from which it was been taken.

Sample Containers (for contaminant analysis). Samples of soil for contaminant testing are placed into appropriate containers (see below). Soil samples for organic analysis are stored in cool boxes, at a temperature of approximately 4°C, until delivery to the selected laboratory.

Anticipated testing	Container(s)
Asbestos identification	500ml plastic tub
pH & metals, and non-volatile organics	500ml glass jar
Speciated TPH	500ml & 50ml glass jars
VOCs (incl. naphthalene and\or GRO)	50ml glass jar

Sample Containers (for geotechnical analysis). The majority of samples are only scheduled for PI and sulphate testing, for which 500g of sample is required (a full 0.5-litre plastic tub). However, bulk bags are taken where scheduling of compaction or grading tests is proposed.

Groundwater

Where encountered during fieldwork, groundwater is recorded on exploratory hole logs. If monitoring wells are installed, groundwater levels are also recorded on one or more occasions after completion of the fieldwork. Long-term monitoring of standpipes or piezometers is always recommended if water levels are likely to have a significant effect on earthworks or foundation design.

It should be borne in mind that the rapid excavation rates used during a ground investigation may not allow the establishment of equilibrium water levels. Water levels are likely to fluctuate with season/rainfall and could be substantially higher at wetter times of the year than those found during this investigation.

Description of strata

Soils encountered during a Lithos investigation are described (logged) in general accordance with BS 5930:2015. The descriptions and depth of strata encountered are presented on the exploratory hole logs and summarised in the Ground Conditions section within the main body of text. The materials encountered in the trial pits are logged, samples taken, and tests performed on the in-situ materials in the excavation faces, to depths of up to 1.2m; below this depth these operations are conducted at the surface on disturbed samples recovered from the excavation.

Key to exploratory hole logs

Keys to logs are presented in the Appendix containing the logs. There are two Keys – Symbols & Legends and Terms & Definitions.

03 – Geotechnical laboratory testing
Generic notes – geoenvironmental investigations

General

Soil samples are delivered to the laboratory for testing along with a schedule of testing drawn up by Lithos. All tests are carried out in accordance with BS 1377:1990. The following laboratory testing is routinely carried out on a selection of samples:

- Atterberg limits & moisture contents
- Soluble sulphate & pH

Where soft, cohesive soils are encountered, one-dimensional consolidation tests are scheduled in order to assess settlement characteristics, and unconsolidated undrained triaxial compression tests to assess shear strength.

The additional tests are typically only scheduled where significant earthworks regrade is anticipated:

- Grading
- Compaction tests
- Particle density

Test results are presented as received in an Appendix to the Geoenvironmental Report.

Atterberg limits & moisture content

The Liquid and Plastic Limits of samples of natural in-situ clay are determined using the cone penetrometer method and the rolling thread test. These tests enable determination of an average Plasticity Index (PI) for each "type" of clay, although judgement is applied where variable results are reported.

PI can be related to shrinkability (low, medium or high) and then to minimum founding depth. Lithos typically only consider a soil to be shrinkable if the proportion finer than 63µm is >35%. PI results are compared against guidance given in the NHBC Standards, Chapter 4.2 (revised April 2003), which advocates the use of modified Plasticity Index (I'p), defined as:

I'p = Ip * (%< 425µm/100)

i.e. if PI is 30%, but the soil contains 80% < 425µm, then: I'p = 30 * 80/100 = 24%.

It should be noted that in accordance with the requirements of BS 1377, the % passing the 425µm sieve is routinely reported by testing labs. Lithos apply engineering judgment where PI results are spread over a range of classifications. Consideration is given to:

- The average values for each particular soil type (ie differentiate between residual soil and alluvium)
- The number of results in each class and
- The actual values

Unless the judgment strongly indicates otherwise, Lithos typically adopts a conservative approach and recommends assumption of the higher classification.

Soluble sulphate and pH

Sulphates in soil and groundwater are the chemical agents most likely to attack sub-surface concrete, resulting in expansion and softening of the concrete to a mush. Another common cause of concrete deterioration is groundwater acidity.

The rate of chemical attack depends on the concentration of aggressive ions and their replenishment at the reaction surface. The rate of replenishment is related to the presence and mobility of groundwater.

Lithos refer to BRE Special Digest 1 (SD1) "Concrete in aggressive ground. Part 1: Assessing the aggressive chemical environment" (2005). SD 1 provides definitions of:

- The nature of the site (greenfield, brownfield or pyritic)
- The groundwater regime (static, mobile or highly mobile)
- The design sulphate class (DS class) and
- The aggressive chemical environment for concrete (ACEC class)

Lithos reports clearly state each of the above for the site being considered.

The concentrations of sulphate in aqueous soil/fill extracts are determined in the laboratory using the gravimetric method. The results are expressed in terms of SO_4 for direct comparison with BS 5328:1997. The pH value of each sample was determined by the electrometric method.

SD1 also discusses determination of "representative" sulphate concentration from a number of tests. Essentially if <10 samples of a given soil-type have been tested, the highest measured sulphate concentration should be taken. If >10 samples have been tested, the mean of the highest 20% of the sulphate test results can be taken. With respect to groundwater, the highest sulphate concentration should always be taken.

With respect to pH (soil & groundwater) the value used is the lowest value if <10 samples have been tested and the mean of the lowest 20% if >10 samples have been tested.

Oedometer (Consolidation) tests

Oedometer tests measure a soil's consolidation properties, and are performed by applying different loads to a soil sample and measuring the deformation response. Typically the sample is subject to 5 incremental pressures (4 loading & 1 unloading), and the convention is for each subsequent pressure to be double the previous pressure. BS1377 suggests the **initial** pressure should be:

a) For stiff soils the effective overburden pressure*
b) For firm soils "somewhat less" than the effective overburden pressure
c) For soft soils "appreciably less" than the effective overburden pressure, usually 25 kPa or less
d) For very soft soils very low, typically 5 kPa or 10 kPa

* Effective **overburden pressure** (kNm^{-2}) = depth (m) x soil bulk unit weight (kNm^{-3})

Results from these tests are used to predict how a soil in the field will deform in response to a change in effective stress.

Triaxial tests

This test measures the mechanical properties of a soil by placing the sample between two parallel platens which apply stress in one (usually vertical) direction, with fluid used to apply a confining pressure in the perpendicular directions. During the test, the surrounding fluid is pressurized, and then stress on the platens is increased until the material in the cylinder fails.

From triaxial test data, it is possible to extract fundamental material parameters, including its angle of shearing resistance, apparent cohesion, and dilatancy angle. These parameters are then used in computer models to predict how the material will behave in a larger-scale engineering application.

Quick (single stage, Unconsolidated, Undrained tests) are most appropriate for foundation design. This is because load is applied relatively quickly, and shear strength of the clay will be lowest initially; after the applied load causes some consolidation of the ground (after drainage results in dissipation of short-term excess pore water pressure), the in-situ clays will become progressively stronger and hence the factor of safety will increase. Confining pressure is specified as equivalent to overburden pressure (kNm^{-2}).

Foundations on granular soils would use effective shear strength parameters (c' and phi') to assess safe bearing capacity, as the soil would fully drain quickly. These effective shear strength parameters could be determined from Consolidated Undrained (or sometimes the more expensive Consolidated Drained) triaxial tests, but often correlations to the SPT are used.

Unconsolidated Undrained triaxial tests are most appropriate for assessment of the stability of fill slopes on clays. Similar to foundations, the application of load gradually increases the strength of the clays and hence the critical case is the short term undrained condition.

Consolidated Undrained (or sometimes **Consolidated Drained**) triaxial tests are most appropriate for assessment of the stability of cut slopes in clays. This is because unloading of the ground leads to short term reduction in pore pressures that approximately balance the unloading, hence the soil strength is largely unchanged. Over time the reduced pore pressures suck water in, which leads in to the progressive increase in pore pressure and loss of strength. The fully drained state is critical, which must be modelled using effective strength parameters and a reasonable estimate of the long term water table conditions.

Slopes formed in granular soils would use effective shear strength parameters (c' and phi') to assess safe bearing capacity, as the soil would fully drain quickly. These effective shear strength parameters could be determined from Consolidated Undrained (or sometimes the more expensive Consolidated Drained) triaxial tests, but often correlations to the SPT are used.

Determination of analytical suite

An assessment of potential contaminants associated with the former usages of the site is undertaken with reference to CLR 8 "Potential contaminants for the assessment of land" and the relevant DETR Industry Profile(s).

Common contaminants

Common **Inorganic** Contaminants include:

- Metals, most notably cadmium, copper, chromium, mercury, lead, nickel, and zinc
- Semi-metals, most notably arsenic, selenium, and (water soluble) boron
- Non-metals, most notably sulphur
- Inorganic anions, most notably cyanides (free & complex), sulphates, sulphides, and nitrates

With respect to the terminology used by most analytical laboratories:

Total cyanide = Free cyanide + Complex cyanide

Total cyanide (CN) is determined by acid extraction; whereas free cyanide is the water soluble fraction. Complex cyanide is "bound" in compounds and is hard to breakdown. Laboratory determination of complex CN involves subjecting the sample to UV digestion for determination of both free and total CN.

Thiocyanate (SCN) is a different species combined with sulphur.

Elemental sulphur (S) and free sulphur are the same. Total sulphur is all forms, including that present in sulphates (SO_4), sulphides etc.

There are 2 forms of chromium (Cr), chromium VI and chromium III. Chromium VI is the more toxic of these. In soils, total chromium is determined by a strong aqua regia acid digestion. Chromium VI is an empirical method based on a water extract test.

Common **Organic** Contaminants include hydrocarbons, phenols, and polychlorinated biphenyls.

Petroleum is a mixture of hydrocarbons produced from the distillation of crude oil, and includes aliphatics (alkanes, alkenes and cycloalkanes), aromatics (benzene and derivatives) and hydrocarbon-like compounds containing minor amounts of oxygen, sulphur or nitrogen. Petroleum hydrocarbons can be grouped based on the carbon number range:

- GRO – Gasoline Range Organics (typically C_6 to C_{10}). Also referred to as PRO – Petroleum Range Organics
- DRO – Diesel Range Organics (typically C_{10} to C_{28})
- LRO - Lubricating Oil Range Organics (typically C_{28} to C_{40})
- MRO – Mineral Oil Range Organics (typically C_{18} to C_{44})

However, it should be borne in mind that the terms "GRO" and "DRO" analysis are purely descriptive terms, the exact definition of which varies. Total Petroleum Hydrocarbons (TPH) is also a poorly defined term; some testing laboratories regard TPH as hydrocarbons ranging from C_5-C_{40}, whereas others define TPH as C_{10}-C_{30}.

The composition of a TPH plume migrating through the ground can vary significantly; this is primarily dictated by the nature of the source (eg petrol, diesel, engine oil etc). Furthermore, different hydrocarbons are affected differently by weathering processes, and this can result in further variation in the chemical composition of the TPH.

Gasoline contains light aliphatic hydrocarbons (especially within the C_4 to C_5 range) that are volatile. The aromatic hydrocarbons in gasoline are primarily benzene, toluene, ethylbenzene and xylenes, referred to as BTEX. Small amounts of polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene may also be present. Diesel and light fuel oils have higher molecular weights than gasoline. Consequently, they are less volatile and less water soluble. About 25 to 35% is composed of aromatic hydrocarbons. BTEX concentrations are generally low.

Heavy Fuel Oils are typically dark in colour and considerably more viscous than water. They contain 15 to 40% aromatic hydrocarbons. Polar nitrogen, sulphur and oxygen-containing compounds (NSO) compounds are also present. Lubricating Oils are relatively viscous and insoluble in groundwater. They may contain 10 to 30% aromatics, including the heavier PAHs. NSO compounds are also common.

Polycyclic Aromatic Hydrocarbons (PAHs) have more than two fused benzene rings as a structural characteristic. PAH compounds are present in both petrol and diesel, although in significantly lower concentrations than in coal tars. Certain PAH compounds are carcinogenic (benzo(a)pyrene) and\or mobile in the environment (naphthalene).

Volatile Organic Compounds (VOCs) are organic chemicals, and most are liquids that readily evaporate on exposure to air. Examples include benzene, toluene, xylene, chloroform etc. Semi-Volatile Organic Compounds (sVOCs) include phenol and benzo(a)pyrene, and have relatively low boiling points. Both groups of chemicals are readily absorbed through skin and some, such as benzene, are believed to be linked to tumour growth.

Phenols are compounds that have a hydroxyl group (-OH) attached to an aromatic ring (ie include a benzene ring and an –OH group). Most are colourless solids. A solution of phenol in water is known as carbolic acid, and is a powerful antiseptic. However, phenol vapour is toxic, and skin contact can result in burns.

Polychlorinated Biphenyls (PCBs) were used in pre-1974 transformers as dielectric fluids. PCB's are of increasing toxicity relative to the degree of chlorination. Acute symptoms of PCB poisoning are irritation of the respiratory tract leading to coughing and shortness of breath. Nausea, vomiting and abdominal pain are caused by ingestion of PCB's.

Dioxins and furans (polychlorinated dibenzodioxins and polychlorinated dibenzofurans) are some of the most toxic chemicals known; in the environment, they tend to bio-accumulate in the food chain. Dioxin is a general term that describes a group of hundreds of chemicals that are highly persistent in the environment. The most toxic compound is 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD.

Dioxin is formed by burning chlorine-based chemical compounds with hydrocarbons. The major source of dioxin in the environment comes from waste-burning incinerators and also from backyard burn-barrels. Dioxin pollution is also affiliated with paper mills which use chlorine bleaching in their process and with the production of Polyvinyl Chloride (PVC) plastics and with the production of certain chlorinated chemicals (like many pesticides).

Methods of analysis (organic compounds)

TPH by GC-FID is an analytical technique which only detects hydrocarbons (aliphatic and aromatic) in the range C_{10} to C_{40} (volatiles, heavy tars, humic material and sulphur are not detected). The laboratory can provide a broad, 'banded' breakdown of the TPH results into gasoline range organics (GRO), diesel range organics (DRO) and heavier lubricating oil range organics (LRO), or fully speciated results with the reporting of hydrocarbon concentrations in 14 specific carbon bandings based upon behavioural characteristics, e.g. aliphatic C_6 to C_8, aromatic C_{10} to C_{12} etc.

Speciated VOC (by GC-MS) analysis quantifies the concentrations of 30 USA-EPA priority compounds. These include chlorinated alkanes and alkenes (in the molecular weight range chloroethane to tetrachloroethane); trimethylbenzenes; dichlorobenzenes; and the 4 BTEX compounds (benzene, ethyl-benzene, toluene & xylene).

Speciated sVOC by (GC-MS) analysis quantifies the concentrations of a variety of organic compounds, including the 16 USA-EPA priority PAHs, phenols, 7 USA EPA priority PCB congeners, herbicides & pesticides.

Note: PAHs are hydrocarbons and consequently (where present) will be picked-up when scheduling TPH by GC-FID.

Note: Risk assessment models require physiochemical properties (solubilities, toxicities etc) of compounds in order to model their behaviour in the environment. These physiochemical properties cannot be derived from a single "TPH", "GRO" or "DRO" value. However, the carbon banded fractions can be used in risk assessment models.

Current UK guidance

The UK approach to contaminated land is set out in Contaminated Land Report No. 11 (2004) "Model Procedures for the Management of Land Contamination". The approach is based upon risk assessment, where risk is defined as the combination of the probability of occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

In the context of land contamination, there are three essential elements to any risk: (1) a contaminant source; (2) a receptor (eg controlled water or people); and (3) a pathway linking (1) and (2). Risk can only exist where all three elements combine to create a pollutant linkage. Risk assessment requires the formulation of a conceptual model which supports the identification and assessment of pollutant linkages.

Lithos adopt a tiered approach to risk assessment, consistent with UK guidance and best practice. The initial step of such a risk assessment (or Tier 1) is the comparison of site data with appropriate UK guidance levels, Lithos risk-derived screening values, or remedial targets. It should be noted that exceedance of Tier 1 does not necessarily mean that remedial action will be required.

Soil screening values used by Lithos

In March 2002 DEFRA and the Environment Agency published a series of technical papers (R&D Publications CLR 7, 8, 9 and 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 and 10 and all corresponding SGV and Tox reports were withdrawn and superseded by new guidance including:

- Guidance on Comparing Soil Contamination Data with a Critical Concentration - CL:AIRE and CIEH, May 2008
- Evaluation of models for predicting plant uptake of chemicals from soil - Science Report – SC050021/SR
- Human health toxicological assessment of contaminants in soil - Science Report: SC050021/SR2
- Updated technical background to the CLEA model - Science Report: SC050021/SR3
- CLEA Software Handbook (Version 1.071), Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

The approach set out in these documents represents current scientific knowledge and thinking; and includes the Contaminated Land Exposure Model (CLEAv1.06). The Environment Agency are in the process of using this updated approach to regenerate a selection of Soil Guideline Values (SGVs).

CLEA SGVs were derived for standard land use scenarios predominantly in the context of Part IIA, using a conceptual site model (CSM) defined in SR3. Lithos have incorporated amendments to the CSM used to derive SGVs, that more accurately reflect redevelopment within the planning regime; consequently, Lithos have not adopted any published SGV as a screening value.

The CLEA conceptual site model assumes a source located in a sandy loam, with 6% soil organic matter (SOM) - equivalent to 3.5% total organic carbon (TOC). However, where the average TOC value for a particular soil type is significantly lower than the 3.5%, evaluation of Lithos Screening Values should be undertaken and a site specific risk assessment will usually be required. Other CLEA default characteristics adopted by Lithos are:

Sandy Loam characteristics (source)	Default values adopted
Total porosity (fraction)	0.53
Water filled porosity (fraction)	0.33
Air filled porosity (fraction)	0.2

Lithos have derived Screening Values for four different CSMs (scenarios); these are:

A - Residential with gardens, but no cover (or only up to 300mm)

B - Residential with gardens and 600mm 'clean' cover

C - Residential apartments with landscaping (i.e. no home grown produce)

D - Commercial/industrial with landscaping

E – Importation of soil cover

The **exposure** pathways considered for each scenario are detailed in the table below.

Scenario	Land use	Pathways	Justification
A	Residential with garden, but no cover (or only up to 300mm)	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	Minimal cover – insufficient to break any pathways therefore all exposure pathways are relevant.
B	Residential with garden minimum 600mm cover	• Inhalation of indoor vapours • Inhalation of outdoor vapours	The 600mm cover removes the risk from all pathways other than inhalation.
C	Residential apartments with landscaped areas and minimum 300mm cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. However consumption of home grown produce not included as unlikely to be grown in landscaped areas. Where vegetables are to be grown site specific QRA may be required.
D	Commercial/ industrial with landscaped areas no cover	• Direct ingestion of soil • Dermal contact • Inhalation of indoor vapours and dust • Inhalation of outdoor vapours and dust	All pathways applicable due to possible exposure from landscaped areas. Assumed the commercial development consists of offices to provide a conservative assessment.
E	Importation of soil for cover in garden and landscaped areas	• Direct ingestion of soil • Dermal contact • Consumption of vegetables & soil attached to vegetables • Inhalation of outdoor vapours and dust	Material used as cover to break existing pathways therefore all direct and indirect pathways relevant; however cover is **not** placed below plots therefore indoor inhalation is not relevant.

Lithos have assumed the source of contamination is directly below the building foundations; i.e. a depth to source of 0.15m as opposed to the CLEA default of 0.65m. This assumption provides for a more conservative approach than the UK default. This adjustment has been included to account for sites where made ground is re-engineered to enable new buildings to be established on raft foundations. In such situations contamination may lie directly beneath the foundation.

The Soil Screening Values referred to in this document are **not** intended to be used when considering potential risks associated with:

- Existing land uses in the context of Part IIA of the Environment Protection Act 1990;
- End uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; and
- Controlled waters.

In December 2013 Defra published the results of research project SP1010 – Development of Category 4 Screening Levels (C4SLs) for Assessment of Land Affected by Contamination. The objective of this project was provide technical guidance in support of Defra's revised Statutory Guidance for Part 2A of the Environmental Protection Act 1990 (Part 2A). The revised Statutory Guidance, published in April 2012, introduced a new four-category system for classifying land under Part 2A where Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is acceptably low. Project SP1010 aimed to deliver:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- Demonstration of the methodology, via derivation of C4SLs for 6 substances – arsenic, cadmium, chromium IV, lead, benzene & benzo(a)pyrene.

The methodology for deriving both the previous Soil Guideline Values and the new Category 4 Screening Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology. Development of C4SLs has been achieved by modifying the toxicological and\or exposure parameters used within CLEA (while maintaining current exposure parameters).

The Part 2A Statutory Guidance was developed on the basis that C4SLs could be used under the planning regime. However, policy responsibility for the National Planning Policy Framework falls to the Department for Communities and Local Government. Defra anticipate that, where they exist, C4SLs will be used as generic screening criteria, and Lithos consider C4SLs to be suitable for use as Tier 1 Screening Values. Lithos have discussed this matter with both NHBC and YALPAG (collection of Yorkshire & Lincolnshire local authorities) and received confirmation that they are satisfied with this approach.

With respect to **inorganic** determinands, Lithos derived Tier 1 values for the five Scenarios A to E are presented below:

Inorganic contaminant	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
As	32	37	37	Use (A) in SI Report for initial "screen". If >5 x A, then consider increase of cover to 1,000mm	40	640	37	C4SL adopted
Cd	10	26	26		149	410	26	C4SL adopted
Cr			3,000		3,000	30,000	3,000	Assumes Cr is CrIII
Pb	450	200	200		310	2,330	200	C4SL adopted
Ni	130		127		127	1,700	127	Assessment of health risk only
Se	350		350		595	13,000	434	
Hg	170		169		238	3,640	199	Assumes in an inorganic compound
B			5		5	5	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Cu			80-200		80-200	80-200	80-200	
Zn			200		200	200	200	

With respect to **organic** determinands, Lithos derived Tier 1 values for the five Scenarios A to E are presented below:

Organic contaminant (all sourced via CLEA)	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
Benzene	0.33	0.87	0.9	0.9	3.3	98	N/A	C4SL adopted
Toluene	610		600	3,000	2,700	5,000	N/A	Calculated value over 10,000
Ethyl Benzene	350		350	932	843	5,000	N/A	
Xylenes	240		246	327	321	5,000	N/A	
Phenol	420		412	2,400	519	5,000	N/A	
PCBs			2	8	2	38	N/A	Based on toxicity of EC7
Benzo(a)pyrene		5	5	25	5.3	76	5	C4SL adopted. Where source is not a coal tar
Naphthalene			8	9	9	1,000	12	
Gasoline Range Organics			30	34	34	5,000	45	See 3-step assessment of TPH below
Diesel Range Organics			151	156	154	5,000	219	
Lubricating Range Org			1,000	5,000	2,000	5,000	1,000	

* *For a residential end use*

The significance of PAHs can be determined by considering indicator compounds. In most cases benzo(a)pyrene (BaP) is adopted as an indicator due to the amount of toxicological data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. A surrogate marker approach can be used to estimate the toxicity of a mixture of PAHs in soil using toxicity data for individual indicator compounds within that mixture. Exposure to the surrogate marker is assumed to represent exposure to all PAHs in that matrix. The surrogate marker approach relies on a number of assumptions:

- Surrogate marker (bap) must be present in all soil samples
- Profile of the different pah relative to bap should be similar in all samples
- PAH profile in the soil samples should be similar to that used in the pivotal toxicity study[1]

[1] SP1010 Appendix E, Provisional C4SIs for benzo(a)pyrene as a surrogate marker for PAHs, CL:AIRE 2013

To assess the PAH profile in a soil sample, the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated. The ratio relative to BaP should lie within an order of magnitude above and below the mean ratio to BaP.

Naphthalene should also be considered separately against its generic screen. Whilst classed as a PAH, naphthalene is more volatile and mobile in the environment than most other PAHs. As such the significance of naphthalene cannot be considered within the surrogate marker approach.

Similarly, **TPH** cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "The UK approach for evaluating human health risks from petroleum hydrocarbons in soils". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG). The TPHCWG have broken down "TPH" into representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the bandings.

The significance of speciated TPH results can be assessed by following the 3 steps outlined in the tables below.

Step	Result	Action
1. Consider indicator compounds: Are BTEX, naphthalene, benzo(a)pyrene above their respective Tier 1 values?	Yes	Remediation or dQRA required
	No	Proceed to Step 2
2. Consider individual TPH fractions: are they above respective screening values?	Yes	Remediation or dQRA required
	No	Proceed to Step 3
3. Assess Cumulative effects: Is the calculated Hazard Index for each source >1	Yes	Remediation or dQRA required
	No	TPH compounds pose no significant risk

Step 1 - Assessing indicator compounds

TPH fraction Indicator compound	End use specific screening value (mg/kg)			
	A: Residential no cover	B: Residential with 600mm cover	C: Residential no gardens	D: Commercial\ industrial
Benzene	0.9	0.9	3.3	98
Toluene	600	3,000	2,700	5,000
Ethyl Benzene	350	932	843	5,000
Xylenes	246	327	321	5,000
Naphthalene	8	9	9	1,000
Benzo(a)pyrene	5	25	5.3	76

Step 2 - Assessing individual TPH fractions

TPH fraction		End use specific screening value (mg/kg)			
		A: Residential no cover	B: Residential with 600mm cover	C: Residential with no gardens	D: Commercial/ industrial
Aliphatic 5-6	GRO	41	41	42	5,000^ per fraction
Aliphatic 6-8	GRO	125	125	125	
Aliphatic 8-10	GRO	31	31	32	
Aliphatic 10-12	DRO	151	156	154	
Aliphatic 12-16	DRO	500^	500^	500^	
Aliphatic 16-21	DRO	1,000^	5,000#	1,000^	
Aliphatic 21-35	LRO	1,000^	5,000#	1,000^	
Aromatic 5-7	GRO	100	123	122	
Aromatic 7-8	GRO	30	34	34	
Aromatic 8-10	GRO	47	50	50	
Aromatic 10-12	DRO	215	287	266	
Aromatic 12-16	DRO	689	1,000*	1,000*	
Aromatic 16-21	DRO	1,000^	5,000#	1,000^	
Aromatic 21-35	LRO	1,000^	5,000#	1,000^	

* Calculated Screening Value exceeded soil saturation limit and could indicate free product, therefore calculated soil saturation limit adopted as a target

^ Calculated Screening Value close to soil saturation limit, screening value selected by Lithos considering visual and olfactory impacts.

Five times the screening value for Scenario A.

Step 3 - Assessing Cumulative Effects

$$HI = \sum_{F_i=1}^{16} HQ\ F_i = \frac{Measured\ concentration\ F_i\ (mg\,kg^{-1})}{SGV\ F_i\ (mg\,kg^{-1})}$$

where HI = Hazard Index
HQ = Hazard Quotient
F_i = Fraction $_i$
SGV = Soil Guideline Value

Other screening values used by Lithos

Tier 1 risk assessment of **hazardous gas** is undertaken through reference to the following documents (and further information is presented in Generic Note No. 5 – Hazardous Gas):

- Approved Document C, Building Regulations 2000
- Boyle & Witherington (2007) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating "traffic lights". Report Ref. 10627-R01-(02), for NHBC
- CIRIA C665 (2007) – Assessing risks posed by hazardous ground gases to buildings
- BS 8485:2015 – Code of Practice for the characterisation & remediation from ground gas in affected developments

With respect to the assessment of potential **phytotoxic effects** of contaminants, Lithos refer to "The Soil Code" (MAFF, 1998) for copper and zinc. The CLEA SGV is adopted for nickel due to its human health effects.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, 'Concrete in aggressive ground', 2005.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCL Note 61/84 "Notes on the fire hazards of contaminated land" which states that: "*In general … it seems likely that materials whose CV's exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn*".

Tier 1 **groundwater** risk assessments are undertaken by comparing leachate or groundwater concentrations with the appropriate water quality standard. Tier 1 Screening Values have been discussed with the Environment Agency, and typically those in **bold** below are adopted.

Analyte	Source of Tier 1 Screening Value (µg/l)			
	Surface water (Abstraction for drinking) 1996	Water Supply Regulations 2000	Water Framework Directive	EA Advice
Arsenic	50	10	**50**	
Selenium	10	**10**		
Cadmium	5	5	**1.5**	
Chromium	50	50	**32**	
Copper	50	2,000	**28**	
Lead	50	10	**7.2**	
Nickel		20	**20**	
Zinc	3,000		**125**	
Boron		**1,000**		
Mercury	1	1	**0.07**	
Petroleum Hydrocarbons				**10**
1,1,1-Trichloroethane			**100**	
1,1 Dichloroethane				**100**
1,2-Dichloroethane		3	**10**	
1,1-Dichloroethene				**100**
Benzene		1	**10**	
Ethylbenzene				**10**
Tetrachloroethene		10	**10**	
Toluene			**50**	
Trichloroethene		10	**10**	
Vinyl Chloride		**0.5**		
Trichloromethane			**2.5**	
Xylenes			**30**	
Chloroethane				**100**

Waste classification & WAC

In the context of waste soils generated by remediation and\or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated 'natural' soil, bricks, concrete, tiles & ceramics)
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds)
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds)

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

Landfill operators require Waste Acceptance Criteria (WAC) laboratory data, if soil waste is classified as **hazardous**, and such waste must have been subjected to pre-treatment. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Lithos typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated, for example where redevelopment proposals include basement construction etc. If off-site disposal of soils classified as hazardous waste during redevelopment is anticipated, then WAC analysis should be scheduled at an early stage in the remediation programme. However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous, and these contaminants can often be dealt with by alternative technologies (eg by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (eg WAC) is required.

Possible action in event of Tier 1 exceedance

Should any of the Tier 1 criteria detailed above be exceeded, then three potential courses of action are available. (The first is only applicable in terms of human health, but the second and third could also be applied to groundwater or landfill gas).

1. Undertake further statistical analysis following the approach set out in "*Guidance on Comparing Soil Contamination Data* with *a Critical Concentration - CL:AIRE and CIEH, May 2008*" in order to determine whether contaminant concentrations of inorganic contaminants within soil\fill actually present a risk (only applicable to assessing the risk to human health).
2. Carry out a more detailed quantitative risk assessment in order to determine whether contamination risks actually exist.
3. Based on a qualitative risk assessment, advocate an appropriate level of remediation to "break" the pollutant linkage - for example the removal of the contaminated materials or the provision of a clean cover.

Prior to undertaking any statistical analysis the issue of the **averaging area** requires further consideration. The CL:AIRE\CIEH document still refers to CLR 7, which suggests averaging area should reflect receptor behaviour and therefore might be a single garden, or an open area used by the local community as a play area. This approach to averaging areas is considered applicable within the context of Part IIA of the Environmental Protection Act (EPA) 1990, in terms of an existing residential development.

However, Lithos consider the concept of a single garden as an averaging area to be inappropriate with respect to brownfield redevelopment, which is regulated by the planning regime. In this context, contamination across the entire site needs to be characterised by reference to the Conceptual Site Model. Consequently, Lithos gather and analyse sample results by fill type, and\or by former use in a given sub-area of the site, before undertaking statistical analysis; ie the averaging area is associated with the extent of a particular fill type, or an area affected by spillage\leakage.

In terms of brownfield redevelopment, this is considered a more appropriate methodology which provides a more representative sample population for statistical analysis. As such the entire site is considered in terms of the proposed end use, be this residential with, or without gardens.

Analysis by soil\fill type is appropriate for essentially immobile contaminants associated with a particular fill type, for example arsenic in colliery spoil, metals in ash & clinker, sulphate in plaster-rich demolition rubble etc.

Analysis by former use is appropriate where more mobile contaminants have entered the ground, for example diesel associated with leakage from a former fuel tank, downward migration of leachable metals through granular materials, various soluble contaminants present in a wastewater leaking into the ground via a fractured sewer etc. In these circumstances, it may be appropriate to undertake statistical analysis of sample results from a variety of different soil\fill types. However, consideration would have to be given to factors such as porosity which might influence impregnation of a mobile contaminant into the soil mass, ie contamination would normally be more pervasive and significant in granular soils than cohesive soils

Appendix B

Drawings

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT	LINDEN HOMES EAST YORKSHIRE
JOB TITLE	NORTH MOOR VIEW, BRIMINGTON
DRAWING TITLE	SITE LOCATION PLAN
DRAWN	CC
DATE	22 01 2020
CHECKED	MJT
DATE	22 01 2020
STATUS	FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑
SCALE	1:25,000
SHEET	A4
DRAWING NO.	3569/1
REVISION	

NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM WHITTAM COX ARCHITECTS DRAWING REFERENCE SK-007, DATED OCTOBER 2019

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

LINDEN HOMES
EAST YORKSHIRE

JOB TITLE

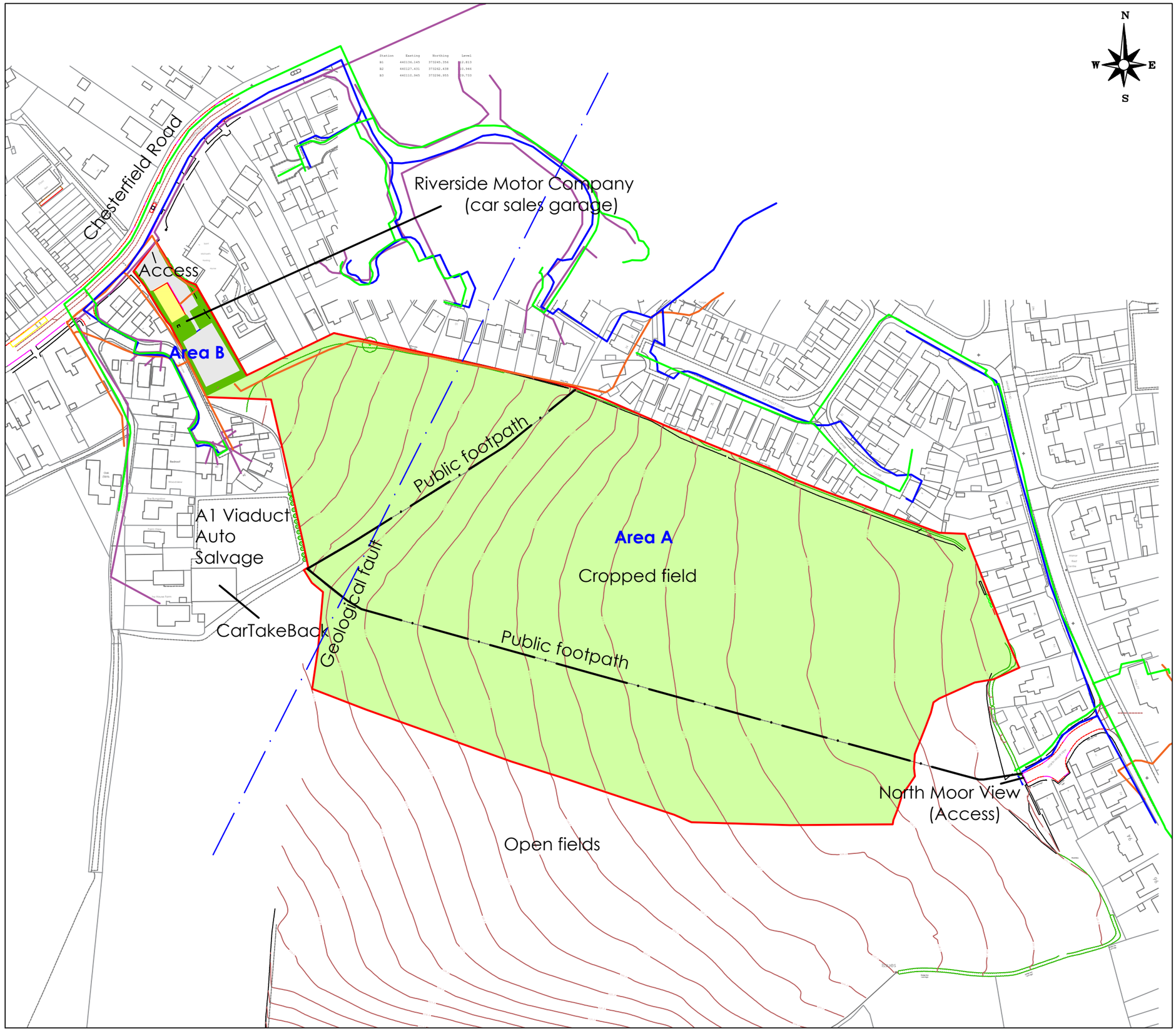
NORTH MOOR VIEW, BRIMINGTON

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
CC	22 01 2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
MJT	22 01 2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:2000	A3	3569/2	



NOTES

- CROPPED FIELD
- BUILDING
- TARMAC HARDSTAND
- FUEL STORAGE TANK
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

LINDEN HOMES
EAST YORKSHIRE

JOB TITLE

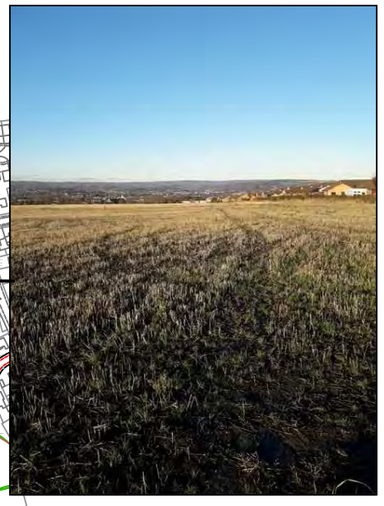
NORTH MOOR
VIEW,
BRIMINGTON

DRAWING TITLE

SITE FEATURES

DRAWN	DATE	STATUS
CC	22 01 2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
MJT	22 01 2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:2000	A3	3569/3	



NOTES

- GRASS & OVERGROWN AREAS
- BUILDING
- TARMAC HARDSTAND
- APPROXIMATE SITE BOUNDARY
- LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

LINDEN HOMES
EAST YORKSHIRE

JOB TITLE

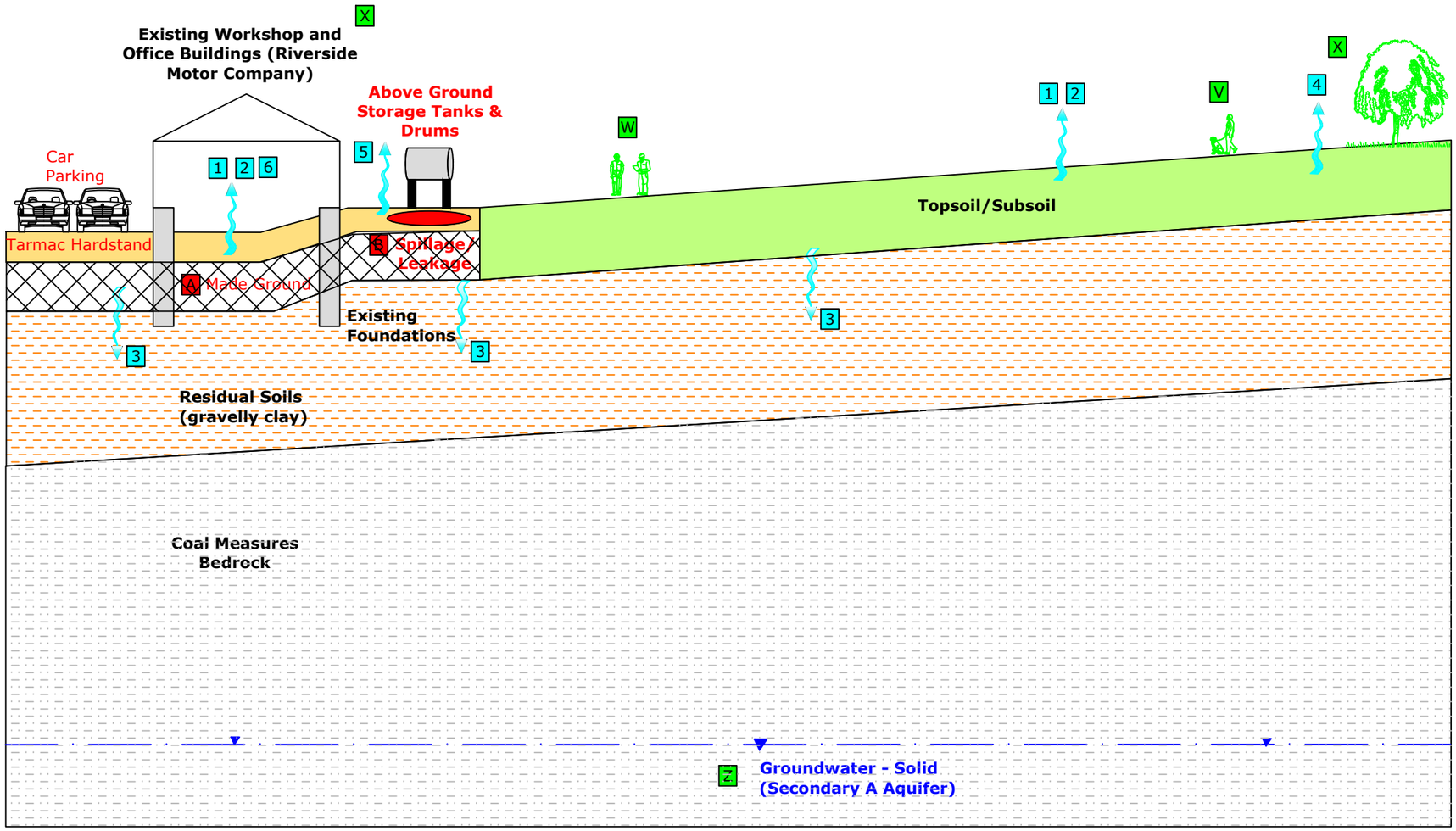
NORTH MOOR
VIEW,
BRIMINGTON

DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	DATE	STATUS
CC	21 01 2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
MJT	27 01 2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
NOT TO SCALE	A3	3569/4	



SOURCES	PATHWAYS	RECEPTORS
A MADE GROUND (INORGANICS)	1 DERMAL CONTACT	V END USERS (RESIDENTS)
B LEAKAGE/SPILLAGE (ORGANICS)	2 INGESTION/INHALATION	W SITE WORKERS
	3 LEACHING OF CONTAMINANTS	X VEGETATION
	4 UPTAKE BY PLANTS	Z GROUNDWATER
	5 VOLATILISATION	
	6 MIGRATION OF GAS	

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

LINDEN HOMES
EAST YORKSHIRE

JOB TITLE

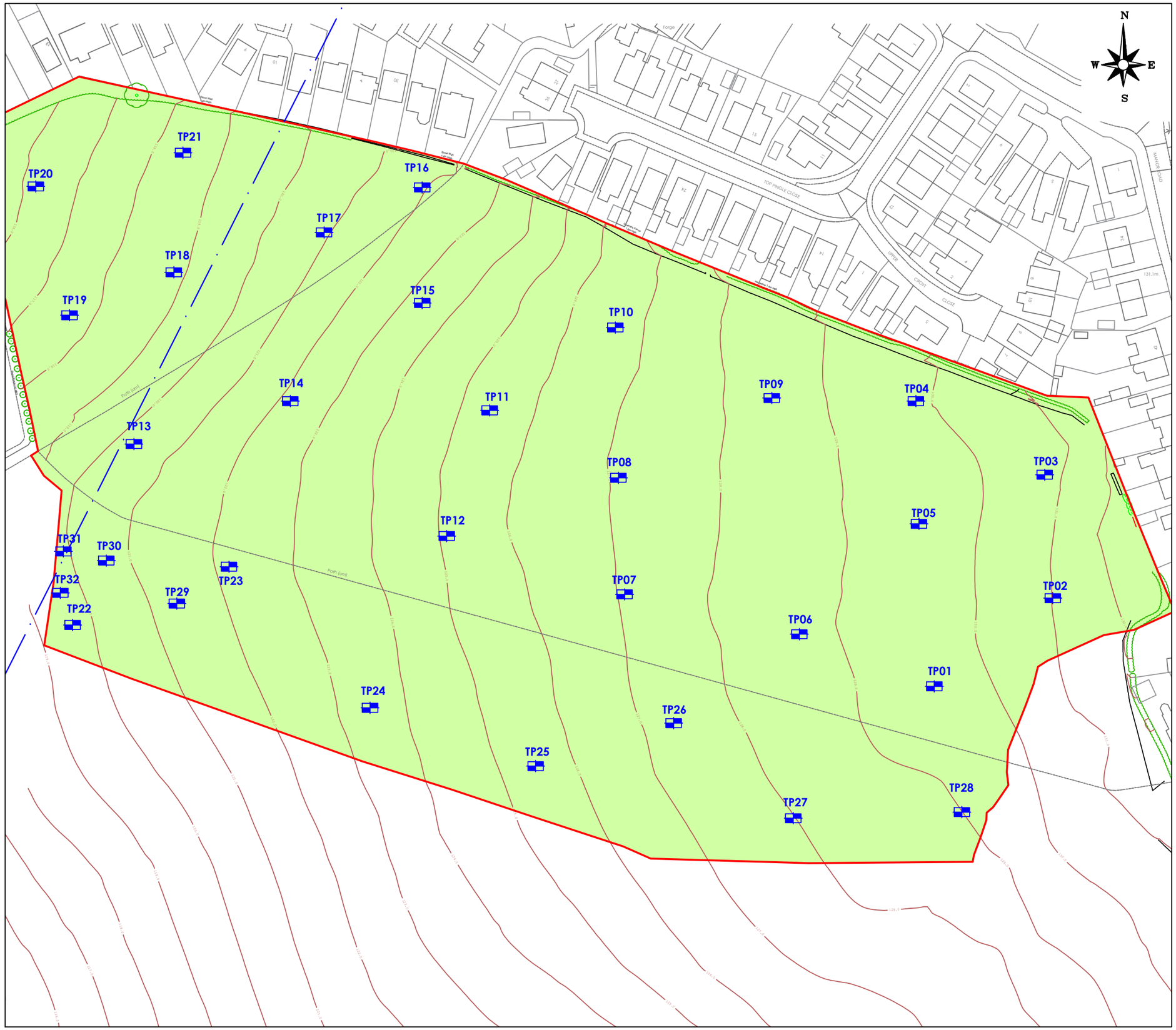
NORTH MOOR VIEW, BRIMINGTON

DRAWING TITLE

PRELIMINARY CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
CC	24/01/2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
MJT	24/01/2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	3569/5	



NOTES

- TRIAL PIT LOCATION
- WINDOW SAMPLE LOCATION
- SAMPLE PIT LOCATION
- FUEL STORAGE TANK
- CROPPED FIELD
- GRASS AND TREES
- BUILDING
- TARMAC HARDSTAND

- APPROXIMATE SITE BOUNDARY
- PUBLIC FOOTPATH
- GEOLOGICAL FAULT

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

LINDEN HOMES
EAST YORKSHIRE

JOB TITLE

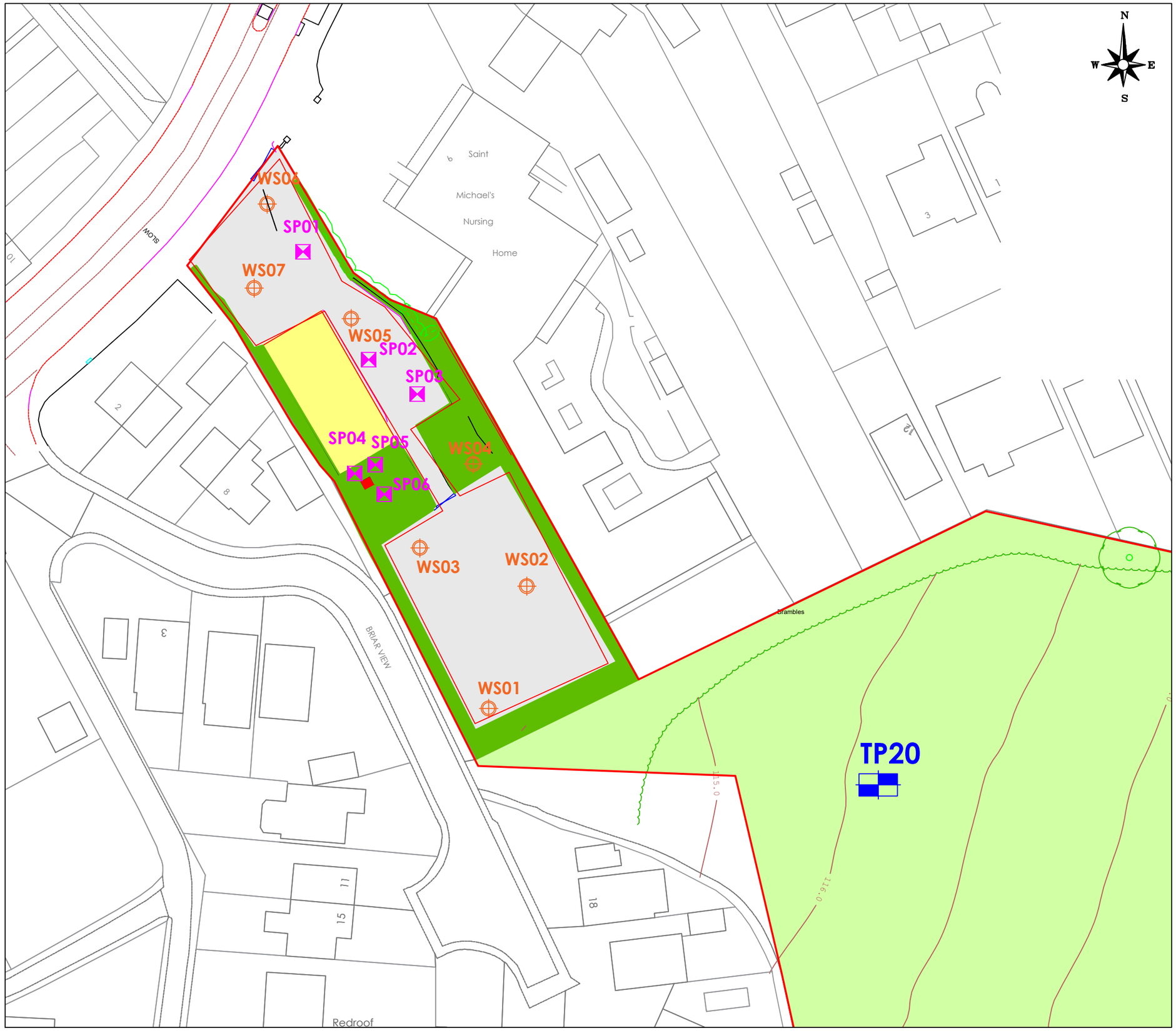
NORTH MOOR
VIEW,
BRIMINGTON

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS
(AREA A)

DRAWN	DATE	STATUS
CC	30 01 2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
MJT	30 01 2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1250	A3	3569/6	



NOTES

- TRIAL PIT LOCATION
- WINDOW SAMPLE LOCATION
- SAMPLE PIT LOCATION
- FUEL STORAGE TANK
- CROPPED FIELD
- GRASS AND TREES
- BUILDING
- TARMAC HARDSTAND

- APPROXIMATE SITE BOUNDARY
- PUBLIC FOOTPATH
- GEOLOGICAL FAULT

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

LINDEN HOMES
EAST YORKSHIRE

JOB TITLE

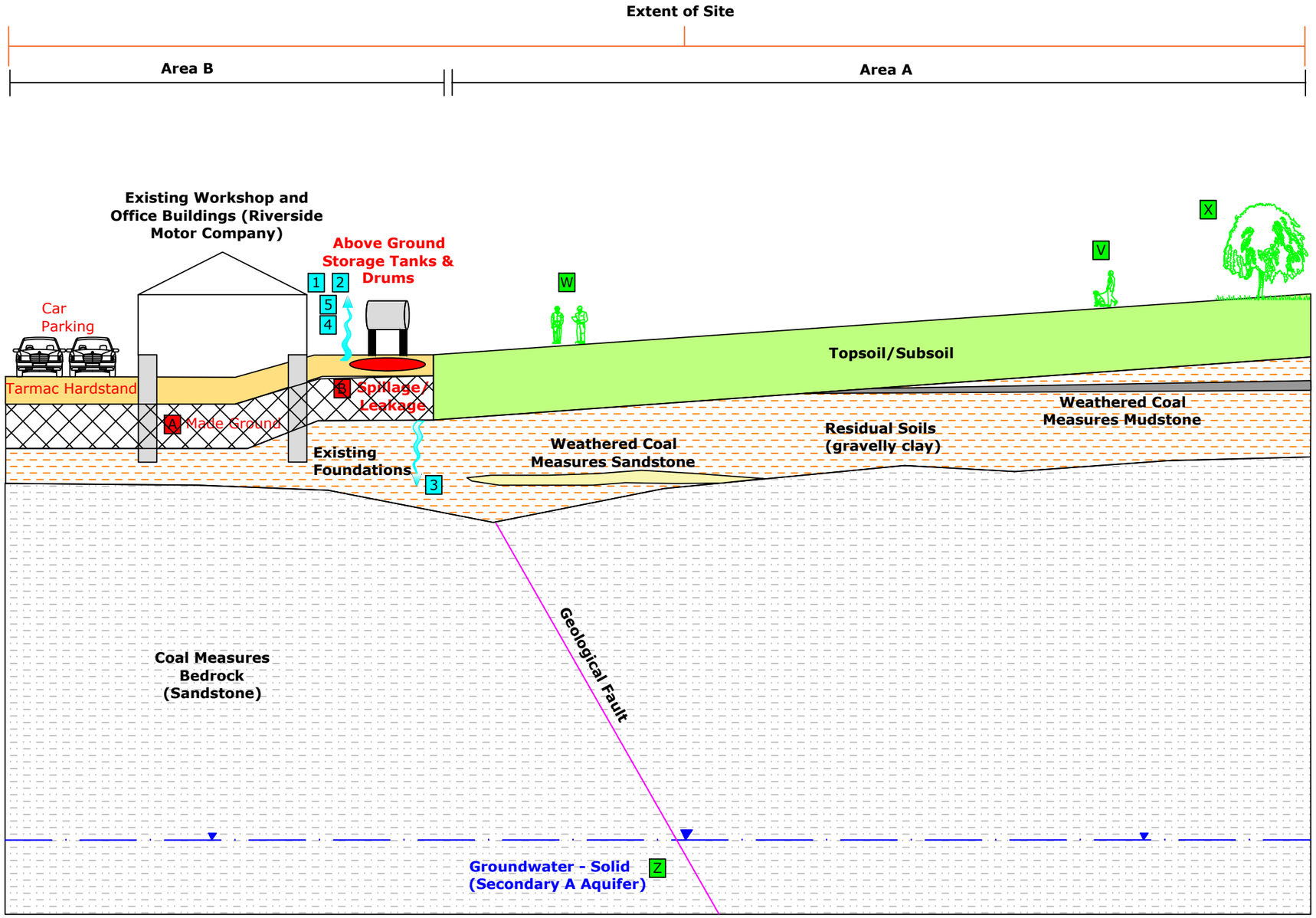
NORTH MOOR
VIEW,
BRIMINGTON

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS
(AREA B)

DRAWN	DATE	STATUS
CC	30 01 2020	FOR COMMENT ☐
		FOR APPROVAL ☐
		DRAFT ☐
CHECKED	DATE	FINAL ☑
MJT	30 01 2020	

SCALE	SHEET	DRAWING NO.	REVISION
1:500	A3	3569/6A	



SOURCES	PATHWAYS	RECEPTORS
B LEAKAGE/SPILLAGE (ORGANICS)	1 DERMAL CONTACT	V END USERS (RESIDENTS)
	2 INGESTION/INHALATION	W SITE WORKERS
	3 LEACHING OF CONTAMINANTS	X VEGETATION
	4 UPTAKE BY PLANTS	Z GROUNDWATER
	5 VOLATILISATION	

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

LINDEN HOMES
EAST YORKSHIRE

JOB TITLE

NORTH MOOR VIEW, BRIMINGTON

DRAWING TITLE

REVISED CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
CC	21 02 2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
MJT	21 02 2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	3569/7	

NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM WHITTAM COX ARCHITECTS DRAWING REFERENCE SK-007, DATED OCTOBER 2019

GEOLOGICAL FAULT

PLOTS REQUIRING REINFORCEMENT (25M BUFFER)

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

info@lithos.co.uk
www.lithos.co.uk

Tel 01937 545330

CLIENT

LINDEN HOMES
EAST YORKSHIRE

JOB TITLE

NORTH MOOR VIEW, BRIMINGTON

DRAWING TITLE

GEOLOGICAL FAULT

DRAWN	DATE	STATUS
CC	03 02 2020	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
MJT	03 02 2020	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:2000	A3	3569/8	

Appendix C

Commission

003/3569/REG

19th September 2019

Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

T 01937 545 330

www.lithos.co.uk

Mr A Cramer
Linden Home East Yorkshire
2nd Floor, Spinner Point
South Quay
Lakeside Boulevard
Doncaster
DN4 5PL

Dear Andy

North Moor View, Brimington

Further to your recent invitation, please find attached our proposal for undertaking a site investigation on the above land. We understand that your proposed development will include traditional 2 storey domestic dwellings with associated gardens, POS and adoptable roads and sewers; an indicative masterplan has been provided which shows development within c. 6.5 ha of a wider site (c. 15 ha).

Review of Google Maps suggests the site is a large agricultural field sloping relatively gently to the west. However, the proposed development will be accessed via Riverside Motor Company (a car dealership) - offices & workshop, surrounded by hardstand.

Brief review of Old Maps and Environment Agency data suggests the site:

- Appears to have remained undeveloped throughout its history;
- Is not located within 250m of a known landfill site; and,
- Is not within a groundwater source protection zone.

Brief examination of the relevant geological map suggests the site is directly underlain by Coal Measures bedrock (but likely weathered to a firm/stiff clay within 2m of surface). This site (masterplan area) is located within a Coal Mining Development Low Risk Area, therefore a mining report will be obtained (however, at this stage an intrusive mining investigation is considered unlikely to be required). Land in the far south of the wider site lies within a CA High Risk area.

The scope of works outlined in this letter should enable us to assess abnormal development issues, associated with ground. However, the nature of site investigation is such that it is not always possible to foresee all the potential issues. Consequently, it is sometimes necessary to recommend additional work, but where this occurs we will inform you immediately, provide costs, and seek your further instruction.

We will need a Promap or topo survey in CAD format, to provide a base plan for technical drawings etc. If you do not have one, we could obtain at cost plus £**.

Our site investigation will be undertaken in accordance with UK good practice (as outlined in BS5930, BS10175, CLR11 etc). Our Report may not be fully compliant with Eurocode 7 (EC7) and will not purport to be a Ground Investigation Report, nor a Geotechnical Design Report as defined by EC7. Our ground appraisal is intended to assist others as they proceed with design of the proposed development.

This proposal allows for the following works:

Desk study: Environmental search data and historical maps (obtained from Landmark or Groundsure), will be reviewed in order to determine whether past land uses have had any effect on the proposed development. In addition, published geological plans of the area will be examined.

We will also visit site to review current operations (Riverside Garage) and undertake a walkover survey.

Fieldwork: We have allowed for 2 day's trial pitting (field) and a day's dynamic sampling using a mini percussion drilling rig, equipped with a concrete corer (Riverside Garage). All trial pits and boreholes will be supervised and logged by an experienced geoenvironmental engineer.

We will make every effort to compact arisings and 'sweep' them over each **pit**. However, you should be aware that on completion of the investigation, "graves" of spoil (each about 3m long by 1m wide) unsuitable for trafficking, will be left up to 400mm proud at each trial pit location. At this stage, no allowance has been made for any further reinstatement such as removal of excess arisings, replacement of turf.

If the pitting encounters significant thicknesses of made ground or very soft/loose deposits (neither considered likely), boreholes may be required to obtain geotechnical data from greater depth. We will advise you of any need for boreholes within 2 days of completion of the pitting.

Based on anticipated ground, **soakaways** are considered unlikely to provide a satisfactory solution for surface water drainage, and no allowance has been made for soakaway testing at this stage. If required, or considered feasible based on the ground actually encountered, soakaway tests could be undertaken for an additional fee of about £**.

Representative soil samples of natural and man-made ground, including any contaminated samples, will be taken during the works. In-situ shear strengths of any cohesive soils encountered will be determined by the use of a hand-held shear vane.

Clearly, constraints associated with existing buildings will prevent trial pitting with a mechanical excavator within the Riverside Garage sub-area. **Dynamic sampling** is considered the most suitable technique, since this technique results in minimal disturbance of the ground (a 150mm diameter tarmac/concrete core can be lifted and put to one side).

However, it should be noted that window sampling allows only a limited inspection of the ground (cf trial pitting). Consequently, some uncertainties may remain and a supplementary, post-demolition ground investigation may be required. Nonetheless, useful data can be obtained at this time and we will certainly aim to resolve as much uncertainty relating to ground as possible, in order to enable you to make an unconditional offer for the site.

This investigation should yield sufficient data to enable a foundation zoning plan, and possibly a detailed Foundation Schedule. However, if ground conditions are found to be more variable than anticipated, a 'tighter' grid of pits will be necessary prior to preparation of a detailed Foundation Schedule. This proposal does not allow for the preparation of a detailed Foundation Schedule, but we will provide a quote on completion of the site investigation if requested.

This site is greenfield and therefore highly unlikely to be underlain by significant thicknesses of made ground. Furthermore, we are not aware of any other sources of hazardous **gas** (shallow mine workings, landfill sites etc) within influencing distance of the site. Consequently, at this stage, we have not allowed for undertaking a hazardous gas risk assessment but we will review the need for this in light of desk study data and the ground conditions actually encountered.

Exploratory holes will be positioned a hand-held GPS (typically +/- 3m accuracy); if required we could arrange for a surveyor to pick-up exploratory holes (and provide co-ordinates/ground levels) for an E\O cost of £**.

This proposal has been put together without a recent site visit. If ground conditions are found to be significantly wet/boggy at the time of the investigation, it may be necessary to hire additional resources (bog mats, tracked excavators, tractors, stone etc) in order for works to continue. We will discuss the requirement for any such items and associated costs with you prior to ordering.

Testing: This will comprise routine **geotechnical** soils analysis, including 15 moisture content & Atterberg limits, and 15 pH & water-soluble sulphate.

This site is greenfield and therefore we could obtain in-situ CBR values from plate tests on site. However, at this stage routes, formation level and total length, of proposed estate roads are unknown. Consequently, we will simply estimate CBR values from strata descriptions and classification test results.

The site is understood to be essentially Greenfield, and therefore testing of potentially **contaminated** samples should only be required if made ground is encountered in the exploratory holes. However, we have allowed for analysis of topsoil (9 samples) to confirm its suitability for re-use. The test suite will include heavy metals and speciated PAH. Visible contaminants, sharps and the clay/sand/silt content of 5 topsoil samples will be determined to check compliance with BS3882 requirements.

If more significant made ground is encountered, we will inform you immediately and provide costs for the recommended chemical testing.

Within in our proposal we have allowed for the screening (ID) of 9 samples for asbestos. In the event that positive IDs are reported, it is likely that we will need to schedule further analysis (asbestos quantification), in order to determine the significance of the results. Asbestos quantification is currently a relatively expensive test and consequently we have not allowed for it at this stage. We will inform you immediately after receipt of results if we consider asbestos quantification is required.

Reporting & timescales: In order to provide you with sufficient information to enable assessment of abnormal costs at the earliest opportunity we will issue a concise overview report within 3 days of fieldwork completion.

On completion of the desk study, fieldwork and laboratory testing a comprehensive bound, factual and interpretative report will be issued. This will contain detailed engineering records, laboratory test results, copies of all relevant correspondence and drawings of the site. The report will include qualitative risk assessment with respect to both controlled waters and human health. The report will also include consideration of foundation types.

Fieldwork could be commenced within 3 weeks of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report will be issued within 4 weeks of fieldwork completion.

A completed copy of the YW Contaminated Land Assessment Form will be included in an Appendix to our Report.

Given previous usage of this land (Riverside Garage sub-area), a Remediation Statement may be required by the Local Authority to support discharge of planning Conditions. If required, we will provide a separate Remediation Statement at no additional cost.

A copy of the final report will be issued to the relevant regulatory authorities on receipt of written instruction from yourselves.

Invoicing: The attached proposal provides a breakdown of the costs associated with this project. This breakdown is for information only and the proposal can be regarded as a lump sum price of £** plus VAT. Variation will only occur in the event that a given item is not undertaken or that substantial additional works are recommended, in which case we will inform you immediately, provide costs for the required works, and seek your prior consent.

Our proposal allows for submission of the report to the Local Authority and NHBC, and for submission of a single piece of subsequent correspondence with each regulator to address any queries they may have. Any further meetings, correspondence etc, would be chargeable.

We will submit invoices for this project at the milestones defined below:

- 1st milestone invoice (Items A, B & C) within 5 days of fieldwork completion, with exploratory hole logs and an interim letter report outlining our initial findings
- 2nd and final invoice (Item D, E & F) on issue of the final SI report

Health, safety & welfare: The works outlined above will be carried out in accordance with Lithos' task- and site- specific Risk Assessments and Method Statements.

Details of welfare will be included within the Method Statements, however, this investigation is expected to be completed within 3 working days and therefore it is not considered reasonably practicable to provide formal welfare facilities, and our proposal makes no allowance for so doing.

Utility plans are required in order to protect operatives from the hazards associated with striking buried services and avoid potentially substantial disruption\repair costs. We will make every effort not to damage any services (including review of utility plans and use of a CAT detector). However, Lithos cannot accept liability for damage to any underground services that are not accurately marked on plans made available to us prior to commencement of our field investigation, or have not been accurately marked on the ground by a responsible third party (e.g. utility company, site owner).

Most developers have copies of the necessary utility plans (including electricity, gas, water, drainage & telecom), and it would be appreciated if you could forward these prior to the proposed fieldworks. However, if you do not have the necessary plans, Lithos will obtain them direct from each of the utility companies.

It is highly likely that the Riverside Garage sub-area is underlain by many "private" services and drains etc which will not be shown on statutory utility plans. Consequently, it would be appreciated if copies of plans showing these services could be made available to our field engineer, and\or someone with site knowledge could advise us with respect to safe locations for our exploratory holes.

Under the CDM Regulations 2015, Lithos must be provided with pre-construction information already in your possession, or information that can reasonably be obtained through sensible enquiry. This information must be relevant to the project, have an appropriate level of detail, and be proportionate to the nature of the risks.

Terms & conditions: Linden and Lithos have an agreed Appointment document, and this work will be undertaken in accordance with that.

It is hoped the above is sufficient for your present needs. However, should you require any further information, please contact the undersigned.

Yours sincerely

Mark Perrin
Director
for and on behalf of
LITHOS CONSULTING LIMITED

Charlotte Copley

Subject: FW: Chesterfield Rd Brimington

From: Andy Cramer (Linden Homes) <andy.cramer@lindenhomes.co.uk>
Sent: 26 November 2019 12:48
To: Reg <Reg@lithos.co.uk>; Matt Thompson <Matt.thompson@lithos.co.uk>
Subject: FW: Chesterfield Rd Brimington

Reg/Matt
Further to your letter dated 19/9/19 I am pleased to advise we are now likely to acquire this proposed development site With that in mind I herewith confirm acceptance to your quotation on the basis this is in accordance with our usual standard terms of appointment which need to be singed and returned in the usual manner

I attach a copy of the topo survey and initial site layout FYI and use along with service record plans

Please can you advise program dates and also provide a plan for the garage area where you ideally wish to undertake intrusive investigation please (obviously thy wish to avoid internally to the buildings – But I want to ensure the investigation is robust), as I need to liaise with the vendors on this and ensure adequate access is given

Many Thanks

Andy

Linden Homes East Yorkshire
2nd Floor, Spinner Point
South Quay, Lakeside Boulevard
Doncaster
DN4 5PL
www.lindenhomes.co.uk

Andy Cramer Technical Director
andy.cramer@lindenhomes.co.uk
Tel: +441302 347130
Mob: +447918 640026

From: Reg [mailto:Reg@lithos.co.uk]
Sent: 19 September 2019 20:43
To: Andy Cramer (Linden Homes) <andy.cramer@lindenhomes.co.uk>
Cc: Matt Thompson <Matt.thompson@lithos.co.uk>
Subject: RE: Chesterfield Rd Brimington

Andy

SI quote as promised. As always, this allows for robust scope of works (a days' pitting, with the usual testing & reporting etc) that should enable you to submit a bid that is unconditional with respect to ground.

Any queries, please call.

Regards

Mark Perrin
Director
Lithos Consulting Ltd
M 07703 396 635
DD 01937 545 331

www.lithos.co.uk

From: Andy Cramer (Linden Homes) <andy.cramer@lindenhomes.co.uk>
Sent: 13 September 2019 14:38
To: Reg <Reg@lithos.co.uk>; Matt Thompson <Matt.thompson@lithos.co.uk>
Subject: Chesterfield Rd Brimington

Reg/Matt
Can you please provide me with a GI quote for the above mentioned site (no need for soakaway testing)
Note the proposed access road is off Chesterfield Road (currently a car sales garage)

Many Thanks

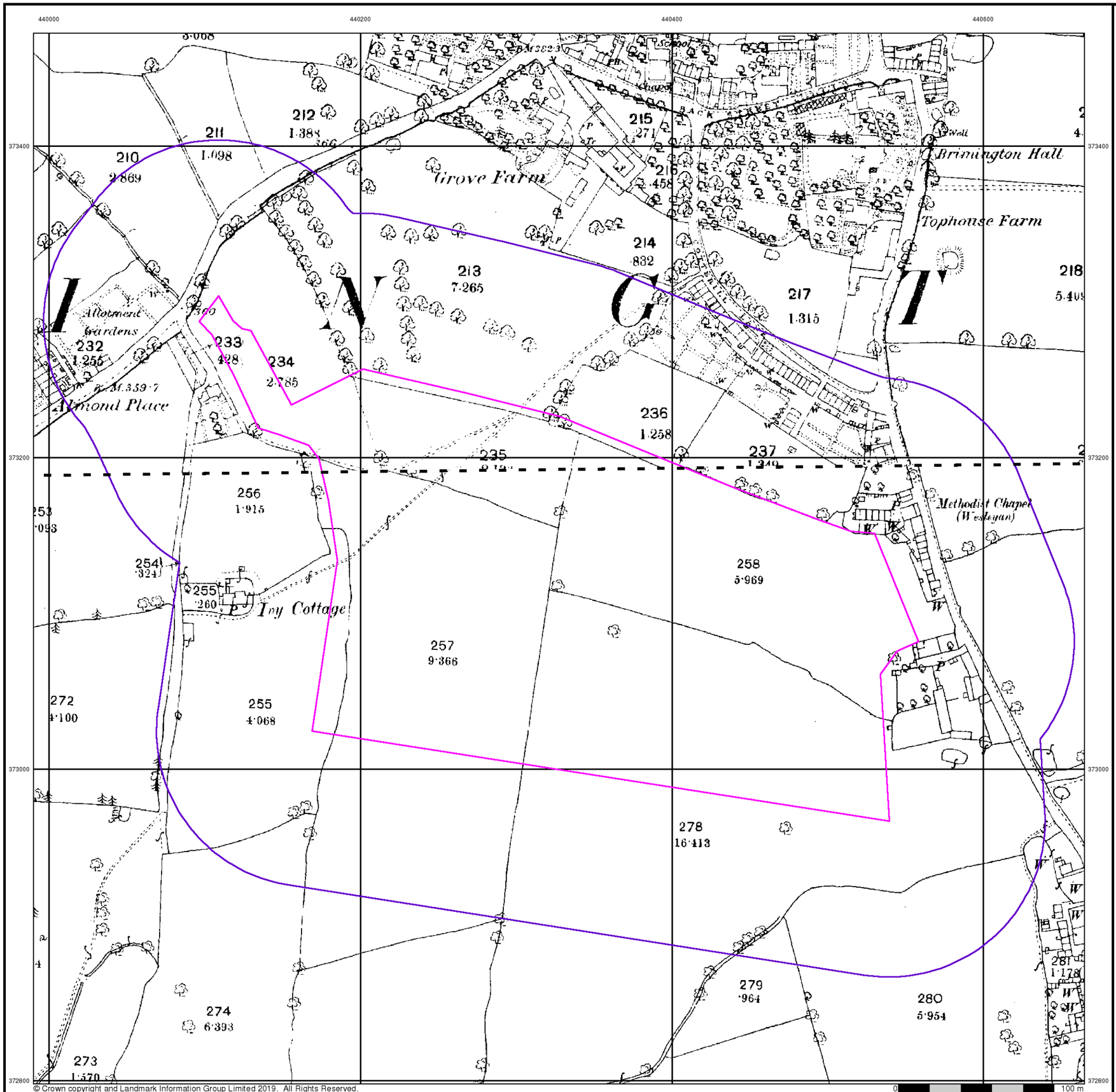
Andy

Linden Homes East Yorkshire
2nd Floor, Spinner Point
South Quay, Lakeside Boulevard
Doncaster
DN4 5PL
www.lindenhomes.co.uk

Andy Cramer Technical Director
andy.cramer@lindenhomes.co.uk
Tel: +441302 347130
Mob: +447918 640026

Appendix D

Historical OS Plans



LITHOS CONSULTING

Derbyshire

Published 1877

Source map scale - 1:2,500

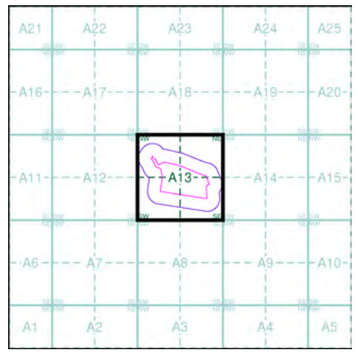
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

018_15
1877
1:2,500

025_03
1877
1:2,500

Historical Map - Segment A13



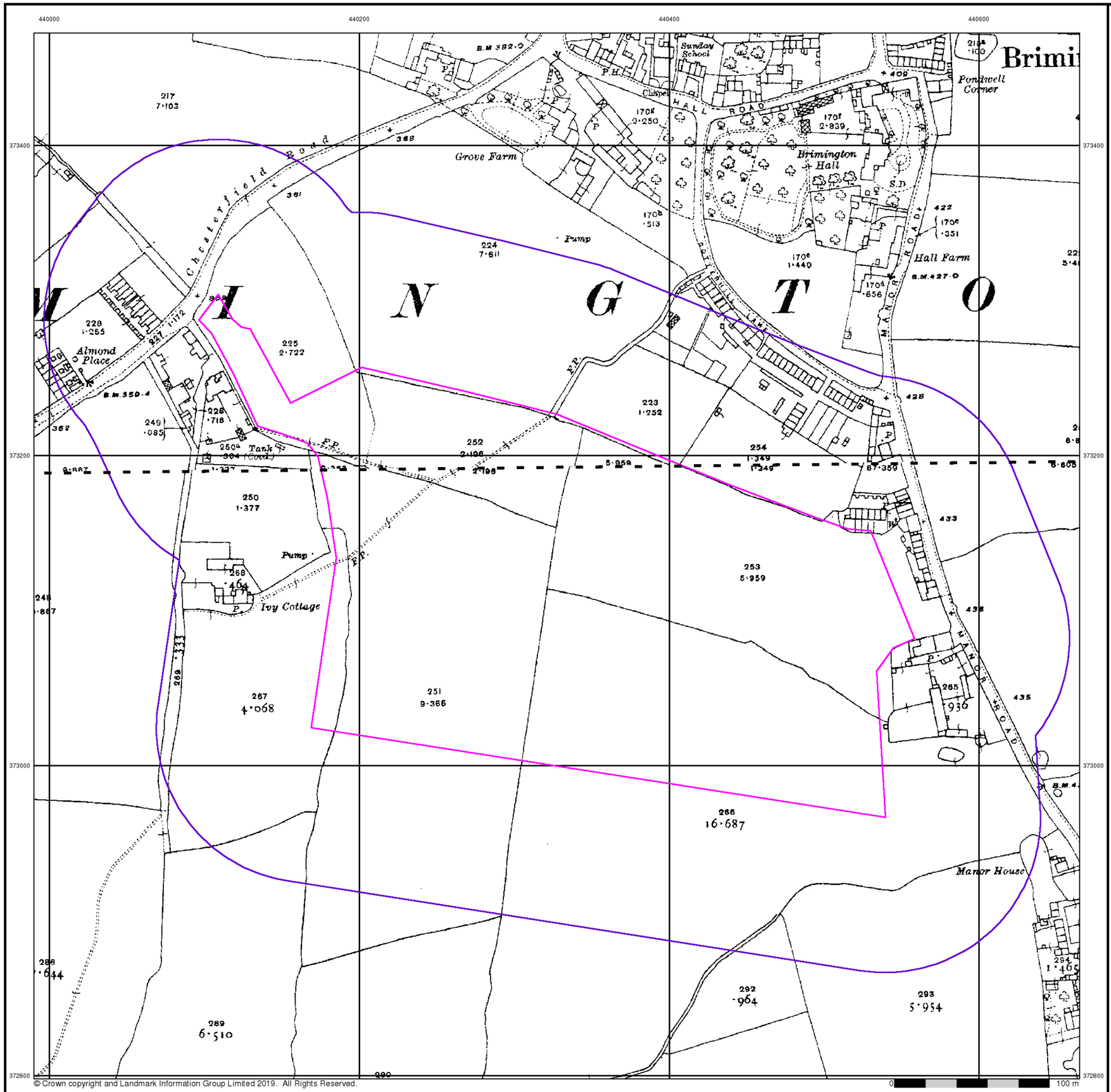
Order Details

Order Number:	227164156_1_1
Customer Ref:	PO15455/JW/3569
National Grid Reference:	440320, 373130
Slice:	A
Site Area (Ha):	8.03
Search Buffer (m):	100

Site Details

Chesterfield Road, Brimington, S43 1EJ

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

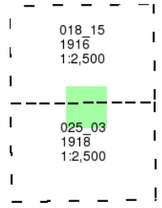
Derbyshire

Published 1916 - 1918

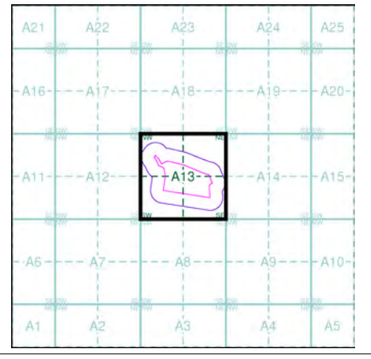
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



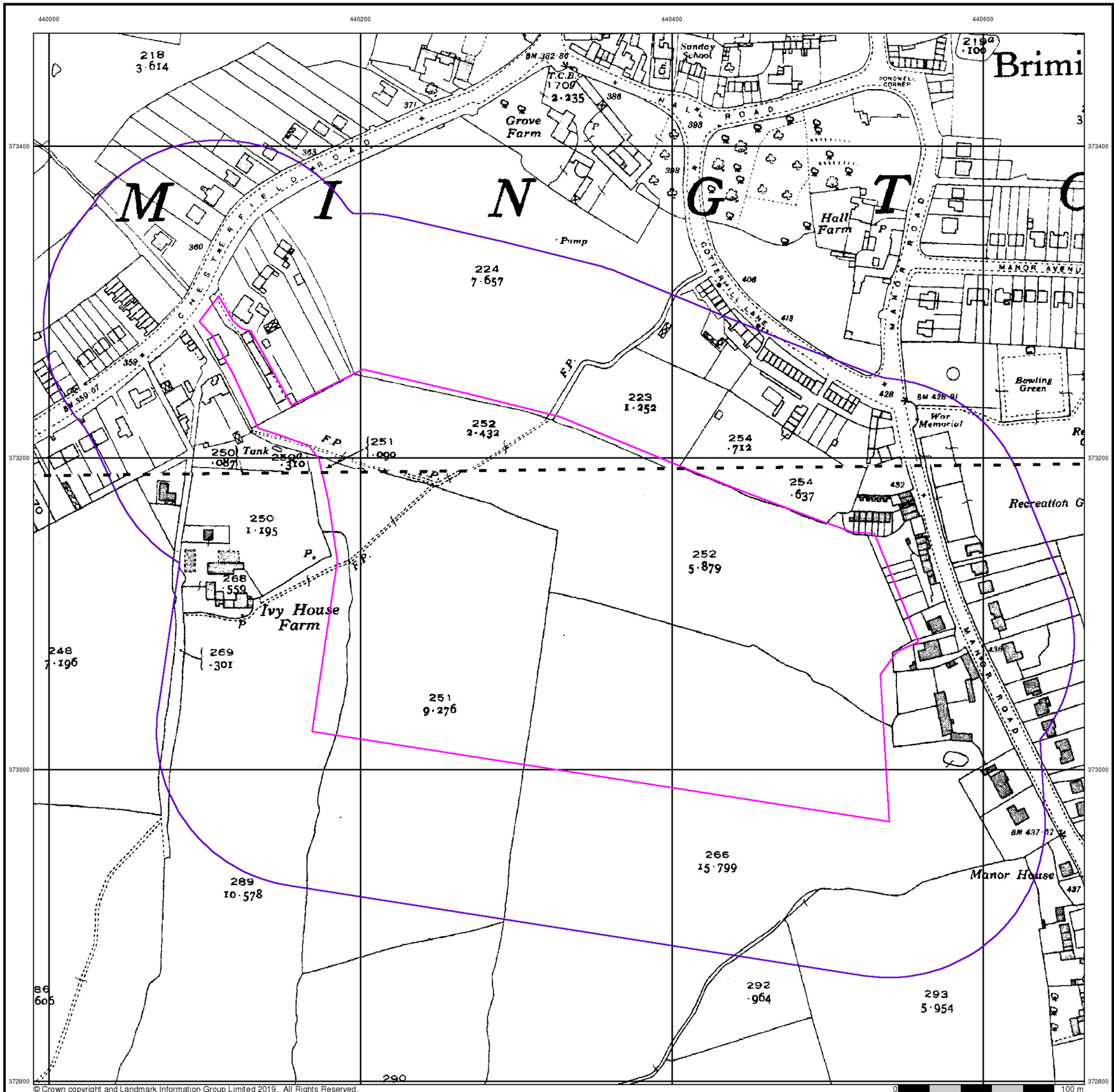
Order Details

Order Number:	227164156_1_1
Customer Ref:	PO15455/JW/3569
National Grid Reference:	440320, 373130
Slice:	A
Site Area (Ha):	8.03
Search Buffer (m):	100

Site Details

Chesterfield Road, Brimington, S43 1EJ

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

Derbyshire

Published 1938

Source map scale - 1:2,500

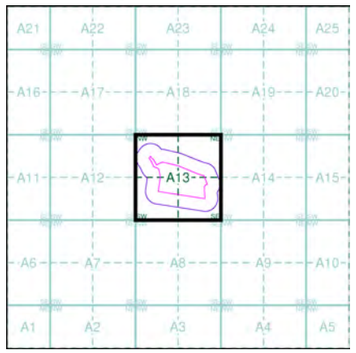
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)

018_15
1938
1:2,500

025_03
1938
1:2,500

Historical Map - Segment A13



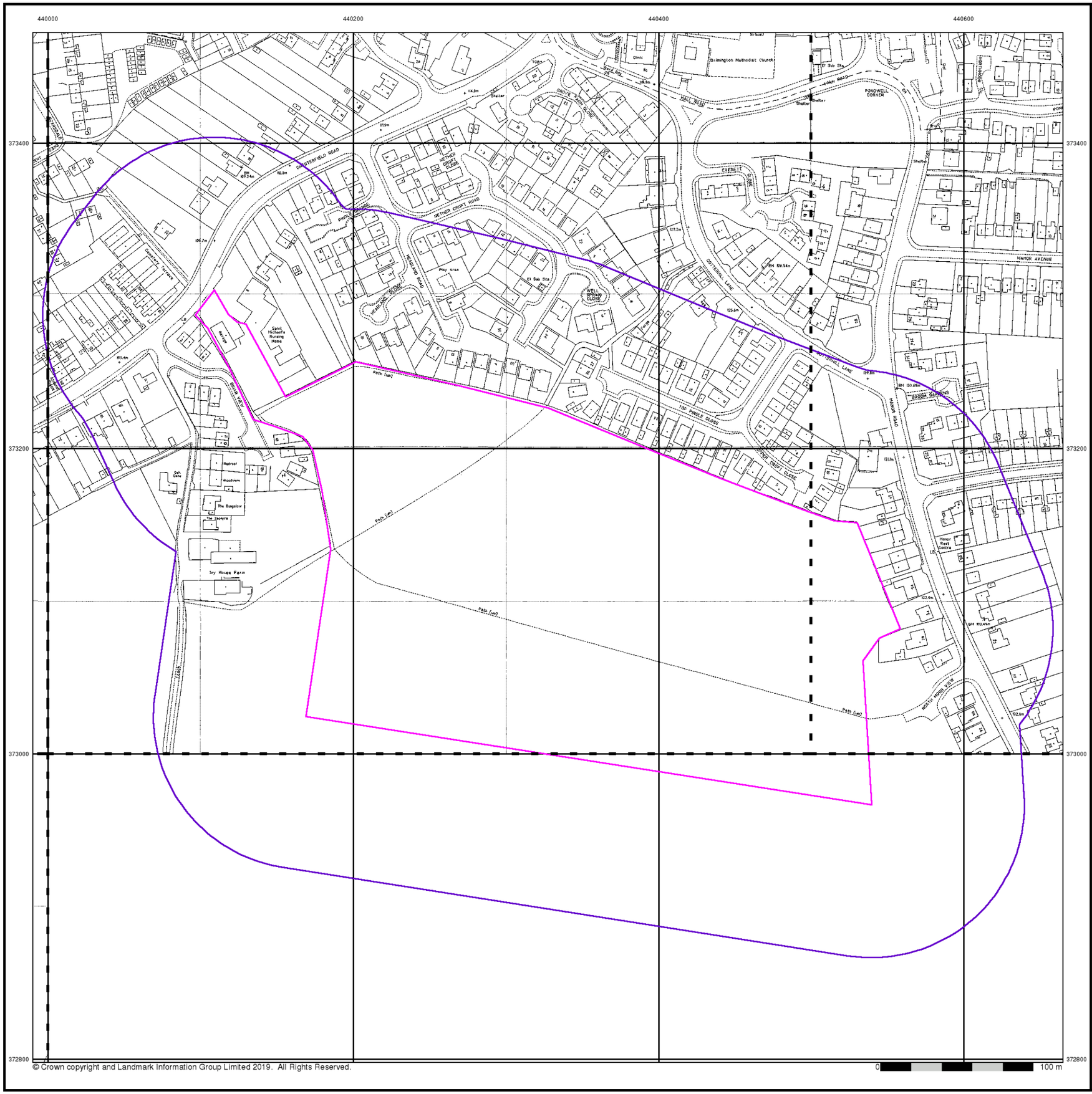
Order Details

Order Number:	227164156_1_1
Customer Ref:	PO15455/JW/3569
National Grid Reference:	440320, 373130
Slice:	A
Site Area (Ha):	8.03
Search Buffer (m):	100

Site Details

Chesterfield Road, Brimington, S43 1EJ

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

Large-Scale National Grid Data

Published 1993

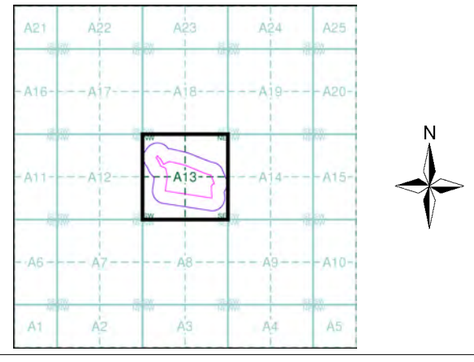
Source map scale - 1:1,250

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

SK3973SE 1993 1:1,250	SK4073SW 1993 1:1,250	SK4073SE 1993 1:1,250
SK3972NE 1993 1:1,250		

Historical Map - Segment A13



Order Details

Order Number:	227164156_1_1
Customer Ref:	PO15455/JW/3569
National Grid Reference:	440320, 373130
Slice:	A
Site Area (Ha):	8.03
Search Buffer (m):	100

Site Details

Chesterfield Road, Brimington, S43 1EJ

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix E

Search Responses & other Correspondence

Envirocheck® Report:

Datasheet

Order Details:

Order Number:
227164156_1_1

Customer Reference:
PO15455/JW/3569

National Grid Reference:
440320, 373130

Slice:
A

Site Area (Ha):
8.03

Search Buffer (m):
1000

Site Details:

Chesterfield Road
Brimington
S43 1EJ

Client Details:

Mr M Perrin
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

Prepared For:

LS22 5DZ

Contents

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination.
For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.
In this datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

Report Version v53.0

LITHOS CONSULTING

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1	Yes	Yes	Yes	n/a
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 1				13
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control					
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls	pg 5			4	1
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 5		Yes		
Pollution Incidents to Controlled Waters	pg 6				17
Prosecutions Relating to Authorised Processes	pg 8				1
Registered Radioactive Substances					
River Quality	pg 9				2
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register	pg 9				2
Water Abstractions	pg 9				(*11)
Water Industry Act Referrals					
Groundwater Vulnerability Map	pg 12	Yes	n/a	n/a	n/a
Groundwater Vulnerability - Soluble Rock Risk			n/a	n/a	n/a
Groundwater Vulnerability - Local Information			n/a	n/a	n/a
Bedrock Aquifer Designations	pg 12	Yes	n/a	n/a	n/a
Superficial Aquifer Designations			n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
OS Water Network Lines	pg 13		1	17	47

Summary

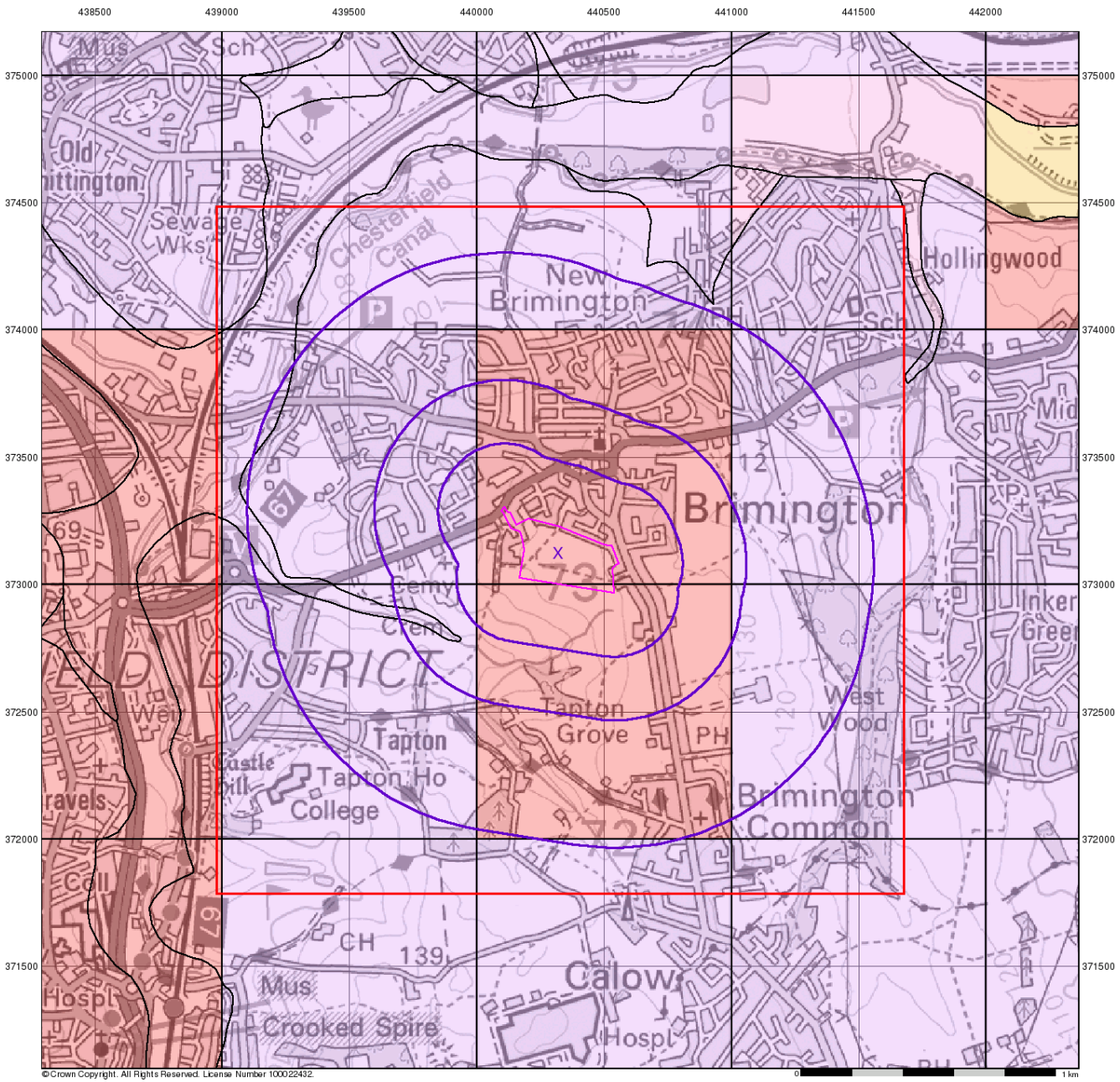
Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Waste					
BGS Recorded Landfill Sites					
Historical Landfill Sites	pg 21				1
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)	pg 21		1		
Local Authority Landfill Coverage	pg 21	2	n/a	n/a	n/a
Local Authority Recorded Landfill Sites					
Potentially Infilled Land (Non-Water)	pg 21			7	9
Potentially Infilled Land (Water)	pg 22		5	3	5
Registered Landfill Sites					
Registered Waste Transfer Sites	pg 23			2	
Registered Waste Treatment or Disposal Sites	pg 23		1		
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Geological					
BGS 1:625,000 Solid Geology	pg 24	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 24	Yes	Yes	Yes	Yes
BGS Recorded Mineral Sites	pg 28			5	4
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
CBSCB Compensation District			n/a	n/a	n/a
Coal Mining Affected Areas	pg 30	Yes	n/a	n/a	n/a
Mining Instability	pg 30	Yes	n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain	pg 30	Yes	Yes	n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 30	Yes	Yes	n/a	n/a
Potential for Compressible Ground Stability Hazards				n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 30	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards				n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 31	Yes	Yes	n/a	n/a
Radon Potential - Radon Affected Areas	pg 31	Yes	n/a	n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries	pg 32	1	10	18	26
Fuel Station Entries	pg 37			2	
Points of Interest - Commercial Services	pg 37		4	12	15
Points of Interest - Education and Health					
Points of Interest - Manufacturing and Production	pg 39		3	1	2
Points of Interest - Public Infrastructure	pg 40			11	3
Points of Interest - Recreational and Environmental	pg 41		2	4	7
Gas Pipelines					
Underground Electrical Cables					

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland	pg 43				1
Areas of Adopted Green Belt					
Areas of Unadopted Green Belt					
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones	pg 43	1			
Ramsar Sites					
Sites of Special Scientific Interest					
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					



LITHOS CONSULTING

Groundwater Vulnerability

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

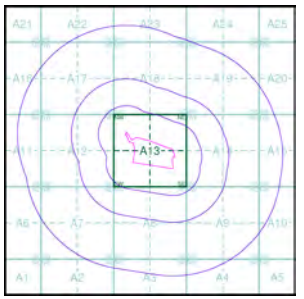
Agency and Hydrological

Bedrock Aquifers	Superficial Aquifers
High Vulnerability, Principal Aquifer	High Vulnerability, Principal Aquifer
High Vulnerability, Secondary Aquifer	High Vulnerability, Secondary Aquifer
Medium Vulnerability, Principal Aquifer	Medium Vulnerability, Principal Aquifer
Medium Vulnerability, Secondary Aquifer	Medium Vulnerability, Secondary Aquifer
Low Vulnerability, Principal Aquifer	Low Vulnerability, Principal Aquifer
Low Vulnerability, Secondary Aquifer	Low Vulnerability, Secondary Aquifer

Unproductive Aquifer

Soluble Rock

Site Sensitivity Context Map - Slice A



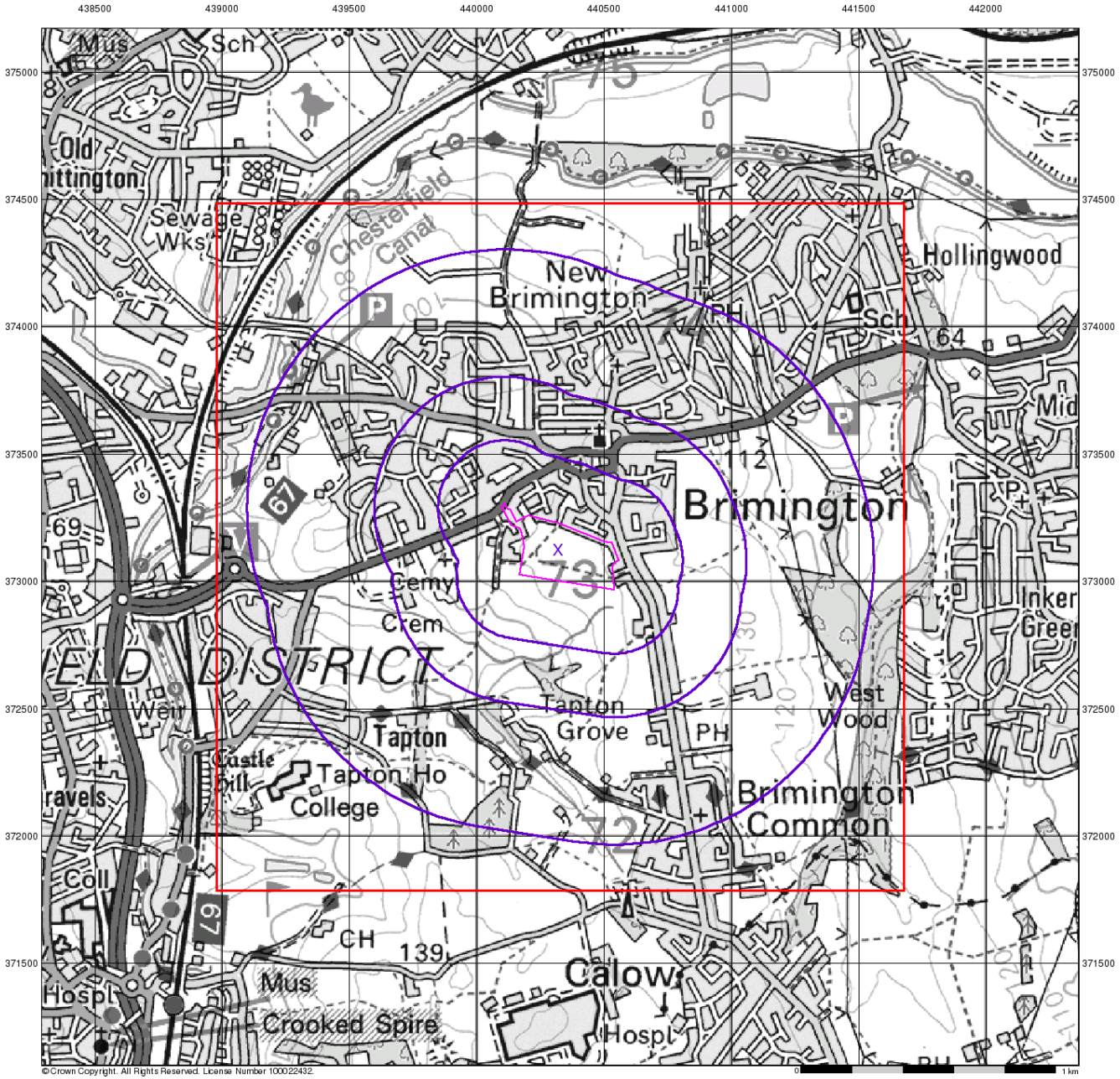
Order Details

Order Number:	227164156_1_1
Customer Ref:	PO15455/JW/3569
National Grid Reference:	440320, 373130
Slice:	A
Site Area (Ha):	8.03
Search Buffer (m):	1000

Site Details

Chesterfield Road, Brimington, S43 1EJ

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

Source Protection Zones

General

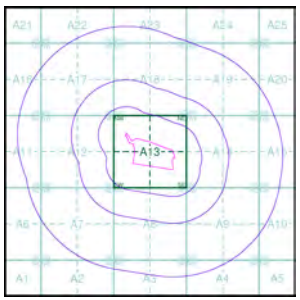
Specified Site | Specified Buffer(s) | Bearing Reference Point

Slice | Map ID

Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

Site Sensitivity Context Map - Slice A



Order Details

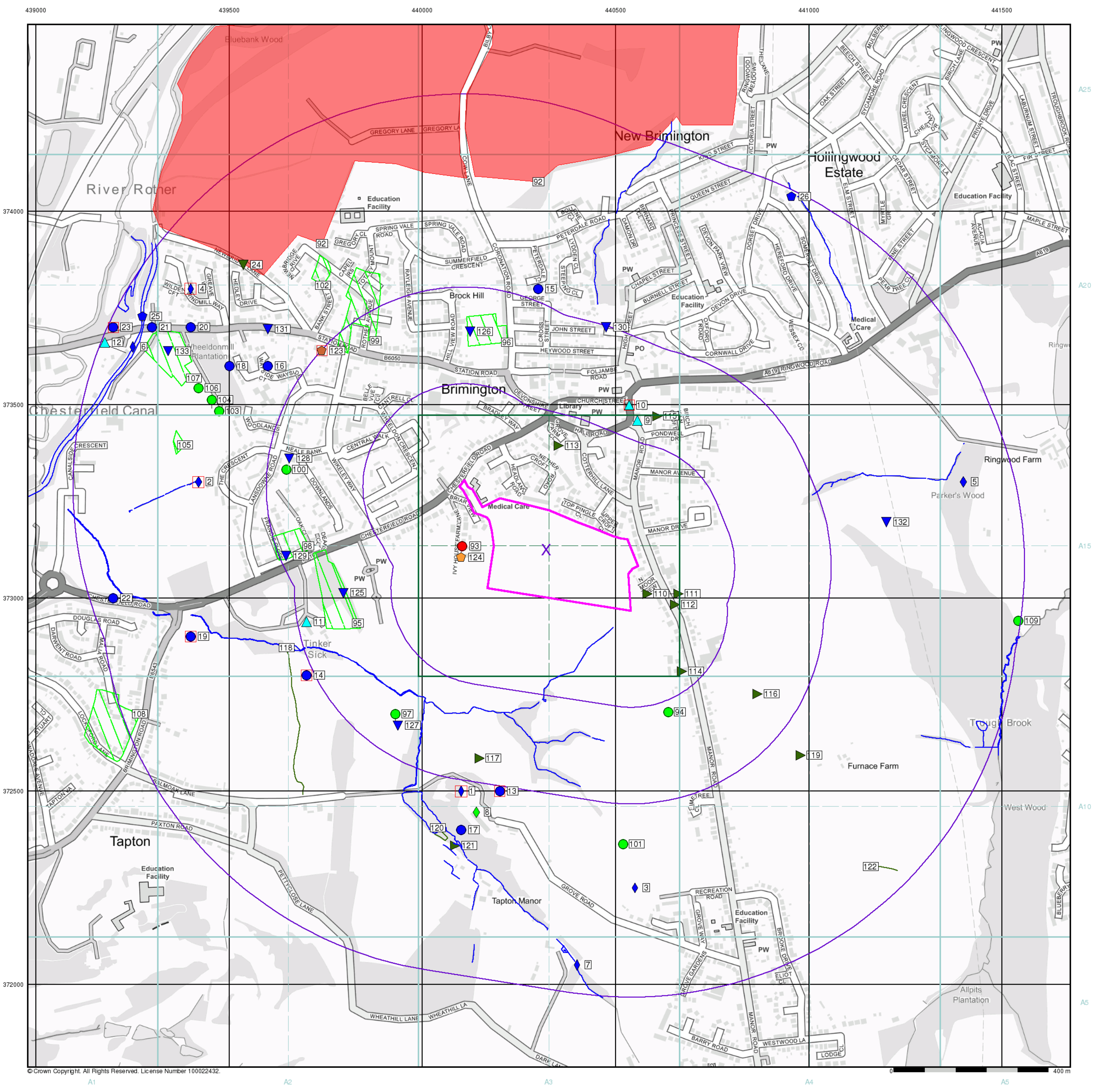
Order Number:	227164156_1_1
Customer Ref:	PO15455/JW/3569
National Grid Reference:	440320, 373130
Slice:	A
Site Area (Ha):	8.03
Search Buffer (m):	1000

Site Details

Chesterfield Road, Brimington, S43 1EJ

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID
- Several of Type at Location

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Hazardous Substances

- COMAH Site
- Explosive Site
- NIHHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

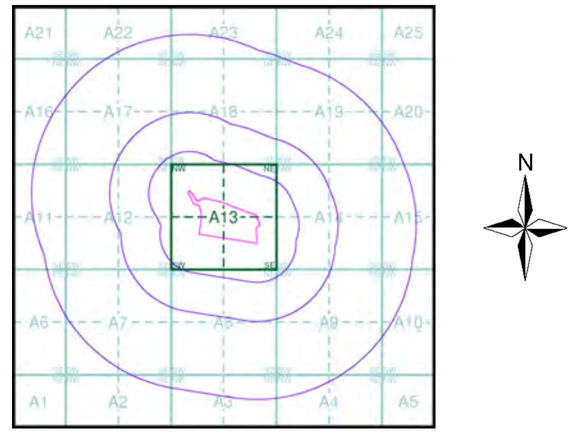
Geological

- BGS Recorded Mineral Site

Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Site Sensitivity Map - Slice A



Order Details

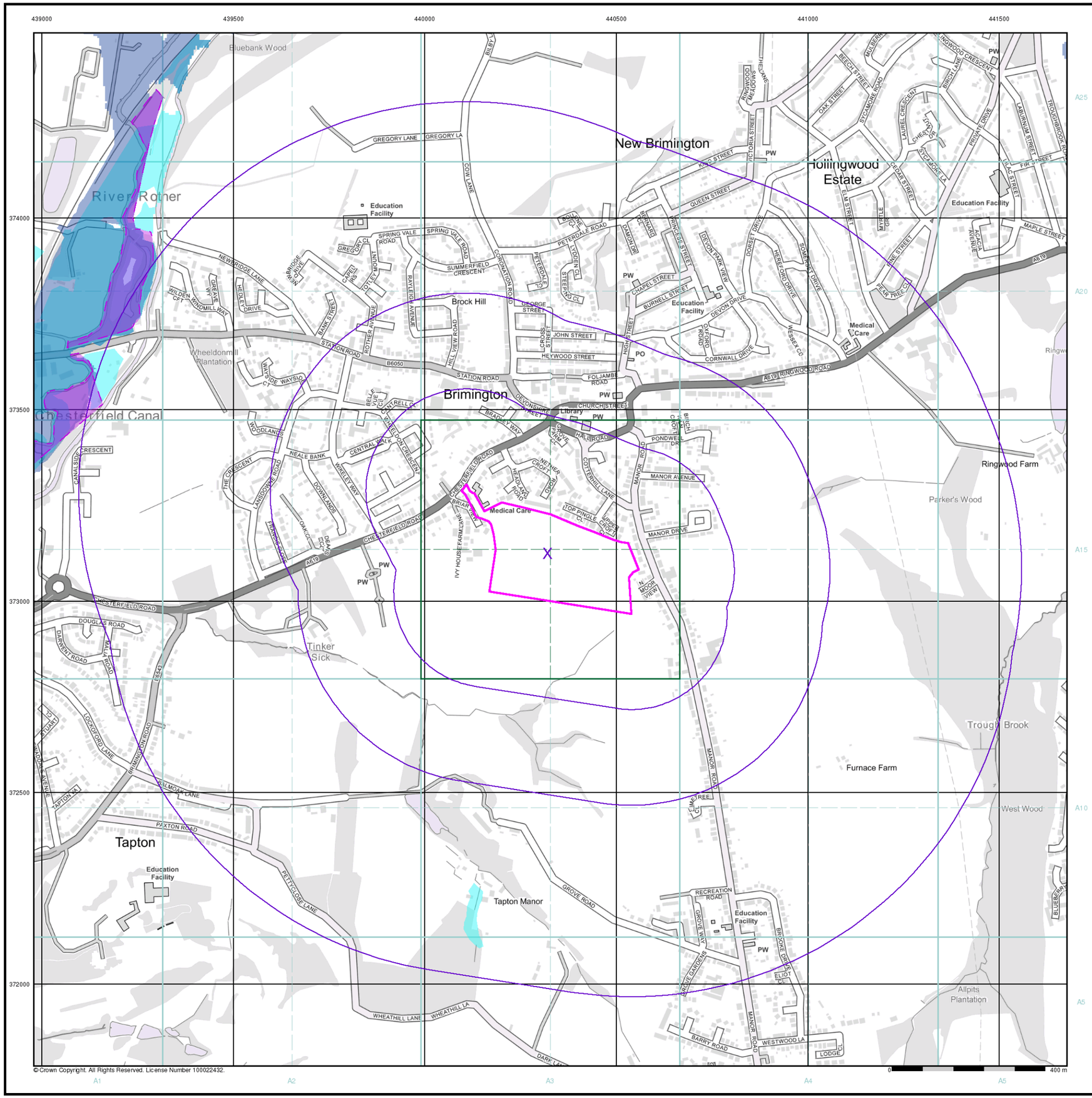
Order Number:	227164156_1_1
Customer Ref:	PO15455/JW/3569
National Grid Reference:	440320, 373130
Slice:	A
Site Area (Ha):	8.03
Search Buffer (m):	1000

Site Details

Chesterfield Road, Brimington, S43 1EJ

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

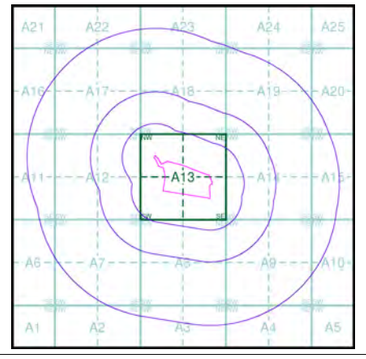
General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A



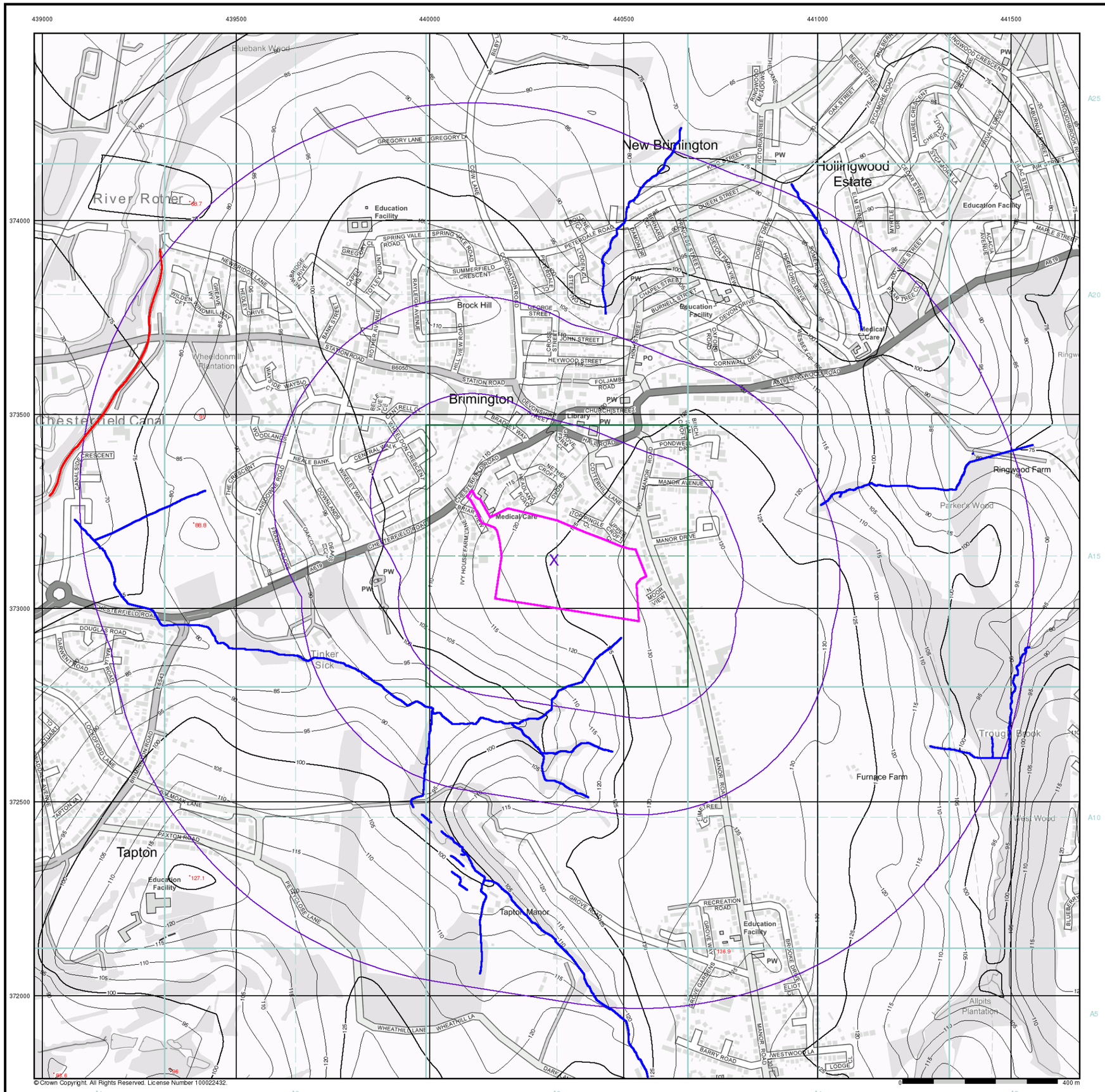
Order Details

Order Number:	227164156_1_1
Customer Ref:	PO15455/JW/3569
National Grid Reference:	440320, 373130
Slice:	A
Site Area (Ha):	8.03
Search Buffer (m):	1000

Site Details

Chesterfield Road, Brimington, S43 1EJ

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



LITHOS CONSULTING

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

OS Water Network Data

- Canal
- Reservoir
- Foreshore
- Marsh
- Tidal River
- Inland River
- Drain
- Other
- Lake
- Transfer
- Lock Or Flight Of Locks
- Sea

Contours (height in meters)

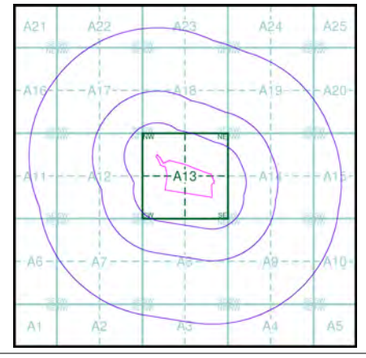
Standard Contour 105 100 95

Master Contour

Spot Height 167.3

- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



Order Details

Order Number:	227164156_1_1
Customer Ref:	PO15455/JW/3569
National Grid Reference:	440320, 373130
Slice:	A
Site Area (Ha):	8.03
Search Buffer (m):	1000

Site Details

Chesterfield Road, Brimington, S43 1EJ

Landmark INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix F

Trial Pit Logs

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP01**

Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440480.00 - 373057.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2 × 0.6, Depth 2.40	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20 0.20	B J&T					TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
				0.40			Firm light orange mottled grey slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	0.80	D	HVP=65 HVP=62				
			HVP=86	1.30			Stiff dark grey thinly laminated CLAY. (COHESIVE RESIDUAL SOIL)
				1.70			Weak dark grey MUDSTONE. Recovered as angular tabular fine to coarse gravel. (WEATHERED COAL MEASURES)
				2.10			Light grey clayey angular to subangular fine to medium GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				2.30 2.40			Weak dark grey thinly laminated MUDSTONE. Recovered as angular tabular fine to coarse gravel with a low cobble content. (COAL MEASURES) *At 2.4m, unable to excavate further due to bedrock.* End of pit at 2.40 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP02**

Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440514.00 - 373085.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.4 × 0.6 Depth 3.30	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies including sandstone and mudstone. (TOPSOIL)
			HVP=70				Firm light orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
			HVP=76				
	1.20	D		1.30			Light grey very clayey angular tabular fine to medium GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
			HVP=48	2.50			Firm light orange mottled grey gravelly CLAY. Gravel is subangular to subrounded of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	2.90	D		2.80			Light grey slightly clayey angular tabular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				3.20			Weak dark grey MUDSTONE. Recovered as coarse tabular gravel. (COAL MEASURES)
				3.30			End of pit at 3.30 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP03
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440516.00 - 373126.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.3 × 0.6, Depth 2.30	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30			TOPSOIL: Dark brown gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mudstone and sandstone. (TOPSOIL)
	0.70	D	HVP=42 HVP=52	1.80			Firm light orange mottled grey slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	1.90	D		2.20 2.30			Firm light grey gravelly CLAY. Gravel is horizontally laminated angular tabular of mudstone. (COHESIVE RESIDUAL SOIL) Weak dark grey thinly laminated MUDSTONE. Recovered as angular tabular fine to coarse gravel. (COAL MEASURES) *At 2.3m, unable to excavate further due to bedrock.* End of pit at 2.30 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP04
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440474.00 - 373150.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.4 × 0.6, Depth 1.40	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J&T		0.30			TOPSOIL: Dark greyish brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
			HVP=68	0.70			Firm light orange mottled grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mixed lithologies. (COHESIVE RESIDUAL SOIL)
				1.10			Dark grey MUDSTONE. Recovered as angular tabular fine to coarse gravel. (WEATHERED COAL MEASURES)
	1.20	D		1.40			Light orange slightly clayey slightly sandy subangular to subrounded fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL) *At 1.4m, unable to excavate further due to sandstone bedrock.* End of pit at 1.40 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP05
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440475.00 - 373110.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.4 × 0.6, Depth 2.20	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
			HVP=62				Firm light orange mottled grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mudstone. (COHESIVE RESIDUAL SOIL)
			HVP=65				
			HVP=82	1.30			Stiff light grey slightly gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone. (COHESIVE RESIDUAL SOIL)
	1.70	D		1.60			Weak dark grey MUDSTONE. Recovered as angular tabular gravel. (WEATHERED COAL MEASURES)
				2.00			Light greyish brown sandy angular to subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
				2.20			*At 2.2m, unable to excavate further due to sandstone bedrock.* End of pit at 2.20 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP06
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440436.00 - 373074.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.3 × 0.6 Depth 1.60	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.30	J&T		0.40			TOPSOIL: Dark greyish brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
	0.60	D	HVP=54				Firm light orange mottled grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	1.30	D		1.20			Weak dark grey MUDSTONE. Recovered as angular tabular fine to coarse GRAVEL. (WEATHERED COAL MEASURES)
				1.50 1.60			Light greyish brown slightly clayey slightly sandy subangular to subrounded GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL) *At 1.6m, unable to excavate further due to sandstone bedrock.* End of pit at 1.60 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP07
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440379.00 - 373087.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.5 × 0.6, Depth 2.50	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J&T	HVP=70	0.30			TOPSOIL: Dark brown gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
	1.10	D		1.80			Firm light orange and grey mottled slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone lithorelicts. (COHESIVE RESIDUAL SOIL) *From 0.3m to 1.8m, becomes more sandy with depth.*
				2.50			Light brown slightly clayey slightly sandy angular to subangular fine to coarse GRAVEL of sandstone and sandstone lithorelicts. (GRANULAR RESIDUAL SOIL) *At 2.5m, unable to excavate further due to sandstone bedrock.* End of pit at 2.50 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP08
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440377.00 - 373125.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.2 × 0.6 Depth 2.10	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
	0.80	D	HVP=71	1.80			Firm light orange mottled grey gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone and sandstone lithorelicts. (COHESIVE RESIDUAL SOIL)
				2.10			Light orangish grey slightly clayey sandy angular to subangular fine to coarse GRAVEL of sandstone lithorelicts. (GRANULAR RESIDUAL SOIL) *At 2.1m, unable to excavate further due to sandstone bedrock.* End of pit at 2.10 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP09
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440427.00 - 373151.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.5 × 0.6, Depth 1.30	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 0.10	B J&T					TOPSOIL: Dark greyish brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
				0.40			Stiff light orange mottled grey gravelly CLAY. Gravel is angular to subrounded fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
			HVP=90				
			HVP=92				
				1.30			*At 1.3m, unable to excavate further due to sandstone bedrock.* End of pit at 1.30 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP10
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440376.00 - 373174.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.2 × 0.6, Depth 2.00	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
				0.50			Firm light orange mottled grey gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
							Moderately strong light brown finely grained SANDSTONE. Recovered as angular tabular fine to coarse gravel with a high cobble content. (WEATHERED COAL MEASURES)
							From 0.5m to 1.0m, thinly bedded.
				1.00			Light orangish brown sandy angular to subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
	1.30	D					
							At 2.0m, unable to excavate further due to sandstone bedrock.
				2.00			End of pit at 2.00 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit were unstable between 0.5m and 1.0m depth during excavation with some overbreak in the granular strata.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP11
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440335.00 - 373147.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.3 × 0.6, Depth 2.10	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J&T		0.30			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
	0.70	D	HVP=66	1.00			Firm light orange mottled grey slightly gravelly sandy CLAY. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				2.10			Light orangish brown slightly clayey sandy subangular to subrounded fine to coarse GRAVEL of sandstone with a low cobble content. Cobbles are angular tabular of sandstone. (GRANULAR RESIDUAL SOIL) *At 2.1m, unable to excavate further due to sandstone bedrock.* End of pit at 2.10 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP12
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440321.00 - 373106.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.4 × 0.6, Depth 1.60	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20 0.20	B J&T		0.40			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
			HVP=56	1.00			Firm light orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
				1.60			Light orangish brown clayey sandy angular to subrounded fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL) *At 1.6m, unable to excavate further due to sandstone bedrock.* End of pit at 1.60 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP13
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440219.00 - 373136.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.5 × 0.6, Depth 2.00	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
			HVP=71				Firm light orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	0.90	D					
			HVP=68				
				1.60			Light orangish brown slightly clayey sandy angular to subangular fine to coarse GRAVEL of sandstone and sandstone lithorelicts. (GRANULAR RESIDUAL SOIL)
	1.80	D					*At 2.0m, unable to excavate further due to sandstone bedrock.*
				2.00			End of pit at 2.00 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP14
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440270.00 - 373150.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.5 × 0.6, Depth 2.20	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T					TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
				0.30			Firm light orange mottled grey slightly sandy gravelly CLAY. Gravel is angular tabular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=58				
							From 1.2m, clay becomes friable, recovered as gravel sized fragments.
			HVP=56				
				2.00			Light greyish orange slightly clayey slightly sandy angular to subangular fine to coarse GRAVEL of sandstone and sandstone lithorelicts. (GRANULAR RESIDUAL SOIL)
				2.20			*At 2.2m, unable to excavate further due to sandstone bedrock.* End of pit at 2.20 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP15
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440313.00 - 373182.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.7 × 0.6, Depth 1.90	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
	0.70	D	HVP=75	1.00			Firm light orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	1.30	D	HVP=65	1.60			Firm light grey mottled orange gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone and sandstone lithorelicts. (COHESIVE RESIDUAL SOIL)
				1.90			Light greyish brown sandy angular to subangular fine to coarse GRAVEL of sandstone and sandstone lithorelicts. (GRANULAR RESIDUAL SOIL) *At 1.9m, unable to excavate further due to sandstone bedrock.* End of pit at 1.90 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP16**

Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440313.00 - 37321.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.5 × 0.6, Depth 2.70	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	J&T		0.40			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
	0.50	D	HVP=43	0.70			Firm light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
			HVP=84	1.50			Stiff light orange mottled grey gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=95	2.10			Stiff light grey mottled orange gravelly CLAY. Gravel is angular fine to coarse of mudstone. (COHESIVE RESIDUAL SOIL)
				2.70			Light greyish brown sandy angular to subangular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
							End of pit at 2.70 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP17**

Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440281.00 - 373205.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.4 × 0.6, Depth 2.40	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20 0.20	B J&T		0.40			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
			HVP=70	1.10			Firm light orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	1.30	D	HVP=65	1.50			Firm light orange mottled grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
	1.80	D	HVP=79	2.20			Stiff dark grey slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				2.40			Light grey slightly clayey slightly sandy angular to subangular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL) *At 2.4m, unable to excavate further due to bedrock.* End of pit at 2.40 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP18
Sheet 1 of 1

Project Name:	North Moor View, Brimington	Project No. 3569	Co-ords: 440232.00 - 373192.00 Level:	Date 28/01/2020
Location:	Brimington		Dimensions (m): 2.1 × 0.6 Depth 2.50	Scale 1:25
Client:	Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
			HVP=100				Stiff light orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of mixed lithologies. (COHESIVE RESIDUAL SOIL)
			HVP=110				
				1.10			Stiff light grey slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone. (COHESIVE RESIDUAL SOIL)
			HVP=82				
				2.00			Light grey sandy angular tabular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
							At 2.5m, unable to excavate further due to sandstone bedrock.
				2.50			End of pit at 2.50 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP19
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440198.00 - 373178.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.2 × 0.6 Depth 2.50	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T					TOPSOIL: Dark brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
				0.40			
	0.60	D	HVP=94 HVP=96				Stiff light orange mottled grey slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
				0.90			
			HVP=104				Stiff light grey slightly gravelly CLAY. Gravel is angular fine to coarse of mudstone. (COHESIVE RESIDUAL SOIL)
				2.10			Light grey slightly clayey slightly sandy angular tabular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				2.50			*At 2.5m, unable to excavate further due to sandstone bedrock.* End of pit at 2.50 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP20
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440187.00 - 373220.00 Level:	Date 28/01/2020
Location: Brimington		Dimensions (m): 2.5 × 0.6, Depth 2.00	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
			HVP=84	0.60			Stiff light orange slightly gravelly slightly sandy CLAY. Gravel is angular to subangular fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	0.90	D	HVP=76				Stiff light grey gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone. (COHESIVE RESIDUAL SOIL)
				1.30			Light orangish grey slightly sandy clayey angular to subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
	1.50	D					*At 2.0m, unable to excavate further due to sandstone bedrock.*
				2.00			End of pit at 2.00 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP21
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440235.00 - 373231.00 Level:	Date 29/01/2020
Location: Brimington		Dimensions (m): 2.4 × 0.6, Depth 2.50	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J&T		0.30			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
			HVP=78 HVP=85	0.90			Stiff light orange mottled grey slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	1.20	D		1.70			Stiff friable light grey mottled orange slightly sandy slightly gravelly CLAY. Gravel is angular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL) *Unable to obtain handvane reading due to friable clay.*
				2.50			Light grey sandy angular tabular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL) *At 2.5m, unable to excavate further due to sandstone bedrock.* End of pit at 2.50 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP22
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440199.00 - 373077.00 Level:	Date 29/01/2020
Location: Brimington		Dimensions (m): 2.2 × 0.6, Depth 2.80	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J&T		0.30			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
	0.50	D	HVP=35	0.60			Damp soft light brown sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	0.70	D	HVP=28				Damp soft light orange mottled grey slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				1.10			Light greyish brown sandy angular tabular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
	1.40	D					
▼							*At 2.8m, slight groundwater seepage.*
							At 2.8m, unable to excavate further due to sandstone bedrock.
				2.80			End of pit at 2.80 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Slight groundwater seepage at 2.8m during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP23
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440250.00 - 373096.00 Level:	Date 29/01/2020
Location: Brimington		Dimensions (m): 2.5 × 0.6, Depth 1.40	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.40			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
			HVP=70				Firm light orange mottled grey slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	0.90	D	HVP=80	1.10			Strong light orange fine grained SANDSTONE. Recovered as angular tabular fine to coarse gravel with a medium cobble content. Cobbles are angular tabular, up to 30cm in size. (COAL MEASURES)
				1.40			*At 1.4m, unable to excavate further due to sandstone bedrock.* End of pit at 1.40 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP24
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440296.00 - 373050.00 Level:	Date 29/01/2020
Location: Brimington		Dimensions (m): 2.5 × 0.6, Depth 0.90	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J&T		0.30			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
			HVP=63				Firm light orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
▼							*At 0.9m, slight groundwater seepage.*
							At 0.9m, unable to excavate further due to sandstone bedrock.
				0.90			End of pit at 0.90 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Slight groundwater seepage at 0.9m during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP25
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440350.00 - 373031.00 Level:	Date 29/01/2020
Location: Brimington		Dimensions (m): 2.4 × 0.6 Depth 1.30	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20 0.20	B J&T		0.30			TOSOIL: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
			HVP=60				Firm light orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	0.70	D					
			HVP=65				
				1.20 1.30			Strong light brown medium grained SANDSTONE. Recovered as sandy angular tabular fine to coarse gravel. (COAL MEASURES) *At 1.3m, unable to excavate further due to sandstone bedrock.* End of pit at 1.30 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP26
Sheet 1 of 1

Project Name:	North Moor View, Brimington	Project No. 3569	Co-ords: 440395.00 - 373045.00 Level:	Date 29/01/2020
Location:	Brimington		Dimensions (m): 2.5 × 0.6, Depth 1.40	Scale 1:25
Client:	Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
				0.40			Firm light orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
				0.80			Dark grey very thinly laminated MUDSTONE. Recovered as slightly sandy angular tabular fine to coarse gravel. (WEATHERED COAL MEASURES)
	1.00	D	HVP=90				Stiff light orange motted grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone. (COHESIVE RESIDUAL SOIL)
				1.30			Light brown SANDSTONE. Recovered as slightly sandy angular tabular fine to coarse gravel. (COAL MEASURES)
				1.40			*At 1.4m, unable to excavate further due to sandstone bedrock.* End of pit at 1.40 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP27
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440434.00 - 373014.00 Level:	Date 29/01/2020
Location: Brimington		Dimensions (m): 2.5 × 0.6 Depth 1.50	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.30	J&T		0.40			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
			HVP=62	0.80			Firm light orange mottled grey slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	0.90	D		1.10			Weak dark grey MUDSTONE. Recovered as slightly sandy angular fine to coarse GRAVEL. (WEATHERED COAL MEASURES)
				1.40			Stiff light grey mottled orange slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
				1.50			Strong light brown SANDSTONE. Recovered as sandy angular tabular fine to coarse gravel. (COAL MEASURES) *At 1.5m, unable to excavate further due to sandstone bedrock.* End of pit at 1.50 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP28**

Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440489.00 - 373016.00 Level:	Date 29/01/2020
Location: Brimington		Dimensions (m): 2.6 × 0.4, Depth 2.20	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40			TOPSOIL: Dark brown slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
			HVP=63				Firm light orange mottled grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
			HVP=60				
				1.40			Stiff light grey CLAY. (GRANULAR RESIDUAL SOIL)
	1.60	D	HVP=76				
				2.10			Weak dark grey thinly laminated MUDSTONE. Recovered as slightly clayey slightly sandy fine to coarse gravel. (WEATHERED COAL MEASURES)
				2.20			*At 2.2m, unable to excavate further due to sandstone bedrock.* End of pit at 2.20 m

1 2 3 4 5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP29
Sheet 1 of 1

Project Name:	North Moor View, Brimington	Project No. 3569	Co-ords: 440233.00 - 373084.00 Level:	Date 29/01/2020
Location:	Brimington		Dimensions (m): 2.4 × 0.6 Depth 0.90	Scale 1:25
Client:	Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
				0.90			Light brown slightly clayey sandy angular to subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL) *From 0.8m, becoming difficult to sandstone excavate.* End of pit at 0.90 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP30
Sheet 1 of 1

Project Name:	North Moor View, Brimington	Project No. 3569	Co-ords: 440210.00 - 373098.00 Level:	Date 29/01/2020
Location:	Brimington		Dimensions (m): 1.8 × 0.6 Depth 0.70	Scale 1:25
Client:	Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithologies. (TOPSOIL)
				0.70			Moderately strong light orange SANDSTONE. Recovered as angular tabular fine to coarse gravel. (COAL MEASURES)
							End of pit at 0.70 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP31
Sheet 1 of 1

Project Name:	North Moor View, Brimington	Project No. 3569	Co-ords: 440196.00 - 373101.00 Level:	Date 29/01/2020
Location:	Brimington		Dimensions (m): 2.3 × 0.6 Depth 0.70	Scale 1:25
Client:	Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
				0.40			Moderately strong light brown SANDSTONE. Recovered as slightly sandy angular tabular fine to coarse gravel. (COAL MEASURES)
				0.70			*At 0.7m, unable to excavate further due to sandstone bedrock.*
							End of pit at 0.70 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP32
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440191.00 - 373087.00 Level:	Date 29/01/2020
Location: Brimington		Dimensions (m): 2.4 × 0.6, Depth 1.30	Scale 1:25
Client: Linden Homes East Yorkshire			Logged CC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
▼			HVP=43	0.30			TOPSOIL: Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (TOPSOIL)
							Soft light orange mottled grey sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
							At 0.6m, groundwater seepage.
				1.10			Light greyish brown slightly clayey GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
				1.30			*At 1.3m, unable to excavate further due to sandstone bedrock.* End of pit at 1.30 m

1
2
3
4
5

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

Stability: 1. The sides of the trial pit remained stable during excavation.

AGS

Appendix G

Borehole Logs

LITHOS CONSULTING

Borehole Log

Borehole No.
WS01
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440136.00 - 373230.00	Hole Type WS
Location: Brimington		Level:	Scale 1:25
Client: Linden Homes East Yorkshire		Dates: 27/01/2020 - 27/01/2020	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	J&T					MADE GROUND: Dark red slightly ashy sandy angular to subangular fine to coarse GRAVEL of mixed lithologies including sandstone, mudstone, clinker and burnt shale. (GRANULAR MADE GROUND)
					0.40			
		0.60	J&T					MADE GROUND: Firm dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is angular to subangular fine to medium of glass, brick, sandstone and mudstone. (REWORKED NATURAL)
					0.70			
		0.90	D					Firm light orange mottled grey slightly sandy gravelly CLAY. Gravel is angular to subangular fine to medium of mixed lithologies including sandstone, mudstone and coal. (COHESIVE RESIDUAL SOIL)
								At 1.3m, refusal on cobble or bedrock.
					1.30			End of borehole at 1.30 m

1
2
3
4
5

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
WS02
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440141.00 - 373246.00	Hole Type WS
Location: Brimington		Level:	Scale 1:25
Client: Linden Homes East Yorkshire		Dates: 27/01/2020 - 27/01/2020	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	J&T		0.30			MADE GROUND: Dark reddish grey slightly clayey slightly sandy angular to subangular fine to coarse GRAVEL of mixed lithologies including sandstone and burnt shale. (GRANULAR MADE GROUND)
		0.40	J&T	HVP=65	0.50			MADE GROUND: Firm dark greenish grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mixed lithologies including sandstone, mudstone, coal and burnt shale. (REWORKED NATURAL)
		0.80	D	HVP=66	1.00			Firm light orange and grey mottled slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mixed lithologies including sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
								At 1.0m, refusal on possible bedrock.
								End of borehole at 1.00 m

1
2
3
4
5

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

AGS

Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440127.00 - 373251.00	Hole Type WS
Location: Brimington		Level:	Scale 1:25
Client: Linden Homes East Yorkshire		Dates: 27/01/2020 - 27/01/2020	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J&T		0.20			MADE GROUND: Dark grey angular to subrounded fine to medium GRAVEL of mudstone coal and sandstone. (GRANULAR MADE GROUND)
		0.50	D		0.70			Firm dark brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mixed lithologies including sandstone, mudstone and coal. (COHESIVE RESIDUAL SOIL)
		0.80	D	HVP=40	1.00			Firm light orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone, mudstone and coal. (COHESIVE RESIDUAL SOIL)
								From 0.9m to 1.0m, fine grained SANDSTONE.
								At 1.0m, refusal on possible bedrock.
								End of borehole at 1.00 m

1
2
3
4
5

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

LITHOS CONSULTING

Borehole Log

Borehole No.
WS04
Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440134.00 - 373262.00	Hole Type WS
Location: Brimington		Level:	Scale 1:25
Client: Linden Homes East Yorkshire		Dates: 27/01/2020 - 27/01/2020	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J&T		0.20			MADE GROUND: Dark greyish brown gravelly CLAY with many rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies including plastic and sandstone. (MADE GROUND TOPSOIL)
		0.40	D		0.60			Firm light orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
					0.90			Moderately strong light brown finely grained SANDSTONE. Recovered as slightly clayey angular coarse gravel. (COAL MEASURES)
								At 0.9m, refusal on possible bedrock.
								End of borehole at 0.90 m

1
2
3
4
5

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

AGS

Borehole Log

Borehole No. **WS05**

Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440118.00 - 373281.00	Hole Type WS
Location: Brimington		Level:	Scale 1:25
Client: Linden Homes East Yorkshire		Dates: 27/01/2020 - 27/01/2020	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J&T		0.20			MADE GROUND: Dark grey MACADAM. (MACADAM HARDSTAND)
		0.25	D		0.30			Firm dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mixed lithologies. (COHESIVE RESIDUAL SOIL)
					0.40			Moderately strong light brown slightly clayey SANDSTONE. Recovered as angular coarse gravel. (COAL MEASURES)
								End of borehole at 0.40 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

Borehole Log

LITHOS CONSULTING

Borehole No. **WS06** Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440107.00 - 373296.00	Hole Type WS
Location: Brimington		Level:	Scale 1:25
Client: Linden Homes East Yorkshire		Dates: 27/01/2020 - 27/01/2020	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J&T					MADE GROUND: Dark grey MACADAM. (MACADAM HARDSTAND)
					0.30			Firm dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mixed lithologies including coal, sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	▼	0.50	D		0.60			Stiff light orange mottled grey gravelly CLAY. Gravel is angular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
								At 0.6m, groundwater seepage.
					1.00			*At 1.0m, refusal on possible bedrock.* End of borehole at 1.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was apparent at 0.6m during drilling.

AGS

Borehole Log

Borehole No. **WS07**

Sheet 1 of 1

Project Name: North Moor View, Brimington	Project No. 3569	Co-ords: 440105.00 - 373285.00	Hole Type WS
Location: Brimington		Level:	Scale 1:25
Client: Linden Homes East Yorkshire		Dates: 27/01/2020 - 27/01/2020	Logged By CC

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10	J					MADE GROUND: Dark grey MACADAM. (MACADAM HARDSTAND)
					0.20			
		0.30	J&T					MADE GROUND: Dark grey gravelly CLAY. Gravel is angular fine to medium of brick, sandstone and mudstone. (COHESIVE MADE GROUND)
					0.40			
		0.60	D					Firm dark brownish grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mixed lithologies. (COHESIVE RESIDUAL SOIL)
								At 0.9m, refusal on possible bedrock.
					0.90			End of borehole at 0.90 m

1
2
3
4
5

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

Appendix H

Contaminated land assessment for selection of water supply pipes

Contaminated Land Assessment Form

Introduction

In January 2011, UK Water Industry Research (UKWIR) published “Guidance for the selection of Water Supply Pipes to be used in Brownfield Sites” (UKWIR 2010 Ref 10/WM/03/21). The aim of this publication is to ensure that the correct materials are selected for Water Pipes to be used below ground in Brownfield Sites. It supersedes the Water Regulations Advisory Scheme (WRAS) Information and Guidance Note 9-04-03 “Laying Pipes in Contaminated Land” which has now been withdrawn.

The UKWIR guidance is for use by Water Companies, Self Lay Organisations, Developers and Consultants during the planning, designing and construction of water mains and/or services in Brownfield Sites. The guidance defines a Brownfield Site as “Land or premises that have not previously been used or developed. They may also be vacant or derelict. However, they are not necessarily contaminated.” UKWIR state the guidance does not apply to Greenfield Sites, however YW reserve the right to apply relevant sections of the publication to Greenfield Sites that may potentially be contaminated.

Contamination Risk Assessment

Please complete the form below to allow us to assess the risk of contamination of the drinking water supply from chemicals within the soil. Yorkshire Water now lays all its water mains and service pipes in plastic. Many organic compounds (i.e. Phenols, Fuels and other hydrocarbons) can either permeate through the walls of plastic pipes into the water supply or dissolve and weaken the pipe causing water leaks.

As a minimum a desk top study (Preliminary Risk Assessment) shall be provided to YW that sets out whether the land through which the Water Pipes are to be laid may be affected by contamination. For those sites where land contamination may be present, appropriate testing shall be undertaken on existing ground materials and remediated materials. The testing requirements are as described below:

Testing Requirements

The tests that are required on all sites where the potential for contamination has been established through the desk top study and where water pipes are proposed to be laid must be undertaken by bodies with accreditation from UKAS (United Kingdom Accreditation Service) and where possible MCERTS (Environment Agency’s Monitoring Certification Service).

The tests on soil/water samples shall be those to detect and report on the levels of the following contaminant groups and chemical characteristics: **VOC’s, SVOC’s, Mineral Oil compounds C10-C40, Conductivity, pH** and **Redox potential** (as stipulated in the UKWIR guidance Appendix G).
If the previous function of the site involved the use, storage, manufacture or disposal of any of the following elements, appropriate testing for these substances will be required:

Ethers, Nitrobenzene, Ketones, Aldehydes and Amines. Please note UKWIR guidance states the presence of Amines on any site precludes the use of Polyethylene pipework.

Sufficiency of Testing

Samples taken must be representative of the soil conditions in which the Water Pipes are proposed to be laid (normally Water Pipes are laid at a depth between 0.7m and 1.3m below finished ground level). As a result samples must be taken at least 500mm below the base of the proposed pipe where the proposed location is known. If the proposed location is unknown then samples must be taken at intervals between the surface level and 1.5m from below finished ground level as a minimum. Where appropriate groundwater sampling and groundwater monitoring will also be necessary (see UKWIR guidance).

Further guidance on representative sampling is contained within BS10175:2011 “Code of practice for the Investigation of Potentially Contaminated Sites”.

The table in section 3 lists the contaminants and their respective levels which can permeate or damage plastic water pipes with consequent risk to the water supply. Where soil analysis results indicate levels of these contaminants above the maximum allowable concentration shown, then Yorkshire Water will determine that all mains and service pipes are laid in suitable materials resistant to the risks posed by those contaminants. Where sites have been used for any of the activities listed in Section 2 all mains and services shall be laid in suitable permeation resistant pipe systems due to the high risk of these contaminants being present.

Health & Safety Assessment

The UKWIR guidance does not cover Health & Safety considerations as part of any operational activities undertaken on Brownfield Sites. In order to maintain the safety of our staff, service partners and customers YW will also assess the site based on the EA CLEA (Contaminated Land Exposure Assessment) guidelines.

In order to comply with Yorkshire Water’s Health & safety requirements please review the following information relating to trigger values for Health & Safety considerations when laying Water Pipes in contaminated Land.

	Contaminant	Mg/Kg		Contaminant	Mg/Kg
Inorganic (Green = no exceedances)	Arsenic	32	Organic (Green = no exceedances)	Benzene	0.33
	Nickel	130		Toulene	610
	Mercury	170		Ethylbenzene	350
	Selenium	35		Xylene	230
	Cadmium	10		Phenol	420

1. Your Details

Company Name	Contact Name
Lithos Consulting Ltd	Matthew Thompson

Site Address	Contact Number
North Moor View, Brimington, Chesterfield S43 1QY	N / A

2. The Previous Use of the Site

Please indicate below the previous uses of the site being developed

The site is predominantly greenfield with no past development. A car sales garage is present in the far north of the site, that can be accessed off Chesterfield Road in the North. Historical Maps show the car sales garage was built in 1938.

Please indicate if the site (or part of it) has previously been used for any of the following activities:

no	Chemicals Manufacture	no	Paint or Ink Manufacture
no	Explosives / Ordnance Manufacture	no	Railway Land / Railway Engineering
no	Fuel Filling Stations / Storage	no	Scrap metals
no	Metal Finishing / Treating	no	Shipbuilding & Repair
no	Mechanical Engineering Works	yes	Vehicle Repair Garages
no	Oil & Gas Refineries / Storage	no	Vehicle Manufacturing

3. Contaminants

Please complete the table below with the highest concentrations in mg/kg of each or any of the contaminants listed. The information should be extracted from your soil reports already undertaken, if any of the contaminants were not tested for, this should be declared on the form along with the reasons for this. If you have any difficulty interpreting the results of your soil sample analyses and transposing them into the table, then you should consult the body who undertook the sampling and reporting. If there are more than 3 sample locations with associated test results please copy the table for each location and label each with the sample reference and its location on a site plan.

Laboratory Name:		Date	Depth (m)	
Group No.	Parameter group	Unit	Concentration	Detection Limit
1	Extended VOC suite (with TIC)	mg/kg	Not tested	0.5
1a	BTEX & MTBE	mg/kg	<0.1mg/kg	0.1
2	Extended SVOC suite (with TIC)	mg/kg	B(a)P <17mg/kg (WS03)	2
2e	Phenols	mg/kg	Not tested	2
2f	Cresols and chlorinated phenols	mg/kg	Not tested	2
3	Mineral Oils C_{11}-C_{20}	mg/kg	TPH (DRO) 685mg/kg (SP04) & 813mg/kg (SP05)	10
4	Mineral Oils C_{21}-C_{40}	mg/kg	TPH (LRO) 15400mg/kg (SP04) & 14980 mg/kg (SP05)	500
5	Corrosive (Conductivity, Redox & pH)		Not tested	
	Conductivity	µS/cm	Not tested	
	Redox	Volt	Not tested	
	pH	pH	5.3 to 10.8 (range recorded across site)	
2a	Ethers	mg/kg	Not tested	0.5
2b	Nitrobenzene	mg/kg	Not tested	0.5
2c	Ketones	mg/kg	Not tested	0.5
2d	Aldehydes	mg/kg	Not tested	0.5
6	Amines	mg/kg	Not tested	Any presence

DO NOT include a copy of your soil report with your application, if you do not complete the table above your application will be returned to you.

Please include a site plan highlighting the locations of the above sample points.
Drawing 3569/6 shows the locations of exploratory holes.

4. Remediation of the site

Please indicate below any remediation work that will be undertaken on the site to remove / mitigate the effect of any contaminants identified in the soil report. Please include the nature and depth of any remediation work.

General site clearance of surface materials. Turnover of the full thickness of made ground is recommended to allow removal of below ground obstructions and enable inspection of the made ground within the sales garage in the far north-west. The only contamination of significance is associated with the sales garage area in the far north-west. No new housing is proposed in this area; just an access road and landscaping.

5. Can I use plastic pipe if I undertake remediation works?

Yes, as long as the remediation work either removes the contaminated soil or reduces the level of contaminants below trigger levels. Moving contaminated material so that it is under roads and footpaths is not acceptable as this is the likely location of the water mains.

As water mains are lad to a depth of 0.9m to the top of the pipe, any contaminated soil to a depth of 1.3m must be removed. We will require post remediation sampling results confirming contamination has fallen below the trigger levels prior to releasing any works to our Service Partners.

If contamination is found all water mains and services on the site must be laid in a suitable barrier pipe. Yorkshire Water will not change the agreed mains material after the agreement has been signed by all parties. So please ensure your remediation proposals are made clear at this stage.

6. Declaration

I hereby confirm that the information provided in this form is true and I understand that should the site conditions change from those indicated in this report that I may incur additional costs.

Your Signature	Date
	3rd March 2020

Your Name & Title (PLEASE PRINT	Role in organisation
Mark Perrin	Director

Please return this completed form with your application to Developer Services, Yorkshire Water Services Ltd, PO Box 52, Bradford BD3 7YD

References

BS10175:2011 “Investigation of Potentially Contaminated Sites Code of Practice

UK Water Industry Research (UKWIR) “ Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites” (Ref 10/WM/03/21)

Appendix I

Chemical Results

Certificate of Analysis

Certificate Number	20-02196-2
	25-Feb-20
Client	Lithos Consulting Ltd Parkhill Walton Rd Wetherby LS22 5DZ
Our Reference	20-02196-2
Client Reference	3569
Order No	15650/3569/CC
Contract Title	North Moor View, Brimington
Description	23 Soil samples.
Date Received	04-Feb-20
Date Started	04-Feb-20
Date Completed	25-Feb-20
Test Procedures	Identified by prefix DETSn (details on request).
Notes	**This report supersedes 20-02196, extra testing.** Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Adam Fenwick
Contracts Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

				Lab No	1632735	1632736	1632737	1632738	1632739	1632740
				Sample ID	TP01	TP03	TP07	TP09	TP12	TP16
				Depth	0.20	0.10	0.20	0.10	0.20	0.30
				Other ID						
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020
				Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Asbestos Quantification	DETSC 1102	0.001	%							
Preparation										
Clay content	$*		%	29			20	17		
Silt content	$*		%	60			60	58		
Sand content	$*		%	11			20	25		
Stones >2mm	DETSC 1003*	1	% m/m	2.0			6.0	18		
Stones >20mm	DETSC 1003*	1	% m/m	< 1.0			< 1.0	< 1.0		
Stones >50mm	DETSC 1003*	1	% m/m	< 1.0			< 1.0	< 1.0		
Visible contaminants >2 mm of which plastics	*	0.1	% m/m	< 0.1			< 0.1	< 0.1		
Visible contaminants >2 mm man made sharps	*	0.1	% m/m	< 0.1			< 0.1	< 0.1		
Metals										
Arsenic	DETSC 2301#	0.2	mg/kg	20	22	18	19	17	18	
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	1.0	1.5	0.7	0.8	0.8	1.0	
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.4	0.3	0.5	0.3	0.3	
Chromium	DETSC 2301#	0.15	mg/kg	24	25	24	22	21	23	
Chromium III	DETSC 2301*	0.15	mg/kg	24	25	24	22	21	23	
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Copper	DETSC 2301#	0.2	mg/kg	37	52	31	41	31	38	
Lead	DETSC 2301#	0.3	mg/kg	83	99	68	80	87	80	
Mercury	DETSC 2325#	0.05	mg/kg	0.07	0.12	0.07	0.08	0.08	0.11	
Nickel	DETSC 2301#	1	mg/kg	23	27	18	19	19	19	
Selenium	DETSC 2301#	0.5	mg/kg	1.0	1.3	1.7	2.6	1.3	1.0	
Zinc	DETSC 2301#	1	mg/kg	120	140	110	140	110	110	
Inorganics										
pH	DETSC 2008#		pH	6.9	6.5	6.2	6.5	6.6	6.6	
Total Organic Carbon	DETSC 2084#	0.5	%	4.9	7.2	3.5	6.3	4.0	4.1	
Petroleum Hydrocarbons										
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg							
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg							
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg							
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg							
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg							
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg							
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg							
Aliphatic C5-C35	DETSC 3072*	10	mg/kg							
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg							
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg							
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg							
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg							
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg							
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg							
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg							

Summary of Chemical Analysis
Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

				Lab No	1632735	1632736	1632737	1632738	1632739	1632740
				Sample ID	TP01	TP03	TP07	TP09	TP12	TP16
				Depth	0.20	0.10	0.20	0.10	0.20	0.30
				Other ID						
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020
				Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Aromatic C5-C35	DETSC 3072*	10	mg/kg							
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg							
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg							
EPH (C10-C12)	DETSC 3311	10	mg/kg							
EPH (C12-C16)	DETSC 3311	10	mg/kg							
EPH (C16-C21)	DETSC 3311	10	mg/kg							
EPH (C21-C35)	DETSC 3311	10	mg/kg							
EPH (C35-C40)	DETSC 3311	10	mg/kg							
EPH (C10-C40)	DETSC 3311#	10	mg/kg							
Benzene	DETSC 3321#	0.01	mg/kg							
Ethylbenzene	DETSC 3321#	0.01	mg/kg							
Toluene	DETSC 3321#	0.01	mg/kg							
Xylene	DETSC 3321#	0.01	mg/kg							
MTBE	DETSC 3321	0.01	mg/kg							
PAHs										
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.06
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.04	0.06	0.03	0.04	0.04	0.08
Pyrene	DETSC 3303#	0.03	mg/kg	0.03	0.05	< 0.03	0.03	< 0.03	0.07
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	0.11	< 0.10	< 0.10	< 0.10	0.21

Summary of Chemical Analysis
Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

				Lab No	1632741	1632742	1632743	1632744	1632745	1632746
				Sample ID	TP17	TP21	TP25	WS01	WS03	SP04
				Depth	0.20	0.20	0.20	0.20	0.10	0.10
				Other ID						
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020
				Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Asbestos Quantification	DETSC 1102	0.001	%						< 0.001	
Preparation										
Clay content	$*		%		26		23			
Silt content	$*		%		70		66			
Sand content	$*		%		4		11			
Stones >2mm	DETSC 1003*	1	% m/m		4.0		3.0			
Stones >20mm	DETSC 1003*	1	% m/m		< 1.0		< 1.0			
Stones >50mm	DETSC 1003*	1	% m/m		< 1.0		< 1.0			
Visible contaminants >2 mm of which plastics	*	0.1	% m/m		< 0.1		< 0.1			
Visible contaminants >2 mm man made sharps	*	0.1	% m/m		< 0.1		< 0.1			
Metals										
Arsenic	DETSC 2301#	0.2	mg/kg		18	19	14	9.6	4.9	
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg		1.0	0.9	0.9	0.3	0.5	
Cadmium	DETSC 2301#	0.1	mg/kg		0.3	0.3	0.3	< 0.1	0.4	
Chromium	DETSC 2301#	0.15	mg/kg		27	29	24	200	420	
Chromium III	DETSC 2301*	0.15	mg/kg		27	29	24	200	420	
Chromium, Hexavalent	DETSC 2204*	1	mg/kg		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Copper	DETSC 2301#	0.2	mg/kg		43	42	53	29	44	
Lead	DETSC 2301#	0.3	mg/kg		84	95	73	25	61	
Mercury	DETSC 2325#	0.05	mg/kg		0.10	0.14	0.08	< 0.05	< 0.05	
Nickel	DETSC 2301#	1	mg/kg		22	21	16	14	56	
Selenium	DETSC 2301#	0.5	mg/kg		1.2	0.9	1.8	1.7	3.2	
Zinc	DETSC 2301#	1	mg/kg		130	130	120	32	76	
Inorganics										
pH	DETSC 2008#		pH		6.6	6.9	7.6	10.4	10.8	
Total Organic Carbon	DETSC 2084#	0.5	%		4.5	5.3	3.5	0.8	1.9	7.3
Petroleum Hydrocarbons										
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg							< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg							< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg							< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg							2.1
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg							19
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg							210
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg							7200
Aliphatic C5-C35	DETSC 3072*	10	mg/kg							7400
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg							< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg							< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg							< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg							< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg							6.9
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg							120
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg							2800

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). $ -subcontracted. n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

				Lab No	1632741	1632742	1632743	1632744	1632745	1632746
				Sample ID	TP17	TP21	TP25	WS01	WS03	SP04
				Depth	0.20	0.20	0.20	0.20	0.10	0.10
				Other ID						
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020
				Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Aromatic C5-C35	DETSC 3072*	10	mg/kg							2900
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg							10000
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg							< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg							23
EPH (C12-C16)	DETSC 3311	10	mg/kg							92
EPH (C16-C21)	DETSC 3311	10	mg/kg							570
EPH (C21-C35)	DETSC 3311	10	mg/kg							14000
EPH (C35-C40)	DETSC 3311	10	mg/kg							1400
EPH (C10-C40)	DETSC 3311#	10	mg/kg							16000
Benzene	DETSC 3321#	0.01	mg/kg							< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg							< 0.01
Toluene	DETSC 3321#	0.01	mg/kg							< 0.01
Xylene	DETSC 3321#	0.01	mg/kg							< 0.01
MTBE	DETSC 3321	0.01	mg/kg							< 0.01
PAHs										
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.46	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.12	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.26	1.9	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.10	0.76	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	1.8	18	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.44	3.4	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.04	0.04	< 0.03	3.5	44	0.04
Pyrene	DETSC 3303#	0.03	mg/kg	0.04	0.04	< 0.03	3.1	41	0.04
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.87	14	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	1.2	17	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	< 0.03	1.2	23	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.49	9.1	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.87	17	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.36	7.0	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.11	1.9	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.57	8.6	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	< 0.10	15	210	< 0.10

Summary of Chemical Analysis
Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

	Lab No	1632747	1632748	1632749	1632750	1632751	1632752
	Sample ID	SP05	WS07	WS01	WS02	WS04	SP06
	Depth	0.10	0.30	0.60	0.40	0.10	0.10
	Other ID						
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Asbestos Quantification	DETSC 1102	0.001	%						
Preparation									
Clay content	$*		%						
Silt content	$*		%						
Sand content	$*		%						
Stones >2mm	DETSC 1003*	1	% m/m						
Stones >20mm	DETSC 1003*	1	% m/m						
Stones >50mm	DETSC 1003*	1	% m/m						
Visible contaminants >2 mm of which plastics	*	0.1	% m/m						
Visible contaminants >2 mm man made sharps	*	0.1	% m/m						
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg		7.9	19	18	14	
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg		1.3	1.0	1.4	0.4	
Cadmium	DETSC 2301#	0.1	mg/kg		< 0.1	1.0	0.7	0.6	
Chromium	DETSC 2301#	0.15	mg/kg		12	26	18	17	
Chromium III	DETSC 2301*	0.15	mg/kg		12	26	18	17	
Chromium, Hexavalent	DETSC 2204*	1	mg/kg		< 1.0	< 1.0	< 1.0	< 1.0	
Copper	DETSC 2301#	0.2	mg/kg		81	64	63	32	
Lead	DETSC 2301#	0.3	mg/kg		33	220	170	100	
Mercury	DETSC 2325#	0.05	mg/kg		< 0.05	0.09	0.07	< 0.05	
Nickel	DETSC 2301#	1	mg/kg		14	30	21	22	
Selenium	DETSC 2301#	0.5	mg/kg		0.6	1.4	0.9	1.9	
Zinc	DETSC 2301#	1	mg/kg		46	270	190	240	
Inorganics									
pH	DETSC 2008#		pH		10.4	7.6	7.1	7.4	
Total Organic Carbon	DETSC 2084#	0.5	%	6.5	9.8	5.6	4.5	3.4	
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01					
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01					
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01					
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	2.4					
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	20					
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	210					
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	6000					
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	6200					
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01					
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01					
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01					
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9					
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	8.8					
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	120					
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	3000					

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). $ -subcontracted. n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

				Lab No	1632747	1632748	1632749	1632750	1632751	1632752
				Sample ID	SP05	WS07	WS01	WS02	WS04	SP06
				Depth	0.10	0.30	0.60	0.40	0.10	0.10
				Other ID						
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020
				Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Aromatic C5-C35	DETSC 3072*	10	mg/kg	3100					
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	9300					
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1			< 0.1		< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	33			< 10		< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	120			10		10
EPH (C16-C21)	DETSC 3311	10	mg/kg	660			28		27
EPH (C21-C35)	DETSC 3311	10	mg/kg	14000			380		250
EPH (C35-C40)	DETSC 3311	10	mg/kg	980			100		72
EPH (C10-C40)	DETSC 3311#	10	mg/kg	16000			520		360
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01					
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01					
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01					
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01					
MTBE	DETSC 3321	0.01	mg/kg	< 0.01					
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.27	< 0.03	0.07	0.06	
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	0.06	< 0.03	< 0.03	< 0.03	
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.03	1.1	0.06	0.17	0.13	
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	1.0	0.06	0.16	0.12	
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.42	0.04	0.05	0.04	
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	0.46	0.06	0.09	0.04	
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.53	0.07	0.11	0.05	
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.21	< 0.03	0.04	< 0.03	
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.37	0.04	0.07	< 0.03	
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.13	< 0.03	0.05	< 0.03	
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	< 0.03	< 0.03	< 0.03	
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.15	< 0.03	0.06	< 0.03	
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	4.7	0.30	0.86	0.44	

Summary of Chemical Analysis
Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

	Lab No	1632753	1632754	1632755	1632756	1639884
	Sample ID	WS06	WS07	SP01	SP05	SP04
	Depth	0.10	0.10	0.10	0.20	0.20
	Other ID					
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020
	Sampling Time	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**			
Asbestos Quantification	DETSC 1102	0.001	%			
Preparation						
Clay content	$*		%			
Silt content	$*		%			
Sand content	$*		%			
Stones >2mm	DETSC 1003*	1	% m/m			
Stones >20mm	DETSC 1003*	1	% m/m			
Stones >50mm	DETSC 1003*	1	% m/m			
Visible contaminants >2 mm of which plastics	*	0.1	% m/m			
Visible contaminants >2 mm man made sharps	*	0.1	% m/m			
Metals						
Arsenic	DETSC 2301#	0.2	mg/kg			
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg			
Cadmium	DETSC 2301#	0.1	mg/kg			
Chromium	DETSC 2301#	0.15	mg/kg			
Chromium III	DETSC 2301*	0.15	mg/kg			
Chromium, Hexavalent	DETSC 2204*	1	mg/kg			
Copper	DETSC 2301#	0.2	mg/kg			
Lead	DETSC 2301#	0.3	mg/kg			
Mercury	DETSC 2325#	0.05	mg/kg			
Nickel	DETSC 2301#	1	mg/kg			
Selenium	DETSC 2301#	0.5	mg/kg			
Zinc	DETSC 2301#	1	mg/kg			
Inorganics						
pH	DETSC 2008#		pH			
Total Organic Carbon	DETSC 2084#	0.5	%			
Petroleum Hydrocarbons						
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg			
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg			
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg			
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg			
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg			
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg			
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg			
Aliphatic C5-C35	DETSC 3072*	10	mg/kg			
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg			
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg			
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg			
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg			
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg			
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg			
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg			

Summary of Chemical Analysis
Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

				Lab No	1632753	1632754	1632755	1632756	1639884
				Sample ID	WS06	WS07	SP01	SP05	SP04
				Depth	0.10	0.10	0.10	0.20	0.20
				Other ID					
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
				Sampling Date	27/01/2020	27/01/2020	27/01/2020	27/01/2020	27/01/2020
				Sampling Time	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Aromatic C5-C35	DETSC 3072*	10	mg/kg						
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg						
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg					< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg					< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg					< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg					49	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg					890	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg					81	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg					1000	< 10
Benzene	DETSC 3321#	0.01	mg/kg						
Ethylbenzene	DETSC 3321#	0.01	mg/kg						
Toluene	DETSC 3321#	0.01	mg/kg						
Xylene	DETSC 3321#	0.01	mg/kg						
MTBE	DETSC 3321	0.01	mg/kg						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	4.1		
Acenaphthylene	DETSC 3303#	0.03	mg/kg	0.08	0.13	0.11		
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.38	0.07	6.7		
Fluorene	DETSC 3303	0.03	mg/kg	0.21	0.04	7.3		
Phenanthrene	DETSC 3303#	0.03	mg/kg	3.1	0.69	44		
Anthracene	DETSC 3303	0.03	mg/kg	0.96	0.25	7.5		
Fluoranthene	DETSC 3303#	0.03	mg/kg	15	2.1	35		
Pyrene	DETSC 3303#	0.03	mg/kg	16	2.9	28		
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	7.7	1.3	7.7		
Chrysene	DETSC 3303	0.03	mg/kg	6.0	1.5	6.6		
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	6.5	7.3	6.7		
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	7.7	2.7	3.0		
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	6.2	6.1	5.4		
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	2.1	3.6	1.9		
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.53	0.92	0.54		
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	3.0	6.0	2.8		
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	75	36	170		

Summary of Asbestos Analysis
Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1632735	TP01 0.20	SOIL	NAD	none	Joanne Luscombe
1632736	TP03 0.10	SOIL	NAD	none	Joanne Luscombe
1632737	TP07 0.20	SOIL	NAD	none	Joanne Luscombe
1632738	TP09 0.10	SOIL	NAD	none	Joanne Luscombe
1632739	TP12 0.20	SOIL	NAD	none	Joanne Luscombe
1632740	TP16 0.30	SOIL	NAD	none	Joanne Luscombe
1632741	TP17 0.20	SOIL	NAD	none	Joanne Luscombe
1632742	TP21 0.20	SOIL	NAD	none	Joanne Luscombe
1632743	TP25 0.20	SOIL	NAD	none	Joanne Luscombe
1632744	WS01 0.20	SOIL	NAD	none	Joanne Luscombe
1632745	WS03 0.10	SOIL	Chrysotile	small bundle of Chrysotile present	Joanne Luscombe
1632748	WS07 0.30	SOIL	NAD	none	Joanne Luscombe
1632749	WS01 0.60	SOIL	NAD	none	Joanne Luscombe
1632750	WS02 0.40	SOIL	NAD	none	Joanne Luscombe
1632751	WS04 0.10	SOIL	NAD	none	Joanne Luscombe

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Summary of Asbestos Quantification Analysis

Soil Samples

Our Ref 20-02196-2
Client Ref 3569
Contract Title North Moor View, Brimington

Lab No	1632745
Sample ID	WS03
Depth	0.10
Other ID	
Sample Type	SOIL
Sampling Date	27/01/2020
Sampling Time	

Test	Method	Units	
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	**< 0.001**
Gravimetric Quantification (a)	DETSC 1102	Mass %	na
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	<0.001
Quantification by PCOM (c)	DETSC 1102	Mass %	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na
Breakdown of Gravimetric Analysis (a)			
Mass of Sample		g	135.66
ACMs present*		type	
Mass of ACM in sample		g	
% ACM by mass		%	
% asbestos in ACM		%	
% asbestos in sample		%	
Breakdown of Detailed Gravimetric Analysis (b)			
% Amphibole bundles in sample		Mass %	na
% Chrysotile bundles in sample		Mass %	<0.001
Breakdown of PCOM Analysis (c)			
% Amphibole fibres in sample		Mass %	na
% Chrysotile fibres in sample		Mass %	na
Breakdown of Potentially Respirable Fibre Analysis (d)			
Amphibole fibres		Fibres/g	na
Chrysotile fibres		Fibres/g	na

* Denotes test or material description outside of UKAS accreditation.
% asbestos in Asbestos Containing Materials (ACMs) is determined by
by reference to HSG 264.
Recommended sample size for quantification is approximately 1kg
# denotes deviating sample

Information in Support of the Analytical Results

Our Ref 20-02196-2
Client Ref 3569
Contract North Moor View, Brimington

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1632735	TP01 0.20 SOIL	27/01/20	GJ 250ml, PG, PT 1L	pH + Conductivity (7 days)	
1632736	TP03 0.10 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632737	TP07 0.20 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632738	TP09 0.10 SOIL	27/01/20	GJ 250ml, PG, PT 1L	pH + Conductivity (7 days)	
1632739	TP12 0.20 SOIL	27/01/20	GJ 250ml, PG, PT 1L	pH + Conductivity (7 days)	
1632740	TP16 0.30 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632741	TP17 0.20 SOIL	27/01/20	GJ 250ml, PG, PT 1L	pH + Conductivity (7 days)	
1632742	TP21 0.20 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632743	TP25 0.20 SOIL	27/01/20	GJ 250ml, PG, PT 1L	pH + Conductivity (7 days)	
1632744	WS01 0.20 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632745	WS03 0.10 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632746	SP04 0.10 SOIL	27/01/20	GJ 250ml, GJ 60ml, PT 1L		
1632747	SP05 0.10 SOIL	27/01/20	GJ 250ml, GJ 60ml, PT 1L		
1632748	WS07 0.30 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632749	WS01 0.60 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632750	WS02 0.40 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632751	WS04 0.10 SOIL	27/01/20	GJ 250ml, PT 1L	pH + Conductivity (7 days)	
1632752	SP06 0.10 SOIL	27/01/20	GJ 250ml, GJ 60ml, PT 1L		
1632753	WS06 0.10 SOIL	27/01/20	GJ 250ml, PT 1L		
1632754	WS07 0.10 SOIL	27/01/20	GJ 250ml		
1632755	SP01 0.10 SOIL	27/01/20	GJ 250ml x2		
1632756	SP05 0.20 SOIL	27/01/20	GJ 250ml		
1639884	SP04 0.20 SOIL	27/01/20	GJ 250ml	BTEX (14 days), EPH/TPH (14 days)	

Key: G-Glass P-Plastic J-Jar G-Bag T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Appendix J

Geotechnical Test Results

TERRA TEK
SITE INVESTIGATION & LABORATORY SERVICES

Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
Leeds
LS22 5DZ
For the attention of Charlotte Copley

Report No: B24141
Issue No 01

LABORATORY TEST REPORT

Project Name	**NORTH MOOR VIEW, BRIMINGTON**		
Project Number	**B24141**	Date samples received	31/01/2020
Your Ref		Date written instructions received	03/02/2020
Purchase Order	PO15651/3569/CC	Date testing commenced	03/02/2020

Please find enclosed the results as summarised below

Figure / Table	Test Quantity	Description	ISO 17025 Accredited
1	15	Summary of Geotechnical Tests	Yes
2-16	15	Atterberg Limit	Yes

Remarks :

Issued by : Stephen Langman Date of Issue : 13/02/2020

Approved Signatories : S Langman 13/02/2020

G Wilson (JMD/Laboratories Director), S Langman (Laboratory Coordinator)

Key to symbols used in this report
S/C : Testing was sub-contracted

Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.
The results reported relate to samples received in the laboratory only.
All results contained in this report are provisional unless signed by an approved signatory
This report should not be reproduced except in full without the written approval of the laboratory.
Under multisite accreditation the testing contained in this report may have been performed at another Terra Tek laboratory.
The enclosed results remain the property of Terra Tek Limited and we reserve the right to withdraw
our report if we have not received cleared funds in accordance with our standard terms and conditions
Only those results indicated in this report are UKAS accredited and any opinions or interpretations expressed are outside the scope of UKAS accreditation.
Feedback on the this report may be left via our website www.terratek.co.uk/contact-us

mCERTS UKAS TESTING 0126 25 YEARS 1990-2015

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: NORTH MOOR VIEW, BRIMINGTON

Client:

Engineer:

Contract No B24141

Sample Identification							Atterberg limits						Density		Total Stress			
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Other Tests
TP01	0.80		T	718923	Grey mottled brown CLAY with some gravel. Gravel is fine to medium.	32	71	26	45	19	CV							BRE SD1 Suite
TP03	0.70		T	718926	Grey mottled brown CLAY.	42	71	30	41	0	CV							BRE SD1 Suite
TP04	1.20		T	718928														BRE SD1 Suite
TP06	0.60		T	718930	Brown mottled grey CLAY.	33	74	30	44	0	CV							BRE SD1 Suite
TP06	1.30		T	718931														BRE SD1 Suite
Notes: Opinions and interpretations are outside the scope of UKAS accreditation					UKAS Accredited Test Y/N	Test details are given on the 'Notes on Laboratory Procedures' sheet												See individual report sheets
						Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	

Originator	Approved
PM	S. Langman 13/02/2020

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: NORTH MOOR VIEW, BRIMINGTON

Client:

Engineer:

Contract No B24141

Sample Identification							Atterberg limits						Density		Total Stress			
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Other Tests
TP08	0.80		T	718932	Brown mottled grey slightly sandy CLAY.	17	40	20	20	0	CI							BRE SD1 Suite
TP10	1.30		T	718934														BRE SD1 Suite
TP13	0.90		T	718936	Grey mottled brown slightly sandy CLAY.	18	42	20	22	0	CI							BRE SD1 Suite
TP15	1.30		T	718939	Brown slightly sandy, silty CLAY.	17	40	18	22	0	CI							BRE SD1 Suite
TP17	1.30		T	718941	Brown mottled grey CLAY.	23	48	20	28	0	CI							BRE SD1 Suite
Notes: Opinions and interpretations are outside the scope of UKAS accreditation					UKAS Accredited Test Y/N	Test details are given on the 'Notes on Laboratory Procedures' sheet												See individual report sheets
						Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	

Originator	Approved
PM	S. Langman 13/02/2020

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: NORTH MOOR VIEW, BRIMINGTON

Client:

Engineer:

Contract No B24141

Sample Identification				Lab Sample ID	Non Engineering Sample Description	Moisture Content	Atterberg limits					Particle Density	Density		Total Stress			Other Tests
Exploratory Hole	Depth m	Sample Ref	Sample Type				Liquid Limit	Plastic Limit	Plasticity Index	Percentage retained 425µm	Atterberg Classification		Bulk	Dry	Shear Strength	Apparent Cohesion C	Angle of Shearing Resistance Phi	
						%	%	%		%		Mg/m³	Mg/m³	Mg/m³	kPa	kPa		
TP19	0.60		T	718943	Grey mottled brown CLAY with occasional gravel. Gravel is fine.	25	53	23	30	4	CH							BRE SD1 Suite
TP20	1.50		T	718945														BRE SD1 Suite
TP21	1.20		T	718946	Grey CLAY with some siltstone. Siltstone is fine to medium.	14	53	24	29	8	CH							BRE SD1 Suite
TP22	0.70		T	718947	Brown silty, sandy CLAY with much gravel. Gravel is fine to coarse.	19	36	17	19	47	CI							BRE SD1 Suite
TP22	1.40	4	T	718949														BRE SD1 Suite
Notes: Opinions and interpretations are outside the scope of UKAS accreditation					UKAS Accredited Test Y/N	Test details are given on the 'Notes on Laboratory Procedures' sheet												See individual report sheets
						Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	

Originator	Approved
PM	S. Langman 13/02/2020

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: NORTH MOOR VIEW, BRIMINGTON

Client:

Engineer:

Contract No B24141

Sample Identification							Atterberg limits						Density		Total Stress			
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Other Tests
TP23	0.90		T	718950	Brown silty, very sandy CLAY with some gravel. Gravel is fine to medium.	15	30	16	14	7	CL							BRE SD1 Suite
TP27	0.90		T	718953														BRE SD1 Suite
WS01	0.90		T	718955	Brown silty CLAY with much gravel. Gravel is fine to medium.	18	59	26	33	26	CH							BRE SD1 Suite
WS03	0.50		T	718957	Dark brown slightly sandy, silty CLAY with some gravel. Gravel is fine to medium.	32	49	27	22	19	CI							BRE SD1 Suite
WS04	0.40		T	718959	Brown sandy, clayey SILT with some gravel. Gravel is fine to coarse	16		non plastic	~	24								BRE SD1 Suite
Notes: Opinions and interpretations are outside the scope of UKAS accreditation					UKAS Accredited Test Y/N	Test details are given on the 'Notes on Laboratory Procedures' sheet												See individual report sheets
						Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	

Originator	Approved
PM	S. Langman 13/02/2020

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: NORTH MOOR VIEW, BRIMINGTON

Client:

Engineer:

Contract No B24141

Sample Identification							Atterberg limits						Density		Total Stress			
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Other Tests
WS06	0.50		T	718960	Dark brown silty, sandy CLAY with some gravel. Gravel is fine to medium.	27	46	27	19	23	MI							BRE SD1 Suite
Notes	Opinions and interpretations are outside the scope of UKAS accreditation				UKAS Accredited Test Y/N	Test details are given on the 'Notes on Laboratory Procedures' sheet: Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	See individual report sheets

Originator	Approved
PM	S. Langman 13/02/2020

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

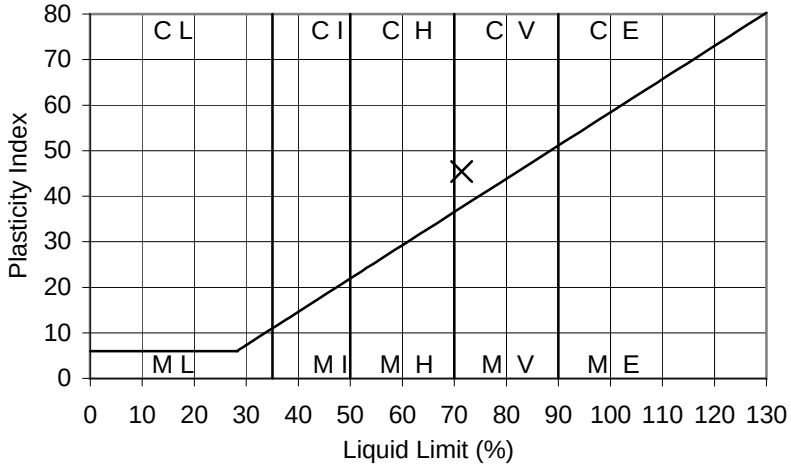
Engineer

Contract No. B24141

Hole ID TP01
Sample Ref
Depth (m) 0.80
Sample Type T

Non Engineering Description : Grey mottled brown CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample as received



Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	32	%
Percentage retained on 425µm sieve :	19	%
Liquid Limit :	71	%
Plastic Limit :	26	%
Plasticity Index :	45	
Equivalent moisture content of material passing 425µm sieve :	39	%
Liquidity Index :	0.29	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method) Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 2**
LC	13/02/2020		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

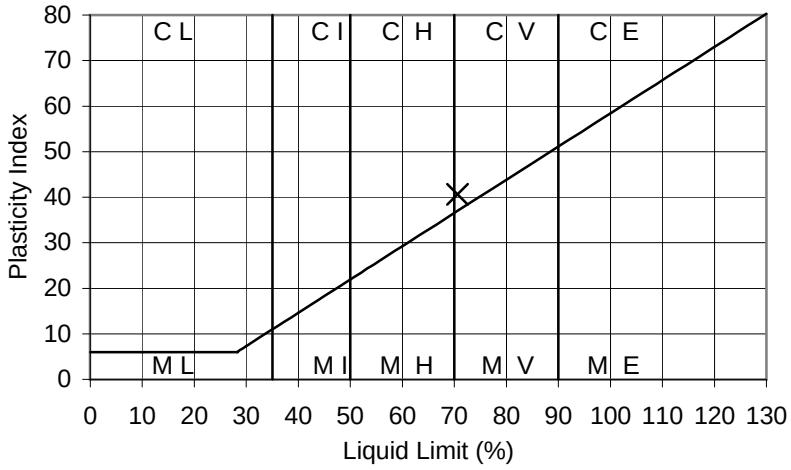
Engineer

Contract No. B24141

Hole ID TP03
Sample Ref
Depth (m) 0.70
Sample Type T

Non Engineering Description : Grey mottled brown CLAY.

Preparation : Sample as received



Results :

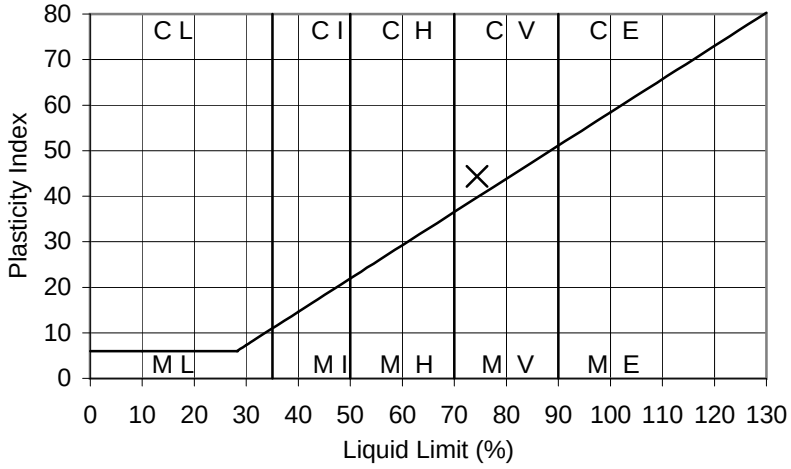
As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	42	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	71	%
Plastic Limit :	30	%
Plasticity Index :	41	
Equivalent moisture content of material passing 425µm sieve :	42	%
Liquidity Index :	0.29	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method) Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 3**
LC	13/02/2020		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site NORTH MOOR VIEW, BRIMINGTON	**Contract No. B24141**
	Client	Hole ID TP06
	Engineer	Sample Ref Depth (m) 0.60 Sample Type T

Non Engineering Description : Brown mottled grey CLAY.

Preparation : Sample as received



Results :

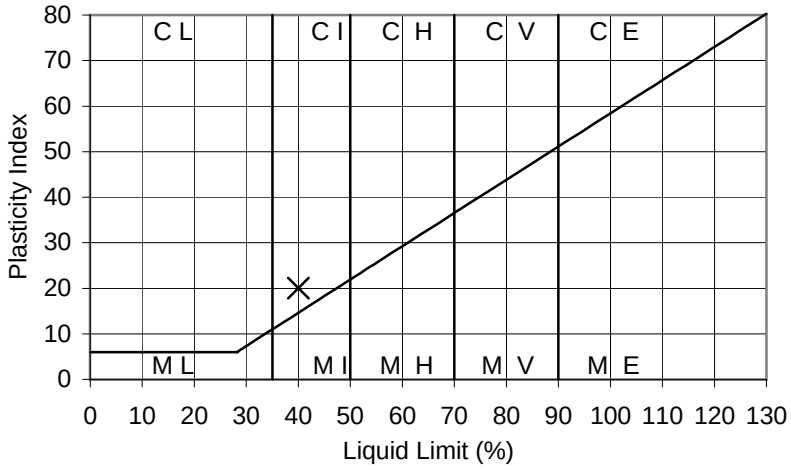
As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	33	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	74	%
Plastic Limit :	30	%
Plasticity Index :	44	
Equivalent moisture content of material passing 425µm sieve :	33	%
Liquidity Index :	0.07	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 4**
LC	13/02/2020		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site NORTH MOOR VIEW, BRIMINGTON	**Contract No. B24141**
	Client	Hole ID TP08
	Engineer	Sample Ref Depth (m) 0.80 Sample Type T

Non Engineering Description : Brown mottled grey slightly sandy CLAY.

Preparation : Sample as received



Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	17	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	40	%
Plastic Limit :	20	%
Plasticity Index :	20	
Equivalent moisture content of material passing 425µm sieve :	17	%
Liquidity Index :	-0.15	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 5**
LC	13/02/2020		Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

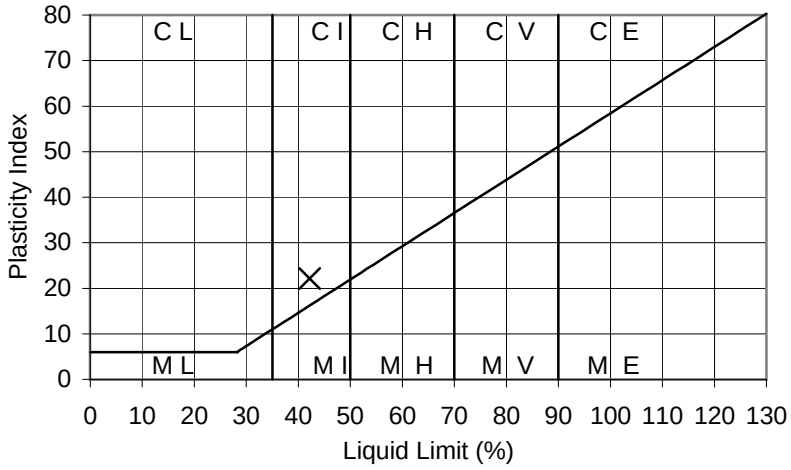
Engineer

Contract No. B24141

Hole ID TP13
Sample Ref
Depth (m) 0.90
Sample Type T

Non Engineering Description : Grey mottled brown slightly sandy CLAY.

Preparation : Sample as received



Results :

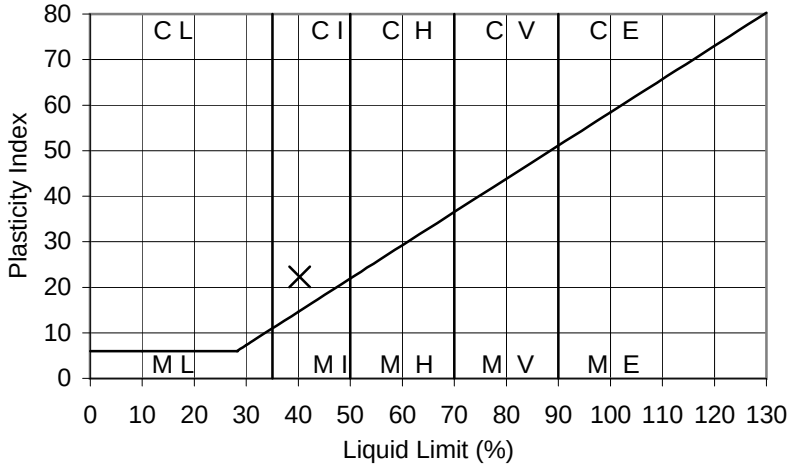
As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	18	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	42	%
Plastic Limit :	20	%
Plasticity Index :	22	
Equivalent moisture content of material passing 425µm sieve :	18	%
Liquidity Index :	-0.09	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method) Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 6**
LC	13/02/2020		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site NORTH MOOR VIEW, BRIMINGTON	**Contract No. B24141**
	Client	Hole ID TP15
	Engineer	Sample Ref Depth (m) 1.30 Sample Type T

Non Engineering Description : Brown slightly sandy, silty CLAY.

Preparation : Sample as received



Results :

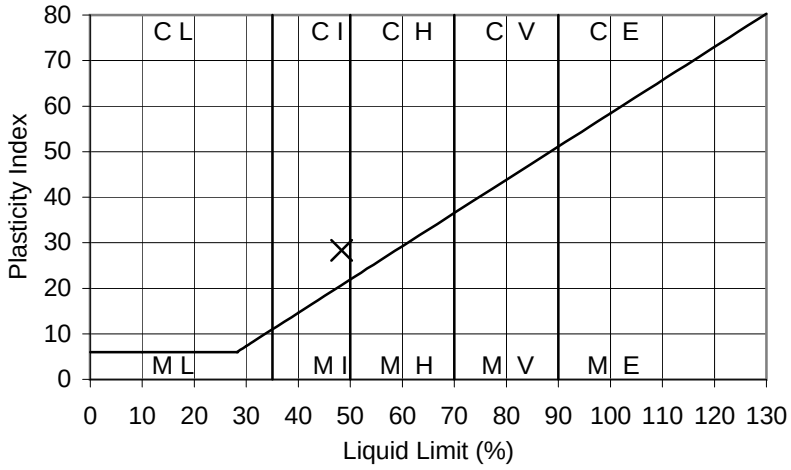
As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	17	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	40	%
Plastic Limit :	18	%
Plasticity Index :	22	
Equivalent moisture content of material passing 425µm sieve :	17	%
Liquidity Index :	-0.05	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 7**
LC	S. Langman 13/02/2020		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site NORTH MOOR VIEW, BRIMINGTON	**Contract No. B24141**
	Client	Hole ID TP17
	Engineer	Sample Ref Depth (m) 1.30 Sample Type T

Non Engineering Description : Brown mottled grey CLAY.

Preparation : Sample as received



Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	23	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	48	%
Plastic Limit :	20	%
Plasticity Index :	28	
Equivalent moisture content of material passing 425µm sieve :	23	%
Liquidity Index :	0.11	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 8**
LC	13/02/2020		Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

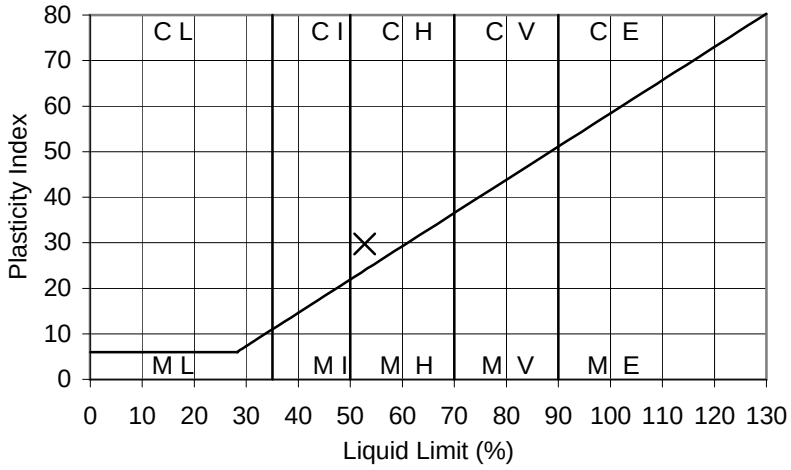
Engineer

Contract No. B24141

Hole ID TP19
Sample Ref
Depth (m) 0.60
Sample Type T

Non Engineering Description : Grey mottled brown CLAY with occasional gravel. Gravel is fine.

Preparation : Sample as received



Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	25	%
Percentage retained on 425µm sieve :	4	%
Liquid Limit :	53	%
Plastic Limit :	23	%
Plasticity Index :	30	
Equivalent moisture content of material passing 425µm sieve :	26	%
Liquidity Index :	0.10	

Originator	Checked & Approved
LC	13/02/2020

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS 1377:Part 2:Clause 4.4:1990
BS 1377:Part 2:Clause 5:1990

Figure 9

Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

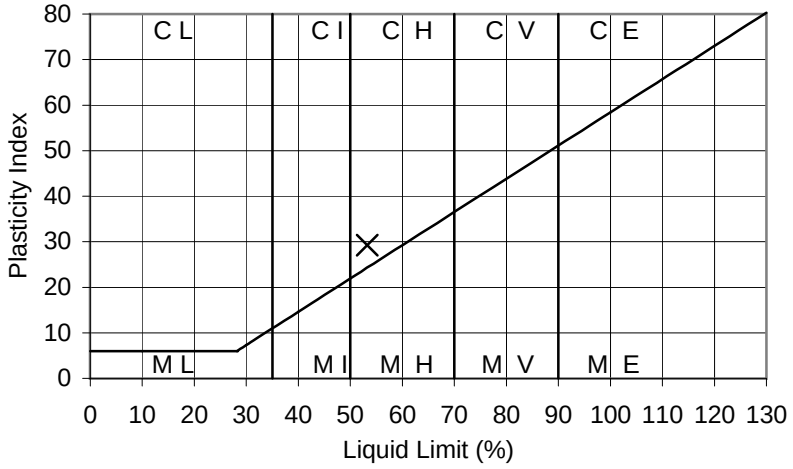
Engineer

Contract No. B24141

Hole ID TP21
Sample Ref
Depth (m) 1.20
Sample Type T

Non Engineering Description : Grey CLAY with some siltstone. Siltstone is fine to medium.

Preparation : Sample washed and air dried



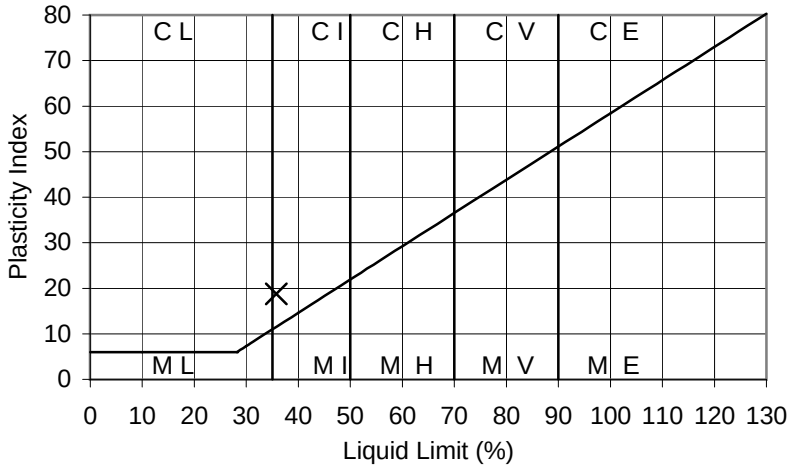
Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	14	%
Percentage retained on 425µm sieve :	8	%
Liquid Limit :	53	%
Plastic Limit :	24	%
Plasticity Index :	29	
Equivalent moisture content of material passing 425µm sieve :	15	%
Liquidity Index :	-0.31	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method) Plastic Limit, Plasticity Index & Liquidity Index**	**Figure 10**
LC	13/02/2020	BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	Sheet 1 of 1

Non Engineering Description : Brown silty, sandy CLAY with much gravel. Gravel is fine to coarse.

Preparation : Sample washed and air dried



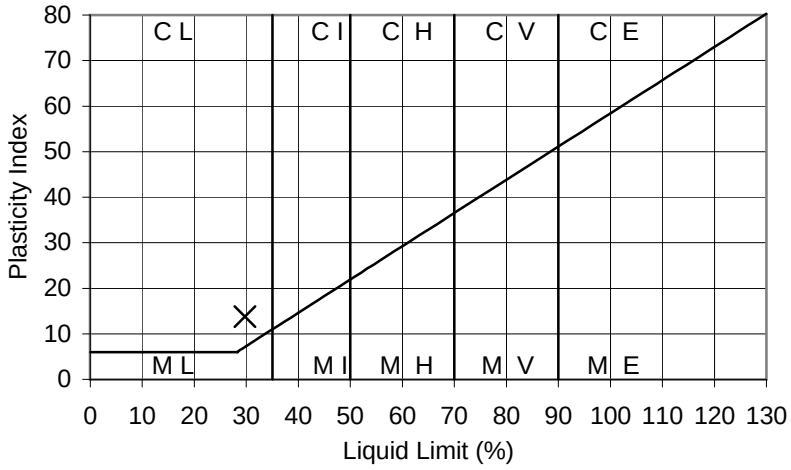
Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	19	%
Percentage retained on 425µm sieve :	47	%
Liquid Limit :	36	%
Plastic Limit :	17	%
Plasticity Index :	19	
Equivalent moisture content of material passing 425µm sieve :	36	%
Liquidity Index :	1.00	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method) Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 11**
LC	13/02/2020		Sheet 1 of 1

Non Engineering Description : Brown silty, very sandy CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample as received



Results :

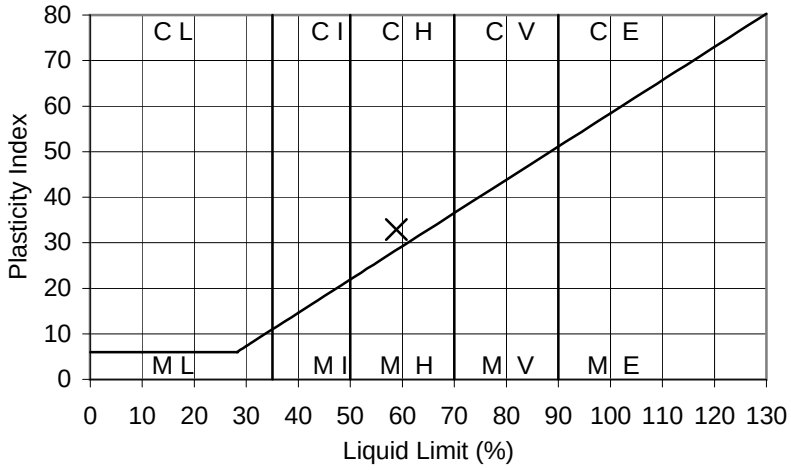
As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	15	%
Percentage retained on 425µm sieve :	7	%
Liquid Limit :	30	%
Plastic Limit :	16	%
Plasticity Index :	14	
Equivalent moisture content of material passing 425µm sieve :	16	%
Liquidity Index :	0.00	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method) Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 12**
LC	13/02/2020		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site NORTH MOOR VIEW, BRIMINGTON	**Contract No. B24141**
	Client	Hole ID WS01
	Engineer	Sample Ref Depth (m) 0.90 Sample Type T

Non Engineering Description : Brown silty CLAY with much gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried



Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	18	%
Percentage retained on 425µm sieve :	26	%
Liquid Limit :	59	%
Plastic Limit :	26	%
Plasticity Index :	33	
Equivalent moisture content of material passing 425µm sieve :	24	%
Liquidity Index :	-0.06	

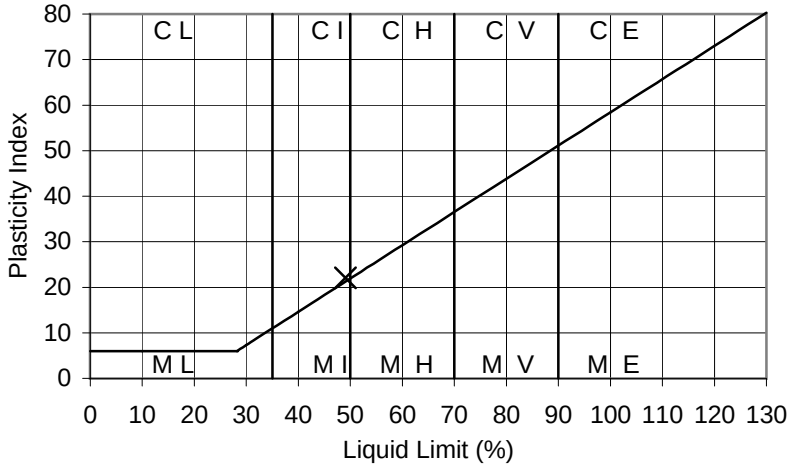
Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	**Figure 13**
LC	S. Langman 13/02/2020		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site	NORTH MOOR VIEW, BRIMINGTON	**Contract No. B24141**
Client		Hole ID WS03
Engineer		Sample Ref Depth (m) 0.50 Sample Type T

Non Engineering Description : Dark brown slightly sandy, silty CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried



Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	32	%
Percentage retained on 425µm sieve :	19	%
Liquid Limit :	49	%
Plastic Limit :	27	%
Plasticity Index :	22	
Equivalent moisture content of material passing 425µm sieve :	39	%
Liquidity Index :	0.55	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method) Plastic Limit, Plasticity Index & Liquidity Index**	
LC	13/02/2020	BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No. B24141

Hole ID WS04
Sample Ref
Depth (m) 0.40
Sample Type T

Non Engineering Description : Brown sandy, clayey SILT with some gravel. Gravel is fine to coarse

Preparation : Sample washed and air dried

Sample was determined to be Non-Plastic after preparation

Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	16 %
Percentage retained on 425µm sieve :	24 %
Equivalent moisture content of material passing 425µm sieve :	21 %

Originator	Checked & Approved
DS	13/02/2020

Plastic Limit
BS 1377:Part 2:Clause 5:1990

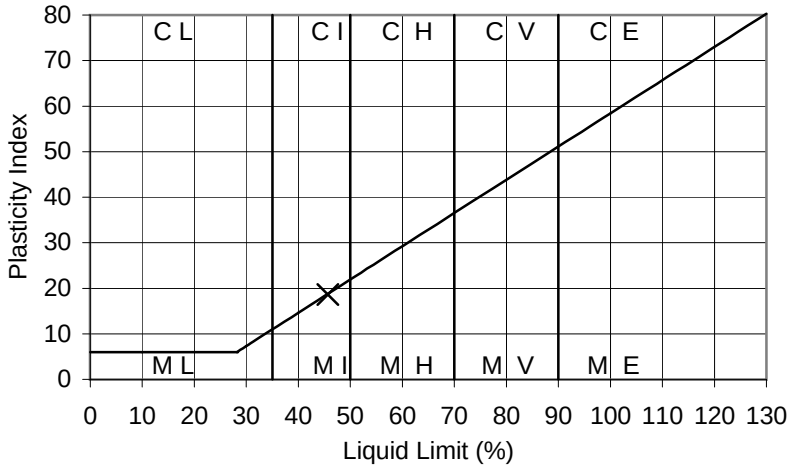
Figure 15

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site	NORTH MOOR VIEW, BRIMINGTON	**Contract No. B24141**
Client		Hole ID WS06
Engineer		Sample Ref Depth (m) 0.50 Sample Type T

Non Engineering Description : Dark brown silty, sandy CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried



Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	27	%
Percentage retained on 425µm sieve :	23	%
Liquid Limit :	46	%
Plastic Limit :	27	%
Plasticity Index :	19	
Equivalent moisture content of material passing 425µm sieve :	35	%
Liquidity Index :	0.42	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method) Plastic Limit, Plasticity Index & Liquidity Index**	**Figure 16**
LC	13/02/2020	BS 1377:Part 2:Clause 4.4:1990 BS 1377:Part 2:Clause 5:1990	Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION & LABORATORY SERVICES

Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
Leeds
LS22 5DZ
For the attention of Charlotte Copley

Report No: B24141
Issue No 02

LABORATORY TEST REPORT

Project Name	**NORTH MOOR VIEW, BRIMINGTON**		
Project Number	**B24141**	Date samples received	31/01/2020
Your Ref		Date written instructions received	03/02/2020
Purchase Order	PO15651/3569/CC	Date testing commenced	03/02/2020

Please find enclosed the results as summarised below

Figure / Table	Test Quantity	Description	ISO 17025 Accredited
1	21	BRE Suite - Soil	Yes
App S1	~	Sample Descriptions - Soil	N/A
App S2	~	Deviating Samples - Soil	N/A
App S3	~	Summary of In-House Analytical Test Methods - Soil	N/A

Remarks :

Issued by : Stephen Langman Date of Issue : 18/02/2020

Approved Signatories : S Langman 18/02/2020

G Wilson (JMD/Laboratories Director), S Langman (Laboratory Coordinator)

Key to symbols used in this report
S/C : Testing was sub-contracted

Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.
The results reported relate to samples received in the laboratory only.
All results contained in this report are provisional unless signed by an approved signatory
This report should not be reproduced except in full without the written approval of the laboratory.
Under multisite accreditation the testing contained in this report may have been performed at another Terra Tek laboratory.
The enclosed results remain the property of Terra Tek Limited and we reserve the right to withdraw
our report if we have not received cleared funds in accordance with our standard terms and conditions
Only those results indicated in this report are UKAS accredited and any opinions or interpretations expressed are outside the scope of UKAS accreditation.
Feedback on the this report may be left via our website www.terratek.co.uk/contact-us

mCERTS UKAS TESTING 0126 25 YEARS 1990-2015

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: NORTH MOOR VIEW, BRIMINGTON

Client:

Engineer:

Contract No B24141

Sample Identification				Lab Sample ID	pH	Sulphate (water soluble in 2:1 extract) as SO4 g/l																
Hole	Depth m	Sample Ref	Sample Type																			
TP01	0.80		T	718923	5.6	0.17																
TP03	0.70		T	718926	5.7	0.21																
TP04	1.20		T	718928	6.3	0.04																
TP06	1.30		T	718931	5.7	0.04																
TP10	1.30		T	718934	6.4	0.01																
TP13	0.90		T	718936	5.7	0.06																
TP15	1.30		T	718939	5.9	0.07																
TP17	1.30		T	718941	5.5	0.05																
TP19	0.60		T	718943	7.4	0.11																
TP20	1.50		T	718945	7.6	0.04																
Limits of Detection					~	0.01																
Terra Tek Analysis Method					TP019	TP169																
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M																

Originator	Checked & Approved
DAB	18/02/2020

BRE SD1 SUITE - SOIL

Figure 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: NORTH MOOR VIEW, BRIMINGTON

Client:

Engineer:

Contract No B24141

Sample Identification				Lab Sample ID	pH	Sulphate (water soluble in 2:1 extract) as SO4 g/l
Hole	Depth m	Sample Ref	Sample Type			
TP21	1.20		T	718946	8.3	0.05
TP22	1.40	4	T	718949	6.3	0.02
TP23	0.90		T	718950	7.1	0.01
TP27	0.90		T	718953	5.3	<0.01
WS01	0.90		T	718955	7.1	0.05
WS03	0.50		T	718957	7.3	0.02
WS04	0.40		T	718959	7.8	<0.01
WS06	0.50		T	718960	7.6	0.02
TP06	0.60		T	718930	5.2	0.13
TP08	0.80		T	718932	5.3	0.04
			Limits of Detection		~	0.01
			Terra Tek Analysis Method		TP019	TP169
			Accreditation M=Mcerts U=UKAS N=No accreditation		M	M

Originator	Checked & Approved
DAB	18/02/2020

BRE SD1 SUITE - SOIL

Figure 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: NORTH MOOR VIEW, BRIMINGTON

Client:

Engineer:

Contract No B24141

Sample Identification				Lab Sample ID	pH	Sulphate (water soluble in 2:1 extract) as SO4																	
Hole	Depth m	Sample Ref	Sample Type			g/l																	
TP22	0.70		T	718947	6.9	0.01																	
Limits of Detection					~	0.01																	
Terra Tek Analysis Method					TP019	TP169																	
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M																	

Originator	Checked & Approved
DAB	18/02/2020

BRE SD1 SUITE - SOIL

Figure 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No E13009/1

Sample Identification				Lab Sample ID	Date Sampled	Temperature on receipt °C	PRIMARY MATRIX	Secondary Matrix	Additional matrix	% Loss at 30C	% Retained 2mm
Exploratory Hole	Depth m	Sample Ref	Sample Type								
TP01	0.80		T	718923	28/01/20	10.8	CLAY	Fine to medium gravel		23.1	12.6
TP03	0.70		T	718926	28/01/20	10.8	CLAY	Fine to medium gravel		28.7	20.0
TP04	1.20		T	718928	28/01/20	10.8	Sandy CLAY	Fine to medium gravel		23.7	20.5
TP06	0.60		T	718930	28/01/20	10.8	CLAY	Fine gravel		23.4	~
TP06	1.30		T	718931	28/01/20	10.8	SANDSTONE			9.8	~
TP08	0.80		T	718932	28/01/20	10.8	CLAY	Fine gravel		14.8	~
TP10	1.30		T	718934	28/01/20	10.8	Sandy CLAY	Fine to medium gravel		8.4	24.8
TP13	0.90		T	718936	28/01/20	10.8	Sandy CLAY	Fine to medium gravel		15.4	14.4
TP15	1.30		T	718939	28/01/20	10.8	Sandy CLAY	Fine gravel		11.7	22.8
TP17	1.30		T	718941	28/01/20	10.8	Sandy CLAY	Fine gravel		18.3	12.5
TP19	0.60		T	718943	28/01/20	10.8	CLAY	Fine gravel		18.7	20.5
TP20	1.50		T	718945	28/01/20	10.8	Clayey SAND	Fine gravel		12.0	13.1
TP21	1.20		T	718946	28/01/20	10.8	CLAY	Fine gravel		11.9	25.0
TP22	0.70		T	718947	28/01/20	10.8	Sandy CLAY	Fine gravel		17.5	22.1
TP22	1.40	4	T	718949	28/01/20	10.8	Sandy CLAY	Fine gravel		10.5	21.0

Notes

Terra Tek are accredited for clay, sand and loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials such as gravel, are not accredited where they comprise the major component of the sample.

Results are expressed on a dry-weight basis (samples dried at <30^{o}C) except where stated.

The laboratory removes any material > 2mm prior to analysis. The quantity and nature of the material is shown as the secondary and additional matrix types in the above table.

Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors List, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	SAMPLE DESCRIPTIONS	Appendix S1
DAB	S. Langman 18/02/2020		Sheet 1 of 2

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No E13009/1

Sample Identification				Lab Sample ID	Date Sampled	Temperature on receipt °C	PRIMARY MATRIX	Secondary Matrix	Additional matrix	% Loss at 30C	% Retained 2mm
Exploratory Hole	Depth m	Sample Ref	Sample Type								
TP23	0.90		T	718950	28/01/20	10.8	Sandy CLAY	Fine gravel		12.5	21.6
TP27	0.90		T	718953	28/01/20	10.8	SANDSTONE			14.0	~
WS01	0.90		T	718955	28/01/20	10.8	Sandy CLAY	Fine gravel		14.7	21.9
WS03	0.50		T	718957	28/01/20	10.8	Sandy CLAY	Fine gravel		21.0	18.9
WS04	0.40		T	718959	28/01/20	10.8	CLAY	Fine gravel		16.5	24.7
WS06	0.50		T	718960	28/01/20	10.8	Sandy CLAY	Fine gravel		20.9	23.8

Notes

Terra Tek are accredited for clay, sand and loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials such as gravel, are not accredited where they comprise the major component of the sample.

Results are expressed on a dry-weight basis (samples dried at <30^{o}C) except where stated.

The laboratory removes any material > 2mm prior to analysis. The quantity and nature of the material is shown as the secondary and additional matrix types in the above table.

Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors List, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	SAMPLE DESCRIPTIONS	Appendix S1
DAB	S. Langman 18/02/2020		Sheet 2 of 2

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No B24141

Sample Identification				Lab Sample ID	Date Sampled	Deviating conditions						Preservatives used
Exploratory Hole	Depth m	Sample Ref	Sample Type			Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		
TP01	0.80		T	718923	28/01/20							
TP03	0.70		T	718926	28/01/20							
TP04	1.20		T	718928	28/01/20							
TP06	1.30		T	718931	28/01/20							
TP10	1.30		T	718934	28/01/20							
TP13	0.90		T	718936	28/01/20							
TP15	1.30		T	718939	28/01/20							
TP17	1.30		T	718941	28/01/20							
TP19	0.60		T	718943	28/01/20							
TP20	1.50		T	718945	28/01/20							
TP21	1.20		T	718946	28/01/20							
TP22	1.40	4	T	718949	28/01/20							
TP23	0.90		T	718950	28/01/20							
TP27	0.90		T	718953	28/01/20							
WS01	0.90		T	718955	28/01/20							

NOTES
1 Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2 The absence of "X" or "Yes" in the table above indicates no reported deviations.
3 Deviations due to use of incorrect sample container are shown on result tables.
4 Deviating results are indicated within result tables.

Originator	Checked & Approved
DAB	S. Longmuir 18/02/2020

DEVIATING SAMPLES - SOIL

Appendix S2

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No B24141

Sample Identification				Lab Sample ID	Date Sampled	Deviating conditions						Preservatives used
Exploratory Hole	Depth m	Sample Ref	Sample Type			Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		
WS03	0.50		T	718957	28/01/20							
WS04	0.40		T	718959	28/01/20							
WS06	0.50		T	718960	28/01/20							
TP06	0.60		T	718930	28/01/20							
TP08	0.80		T	718932	28/01/20							
TP22	0.70		T	718947	28/01/20							

NOTES
1 Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2 The absence of "X" or "Yes" in the table above indicates no reported deviations.
3 Deviations due to use of incorrect sample container are shown on result tables.
4 Deviating results are indicated within result tables.

Originator	Checked & Approved
DAB	S. Longmuir 18/02/2020

DEVIATING SAMPLES - SOIL

Appendix S2

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No B24141

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
GP001	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Preparation of soil samples for chemical analysis	Yes	Yes	N/A
GP012	BS EN 12457-3: Characterisation of Waste - Compliance test for leaching of granular waste materials and sludges (two-stage batch test)	Preparation of soil samples for two-stage leachate test			Dry
TP019	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of pH in 2.5:1 water/soil extract using pH meter.	Yes	Yes	Dry
TP032	MAFF Book 427: The Analysis of Agricultural Materials: Method 8	Determination of water soluble boron by colorimetry	Yes		Dry
TP040	APHA/AWWA, 19th edition: Method 3500Cr-D	Determination of hexavalent chromium by colorimetry.	Yes		Dry
TP041	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of organic matter by titrimetry.	Yes		Dry
TP042	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of loss on ignition at 50-440°C by gravimetry	Yes	Yes	Dry
TP045	GACHAMJA A.M. Chromatography and Analysis: 1992 9-11 (modified)	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS	Yes	Yes	Dry
TP046	MEWAM method: Phenols in water and Effluents: 4-aminoantipyrine method	Determination of monohydric phenols by steam distillation/colorimetry	Yes	Yes	Dry
TP047	MEWAM method: Cyanide in Waters etc	Determination of free cyanide by steam distillation/colorimetry	Yes		Dry
TP048	MEWAM method: Cyanide in Waters etc	Determination of total cyanide by steam distillation/colorimetry.	Yes	Yes	Dry
TP049	MEWAM method: Cyanide in Waters etc	Determination of complex cyanide by calculation	Yes		Dry
TP050	MEWAM method: Determination of Thiocyanate ,1985	Determination of thiocyanate by colorimetry	Yes	Yes	Dry
TP051	USEPA Method 9030B	Determination of acid soluble sulphides by steam distillation/colorimetry.	Yes	Yes	Wet
TP067	TNRCC Method 1005: 2001 (modified)	Determination of pentane/acetone extractable petroleum hydrocarbons (C8 - C40) by GC/FID	Yes	Yes	Wet
TP072	In-house documented method	Determination of ammoniacal nitrogen by colorimetry			Dry
TP073	In-house documented method	Determination of anionic detergent (MBAS) by colorimetry			Dry
TP074	In-house documented method	Determination of water soluble fluoride by ion selective electrode			Dry
TP098	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of acid soluble chloride by titrimetry			Dry
TP099	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry

Notes

1. Terra Tek (Birmingham) are MCERTS accredited for clay, sand & loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials, ie gravel, are not accredited where they comprise the major component of the sample.
2. Results are expressed on a dry-weight basis (samples dried at 30°C ± 5°C) except where stated.
3. The laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors list, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)	Appendix S3
N/A	N/A		Sheet 1 of 2

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No B24141

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
TP100	Wisconsin DNR Modified GRO method, Method for Determining Gasoline Range Organics	Determination of Volatile Petroleum Hydrocarbons/GRO.	Yes	Yes	Wet
TP110	USEPA Methods 8082A & 3665A	Determination of Total & Speciated 7 PCB Congeners by GC/MS SIM	Yes	Yes	Wet
TP114	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of carbonate in soil (rapid titration method)			Dry
TP126	TNRCC Method 1006 (modified)	Extracted petroleum hydrocarbons from TP067 split into aromatic and aliphatic fractions. Analysed by GC/FID.	Yes		Wet
TP129	In-house documented method	Determination of total sulphur by ICP-OES spectroscopy	Yes	Yes	Dry
TP134	In-house documented method	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry
TP135	USEPA Methods 8100 & 8270D. In-house method TP045	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS (with concentration stage)			Dry
TP137	BS7755: Section 3.9: 1995/ISO 11466:1995	Determination of acid extractable metals in soil by ICP-OES	Selected	Selected	Dry
TP145	USEPA Methods 3550C & 8270D	Determination of Semi-Volatile Organic Compounds by GC/MS	Yes	Yes	Wet
TP147	USEPA Methods 8082A & 3665A	Determination of total & speciated WHO 12 PCB Congeners by GC/MS SIM.			Wet
TP150	USEPA Methods 8081B & 8141B	Determination of pesticides and herbicides in soil by GC/MS SIM			Dry
TP152	USEPA Method 556	Determination of carbonyls by GC/MS.			Wet
TP154	USEPA Method 5021. Wisconsin DNR modified GRO method	Determination of volatiles in by GC/MS headspace	Yes	Selected	Wet
TP158	USEPA Method 1671	Determination of glycols by GC/FID DI			Wet
TP169	In-house documented method	Determination of water soluble sulphate in 2:1 water/soil extract by ICP-OES spectroscopy	Yes	Yes	Dry
TP171	In-house documented method	Determination of acid soluble sulphate by ICP-OES spectroscopy	Yes	Yes	Dry
TP174	In-house documented method	Determination of Total Organic Carbon in soils by high temperature combustion & NDIR detection			Dry
TP178	In-house documented method	Determination of water soluble nitrate by ion selective electrode			Dry

Notes

1. Terra Tek (Birmingham) are MCERTS accredited for clay, sand & loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials, ie gravel, are not accredited where they comprise the major component of the sample.
2. Results are expressed on a dry-weight basis (samples dried at 30°C ± 5°C) except where stated.
3. The laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors list, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	**SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)**	**Appendix S3**
N/A	N/A		Sheet 2 of 2

TERRA TEK
SITE INVESTIGATION & LABORATORY SERVICES

Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
Leeds
LS22 5DZ
For the attention of Charlotte Copley

Report No: B24141-2
Issue No 01

LABORATORY TEST REPORT

Project Name	**NORTH MOOR VIEW, BRIMINGTON**		
Project Number	**B24141-2**	Date samples received	21/02/2020
Your Ref		Date written instructions received	21/02/2020
Purchase Order	PO15651/3569/CC	Date testing commenced	21/02/2020

Please find enclosed the results as summarised below

Figure / Table	Test Quantity	Description	ISO 17025 Accredited
1	3	Client Specified Suite - Soil	See report
App S1	~	Sample Descriptions - Soil	N/A
App S2	~	Deviating Samples - Soil	N/A
App S3	~	Summary of In-House Analytical Test Methods - Soil	N/A

Remarks :

Issued by : Stephen Langman Date of Issue : 03/03/2020

Approved Signatories : S. Langman 03/03/2020

G Wilson (JMD/Laboratories Director), S Langman (Laboratory Coordinator)

Key to symbols used in this report
S/C : Testing was sub-contracted

Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.
The results reported relate to samples received in the laboratory only.
All results contained in this report are provisional unless signed by an approved signatory
This report should not be reproduced except in full without the written approval of the laboratory.
Under multisite accreditation the testing contained in this report may have been performed at another Terra Tek laboratory.
The enclosed results remain the property of Terra Tek Limited and we reserve the right to withdraw
our report if we have not received cleared funds in accordance with our standard terms and conditions
Only those results indicated in this report are UKAS accredited and any opinions or interpretations expressed are outside the scope of UKAS accreditation.
Feedback on the this report may be left via our website www.terratek.co.uk/contact-us

mCERTS UKAS TESTING 0126 25 YEARS 1990-2015

Moor Lane, Witton, Birmingham, B6 7HG
Tel: +44 (0)121 344 4838 Fax: +44 (0)121 356 3599
birmingham@terratek.co.uk
www.terratek.co.uk
Terra Tek Ltd is registered in Scotland No. 121594
Offices in Airdrie, Birmingham, Belfast and Chesham
Head Office : 62 Rochsolloch Road, Airdrie, ML6 9BG

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: NORTH MOOR VIEW, BRIMINGTON

Client:

Engineer:

Contract No B24141-2

Sample Identification				Lab Sample ID	Chloride (water soluble) %	Magnesium (water soluble in 2:1 extract) mg/l	Nitrate mg/kg
Hole	Depth m	Sample Ref	Sample Type				
TP06	0.60		T	718930	<0.01	13	20
TP08	0.80		T	718932	<0.01	4	17
TP27	0.90		T	718953	<0.01	2	18
				Limits of Detection	0.01	1	1
				Terra Tek Analysis Method	TP134	TP136	TP178
				Accreditation M=Mcerts U=UKAS N=No accreditation	M	N	N

Originator	Checked & Approved
DAB	03/03/2020

BRE SD1 SUITE - SOIL

Figure 1

Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No E13009/1

Sample Identification				Lab Sample ID	Date Sampled	Temperature on receipt °C	PRIMARY MATRIX	Secondary Matrix	Additional matrix	% Loss at 30C	% Retained 2mm
Exploratory Hole	Depth m	Sample Ref	Sample Type								
TP06	0.60		T	718930	28/01/20	10.8	CLAY	Fine gravel		23.4	~
TP08	0.80		T	718932	28/01/20	10.8	CLAY	Fine gravel		14.8	~
TP27	0.90		T	718953	28/01/20	10.8	SANDSTONE			14.0	~

Notes

Terra Tek are accredited for clay, sand and loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials such as gravel, are not accredited where they comprise the major component of the sample.

Results are expressed on a dry-weight basis (samples dried at <30^{o}C) except where stated.

The laboratory removes any material > 2mm prior to analysis. The quantity and nature of the material is shown as the secondary and additional matrix types in the above table.

Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors List, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	SAMPLE DESCRIPTIONS	Appendix S1
DAB	S. Langman 03/03/2020		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No B24141-2

Sample Identification				Lab Sample ID	Date Sampled	Deviating conditions						Preservatives used
Exploratory Hole	Depth m	Sample Ref	Sample Type			Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		
TP06	0.60		T	718930	28/01/20							
TP08	0.80		T	718932	28/01/20							
TP27	0.90		T	718953	28/01/20							

NOTES
1 Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2 The absence of "X" or "Yes" in the table above indicates no reported deviations.
3 Deviations due to use of incorrect sample container are shown on result tables.
4 Deviating results are indicated within result tables.

Originator	Checked & Approved	DEVIATING SAMPLES - SOIL	Appendix S2
DAB	S. Longmuir 03/03/2020		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No B24141-2

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
GP001	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Preparation of soil samples for chemical analysis	Yes	Yes	N/A
GP012	BS EN 12457-3: Characterisation of Waste - Compliance test for leaching of granular waste materials and sludges (two-stage batch test)	Preparation of soil samples for two-stage leachate test			Dry
TP019	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of pH in 2.5:1 water/soil extract using pH meter.	Yes	Yes	Dry
TP032	MAFF Book 427: The Analysis of Agricultural Materials: Method 8	Determination of water soluble boron by colorimetry	Yes		Dry
TP040	APHA/AWWA, 19th edition: Method 3500Cr-D	Determination of hexavalent chromium by colorimetry.	Yes		Dry
TP041	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of organic matter by titrimetry.	Yes		Dry
TP042	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of loss on ignition at 50-440°C by gravimetry	Yes	Yes	Dry
TP045	GACHAMJA A.M. Chromatography and Analysis: 1992 9-11 (modified)	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS	Yes	Yes	Dry
TP046	MEWAM method: Phenols in water and Effluents: 4-aminoantipyrine method	Determination of monohydric phenols by steam distillation/colorimetry	Yes	Yes	Dry
TP047	MEWAM method: Cyanide in Waters etc	Determination of free cyanide by steam distillation/colorimetry	Yes		Dry
TP048	MEWAM method: Cyanide in Waters etc	Determination of total cyanide by steam distillation/colorimetry.	Yes	Yes	Dry
TP049	MEWAM method: Cyanide in Waters etc	Determination of complex cyanide by calculation	Yes		Dry
TP050	MEWAM method: Determination of Thiocyanate ,1985	Determination of thiocyanate by colorimetry	Yes	Yes	Dry
TP051	USEPA Method 9030B	Determination of acid soluble sulphides by steam distillation/colorimetry.	Yes	Yes	Wet
TP067	TNRCC Method 1005: 2001 (modified)	Determination of pentane/acetone extractable petroleum hydrocarbons (C8 - C40) by GC/FID	Yes	Yes	Wet
TP072	In-house documented method	Determination of ammoniacal nitrogen by colorimetry			Dry
TP073	In-house documented method	Determination of anionic detergent (MBAS) by colorimetry			Dry
TP074	In-house documented method	Determination of water soluble fluoride by ion selective electrode			Dry
TP098	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of acid soluble chloride by titrimetry			Dry
TP099	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry

Notes

1. Terra Tek (Birmingham) are MCERTS accredited for clay, sand & loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials, ie gravel, are not accredited where they comprise the major component of the sample.
2. Results are expressed on a dry-weight basis (samples dried at 30°C ± 5°C) except where stated.
3. The laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors list, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)	Appendix S3
N/A	N/A		Sheet 1 of 2

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site NORTH MOOR VIEW, BRIMINGTON

Client

Engineer

Contract No B24141-2

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
TP100	Wisconsin DNR Modified GRO method, Method for Determining Gasoline Range Organics	Determination of Volatile Petroleum Hydrocarbons/GRO.	Yes	Yes	Wet
TP110	USEPA Methods 8082A & 3665A	Determination of Total & Speciated 7 PCB Congeners by GC/MS SIM	Yes	Yes	Wet
TP114	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of carbonate in soil (rapid titration method)			Dry
TP126	TNRCC Method 1006 (modified)	Extracted petroleum hydrocarbons from TP067 split into aromatic and aliphatic fractions. Analysed by GC/FID.	Yes		Wet
TP129	In-house documented method	Determination of total sulphur by ICP-OES spectroscopy	Yes	Yes	Dry
TP134	In-house documented method	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry
TP135	USEPA Methods 8100 & 8270D. In-house method TP045	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS (with concentration stage)			Dry
TP137	BS7755: Section 3.9: 1995/ISO 11466:1995	Determination of acid extractable metals in soil by ICP-OES	Selected	Selected	Dry
TP145	USEPA Methods 3550C & 8270D	Determination of Semi-Volatile Organic Compounds by GC/MS	Yes	Yes	Wet
TP147	USEPA Methods 8082A & 3665A	Determination of total & speciated WHO 12 PCB Congeners by GC/MS SIM.			Wet
TP150	USEPA Methods 8081B & 8141B	Determination of pesticides and herbicides in soil by GC/MS SIM			Dry
TP152	USEPA Method 556	Determination of carbonyls by GC/MS.			Wet
TP154	USEPA Method 5021. Wisconsin DNR modified GRO method	Determination of volatiles in by GC/MS headspace	Yes	Selected	Wet
TP158	USEPA Method 1671	Determination of glycols by GC/FID DI			Wet
TP169	In-house documented method	Determination of water soluble sulphate in 2:1 water/soil extract by ICP-OES spectroscopy	Yes	Yes	Dry
TP171	In-house documented method	Determination of acid soluble sulphate by ICP-OES spectroscopy	Yes	Yes	Dry
TP174	In-house documented method	Determination of Total Organic Carbon in soils by high temperature combustion & NDIR detection			Dry
TP178	In-house documented method	Determination of water soluble nitrate by ion selective electrode			Dry

Notes

1. Terra Tek (Birmingham) are MCERTS accredited for clay, sand & loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials, ie gravel, are not accredited where they comprise the major component of the sample.
2. Results are expressed on a dry-weight basis (samples dried at 30°C ± 5°C) except where stated.
3. The laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors list, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	**SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)**	**Appendix S3**
N/A	N/A		Sheet 2 of 2