Lidl UK GmbH

Phase 1 Geo-Environmental Desktop Study Report

For

Proposed New Lidl Store

At

Off New Hey Road
Huddersfield
West Yorkshire
HD3 4GP

Beam Consulting
14 Bond Street
Wakefield
West Yorkshire
WF1 2QP

Ref: 09-122-DOC-002

Date: 22 May 2018

REVISION RECORD

Revision	Description	Date	Prepared	Checked	Approved
-	First Issue	22/5/2018	KGP	TM	KGP

CONTENTS

EXECUTIVE SUMMARY

Site Location and Description	The site is located off New Hey Road, approximately 3.7km north-west of the centre of Huddersfield. It comprises a derelict former-public house with associated car park. Behind the car park is a steep grassed field containing a derelict former-stable building.
Site History	Early maps from 1854 show the site as a Public House with a well labelled on the eastern boundary. In 1894 three small building were shown on the east and south-east boundaries. The well was no longer shown and two small buildings are shown in the south eastern corner of the field to the north in 1907. New buildings shown in the south-eastern corner were shown in 1918. In 1938 the original inn is absent and a new building was shown in the footprint of the existing public house. A small building was shown to the north of the public house in 1960. Many small buildings in the south-east of the field and the building to the north of the public house were no longer shown.
Coal Mining / Mineral Extraction	The site lies within a Coal Authority Low Risk area, and no significant risks have been identified. There is no requirement for an intrusive mining investigation.
Geology	Made ground is present in the existing car park – tarmac and sub-base to a depth of 0.3m. Underlying this are areas of reworked clays to a maximum depth of 1.1m. In the north-west of the site there is localised reworked clay to a depth of 1.4m. In the grassed field topsoil (typically 0.3m thick) is underlain by Soft Bed Flags in the far north, Rough Rock Sandstone in the south, and Coal Measures strata in between. The locally overlying residual soils are gravelly clay. BGS technical report states 'slope instability problems may be present or anticipated' Level C.

Hydrogeology and Hydrology	The site is underlain by a minor aquifer (variably permeable) with soil permeability noted as low. The aquifer is classed as a Secondary A Aquifer. No Principal Aquifers are noted on site. Based on Environment Agency online maps the site does not lie with a Flood Zone from rivers or sea and therefore it is not at risk from fluvial flooding. Environment Agency online maps indicate the site is at risk of overland flows of surface water. The existing site drainage connects into sewers on the southern boundary of the site. Attenuation for surface water will be required as soakaways are highly unlikely to provide adequate surface water disposal.
Environmental Considerations	There are no known landfills within 250m of the site boundary. A former sandstone quarry located approximately 50m to the south of the site was shown on the 1854 OS, which has been been developed into residential housing.
Ground Conditions and Contamination	Based on the referenced Lithos report, pad foundations placed in the firm/stiff clays or on the bedrock are likely to be of sufficient capacity to support the proposed store works. Overdeepened foundations will be required near trees in cohesive soils or where depth of fill has been increased. It is recommended that rock coring investigation works should be carried out to determine depth, type and properties of the bedrock. No elevated levels of contaminants have been identified in the soils on the site.
Radon	No radon protection required.
Asbestos	No evidence of asbestos was encountered on site.

1.0 INTRODUCTION

1.1 Beam Consulting Engineers (BCE) were instructed to carry out a Phase 1 Geo-Environmental Desktop Study Report for the proposed new Lidl store off New Hey Road, Huddersfield, West Yorkshire, HD3 4GP, assembling all available relevant information on the site.

1.2 The site is an existing public house on the south of the site and a steep grassed field to the north. Some small buildings are present on the field. All buildings are to be demolished during site preparation works.

1.3 The objective of this Report is to determine key geo-environmental factors which might affect the site, and discuss the impact the results may have on the future use of the site. Such key factors include:

- Site history including available historic maps, coal mining and extraction records
- Geology, hydrogeology and hydrology
- Geotechnical assessment and recommendations for further investigations if required

1.4 Findings and opinions stated in this Report are based on information obtained from various sources, as detailed, which BCE believes are reliable. Nevertheless, BCE cannot guarantee the reliability or accuracy of the information upon which they have formulated this report.

1.5 The information provided in this report has been based on a Geoenvironmental Appraisal by Lithos Consulting from a planning application for a previous proposed development (application number 2014/60/92408/W). Beam Consulting Engineers have reviewed this document as directed by Lidl UK GmbH and, in general, agree with its findings. This document is included in Appendix B for reference.

1.6 Any references to groundwater are based on observations made at the time of the desk study and site investigation report by Lithos Consulting. It should be noted, however, that levels may vary from those reported due to seasonal or other effects.

1.7 Beam Consulting Engineers make no representation whatsoever in relation to the legal significance of findings reported or any legal matters referred to in the body of this Report.

2.0 CONCLUSIONS AND RECOMMENDATIONS

2.1 The desk study has highlighted potential sources of contamination arising from the historical and current activities carried out on the site and has assessed the sensitive environmental receptors.

2.2 No significant levels of contamination were found on the site, and there was no evidence of asbestos.

2.3 It is recommended that further investigations including rock core sampling and trial pits be undertaken to further determine the depth of bedrock beneath the surface across the site, as well as provide information on the viability of excavation into the bedrock on site for the proposed development.

APPENDIX A

SITE PLAN

DO NOT SCALE
ALL DIMENSIONS SHOULD BE CHECKED ONSITE BEFORE WORK COMMENCES

SUBJECT TO TITLE PLAN CHECK

SUBJECT TO HGV TRACKING

SUBJECT TO LEVELS AND FALLS CHECK

SUBJECT TO LIGHTING LAYOUT

SUBJECT TO ARBORICULTURAL SURVEY

MODIFIED TYPE 1309 STORE, IN ACCORDANCE WITH LIDL SPECIFICATION 2017.3

N

APPROXIMATE AREA OF EXISTING DENSE TREES

APPROXIMATE LINE OF RETAINING WALL ON HTC DRAWING F410

EXISTING EMBANKMENT

AREA FOR NEW EMBANKMENT

APPROXIMATE LINE OF RETAINING WALL.

El Sub Sta

DELIVERY BAY POSITION NOT IN LINE WITH LIDL SPECIFICATION - SUBJECT TO LIDL APPROVAL

129 CAR PARKING SPACES INC. 7 DISABLED AND 8 P&C

APPROXIMATE AREA OF EXISTING DENSE TREES

APPROXIMATE AREA OF EXISTING DENSE TREES

TITLE PLANS NEEDED TO SEE IF THIS AREA IS PART OF OUR SITE

EXISTING OPENING TO BE CLOSED OFF - ASSOCIATED PAVING AND KERBS TO BE MADE GOOD

SITE AREA = 9953 sq m 2.46 acres

EXISTING OPENING TO BE WIDENED IN LINE WITH LIDL SPECIFICATION

PEDESTRIAN ISLAND TO BE REMOVED SUBJECT TO HIGHWAYS CONSULTANTS DESIGN

NEW HEY ROAD

Track

Store Type Reference	Type 1100 Store
Sales Areas (sq m)	1104
Number of Aisles	5 Aisle
G/F GIA (sq m)	1794
Building footprint (ex canopy) (sq m)	1866
Building footprint (inc canopy) (sq m)	2061
Lidl Car Park Spaces	113

client
Lidl UK GmbH

project
New Hey Road,
Huddersfield

drawing title
Proposed Type 1100
Site Plan

date May 2018
status Feasibility
scale 1:500 @ A3
drawn AB checked MH/PH
job no. 1814 dwg no. F413 rev. -

htcarchitects
York Place Studio
8 Britannia Street
Leeds
LS1 2DZ
T:(0113) 244 3457
W: www.htcarchitects.co.uk
E: info@htcarchitects.co.uk

APPENDIX B

LITHOS GEOENVIRONMENTAL APPRAISAL

LITHOS

Land at New Hey Road, Huddersfield

For Newett Homes

Report no: 2895/1

Date: December 2017

Tel: 01937 545330 • info@lithos.co.uk • www.lithos.co.uk

SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	2895	**Site area**	1.03ha (2.54 acres)
Client:	Newett Homes	**NGR:**	SE 107 178
Site:	New Hey Road, Huddersfield	**Nearest postcode:**	HD3 4GR

The site is located off New Hey Road, approximately 3.7km north-west of Huddersfield town centre, and currently comprises a derelict public house with surrounding car park (fronting New Hey Road), and a steep grassed field to the rear rising up to the north.

Lithos were commissioned by Newett Homes to provide a geoenvironmental appraisal of the site. It is understood that the site is to be redeveloped with housing. Lithos' investigation included a review of 3rd party reports, the site's history and environmental setting, and a ground investigation comprising 13 trial pits and 7 trial trenches.

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

Issue	Remarks
Made ground	Tarmac and Sub-base to 0.3m depth, associated with the existing car park with underlying reworked clays to a maximum depth of 1.1m with localised reworked clay to 1.4m in the north-west.
Natural ground	Topsoil typically 300mm thick beyond area of public house and car park. Underlain by Soft Bed Flags in the far north, Coal Measures strata in the centre and Rough Rock Sandstone in the south with locally overlying residual soils (gravelly Clay).
Contamination	Testing suggests that topsoil is chemically suitable for re-use. No elevated concentrations of contaminants identified in the soils at the site. Tarmac associated with the existing car park will require excavation and removal or isolation beneath new roads, driveways etc.
Mining & quarrying	Whilst the site lies within a Coal Authority Low Risk area, no significant risks have been identified, and an intrusive mining investigation will not be required. There are no known quarries on, or within 50m of, the site.
Hazardous gas	No radon protection measures required although Public Health England would like to see basic radon measures in all new build. No additional sources of hazardous gas have been identified.
Preparatory works	Demolition of former public house and adjacent outbuildings, with grubbing up of hardstand and relict foundations. Backfill of any existing cellar associated with the public house. General site clearance topsoil strip and stockpile. Topography will require significant regrade earthworks, most notably in the north (where gradients of up to around 1 in 4 are present). Where ground levels are to be reduced, significant excavation of rock will be required to allow for retaining wall construction. Diversion and/or upgrading of the existing culvert.
Foundations	Strip footings at 1.0m depth founded in firm/stiff clays or from 0.45m in bedrock. Foundations in cohesive soils will require overdeepening near trees, however, bedrock likely to be encountered at shallow depth. Overdeepened foundations will also be required where the depth of fill has been increased due to site re-grade and where backfilled cellars/deep made ground are present.
Groundwater & excavations	Minor groundwater seepages encountered in TPs 4, 5 & 6 between 0.5m and 1.6m depth. Spalling occurred in the majority of pits particularly within made ground, weathered Coal Measures and weathered Soft Bed Flags (recovered as angular tabular gravel).
Flooding & drainage	The EA indicate that the site is not located within an indicative floodplain. Soakaways are highly unlikely to provide a suitable means of surface water disposal at the site. Consequently, there is likely to be a need for surface water balancing.
Highways	Based on visual inspection of the shallow natural materials and published guidance, the gravelly clays should provide a CBR value of at least 2%.

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

- Demolition of existing buildings/foundations and grubbing up of hardstand.
- Extensive site re-grade
- Construction of retaining walls

Some further work is required, most notably:

- Post demolition trial pitting with subsequent testing of soils samples recovered
- Rotary cored boreholes in area of proposed retaining wall and cut (far north)
- In-situ field trials to determine suitability of site won materials for compaction during site re-grade

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
2895/1	-	Site location plan
2895/2	-	Proposed site layout
2895/3	-	Site features
2895/4	-	Site photographs
2895/5	-	Preliminary conceptual site model
2895/6	-	Exploratory hole locations
2895/7	-	Geology
2895/8	-	Revised conceptual site model

Appendix C - Commission

Appendix D - Historical OS plans#

Appendix E - Search responses#

From	Date	Content
Landmark	11th October 2017	Environmental search data
Coal Authority	11th October 2017	Mining report
BGS	11th October 2017	Ground stability report

Appendix F - Exploratory records

Appendix F	TP01 to TP13 TT01 to TT07

Appendix G - Chemical test results

Appendix H - Geotechnical test results

Some of this data is not included within the paper or PDF copies of this report; it is all included on the 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.

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 only included on the accompanying 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. All 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.

EXPLORATORY
GEOENVIRONMENTAL APPRAISAL
of land at
NEW HEY ROAD, HUDDERSFIELD

1 INTRODUCTION

1.1 The commission and brief

1.1.1 Lithos Consulting Limited were commissioned by Newett Homes to carry out a geoenvironmental appraisal of land at New Hey Road, Huddersfield.

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

- Review of a third party report
- 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 13 trial pits and 7 trial trenches
- 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 works

1.1.3 Primary aims of this investigation were to identify salient geoenvironmental issues affecting the site to support the submission of a planning application, and also to enable Newett Homes 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 32 no. traditional two storey domestic dwellings, associated gardens, POS and adoptable roads and sewers. A site layout has been prepared by Sten Architecture (Drawing reference 1640.01 Rev K, dated 5th October 2016) which is reproduced as Drawing 2895/2 in Appendix B to this report.

1.2.2 Topography will require significant regrade earthworks, most notably in the north (where gradients of up to around 1 in 4 are present). Where ground levels are reduced significant excavation of rock will be required to allow for retaining wall construction. A retaining wall will then be constructed along the northern site boundary.

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.

2 SITE DESCRIPTION

2.1 General

2.1.1 The site's location is shown on Drawing 2895/1 presented in Appendix B to this report. Site details are summarised in the table below.

Detail	Remarks
Location	3.7km north-west of Huddersfield town centre
NGR	SE 107 178
Approximate area	1.03ha (2.54 acres)
Known services	Underground water, drainage, electric & gas serving the existing buildings Underground drainage culvert in south-west

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on 6th November 2017.

2.2.2 The site currently comprises a single parcel of land with a public house (Spotted Cow) and associated adjacent hardstand (car parking) in the south fronting New Hey Road.

2.2.3 Access to the site is from New Hey Road to the south; access is currently secured with large sandstone boulders.

2.2.4 The public house is of two storey stone construction and currently lies derelict, with a fire reported at the premises in April 2013.

2.2.5 A hatch was noted on the eastern side of the building which may have provided access to a beer cellar. However, the presence of any cellar beneath the building could not be confirmed as no internal access was available.

2.2.6 A small outbuilding previously used as a changing room is located in the north-east corner of the car park adjacent to the site's boundary. A rectangular area of concrete hardstand lies adjacent to the changing rooms.

2.2.7 A dry-stone wall forms the western and northern boundaries of the car park, with a cemented stone wall on the southern boundary. An existing property and stone wall form the eastern boundary. An overgrown grassed area with trees and bushes is located immediately west of the car park, with the western boundary defined by trees, bushes and a stone wall.

2.2.8 A line of tree stumps was noted to the north of the car park area immediately beyond the dry-stone wall.

2.2.9 Three fields separated by post and wire fencing make up the north of the site which steeply rise up at around 1 in 4 towards the northern boundary abutting the rear gardens of houses along Deercroft Crescent.

2.2.10 No evidence of landslip was noted on the slope during the walkover.

2.2.11 Dilapidated stable and garage buildings within an area of overgrown ground, associated with the property to the east, lie on the eastern site boundary in the south-east corner of the northern field. This area could not be accessed at the time of the investigation. A collapsed building was noted within the overgrown area.

2.2.12 A shallow stone culvert enters the site from the west and runs within the south-west boundary. Geophysical surveys suggest the culvert turns south to run along the western boundary of the car park towards New Hey Road.

2.2.13 Existing salient features, at the time of the walkover are presented on Drawing 2895/3 in Appendix B to this report, and summarised in the table below.

Feature	Remarks
Current Access	Off New Hey Road to the south.
Topography	Flat lying around the former Public House, steeply rising to north at around 1 in 4. Some site re-grade will be required prior to redevelopment with the construction of retaining walls.
Approximate areas	7,643m^2 grassed fields 1,100m^2 tarmac hardstand 1,100m^2 overgrown areas 440m^2 buildings (includes 75m^2 collapsed building) 17m^2 concrete
Nature of boundaries	North – garden fences East – concrete post and wire fencing with dry stone walls South – stone walls fronting New Hey Road, dry stone wall forming south west boundary with a line of protected mature trees. West – post and wire fencing
Surrounding land uses	North & east – housing. South – New Hey Road, with housing and Huddersfield New College beyond. West – Rough ground immediately west. 'Salendine Nook Baptist Church' with adjacent cemetery from 30m beyond western boundary.

2.2.14 A selection of site photographs is included on Drawing 2895/4.

3 SITE HISTORY

3.1 Site centred extracts from Ordnance Survey (OS) plans dating back to 1854 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
1854	**Spotted Cow Public House** in the south adjoining the building to the east. **Well** labelled on eastern site boundary. Remainder of the site shown as open fields.	Open fields with **sandstone quarry (**c.500 m²) 50m south with further sandstone quarries along Longwood Edge 550m south. **Lindley Moor Potteries** 290m north-west **Coal pit** 625m north-east, tanyard 700m south-east, Plover Mill Dye Works 850m east.
1894	Three small buildings shown on east and south-east boundaries.	Numerous buildings shown immediately south-east. Sandstone quarry 50m south no longer shown. **Woollen works** 250m west, reservoir (Huddersfield Corporation Water Works) 390m east. Wellington Mill dye works 700m east.
1907	Well no longer shown. Two small buildings shown in south eastern corner of northern field.	Well now shown immediately east, cricket ground immediately west. Burial grounds shown 100m west.
1918	Further buildings in south eastern corner, this area of site now fenced off from remainder of field. Deciduous trees shown in south-west.	Footpath on north-eastern site boundary.
1930	No significant changes.	Housing along Celandine Avenue 150m south west, pumping station 350m north.
1938	Original inn absent, with a new building shown in centre south on footprint of existing public house.	No significant changes.
1960	North-west field boundary amended to that of existing. Further small buildings (around 9 in total) located in south-east corner of northern field (likely farm outbuildings/stables). Small building shown in field immediately north of public house.	No significant changes.
1966	No significant changes	Housing immediately beyond northern boundary. Huddersfield New College shown 180m south-east.
1978	No significant changes	Numerous houses immediately north and within 250m north, east, south and west Cricket ground immediately west now shown as tennis courts
1996	Majority of small buildings in south-east of northern field and building to north of public house no longer shown	No significant changes

3.3 No further significant changes are shown at or adjacent to the site on subsequent plans, however, the public house is now derelict and no longer in use.

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 and the BGS are presented in Appendix D. 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 77 Huddersfield) 1:10,000 BGS map (Sheet SE 11 NW)	No Drift shown to underlie the site Solid – Rough Rock Sandstone (south), Pennine Lower Coal Measures (centre) and Soft Bed Flags (north). Strata dip - 2° east. BGS technical report states 'slope instability problems may be present or anticipated', Level C. See section 4.3.
Mining	Coal Authority	This site is located within a Coal Mining Development Low Risk Area, but no known defined risks have been recorded by the Coal Authority; there may still be unrecorded issues. The discontinuous Pot Clay Coal 0.1m to 0.2m thick lies on the Rough Rock Sandstone and Pennine Lower Coal Measures boundary, but is not shown to outcrop near site. No significant seams lie within 100m of the Pot Clay coal.
Quarrying	Historical OS plans	Sandstone quarry 50m south (c. 500m²) shown on historical OS plans until 1894.
Landfills	Envirocheck Report	No known landfills within 250m. Closest Birchencliffe Tip 890m north-east accepted industrial, commercial and household waste until 1974, gas control measures are in place at the former landfill site.
Radon	Public Health England	The site lies in an area where 1% to 3% of homes are estimated to be above the action level. Therefore, no radon measures are required.
Hydrogeology	Environment Agency	Groundwater Source Protection Zone? None. Aquifer - Secondary A (Solid). Groundwater abstractions? None at or significant to site. Nearest 600m east operated by Calderdale & Huddersfield NHS Trust for boiler feed. No potable abstractions within 1km. Soil leaching potential - High. Pollution incidents? None at or significant to site.
Hydrology	Environment Agency Envirocheck Report	Nearest watercourse(s) – Colne from Wessenden Brook to River Holme 725m south-west. Water quality - moderate. Pollution incidents? None at or significant to site. Abstractions? None at or significant to site. Nearest 840m south-west (2/27/11/061) operated by Hadenfayre Ltd for general industrial use. Discharge consents? None at or significant 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).

4.2 Landfills

4.2.1 There are no known landfills within 250m of the site boundary.

4.2.2 However, a former sandstone quarry (c.500m²) is shown on the 1854 historical OS plan around 50m south of the site.

4.2.3 The quarry is no longer shown on the 1894 OS plan and presumed to be infilled. The Envirocheck report also states "*unknown infilled ground*" 51m south-west, mapped in 1987 which is likely to relate to the former sandstone quarry. The area of the quarry has since been developed with housing.

4.2.4 Given the dates of backfilling, distance from site and the subsequent development of the quarry it is considered unlikely that significant quantities of hazardous gas will be generated that could affect the proposed development.

4.3 Ground stability

4.3.1 Given that the north of the site is steeply sloping at a gradient of 1 in 4, a natural ground stability report has been obtained from the BGS in order to check whether or not landslip is likely to affect the proposed development.

4.3.2 The BGS report (copy included in Appendix E) provides an indication of the potential for natural ground instability to occur within, and within 50m, of a site. It is auto-generated from BGS's GeoSure dataset. The Report assigns hazard levels for shrink-swell (clays), landslides (slope instability), soluble rocks (dissolution), compressible ground, collapsible deposits and running sand, but it does not include mining related subsidence. Hazards are graded on a scale from A to E (low to high), but Levels A & B are considered insignificant.

4.3.3 The BGS report for this site suggests:

- **Soluble Rocks** (dissolution); Rocks that can dissolve and develop underground cavities that may lead to surface collapses and hollows - Level A. Risk considered insignificant.
- **Compressible Ground**; Very soft ground that might compress and progressively sink under the weight of a building - Level A. Risk considered insignificant.
- **Running Sand**; Sand that can wash away or flow into holes or fissures due to presence of water – Level A. Risk considered insignificant.
- **Slope Instability**; Weak or unstable rocks that could slip downhill on steep slopes (>5°) or into excavations – Level C. Risk considered moderate "*slope stability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site*".

4.3.4 Landslides develop where natural slopes are steep (usually greater than 1 in 5). The presence of deeply weathered or fractured, fissile mudstone is another contributory factor. Many landslides occurred in the past under different climatic conditions to those of the present day and, if left undisturbed, they may remain stable for many years. However, renewed instability can occur if the slope is undercut or top-loaded, or if there is a change in the groundwater regime.

4.3.5 The BGS report states "*consider possibility of trench side or slope movement during excavation, or consequence of changes to drainage*". Therefore, particular attention will need to be made towards drainage solutions at the site.

5 PREVIOUS INVESTIGATION FINDINGS

5.1 General

5.1.1 Newett Homes have provided Lithos with a copy of the following report:

- Phase I Environmental Assessment (Ref. 16-0681.01), issued by Delta-Simons in September 2016

5.1.2 The report includes a review of data from a Landmark Envirocheck report and historical OS maps dating back to 1854. A site walkover was also undertaken. Sections 1 to 4 of this Report include similar content to the Delta-Simons report, but with further detail.

6 GROUND INVESTIGATION DESIGN

6.1 Anticipated ground conditions & potential issues

6.1.1 Based on the data reviewed in Sections 4 (Environmental Setting) and 5 (Previous Investigation Findings), anticipated ground conditions are expected to comprise:

Anticipated condition	Remarks
Made ground	Around former public house in area of existing car park. Possible relict foundations from former buildings.
Natural soils	No drift materials shown on BGS plans, however, residual soils from the weathering of bedrock should be anticipated.
Bedrock	Rough Rock Sandstone (south), Lower Coal Measures (centre) and Soft Bed Flags (north) at relatively shallow depth.
Mineworkings	None anticipated
Groundwater	Likely to lie at depth in bedrock

6.1.2 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. inorganics 2. organics	1. localised made ground, most notably in south and south-east 2. spillage/leakage
Potential off-site contamination sources	1. former surrounding history	2. airborne contamination
Potential geotechnical hazards	1. deep made ground 2. relict foundations 3. slope stability	1. possible cellars associated with former and existing public houses, 2. existing and former buildings in south 3. steep slope in north
Other potential constraints	1. existing utilities	1. culvert in south-west 2. electric, gas, water and drainage serving former public house

6.2 Preliminary conceptual site model

6.2.1 A preliminary conceptual site model, presented as Drawing 2895/5 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 6.1 inclusive of this report.

6.2.2 An assessment of potential contaminants associated with the former uses has been undertaken with reference to CLR8. As a consequence of this assessment, anticipated potential contaminants, within soil and/or groundwater include:

- Inorganics (metals, asbestos)
- Organics (fuels, oils)
- Pesticides

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

6.3 Ground investigation design & strategy

6.3.1 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 01 to 13	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
TTs 01 to 07	To determine the location of culvert in the south-west

6.3.2 Proposed exploratory hole locations were selected to provide a representative view of the strata beneath the site and to target potential areas of interest identified in Sections 2 to 6 above. A nominal 20m grid spacing was proposed. Additional exploratory locations might be scheduled by the site engineer in light of the ground conditions actually encountered.

6.3.3 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 trial pits.

7 FIELDWORK

7.1 Objectives

7.1.1 The original investigation strategy is outlined in Section 6.3 above.

7.2 Exploratory hole location constraints

7.2.1 No access was available in the far south west of the site due to the presence of stone walls, in the south-east corner of the northern field due to fencing and existing buildings or within the footprint of the existing public house.

7.3 Scope of works

7.3.1 Fieldwork was supervised by Lithos on 6th November 2017 and comprised the exploratory holes listed below.

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs 01 to 13	1.2m to 3.2m	Vane tests where possible in cohesive soils
	TP02	1.6m	Area of former public house
	TP06	2.2m	Area of former outbuildings in south-east of northern field
Trial trenching (machine dug)	TTs 01 to 07	0.4m to 1.4m	To locate culvert along south western boundary

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

7.3.3 Exploratory hole logs are presented in Appendix F 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

7.3.4 Exploratory hole locations are shown on Drawing 2895/6 presented in Appendix B.

8 GROUND CONDITIONS

8.1 General

8.1.1 A complete record of strata encountered beneath the proposed development site is given on the various exploratory hole records, presented in Appendix F

8.1.2 The site can be divided into three main areas based on existing use:

- **Area A** – the south of the site which is relatively flat lying, encompassing the existing public house, surrounding car park and overgrown strip of land on the south-west boundary
- **Area B** - overgrown dilapidated buildings in the south-east corner of the northern field
- **Area C** – the steeply sloping grassed area to the north which initially rises gently before rising steeply towards the northern boundary.

8.1.3 Typical ground conditions encountered in Areas A & C are described below in Sections 8.2 (made ground) and 8.5 (natural ground), with a summary provided in the table on pages 11 & 12. Area B could not be accessed at the time of the investigation.

8.2 Made ground

8.2.1 Made ground was typically encountered within Area A, with an isolated occurrence in Area C (TP05) and can be categorised as one of four broad types:

- **Tarmac**: Tarmac surfacing within the existing car park, recorded in TPs 01 & 02 (0.1m thick).
- **Sub-base:** underlying the Tarmac car park to 0.3m depth, comprising sandy medium to coarse gravel of limestone
- **Cohesive Made Ground**: typically comprising clay with gravel of mixed lithologies including brick and glass up to 0.6m depth in TPs 01 & 02.

  Deeper Cohesive Made Ground was recorded in Area C to 1.4m depth (TP05) in the north-west
- **Granular Made Ground**: typically comprising gravel of sandstone with occasional cobbles between 0.5m and 1.1m depth in TP02.

8.2.2 Whilst not encountered during this investigation, the possibility of asbestos sheeting (used as shuttering), and/or fragments of asbestos sheeting within the hardcore beneath hardstand, cannot be entirely discounted.

8.3 Obstructions

8.3.1 It is apparent from a review of historical OS Plans (see Section 3) and the site visit that the existing buildings occupy an area of around 440m^2 with a former public house shown in the south-east on historical plans together with farm/outbuildings in the north-east.

8.3.2 Furthermore, Tarmac hardstand, which is typically 0.1mm thick, covers approximately 1,100m^2. Drawing 2895/3 shows the footprints of the former structures, and areas of hardstand.

8.3.3 Constraints associated with the existing public house and underground utilities have prevented trenching to identify and assess the nature/extent of buried obstructions. However, the existing buildings will have foundations (likely strip footings), and may have associated cellars.

8.3.4 Relict foundations and possible backfilled cellars may remain associated with the original public house on the eastern boundary. However, given the proximity of the gable end of the adjacent residential property no trenching was undertaken on the eastern boundary. TP02 in the south-east corner did encounter made ground to >1.1m depth comprising gravel of sandstone with cobbles. However, the base of the made ground could not be proved due to existing services.

8.4 Culvert

8.4.1 A total of 7 trial trenches were excavated in the south-west to locate a culvert understood to run beneath the site. A stone culvert was encountered in two of the trial trenches (TT01 and TT05) in the far west at 0.4m depth. The culvert comprised sandstone block sides with loose sandstone flag covering and measured approximately 0.4m deep by 0.5m wide with standing water noted in the base.

8.4.2 None of the remaining trenches recorded any evidence of the culvert, however, a geophysical survey undertaken by Discovery Surveys recorded an elongate anomaly within the car park at shallow depth which may represent the culvert.

8.5 Natural ground

8.5.1 Natural ground was encountered in the all exploratory holes, and typically comprised a veneer of residual soil, over bedrock, with rockhead typically at shallow depth (0.5m to 3m), average 0.9m. The following ground types were encountered:

- **Topsoil**: typically 300mm thick, identified across the site (Area C) comprising slightly gravelly sandy clay.
- **Residual Soils**: encountered in all of the trial pits, typically comprising firm orangish brown mottled grey gravelly clay.
- **Rough Rock Sandstone**: encountered in Area A and the far south west of Area C (TPs 01& 03 and TTs 06 & 07 from 0.9m to 1.8m depth. Typically strong orangish brown fine to medium grained sandstone which proved difficult to excavate.
- **Pennine Lower Coal Measures:** encountered across the centre of Area C (TPs 04, 06, 07, 09, 11, 12 and 13) from 0.5m to 3.0m depth. Typically very weak dark grey thinly laminated siltstone which proved relatively easy to excavate.

  Carbonaceous Mudstone encountered between 1.4m and 1.6m depth in TP05, underlain by Rough Rock Sandstone at 1.6m depth.
- **Soft Bed Flags**: encountered in the far north of Area C (TPs 08, 10 & 13) from 0.5m to 1.2m depth. Typically very weak orangish brown thinly laminated siltstone and sandstone which proved relatively easy to excavate.

8.5.2 The carbonaceous Mudstone recorded in TP05 may represent the Pot Clay Coal which is recorded between 0.1m and 0.2m thick and is known to underlie the Coal Measures strata at the interface with the Rough Rock Sandstone.

8.5.3 Drawing 2895/7 in Appendix B of this report shows the published geology at the site as shown on BGS plans, amended in accordance with the Lithos exploratory holes. However, the drawing is approximate only, based on extrapolation of data between holes.

8.5.4 Anticipated geology is also overlain on the proposed layout, Drawing 2895/2, to aid foundation design and cut/fill operations.

8.6 Visual & olfactory evidence of organic contamination

8.6.1 No visual and olfactory evidence of organic contamination was noted.

8.6.2 Selected samples were sent for chemical testing in order to confirm the suitability of existing topsoil for re-use; see Section 10.1.

8.7 Groundwater

8.7.1 No significant inflows of groundwater were encountered during the investigation.

8.7.2 Slight groundwater seepages occurred in TPs 04, 05 & 06 at between 0.6m and 1.6m depth.

8.8 Stability

8.8.1 Spalling occurred in the majority of pits particularly within made ground, weathered Coal Measures and weathered Soft Bed Flags (recovered as angular tabular gravel). As such there may be a need for shoring of excavations.

Summary of Ground Conditions (Trial Pits)

Hole ID	Final depth (m)	Topsoil Thickness (m)	Depth to base of made ground (m)	Depth to base of made ground (m)			Depth to base of natural ground (m)			Depth to rockhead (m) Penetration in brackets (m)			Remarks
							Residual Soils (Gravelly clay)						
				Tarmac	Sub base	Cohesive/ Granular Made Ground	Weathered Soft Bed Flags	Weathered Lower Coal Measures	Weathered Rough Rock Sandstone	Soft Bed Flags	Lower Coal Measures	Rough Rock Sandstone	
TP01	1.2	-	0.6	0.1	0.3	0.6	-	-	0.9	-	-	0.9 (0.3)	Unable to excavate >1.2m
TP02	1.6	-	1.1	0.1	0.3	1.1	-	-	>1.6	-	-	-	Cable at 1.0m depth, pit abandoned
TP03	2.1	0.3	-	-	-	-	-	-	1.8	-	-	1.8 (0.3)	Unable to excavate >2.1m
TP04	2.2	0.3	-	-	-	-	-	0.5	-		0.5 (1.7)	-	Seepage and spalling at 0.6m
TP05	3.1	0.3	1.4	-	-	1.4	-	-	>3.1	-	-	-	Spalling 1.0m, seepage at 1.6m.
TP06	2.2	0.3	-	-	-	-	-	0.9	-	-	0.9 (1.3)	-	Spalling at 0.9m, seepage at 1.6m.
TP07	2.0	0.3	-	-	-	-	-	0.9	-	-	0.9 (1.1)	-	Spalling at 0.9m.
TP08	2.4	0.3	-	-	-	-	0.6	-	-	0.6 (1.8)	-	-	Spalling at 0.6m.
TP09	1.9	0.3	-	-	-	-	-	0.5	-	-	0.5 (1.4)	-	Spalling at0.5m.
TP10	2.5	0.2	-	-	-	-	0.5	-	-	0.5 (2.0)	-	-	Spalling at 0.6m.
TP11	2.0	0.3	-	-	-	-	-	0.6	-	-	0.6 (1.4)	-	Spalling at 0.3m.
TP12	1.8	0.3	-	-	-	-	-	1.1	-	-	1.1 (0.7)	-	Spalling at 1.2m.
TP13	3.2	0.3	-	-	-	-	1.2	-	-	1.2	3.0 (0.2)	-	Spalling at 0.9m.

Summary of Ground Conditions (Trial Trenches)

Hole ID	Final depth (m)	Topsoil Thickness (m)	Depth to base of natural ground (m)	Depth to rockhead (m) Penetration in brackets (m)	Remarks
			Residual Soils (Gravelly clay)	Rough Rock Sandstone	
			Weathered Rough Rock Sandstone		
TT01	0.4	0.3	>0.4	-	Stone culvert (0.5m wide by 0.4m deep) from 0.4m depth.
TT02	1.0	0.3	>1.0	-	Culvert not located.
TT03	0.9	0.25	>0.9	-	Culvert not located.
TT04	0.8	0.3	>0.8	-	Culvert not located.
TT05	0.3	0.4	>0.4	-	Stone culvert (0.5m wide by 0.4m deep) from 0.4m depth.
TT06	1.4	0.3	1.3	1.3 (0.1)	Culvert not located, unable to excavate >1.4m.
TT07	1.2	0.3	1.0	1.0 (0.2)	Culvert not located, unable to excavate >1.2m.

8.9 Revised conceptual ground model (ground conditions)

8.9.1 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
- The strength, nature and depth of underlying natural strata

8.9.2 The revised Conceptual Site Model is presented in Appendix B, as Drawing 2895/8.

8.9.3 Further refinement of the Conceptual Site Model is presented in Section 10, where the results of laboratory testing for contaminants have been considered.

9 CONTAMINATION (ANALYSIS)

9.1 General

9.1.1 The south of the site (Area A) has been occupied by a public house with associated car park, and steeply sloping grassed fields to the north (Area C). The south-eastern corner of the northern field (Area B) is occupied by dilapidated stables and garages.

9.1.2 The site's former usage is considered unlikely to have given rise to any significant ground contamination. However, spillage/leakage may have occurred in Area B during use of the garages and possibly in Area C within the carpark. In addition, made ground to >1.1m depth was identified in Area C.

9.1.3 As such, samples of made ground and existing topsoil have been submitted to the laboratory to determine their suitability for re-use.

9.1.4 Further sampling and testing of the soils within Area B are likely to be required post demolition, see Section 15.9.

9.1.5 An assessment of potential contaminants associated with the former uses has been undertaken; see Section 0.

9.1.6 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.

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

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

9.2 Testing scheduled

9.2.1 Based on the above assessment, Lithos submitted a test schedule (summarised in the table below) to a UKAS accredited laboratory.

Type of sample	No. of samples	Determinands
Made ground	2	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID Total Organic Carbon (TOC), Speciated Polycyclic Aromatic Hydrocarbons (PAH)
Tarmac	2	Speciated Polycyclic Aromatic Hydrocarbons (PAH)
Topsoil	8	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID Total Organic Carbon (TOC), Speciated Polycyclic Aromatic Hydrocarbons (PAH)
	2	OCP pesticides
Carbonaceous Mudstone	1	Calorific value

9.2.2 Account was taken of previous uses in specific areas, with PAH analysis concentrated on samples recovered from the vicinity of former car park.

9.3 Soil contamination results

9.3.1 The soil contamination test results are summarised in the table on page 16.

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

Inorganic determinands

9.3.3 Of the 2 samples of made ground and 8 samples of topsoil analysed for inorganic parameters, 7 can be classified as uncontaminated and one could be classified as contaminated.

9.3.4 This sample has 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).

9.3.5 The only contaminant of potential concern was lead at 270mg/kg in one sample of Topsoil.

9.3.6 Statistical analysis of the 8 topsoil results has been carried out in general accordance with the methods outlined in "Guidance on Comparing Soil Contamination Data with a Critical Concentration", CIEH/CL:AIRE (2008) (see comments in Appendix A, Contamination Testing) and the results are summarised below.

Stratum	No. of samples	US_{95} values for contaminants that have yielded one or more Tier 1 exceedances for a given made ground type
		Lead (200)
Topsoil	6 (8)	21 (59)

Notes: Values in brackets include any outliers.

9.3.7 Where there is 95% confidence or greater that the true mean concentration of a given contaminant within a particular soil type is less than the Tier 1 value, it can be concluded that the contaminant does not pose a significant risk to human health.

9.3.8 This statistical analysis indicates that the upper 95th percentile bound values (US_{95}) for lead in the Topsoil do not exceed the Lithos' Tier 1 value of 200mg/kg.

9.3.9 The results for lead failed the outlier test in two of the samples (TPs 08 & 12), although the concentration recorded in the sample from TP08 was well below the Lithos' Tier 1 value.

9.3.10 An outlier may indicate a localised area of contamination (quite possibly associated with an isolated fragment), or simply be the result of a measurement or recording error; but in any event it flags up the need for further investigation.

9.3.11

9.3.12 It is likely, that the higher concentration recorded is due to an isolated fragment of foreign matter and is therefore of limited significance. In addition, the concentration recorded of 270mg/kg is only marginally elevated in comparison to Lithos' Tier 1 of 200mg/kg.

9.3.13 On balance, the slightly elevated concentration of lead in recorded in the Topsoil recovered from TP12 is not considered significant.

9.3.14 Results of the statistical analysis are copied to Appendix G of this report.

9.3.15 No elevated concentrations of contaminants were recorded in either of the two samples of made ground analysed for inorganic parameters.

Calorific value

9.3.16 The Calorific Value (CV) of one sample of carbonaceous mudstone, has yielded a CV of 3.4 MJ/kg. Materials whose CVs exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn.

9.3.17 The CV of the carbonaceous mudstone is at the lower end of the range where potential for combustion exists consequently some remediation to mitigate the risks of combustion will be required (see Section 10.2).

Asbestos

9.3.18 No asbestos fibres were identified in any of the 10 samples screened.

Summary of degree of soils contamination

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 garden**s end-use.												
			pH	As ∞	B ~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg *	Ni	Se	Zn $	PAH		Asbestos I.D.
														B(a)P ∞	Naphthalene	
				37	5	26	3000	200	200	169	127	350	200	4	4	
TP01	0.05	Tarmac	-	-	-	-	-	-	-	-	-	-	-	0.2	<0.1	-
TP02	0.05	Tarmac	-	-	-	-	-	-	-	-	-	-	-	<0.1	<0.1	-
TP02	0.60	Granular Made Ground	5.5	13	0.6	0.3	29	79	190	2.5	26	0.6	72	0.2	<0.1	N.D.
TP05	1.00	Cohesive Made Ground	5.1	12	1.1	0.2	37	52	68	23	23	<0.5	78	<0.1	<0.1	N.D.
TP03	0.10	Topsoil	5.5	6.7	0.4	0.1	30	74	20	0.1	40	0.6	94	0.2	0.2	N.D.
TP05	0.10	Topsoil	5.7	0.8	<0.2	<0.1	32	46	17	<0.1	44	<0.5	78	0.4	<0.1	N.D.
TP06	0.10	Topsoil	5.4	3.0	0.5	<0.1	40	46	23	<0.1	40	<0.5	79	1.0	<0.1	N.D.
TP07	0.10	Topsoil	5.2	2.3	<0.2	0.2	27	35	20	<0.1	36	0.8	100	<0.1	<0.1	N.D.
TP08	0.10	Topsoil	5.5	15	0.7	0.7	15	62	65	0.2	22	0.7	23	<0.1	<0.1	N.D.
TP09	0.10	Topsoil	8.9	4.6	0.2	0.1	53	29	16	<0.1	57	<0.5	60	<0.1	<0.1	N.D.
TP12	0.10	Topsoil	8.1	14	0.4	0.3	15	40	**270**	0.1	16	<0.5	64	<0.1	<0.1	N.D.
TP13	0.10	Topsoil	8.6	4.4	0.3	0.2	82	21	17	0.4	68	<0.5	60	<0.1	<0.1	N.D.

Key	
36	Parameter tested for and found to be in excess of Tier 1 concentration
12	Parameter tested for but not found to be in excess of Tier 1 concentration
-	Parameter not tested for
N.D.	Not detected, applicable to asbestos I.D. screen only
♣	Tier 1 Value is pH dependent
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI screen would be 21mg/kg
*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.

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. Values assume contaminants located in a sandy loam, with 6% soil organic matter (SOM).	
∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE\Defra)
$	Ministry of Agriculture, Fisheries & Food. 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.

Organic determinands

9.3.19 This majority of the site is essentially greenfield and therefore for organic compounds, the Tier 1 Values used in this report have been derived with reference to a CSM that assumes a residential with gardens end use, with no clean soil cover will be placed in gardens/landscaped areas (Lithos Scenario A).

9.3.20 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.

9.3.21 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.

9.3.22 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	1.7	Yes, but no significant organic contamination was recorded in this soil type. All determinands well below "6%" screening value; most below limit of detection.
Made ground	3.0	

Hydrocarbons (TPH & PAH)

9.3.23 Given the previous uses of the site, the absence of any significant made ground and the absence of visual/olfactory evidence of any hydrocarbon contamination, no TPH (testing has been scheduled at this stage.

9.3.24 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.

9.3.25 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).

9.3.26 Speciated analysis has confirmed the absence of significant concentrations of both benzo(a)pyrene and naphthalene in the soils beneath this site.

Insecticides

9.3.27 The two samples of topsoil scheduled for insecticide analysis (Organochlorine Insecticides) yielded results for the various determinands below the laboratory limit of detection of 0.01mg/kg.

10 CONTAMINATION (QUALITATIVE RISK ASSESSMENT)

10.1 Topsoil

10.1 Topsoil, typically 300mm thick underlies the majority of the site (Area C). Testing suggests this material is chemically suitable for re-use.

10.2 Given the nature of the topsoil present on this site it would be expected to be suitable to support plant growth. However, no testing in accordance with BS3882:2015 Specification for Topsoil (N-P-K, clay content etc) has been undertaken to date.

10.2 Revised conceptual ground model (contamination)

10.2.1 No plausible contaminant linkages have been identified.

10.2.2 A revised Conceptual Site Model is presented as Drawing 2895/8 in Appendix B to this report.

10.3 Waste classification

10.3.1 Some excess arisings may be generated by excavations for foundations, sewers etc.

10.3.2 Classification of soils as inert, non-hazardous or hazardous should be undertaken in accordance with the Environment Agency's Technical Guidance WM3[1], and is quite a complex process. However, all soil arisings generated by excavations at this site are likely to be classified inert.

10.3.3 Off-site disposal to landfill is not recommended. In accordance with the CL:AIRE Code of Practice[2] 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.

10.3.4 As discussed in Section 8.2, Tarmac hardstand is present in Area A.

10.3.5 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 BS598-102:2003). 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%).

10.3.6 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 concertation limit of 50mg/kg.

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

10.3.8 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

10.3.9 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.

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

10.3.10 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.

11 HAZARDOUS GAS

11.1 Methane & carbon dioxide

11.1.1 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 (eg quarry, pond, canal etc) considered capable of generating significant quantities of hazardous gas
- Not underlain by a significant thickness of potentially degradable made ground
- Not underlain by peat or shallow chalk deposits

11.2 Radon

11.2.1 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. At present Approved Document C advocates basic measures for the probability banding 3% to 10% (full measures if >10%).

11.2.2 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. Consequently, basic radon protection measures may not be required in new dwellings.

11.2.3 However, Public Health England would like to see all new build include basic measures. Given that the site lies in an area where >1% of homes are estimated to be above the action level, the Developer might consider providing all new dwellings with basic radon protection measures.

12 GEOTECHNICAL TESTING

12.1 General

12.1.1 A total of 7 samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.

12.1.2 The geotechnical laboratory test results are presented in Appendix H to this report.

12.2 Atterberg limits

12.2.1 The plasticity indices of 7 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
Residual Soils	7	14 to 58 (32)	18 to 50 (34)	Low to High

* Modified where appropriate in accordance with Chapter 4.2 of the NHBC Standards BRE Digest 240 (Low-rise buildings on shrinkable clay soils).

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

12.2.2 Shrinkability varied between the soils at the site between Low and High. Average values of PI suggest soils of medium shrinkability.

12.2.3 However, two of the seven results yielded plasticity indices of 49 and 50 (TP03 at 0.9m and TP12 at 0.7m respectively). Therefore, for the purposes of foundations design it would be prudent to assume that all cohesive soils are of high shrinkability.

12.3 Soluble sulphate and pH

12.3.1 In accordance with BRE Special Digest 1:2005, this site has been classified as brownfield with a mobile groundwater regime.

12.3.2 It is envisaged foundations will extend to depths of about 1m 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).

12.3.3 The concentrations of sulphate in the aqueous natural soil extracts of 7 samples were determined. In addition, a further 6 samples were tested as part of the contamination suite. The pH value of each sample has also been determined

12.3.4 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)
Residual Soils	7	5.7	21
Soft Bed Flags	1	9.3	25
Coal Measures	4	4.6	23
Rough Rock Sandstone	1	4.7	<10

12.3.5 A total of 4 samples yielded pH values below 5.5, therefore supplementary analysis to determine the concentrations of magnesium, chloride and nitrate was scheduled. Three of the samples yielded magnesium, chloride and nitrate results of less than 10mg/l.

12.3.6 One of the samples of Coal Measures strata (TP04 at 0.8m) yielded a nitrate concentration of 17mg/l. Consequently, the equivalent sulphate concentrations need to be considered.

12.3.7 The sulphate equivalent of nitrate has been calculated for the above sample which gives a total soluble sulphate concentration of 36mg/l.

12.3.8 Therefore, 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.

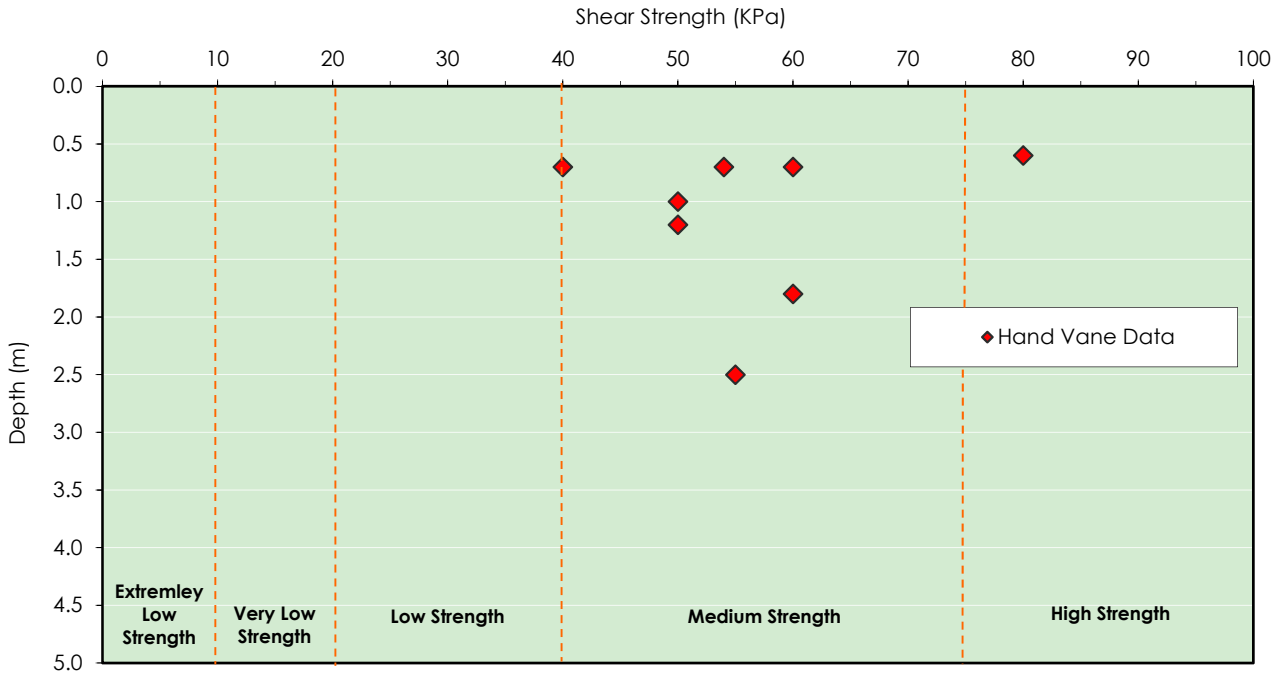
12.4 Undrained shear strength testing

Hand shear vane testing

12.4.1 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.

12.4.2 The deposits were often gravelly and very quickly graded into bedrock from 0.5m in places therefore the opportunity for hand shear vane tests was limited.

12.4.3 The results are summarised within the plot on page 22 and illustrate a typical undrained shear strength (Su) of at least 50KPa within the cohesive strata.



13 GEOTECHNICAL ISSUES

13.1 Conceptual site model

13.1.1 A revised conceptual site model is reproduced as Drawing 2895/8 in Appendix B to this report.

13.1.2 Made ground is typically restricted to Area A (south of the site around existing public house & car park) where up to 1.1m was recorded, with an isolated occurrence in Area C (TP05), 1.4m thick.

13.1.3 Natural ground typically comprises a veneer of residual soil (firm gravelly clay), over bedrock (mostly siltstone & sandstone). Rockhead is typically at shallow depth (0.5m to 3m), average 0.9m.

13.1.4 No significant inflows of groundwater were encountered during the investigation. Slight groundwater seepages occurred in TPs 04, 05 & 06 at between 0.6m and 1.6m depth.

13.1.5 The north of the site rises steeply at around 1 in 4 towards the northern boundary abutting the rear gardens of houses along Deercroft Crescent.

13.2 Mining & quarrying

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

13.2.2 This site is underlain by Soft Bed Flags in the far north, Coal Measures strata in the centre and Rough Rock Sandstone in the south. The Pot Clay Coal, a discontinuous seam (up to 0.2m thick) is recorded to lie at the base of the Coal Measures strata at the interface with the Rough Rock Sandstone.

13.2.3 A Carbonaceous Mudstone encountered in TP05 is believed to represent the Pot Clay Coal. Given the poor quality of the Carbonaceous Mudstone it is considered highly unlikely to have been worked.

13.2.4 The next significant seam (Soft Bed Coal) lies at least 150m below the surface.

13.2.5 Whilst the site lies within a Coal Authority Low Risk area, no significant risks have been identified, and an intrusive mining investigation will not be required.

13.2.6 There are no known quarries at or adjacent to the site.

13.3 Site regrade

13.3.1 It is understood that consideration is being given to redevelopment of the site with 32 no. traditional two storey domestic dwellings, in accordance with a layout prepared by Sten Architecture, copied here as Drawing 2895/2 in Appendix B.

13.3.2 At the time of writing, proposed finished floor levels (FFL) had not been finalised, but given existing topography (especially in the north where gradients of 1 in 4 are present), significant site regrade is anticipated, with a reduction in levels in the far north and raising of levels through the centre of the site (Area C).

13.3.3 Earthworks modelling will be required, but some cut into bedrock is anticipated in the far north, where Soft Bed Flags were encountered from 0.5m depth, with underlying Coal Measures strata encountered from 3m depth.

13.3.4 A retaining wall will be constructed along the northern site boundary after the reduction in site levels.

13.3.5 Careful consideration will need to be given to earthworks design, and implications for slope stability, retaining walls, foundations, highway gradients and drainage.

13.3.6 Any digital terrain modelling undertaken or commissioned by Newett Homes should consider implications for the foundation recommendations outlined below.

13.3.7 Within Area A there are likely to be relict foundations associated with the existing public house and also the former building at the site which will require grubbing together with areas of hardstand.

13.3.8 Any existing cellars will need to be backfilled prior to redevelopment, cellar floors should be punched through to prevent ponding of water. Some, relatively minor foundations may be present within Area B.

13.3.9 Natural ground underlying this site is often clayey, therefore consideration should be given to the implication of undertaking earthworks in poor/wet weather when the ground surface is likely to become difficult to cross with heavy machinery.

13.3.10 Wherever possible, Lithos recommend that excavated soils are retained on site. However, if this is not possible the comments in Section 10.3 should apply.

13.4 Slope Stability

13.4.1 Significant cut into bedrock in the north is anticipated, and this may result in the creation of a rock face. Stable slope geometry will need to be determined after appropriate supplementary ground investigation (including rotary cored boreholes) to characterise the nature of the material to be cut; most notably bedrock type and the spacing\orientation of discontinuities (bedding, joints etc). Such investigation should also enable assessment of excavatability.

13.4.2 On completion of this investigation, slope stability should be assessed using via appropriate computer modelling. In addition to bedrock type and discontinuities, the assessment will also need to consider groundwater.

13.4.3 In the meantime, it is considered likely that batters of around 3H:1V within residual soils, and 2H:1V within Coal Measures bedrock, might be possible.

13.5 Foundation recommendations

General

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

13.5.2 Final development levels will likely differ significantly from ground levels existing at the time of investigation due to the need for significant earthworks regrade in Area C.

13.5.3 Properties in the north of Area C are likely to be founded in rock after reduction of site levels with plots in the south of Area C and possibly Area B likely to be underlain by a significant thickness of fill. Levels in the south of the site (Area A) are unlikely to change significantly from those of existing.

13.5.4 Any digital terrain modelling undertaken, or commissioned by, Newett Homes should consider implications for the foundation recommendations outlined below.

13.5.5 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.

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

13.5.7 There are a number of foundation solution options for two or three storey residential properties constructed on this site and these are discussed below.

Strip/trench fill footings

13.5.8 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for two or three storey houses constructed at the site (Area A and where site levels are reduced (north of Area C). This solution is viable where made ground and\or engineered fill is less than about 2.5m thick, and firm clay or competent rock is the founding material.

13.5.9 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.

13.5.10 Where existing buildings are to be demolished, all concrete slabs and service ducts will require breaking out prior to re-development. However, relict foundations could probably be left in-situ and an allowance made for local breaking out where these conflict with new foundations.

13.5.11 Foundations of plots placed over relict foundations should be taken to greater depth than the relict foundations and into natural ground of adequate bearing capacity.

13.5.12 Based on the current layout all proposed plots currently lie beyond the footprints of the existing and the historical public houses.

13.5.13 Foundations will be required to be placed below a line drawn up at 45° from the base of any service or similar excavation.

13.5.14 Overdeepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.4.

13.5.15 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).

13.5.16 In addition to the above, Newett Homes should review proposed plot designs and layouts, since deeper excavations for trench fill are likely to be unstable where the centre-lines of parallel trenches are closer than about 2m (assuming 600mm widths). Newett Homes should supervise their groundworker to ensure footings are excavated in a controlled and safe manner.

13.5.17 Newett Homes 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.

Cohesive soils

13.5.18 Clay classification tests suggest that natural cohesive soils at the site should be regarded as being of high shrinkability. A minimum founding depth of 1,000mm is therefore recommended for all cohesive soils on the site where strip footings are proposed.

13.5.19 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.

13.5.20 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that up to 65% of the site may be affected by trees, however, bedrock is likely to be encountered at shallow depth.

13.5.21 Overdeepening of foundations will also be required where site re-grade results in areas of deep fill.

13.5.22 Trench fill foundations should be designed in accordance with NHBC Standards, Chapter 4.2. Heave precautions (a suitable approved compressible void former) should be used on the internal face of all external walls where the foundation is within the zone of influence of trees and greater than 1.5m deep.

13.5.23 Any trench fill foundation deeper than 2.5m will need to be designed by a Chartered Engineer, whose status is accepted by NHBC (NHBC Standards, Technical Requirement R5); however, it is likely that the presence of bedrock will result in few, if any, foundations beyond areas of fill being deeper than 2.5m.

13.5.24 A safe bearing capacity of around 150kPa can be assumed if the following are true

- A maximum foundation line load of 90kN/m run
- A foundation length of 10m
- A foundation breadth of 0.6m
- A foundation thickness of 225mm
- A foundation depth of 1.1m depth
- An undrained shear strength of 50kPa for the firm clay (typical minimum recorded on site)

13.5.25 Assuming the foundation geometry detailed above, minimal settlements would be anticipated. However, further advice should be sought from the Structural Engineer responsible for foundation design.

Bedrock

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

13.5.27 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.

13.5.28 Bedrock at the site (Area C) comprises mudstone which can be easily excavated using a backhoe excavator, and will be recovered as a tabular gravel. Where in-situ bedrock is encountered at founding depth (minimum of 450mm), it will provide a suitable founding stratum for two or three storey dwellings, and need only be penetrated by the proposed foundation thickness.

13.5.29 Note: any overlying residual soil (typically clay with gravel-sized lithorelicts) is likely to be a shrinkable soil; mudstone is not.

Coal/carbonaceous mudstone

13.5.30 Some excavations for foundations in Area C may come into contact with coal/carbonaceous mudstone which has been found to be potentially combustible. Care should be taken not to unnecessarily overdeepen foundations, in order to minimise the chance of encountering potentially combustible materials.

13.5.31 Where foundation excavations do come into contact with potentially combustible materials, the foundation should be deepened to found in underlying natural in-situ strata of adequate bearing. The full thickness of potentially combustible material should then be sealed with concrete to create a trench fill foundation. To prevent the ingress of air, the mass concrete fill should be placed as soon as possible after exposing the seam.

13.5.32 By virtue of the provisions of the Coal Industry Act 1994 interests in unworked coal and coal mines previously vested in the British Coal Corporation are now vested in the Coal Authority. The developer will need to contact the Coal Authority to dig or carry away such coal as they encounter in connection with redevelopment of the site (this is often referred to as incidental coal).

Summary of foundation recommendations

13.5.33 In summary, the following foundation solutions are likely to be most appropriate (subject to Newett Homes preferences regarding site preparatory works, final levels & costs associated with each foundation option).

Plot no's	Foundation solution(s)	Remarks (influencing factors)
Plots 5 to 8 and 23 to 29	Trenchfill	Levels likely to be raised during site re-grade, Plots likely to be underlain by deep fill.
Plots 10 to 22	Strips from 0.45m depth	Area of cut, plots likely to be founded in competent bedrock from 0.45m.
Plots 1 to 3, 31 & 32	Strips from 0.45m depth in rock, 1,000mm in cohesive soils	Conventional strip footings, locally overdeepend in areas of deep made ground

13.5.34 Should site levels be raised significantly then alternative foundations such as piles may be required for Plots 5 to 8 and 23 to 29.

13.5.35 Based on the current layout, Plots in Area A lie beyond the footprint of the existing and former public houses and therefore are unlikely to be affected by any deep made ground associated with backfilled cellars. However, further areas of made ground associated with former buildings may be encountered.

13.5.36 Lithos could prepare a detailed Foundation Schedule if provided with: an External Works Drawing (with proposed FFLs & infrastructure details); a topographic survey; a tree survey.

13.5.37 It is understood that regrade works are proposed which will significantly alter foundation depths for plots in the north. Finished Floor Levels have not been provided at this stage, consequently the above recommendations may change significantly, further advice should be sought from Lithos.

13.6 Floor slabs

13.6.1 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).

13.6.2 It is estimated that the thickness of made ground is likely to exceed 600mm beneath at least 50% of the plots.

13.6.3 Where foundations are within the influence of existing or proposed trees, NHBC require a suspended floor slab, with sub-floor void. The floor slab is most commonly a precast block and beam construction, but alternatively could comprise a suspended timber floor, or a slab cast on a suitable compressible void former. Cast in-situ slabs are not acceptable where foundations are within the influence of trees.

13.6.4 In accordance with NHBC Standards Chapter 4.2, a minimum void height of 300mm should be adopted for a precast block and beam (or suspended timber) floor; this includes a 150mm ventilation allowance. If a suspended, cast in-situ slab (on a void former) is proposed, a minimum clear void height of 150mm should be adopted; of course, the actual thickness of the void former will be significantly greater.

13.6.5 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 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.

13.7 Designated concrete mixes

13.7.1 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.

13.7.2 Consequently, Newett Homes should seek advice from their appointed Structural Engineer.

13.8 Excavations

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

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

13.8.3 The stability of even shallow excavations is likely to be poor particularly excavations through made ground and weathered coal measures strata.

13.8.4 Some overbreak should be anticipated in weathered bedrock, most notably where cobbles and boulders are encountered.

13.8.5 Bedrock was encountered in all but two exploratory holes. Based on the exploratory hole logs, excavation greater than 1.2m is likely to prove difficult in Area A and south-west of Area C (Rough Rock Sandstone). Across the remainder of the site excavations in Coal Measures strata (mudstone) and Soft Bed Flags (sandstone and siltstone) should be possible to greater depths (at least 3m), see Drawing 2895/7 in Appendix B to this report.

13.8.6 It would therefore be prudent to allow for excavation of hard rock in any deep excavations where Rough Rock Sandstone is present such as those that may be required for drainage etc.

13.8.7 For deeper excavations in the north of Area C where site levels are to be reduced significantly and retaining walls constructed further characterisation of the ground through rotary coring will be required to confirm strengths, and as such, ease of excavation, see Section 15.9.

13.9 Drainage

13.9.1 Based on observations made during the investigation, soakaways are very unlikely to provide a suitable drainage solution for surface water run-off at the site.

13.9.2 Furthermore, given topography it is considered likely that springs might appear down-gradient if soakaways were adopted as a drainage solution.

13.9.3 Consequently, it will be necessary to consider alternative sustainable drainage systems (SUDS), and there may be a need for surface water balancing.

13.9.4 Whilst the site does not lend itself to the adoption of discrete soakaways, ground should have the capacity to absorb surface water run-off, and systems which spread infiltration over a wider area (e.g. an infiltration basin, swales and\or pervious paving) may provide the best solution, most notably in Area A which is underlain by Rough Rock Sandstone.

13.9.5 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.

13.9.6 Yorkshire Water have published a guide[3] for developers and designers outlining their design requirements for surface water attenuation assets.

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

13.9.7 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. 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.

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

13.9.9 However, CIRIA C753:2015 states that: "*A minimum distance of 1m between the base of the infiltration system and the maximum likely groundwater level should always be adopted. This is to minimise the risk of groundwater rising into the infiltration component and reducing the available storage volume, to protect the functionality of the infiltration process by ensuring a sufficient depth of unsaturated material and to protect the groundwater from any contamination in the run-off*".

13.9.10 It is recommended that the developer contact Yorkshire Water Services with respect to capacity in existing foul and surface water sewers in the vicinity of the development area.

13.10 Highways

13.10.1 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[4] indicate that the Residual Soils would be expected to provide a CBR value of at least 2%. These values should be verified prior to or during construction.

13.10.2 Where made ground is present consultation with the adopting authority, regarding the specification of the highways, is strongly recommended.

13.10.3 Within Area A, the made ground often contains a significant amount of oversize (boulders etc) and obstructions (old foundations etc), which represent potential 'hard-spots'.

13.10.4 Consequently, where made ground is present its full thickness (up to a maximum of 2m - from existing ground level or proposed highway formation, whichever is the lower) should be excavated and either:

- replaced with suitable aggregate in accordance with Series 600 (Earthworks) of The Highways Agency (HA) "Specification for Highway Works" 1998; or
- if it's suitable, screened, to allow selection of suitable material, before being replaced in engineered layers (in accordance with Series 600). Unsuitable materials include any soft or wet materials, biodegradables including topsoil, wood, scrap metal, frozen material and oversize.

13.10.5 Within Area A the proposed highway is shown to span the footprint of the existing public house and as such is likely to span any associated deep cellar.

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

13.10.6 Where highways span the wall of any backfilled former cellars the following precautions are recommended to protect the highway and new drainage infrastructure from damage due to differential settlement:

- The made ground should be excavated over the full width of the adoptable highway to at least 1.5m below deepest sewer invert.
- The base of the excavation (1.5m below sewer invert) should be reinforced with two layers of Tensar Triax TX160 (or equivalent) geogrid sandwiched within at least 300mm of suitable aggregate
- A minimum length of 5m either side of the cellar walls should be treated to the above specification, although the final specification should be agreed with the adopting authority.

13.10.7 Some refinement of the above advice might be possible after highways design (with consideration of the proposed formation level cf existing ground level), and via inspection (and usually CBR testing) of the proposed formation during site preparatory groundworks.

13.10.8 Any residual made ground materials in the base of the excavation should be inspected and (where necessary) any soft spots removed and replaced with suitable engineered fill.

13.10.9 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.

13.10.10 Crushing of demolition/hardstand/foundation arisings will generate aggregate, which (subject to confirmatory testing) should be suitable for use as unbound pavement materials within the highways.

13.11 External works

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

13.11.2 Given the steeply sloping nature of the site (around 1 in 4) and the proposed site re-grade there will be a need for significant retaining walls and underbuild.

14 REDEVELOPMENT ISSUES

14.1 General

14.1.1 This report has presented options with respect to foundation solutions, 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.

14.1.2 If unanticipated ground is encountered during the site preparatory works, the Contractor should immediately seek further advice from the Engineer.

14.2 Remediation strategy

14.2.1 Given the absence of any significant contamination, a remediation strategy is not considered necessary. Nonetheless, some preparatory works will be required, most notably:

- Demolition of the existing buildings
- General site clearance of surface materials and vegetation
- Topsoil strip & stockpile
- Break-up of slabs and hardstand

14.2.2 Immediately prior to demolition of the former public house, changing rooms, garages and stables, 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 Newett Homes.

14.2.3 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.

14.2.4 No areas of gross contamination were encountered during the site investigation. However, if any buried drums, "oily", odorous, brightly coloured etc. materials are encountered, further advice should be sought from Lithos. Further advice should also be sought if deep foundations etc associated with the former public house and stables are encountered during the preparatory works; such obstructions might necessitate revised foundation design.

14.3 Control of excavation arisings

14.3.1 No significantly elevated concentrations of contaminants were identified in any of the soils at the site. However, the groundworker should carefully segregate (and stockpile separately) made ground arisings from arisings of "clean" natural soils, in order that an excessive volume of unsuitable material is not generated.

14.3.2 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; excess clean, natural soil arisings; general construction waste etc.

14.3.3 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed.

14.3.4 Made ground arisings could be:

- Placed in area deliberately left low on completion of the remediation works in order to accommodate construction arisings
- Redistributed beneath concrete oversite, or areas of hardstanding, where they would be satisfactorily isolated from end users;
- Exported from site to a suitably licensed landfill facility

14.4 Good practice guidance

14.4.1 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[5]:
  - PPG6 - Working at construction and demolition sites
  - PPG2 - Above ground oil storage tank
  - PPG7 – The safe operation of refuelling facilities.
  - PPG21 – Incident Response Planning

14.4.2 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).

14.4.3 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.

14.5 New utilities

14.5.1 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.

14.5.2 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[6].

14.5.3 This south of the site is brownfield, and therefore consideration of soil contaminant concentrations is required. Samples taken must be representative of the soil conditions in which the water pipes are proposed to be laid; normally water pipes are laid 0.7m to 1.3m below finished ground level.

14.5.4 At the time of writing, the proposed route(s), and total length, of pipeline were unknown. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance has not been undertaken.

14.5.5 However, given the site's history and the absence of any significantly elevated concentrations of contaminants, the use of 'standard' polyethylene water supply pipes should be acceptable, although Newett Homes should consult Yorkshire Water at the earliest opportunity to confirm this.

14.6 Health & safety issues - construction workers

14.6.1 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.

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

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

14.6.3 No significantly elevated concentrations of contaminants have been identified in the soils beneath this site. However, simple precautionary measures are recommended to protect the health & safety of construction workers, i.e. good personal hygiene and basic personnel protective equipment.

14.6.4 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".

14.7 Shallow coal in garden areas

14.7.1 Carbonaceous Mudstone (0.2m thick, in TP05) may represent the Pot Clay Coal which is known to underlie the Coal Measures strata at the interface with the Rough Rock Sandstone. Although of 'low quality', testing yielded a CV of 3.4 MJ/kg and as such the Carbonaceous Mudstone is considered potentially combustible.

14.7.2 Whilst there is no explicit guidance in NHBC Standards, liaison with NHBC suggests their stance is essentially the same as that they would apply to potentially combustible fills (such as Ash & Clinker). So where significant coal is present at very shallow depth in garden areas (uppermost 1m), it should either be removed, or covered with inert subsoil/topsoil so that it lies at greater than 1m depth.

14.7.3 In theory this could be an issue for about 40% of the total site area. However, given seam dip and topography it seems likely that coal will only be present at such shallow depth beneath less than 10% of the area.

14.7.4 The most pragmatic way of dealing with shallow coal in gardens will be to inspect foundation excavations, and where coal is recorded within the uppermost 1m or so then excavate an inspection pit in the rear garden. Further advice should be sought from Lithos during the construction phase.

14.7.5 As with foundation arisings, the developer will need to contact the Coal Authority to dig or carry away excavated (incidental) coal.

14.8 Potential development constraints

14.8.1 Topography will require significant regrade earthworks, most notably in the north (where gradients of up to around 1 in 4 are present). Where ground levels are reduced significant excavation of rock will be required to allow for retaining wall construction. Further assessment of the nature and strength of the rock will be required, see Section 15.9.

14.8.2 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.

14.8.3 The culvert along the south-western boundary may present a potential development constraint unless it can be located and subsequently diverted. It is likely that some 'upgrading' of the culvert will be required prior to redevelopment.

14.8.4 Shallow excavations in Area A are likely to prove difficult from around 1.2m depth due to competent shallow sandstone strata.

15 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

15.1 General

15.1.1 The site is located off New Hey Road 3.7km north-west of Huddersfield town centre, and comprises a single parcel of land with a former public house and associated hardstand in the south and steep grassed slopes (around 1 in 4) in the north.

15.1.2 It is understood that consideration is being given to redevelopment of the site with 32 no. traditional two storey domestic dwellings. A site layout has been prepared by Sten Architecture, copied here as Drawing 2895/2 in Appendix B.

15.1.3 Made ground is typically restricted to Area A (south of the site around existing public house & car park) where up to 1.1m was recorded, with an isolated occurrence in Area C (TP05), 1.4m thick.

15.1.4 Natural ground typically comprises a veneer of residual soil (firm gravelly clay), over bedrock (mostly siltstone & sandstone). Rockhead is typically at shallow depth (0.5m to 3m), average 0.9m.

15.1.5 No significant inflows of groundwater were encountered during the investigation. Slight groundwater seepages occurred in TPs 04, 05 & 06 at between 0.6m and 1.6m depth.

15.1.6 The north of the site rises steeply at around 1 in 4 towards the northern boundary abutting the rear gardens of houses along Deercroft Crescent

15.2 Mining

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

15.2.2 A Carbonaceous Mudstone encountered in TP05 is believed to represent the Pot Clay Coal. Given the poor quality of the Carbonaceous Mudstone it is considered highly unlikely to have been worked. No significant seams lie within 100m of the Pot Clay Coal.

15.2.3 Whilst the site lies within a Coal Authority Low Risk area, no significant risks have been identified, and an intrusive mining investigation will not be required.

15.3 Hazardous gas

15.3.1 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.

15.3.2 The site is in an area where between 1% and 3% of homes are estimated to be above the radon action level.

15.3.3 As such, no special precautions against hazardous gas are required although Public Health England would like to see all new build include basic measures.

15.4 Contamination & remediation

15.4.1 No significant concentrations of contaminants were encountered in any of the exploratory holes.

15.4.2 Existing Topsoil is considered chemically suitable for re-use.

15.5 Site regrade & slope stability

15.5.1 At the time of writing, proposed finished floor levels (FFL) had not been finalised, but given existing topography (especially in the north where gradients of 1 in 4 are present), significant earthworks regrade is anticipated, with a reduction in levels in the far north and raising of levels through the centre of the site (Area C).

15.5.2 Earthworks modelling will be required, but some cut into bedrock is anticipated in the far north. A retaining wall will then be constructed along the northern site boundary after the reduction in site levels.

15.5.3 Stable slope geometry will need to be determined after appropriate supplementary ground investigation, but in the meantime, it is considered likely that batters of around 3H:1V within residual soils, and 2H:1V within Coal Measures bedrock, might be possible.

15.6 Foundations

15.6.1 Strip footings 0.6m wide from 450mm depth in bedrock, or from 1,000mm in cohesive soils are considered the most suitable founding solution for two to three storey plots.

15.6.2 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that up to 65% of the site may be affected by trees, however, bedrock is likely to be encountered at shallow depth.

15.6.3 Where ground levels are raised as part of site re-grade works, any trench fill foundation deeper than 2.5m will need to be designed by a Chartered Engineer, whose status is accepted by NHBC (NHBC Standards, Technical Requirement R5);

15.6.4 Should site levels be raised significantly then alternative foundations such as piles may be required (Plots 5 to 8 and 23 to 29).

15.6.5 Based on the current layout, Plots in Area A lie beyond the footprint of the existing and former public houses and therefore are unlikely to be affected by any deep made ground associated with backfilled cellars. However, further areas of made ground associated with former buildings may be encountered.

15.7 Flooding

15.7.1 The EA indicate that the site is not located within an indicative floodplain.

15.8 Drainage

15.8.1 Due to the steeply sloping nature of the site and underlying ground conditions, soakaways are very unlikely to provide a suitable drainage solution for surface water run-off. Consequently, it will be necessary to consider alternative sustainable drainage systems (SUDS), and there may be a need for surface water balancing.

15.9 Highways

15.9.1 Based on visual inspection of the shallow natural materials and published guidance, the gravelly clays should provide a CBR value of at least 2%. This value should be verified prior to or during construction.

15.9.2 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.

15.9.3 Special, precautionary measures will be required if highways span any backfilled structures (eg cellars).

15.10 Further works

15.10.1 Post demolition trial pitting within Areas A & B, where access was restricted due to existing buildings and services.

15.10.2 Significant earthworks regrade is proposed with the construction of a retaining wall in the far north of Area C. Consequently, rotary coring in the north of Area C will be required to determine the strength of shallow bedrock, assess the ease of excavation and allow design of a retaining wall.

15.10.3 Consideration could also be given to field compaction trials to determine the suitability of site won materials for use as bulk fill during the anticipated earthworks.

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 YAHPAC (collection of Yorkshire & Humberside 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 D							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 D							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	NEWETT HOMES
JOB TITLE	NEW HEY ROAD, HUDDERSFIELD
DRAWING TITLE	SITE LOCATION PLAN
DRAWN	JEJ
DATE	03/11/17
CHECKED	ASw
DATE	03/11/17
STATUS	FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑
SCALE	1:25,000
SHEET	A4
DRAWING NO.	2895/1
REVISION	

NOTES

- ROUGH ROCK SANDSTONE (STRONG SANDSTONE)
- LOWER COAL MEASURES (WEAK MUDSTONE)
- SOFT BED FLAGS (WEAK SILTSTONE & SANDSTONE)
- APPROXIMATE SITE BOUNDARY

GROUND CONDITIONS ARE APPROXIMATE ONLY, BASED ON PUBLISHED GEOLOGICAL PLANS AND EXTRAPOLATION OF DATA BETWEEN LITHOS EXPLORATORY HOLES.

LAYOUT REPRODUCED FROM STEN ARCHITECTURE DRAWING REFERENCE 1640.01 REV K, DATED OCTOBER 2016

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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

Tel 01937 545330

CLIENT

NEWETT HOMES

JOB TITLE

NEW HEY ROAD, HUDDERSFIELD

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
JEJ	27/11/17	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	27/11/17	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:750	A3	2895/2	

NOTES

- GRASSED FIELD
- BUILDING
- COLLAPSED BUILDING
- OVERGROWN AREAS
- TARMAC HARDSTAND
- CONCRETE
- POSSIBLE CELLAR HATCH
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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

Tel 01937 545330

CLIENT

NEWETT HOMES

JOB TITLE

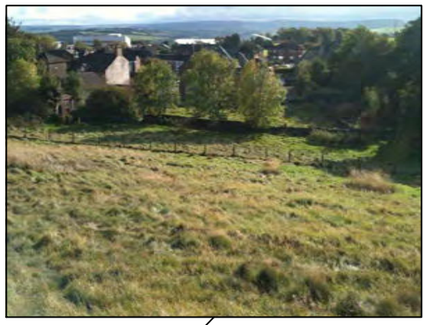
NEW HEY ROAD,
HUDDERSFIELD

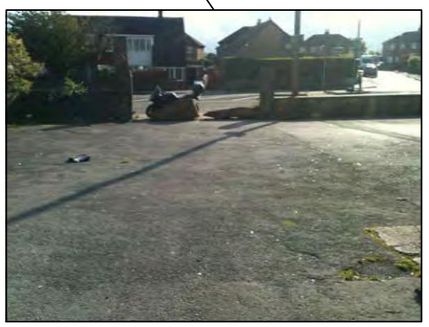
DRAWING TITLE

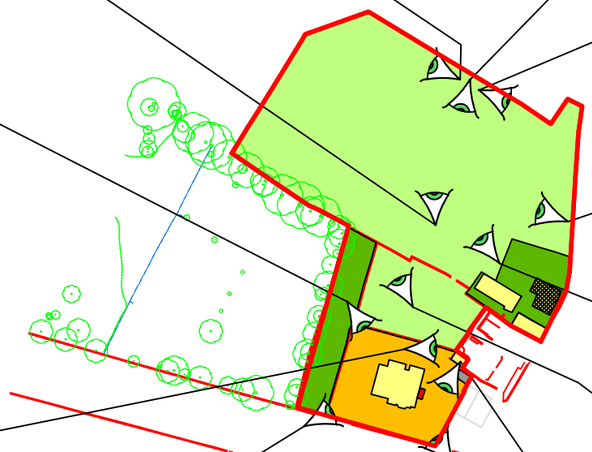
SITE FEATURES

DRAWN	DATE	STATUS
JEJ	09/11/17	FOR COMMENT ☐
		FOR APPROVAL ☐
CHECKED	DATE	DRAFT ☐
ASw	09/11/17	FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:750	A3	2895/3	







NOTES

- GRASSED FIELD
- BUILDING
- COLLAPSED BUILDING
- OVERGROWN AREAS
- TARMAC HARDSTAND
- CONCRETE
- APPROXIMATE SITE BOUNDARY
- LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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

Tel 01937 545330

CLIENT

NEWETT HOMES

JOB TITLE

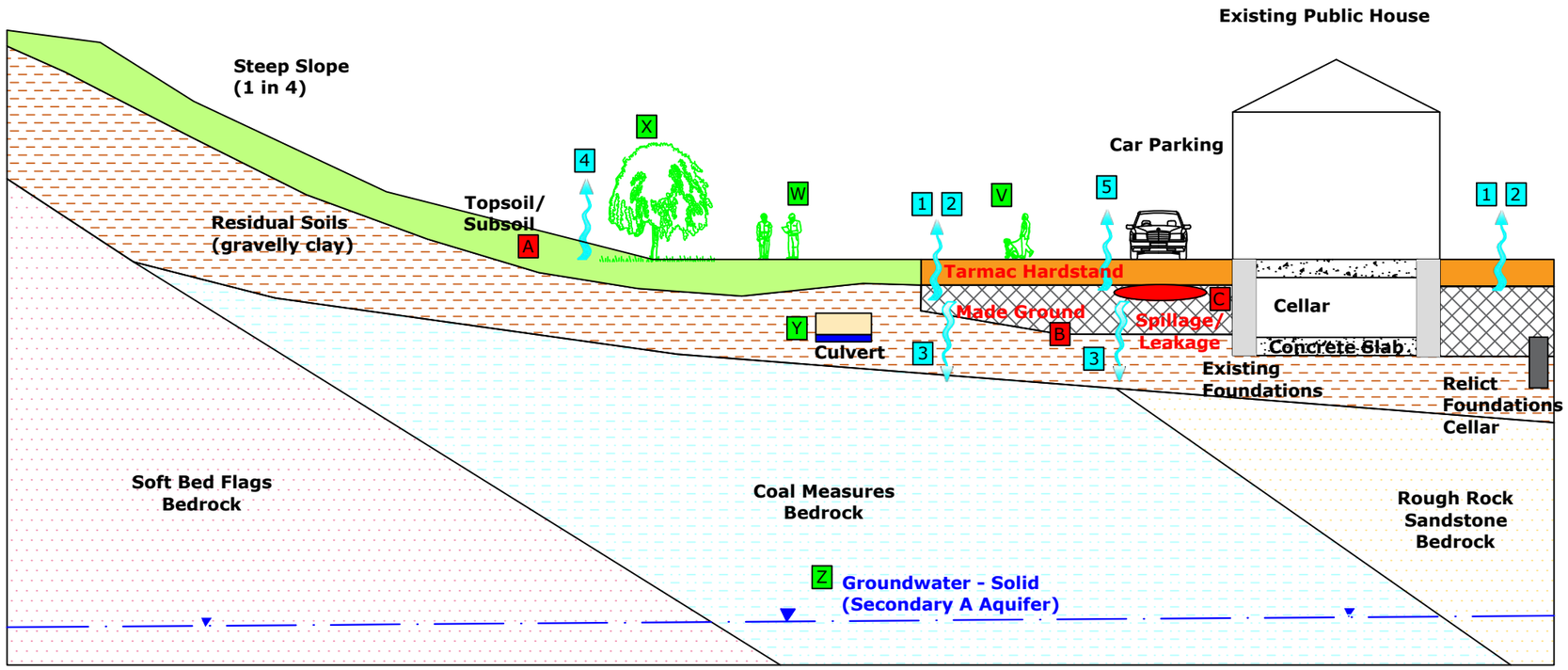
NEW HEY ROAD,
HUDDERSFIELD

DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	DATE	STATUS
JEJ	09/11/17	FOR COMMENT ☐
		FOR APPROVAL ☐
CHECKED	DATE	DRAFT ☐
ASw	09/11/17	FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
NOT TO SCALE	A3	2895/4	



SOURCES	PATHWAYS	RECEPTORS
A TOPSOIL (INORGANICS)	1 DERMAL CONTACT	V END USERS (RESIDENTS)
B MADE GROUND (INORGANICS)	2 INGESTION/INHALATION	W SITE WORKERS
C LEAKAGE/SPILLAGE (ORGANICS)	3 LEACHING OF CONTAMINANTS	X VEGETATION
	4 UPTAKE BY PLANTS	Y SURFACE WATERS (CULVERT)
	5 VOLATLISTION	Z GROUNDWATERS

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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

Tel 01937 545330

CLIENT

NEWETT HOMES

JOB TITLE

NEW HEY ROAD,
HUDDERSFIELD

DRAWING TITLE

PRELIMINARY CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
JEJ	03/11/17	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	03/11/17	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	2895/5	

NOTES

- TRIAL PIT LOCATION
- TRIAL TRENCH LOCATION
- GRASSED FIELD
- BUILDING
- COLLAPSED BUILDING
- OVERGROWN AREAS
- TARMAC HARDSTAND
- CONCRETE
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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

Tel 01937 545330

CLIENT

NEWETT HOMES

JOB TITLE

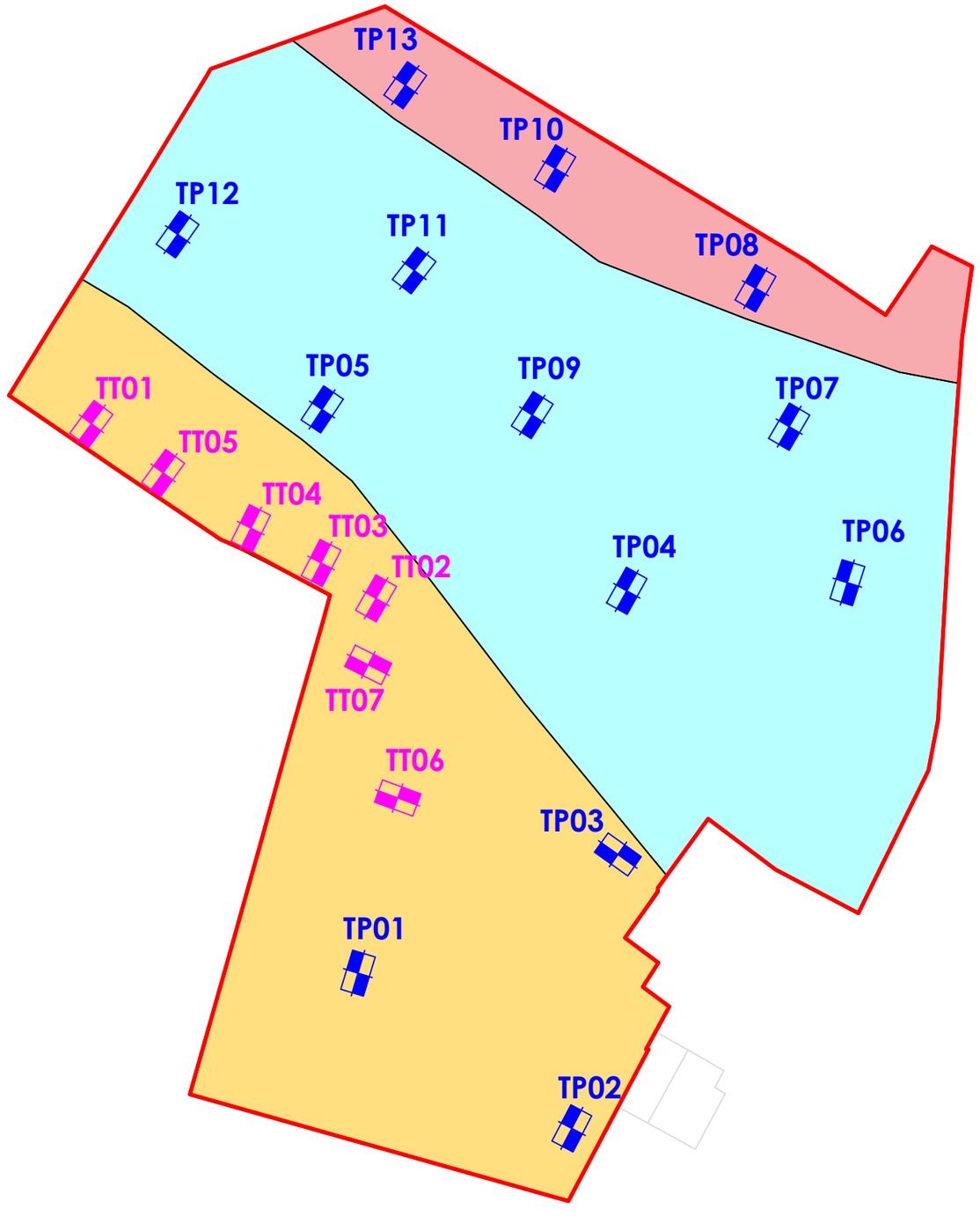
NEW HEY ROAD,
HUDDERSFIELD

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS

DRAWN	DATE	STATUS
JEJ	08/11/17	FOR COMMENT ☐
		FOR APPROVAL ☐
		DRAFT ☐
CHECKED	DATE	FINAL ☑
ASw	08/11/17	

SCALE	SHEET	DRAWING NO.	REVISION
1:750	A3	2895/6	



NOTES

- ROUGH ROCK SANDSTONE (STRONG SANDSTONE)
- LOWER COAL MEASURES (WEAK MUDSTONE)
- SOFT BED FLAGS (WEAK SILTSTONE & SANDSTONE)
- APPROXIMATE SITE BOUNDARY

GEOLOGY INTERPRETED FROM BGS 1:10000 SHEET SE11NW, AMENDED IN ACCORDANCE WITH LITHOS EXPLORATORY HOLE FINDINGS

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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

Tel 01937 545330

CLIENT

NEWETT HOMES

JOB TITLE

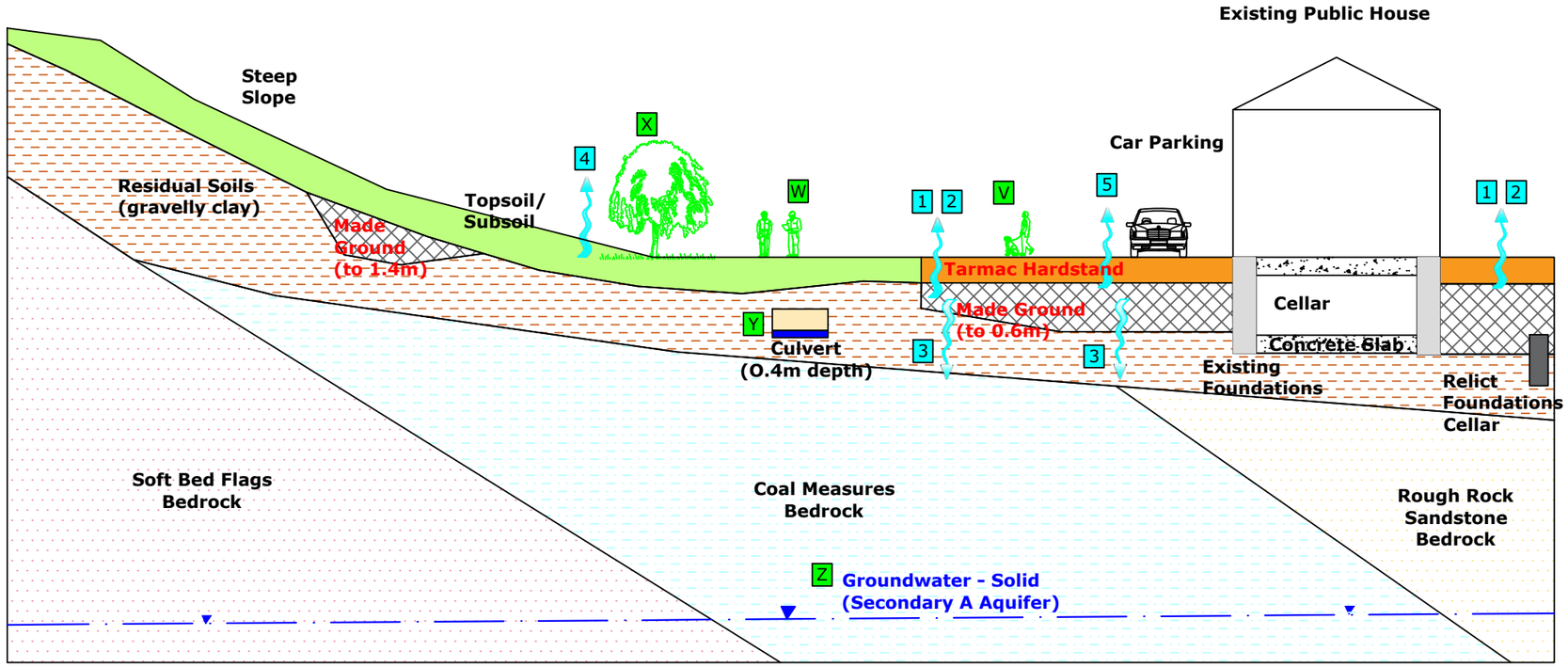
NEW HEY ROAD, HUDDERSFIELD

DRAWING TITLE

GEOLOGY

DRAWN	DATE	STATUS
JEJ	09/11/17	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	09/11/17	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:750	A3	2895/7	



SOURCES
NO CONTAMINANTS IDENTIFIED

PATHWAYS	
1	DERMAL CONTACT
2	INGESTION/INHALATION
3	LEACHING OF CONTAMINANTS
4	UPTAKE BY PLANTS

RECEPTORS	
V	END USERS (RESIDENTS)
W	SITE WORKERS
X	VEGETATION
Y	SURFACE WATERS (CULVERT)
Z	GROUNDWATERS

NOTES

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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

Tel 01937 545330

CLIENT

NEWETT HOMES

JOB TITLE

NEW HEY ROAD, HUDDERSFIELD

DRAWING TITLE

REVISED CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
JEJ	27/11/17	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
ASw	27/11/17	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	2895/8	

Appendix C

Commission

002/2895/ASw

5th October 2017

Mr W Newett
Newett Homes
Thorp Arch Grange
Walton Road
Thorp Arch
Wetherby
LS23 7BA

LITHOS CONSULTING

Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

T 01937 545 330

www.lithos.co.uk

Dear Will

New Hey Road, Huddersfield

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 23 no. traditional 2 storey domestic dwellings with associated gardens, POS and adoptable roads and sewers; a proposed layout has been provided.

As part of the development a substantial retaining feature is to be constructed on the northern boundary.

The following existing reports have been supplied by Newett Homes, which have been reviewed by Lithos:

- Phase I Environmental Assessment, New Hey Road, Huddersfield, Report 16-0681.01 produced September 2016 by Delta Simons
- Outline Engineering Assessment, Proposed Residential Development, New Hey Road, Huddersfield, Report 2629/OEA Rev 1 produced 23rd March 2017 by Bright Young

Review of the information supplied suggests that the site consists of a single parcel of land of approximately 1.1 hectares off New Hey Road.

A possible culvert runs along the south-west boundary and down through the south of the site towards New Hey Road.

Review of Google Maps suggests the south of the site is occupied by a derelict public house with surrounding hardstand with the north comprising overgrown fields rising steeply towards the northern boundary.

Available data suggests the site:

- Appears to have been developed with a public house in the 19th century, the north remaining 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 underlain by Coal Measures strata (Rough Rock in south, undifferentiated Coal Measures strata in centre and Soft Bed Flags in the north). No drift materials are shown at the site.

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.

A Coal Authority mining report states that "*the property is not within a surface area that could be affected by past underground mining*".

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.

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: We will complete a more detailed review of the existing reports, and obtain 'new' environmental search data where necessary.

Fieldwork: We have allowed for 1 day's trial pitting, a tracked machine will be mobilised due to the steeply sloping nature of the site.

All trial pits will be supervised and logged by an experienced geoenvironmental engineer.

Trial pitting will be undertaken across the site to determine underlying shallow ground conditions. Shallow trenches will also be excavated across the anticipated line of the culvert in the south-west.

Should the culvert not be identified and additional trenching were required then this would be chargeable at an extra over rate of £*** per day (hire of excavator with supervision by Lithos engineer).

Based on anticipated ground and topography, soakaways are considered unlikely to provide a satisfactory solution for surface water drainage. No allowance has been made for soakaway testing at this stage. If required, or considered feasible based on the ground actually encountered.

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.

The mechanical excavator will be equipped with a breaker to enable excavation through near-surface hardstand in the south of the site.

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 or reinstatement of the hardstanding.

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 typically 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 further review of the desk study data and the ground conditions actually encountered.

Retaining Wall Investigation: In order to investigate the nature of the ground in the far north of the site in the area of proposed cut and retaining wall construction drilling will be required. It is recommended that a phased approach be adopted as until trial pitting is complete it will not be known if cable percussion (suitable for residual soils and/or highly weathered bedrock) or rotary drilling (where more competent bedrock strata is encountered) will be required.

Based on the proposed layout boreholes drilled to the rear of every other plot along the northern boundary (ie 4 holes) should be sufficient to allow appropriate design of earthworks and retaining wall construction.

Where trial pitting identifies residual soils cable percussion boreholes may be a suitable means of borehole construction.

However, deeper strata are anticipated to comprise more competent rock and as such rotary probing would be required.

This would comprise rotary open hole methods through superficial deposits until competent bedrock strata is reached where coring (minimum 92 mm diameter) will be undertaken to recover rock samples for detailed logging and testing. Coring costs would be dependent on actual meterage drilled, at this stage allow for at least 6m per hole, with each hole advanced to at least 12m (ie 2m below the base of proposed excavations).

Depending on the methods of drilling an allowance should be made for additional testing of samples including unconfined compressive strength (around 8 tests) and point load testing (around 20 tests) of rock or drained triaxial testing (around 8 tests) of soils.

Core will be stored at our Wetherby office for a minimum 3 months or until the project is complete whichever is sooner. No allowance has been made for the long term storage of core though it may be retained by the client if collected at their expense.

Groundwater monitoring wells will be installed in each of the boreholes on completion of drilling.

Rates for drilling, well installation and testing based on the above hole numbers and depths are provided separately (rotary Items 1A to 3A or cable percussion Items B1 to B3) although these may be revised based on initial findings and discussion with the earthworks/retaining wall designer.

These rates allow for provision of a Welfare Unit, with the benefit of full canteen facilities, hot water with full size sink, toilet and drying room as works would be expected to last more than 3 working days.

With reference to the control, management and disposal of surplus water and flush arising from the drilling works, (and in order to avoid additional costs associated with the provision of a telehandler to transfer a weir tank between boreholes, and the provision of a pump to transfer surplus water from the weir tank to an approved disposal point), we have assumed that potentially discoloured surplus water will be allowed to flow and settle into the field.

This proposal has been put together without a visit to the site and it has been assumed that access is available for a 14t tracked excavator along with a lorry mounted drilling rig. However, the north of the site is quite steep. Prior to drilling our contractor would need to visit the site to confirm they could safely access the borehole positions on the northern boundary.

No allowance has been made for additional or specialist plant, scaffolding, protective matting etc. If required these would be chargeable at additional cost.

Testing: This will comprise routine geotechnical soils analysis, including 6 moisture content & Atterberg limits, and 6 pH & water soluble sulphate.

At this stage, we have no reason to expect wide areas of the site to be underlain by significant thicknesses of made ground. Consequently, we have only allowed for contaminant testing of up to 6 made ground samples, plus a further 6 samples of topsoil to confirm its suitability for re-use.

The test suite will include heavy metals, speciated PAH, and banded TPH (with supplementary speciation as/where appropriate); 2 samples will also be analysed for pesticides.

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 12 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 (subject to drilling rig availability). Our comprehensive geoenvironmental appraisal report will be issued within 4 weeks of fieldwork completion.

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 (excludes drilling). 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 (Items 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 last for 1 working day and therefore it is not considered reasonably practicable to provide formal welfare facilities at this stage, and our proposal makes no allowance for so doing during the trial pitting.

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.

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: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed.

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

Yours sincerely

Alan Swales
Principal Engineer
for and on behalf of
LITHOS CONSULTING LIMITED

Josh Jones

Subject: FW: NEW HEY ROAD, HUDDERSFIELD - NEWETT HOMES

From: Jeff Bright [mailto:jeff@brightyoung.co.uk]
Sent: 11 October 2017 07:15
To: Alan Swales <Alan.Swales@lithos.co.uk>
Cc: David Young <David@byconsulting.co.uk>; Will Newett - Newett Homes <Will@newetthomes.co.uk>
Subject: Re: NEW HEY ROAD, HUDDERSFIELD - NEWETT HOMES

Alan

I've spoken to Will and he would like you to proceed on this basis please.

We will need to coordinate your trial pitting with Discovery Surveys so I will come back to you with their preferred dates.

Regards

Jeff Bright

Mob 07736 853574

Bright Young Consulting Ltd
Civil and Structural Engineers
The Media Centre
Northumberland Street
Huddersfield HD1 1RL

> On Thu, Oct 5, 2017 at 4:39 PM, Alan Swales <Alan.Swales@lithos.co.uk> wrote:
>
> > Jeff,
> >
> > Fee proposal attached for the initial trial pit investigation, testing and reporting.
> >
> > As discussed should we need to carry out additional trenching to locate the culvert I have provided an extra over day rate for machine hire with engineer supervision.

I have also attached provisional rates for either cable percussion drilling or rotary probing with coring depending on the nature of the ground encountered at the site. These rates also include provision for a site cabin/welfare unit and for additional laboratory testing.

Laboratory testing of rock samples is relatively straightforward (they basically crush it) but triaxial testing of any soil samples would require drained conditions which is chargeable on a day rate on top of the test costs by the labs.

Testing may take 5 days, it may take 20, you do not know until testing is complete. Consequently should testing of soils be required this may best be quoted as a rate only item, remeasured on completion. I have estimated 8 days each to calculate the attached rates to provide a rough idea of costs. Hopefully the ground will comprise rock anyway and such testing will not be required.

If you need to discuss any of the above then please give me a call. I will run by the site at the weekend just to have a quick look at access so that I can flag any issues before they become a problem.

Rgds

Alan

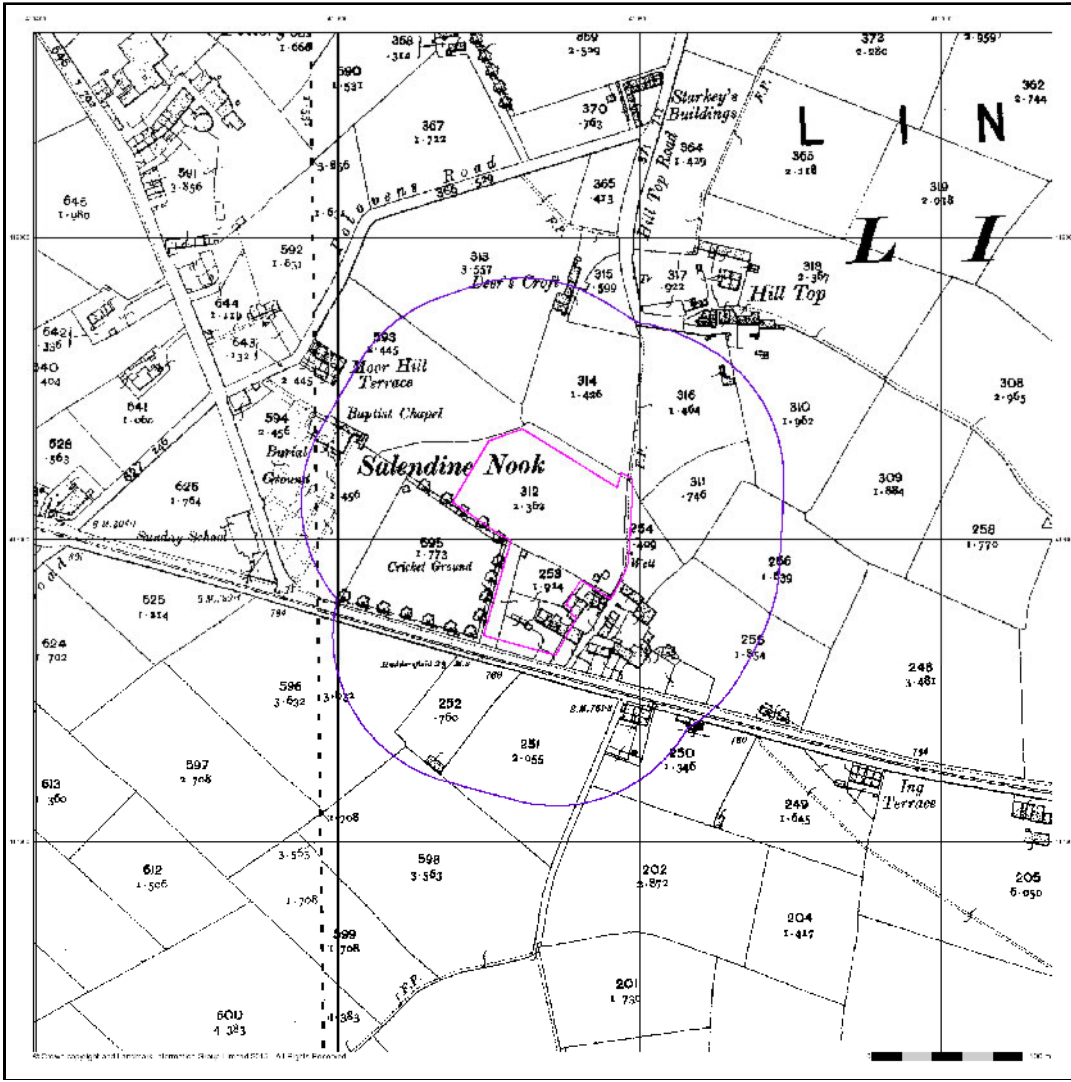
Alan Swales
Lithos Consulting Ltd
M 07548 570 320

DD 01937 545 335

www.lithos.co.uk

Appendix D

Historical OS Plans



Envirocheck

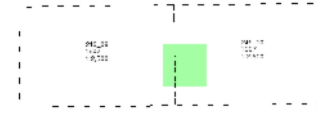
Yorkshire

Published 1907

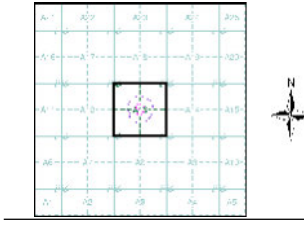
Source map scale - 1:2,500

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

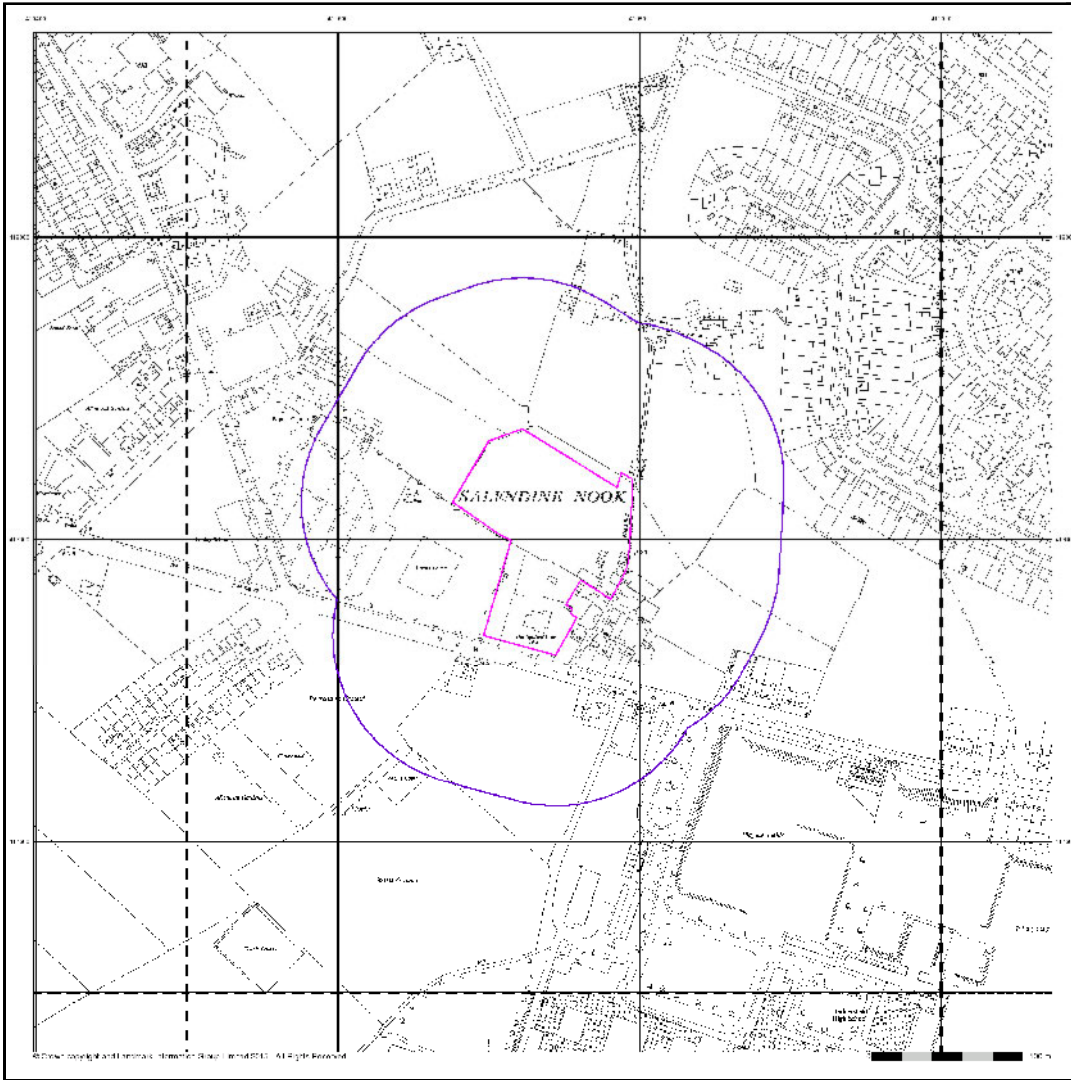


Order Details

Order Number:	97064313_1_1
Customer Ref:	16-0681 New Hay Road
National Grid Reference:	410740, 417800
Slice:	A
Site Area (Ha):	1.07
Search Buffer (m):	100

Site Details

388 New Hey Road, HUDDERSFIELD, HD3 4GP

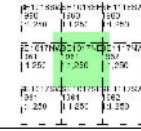


Envirocheck

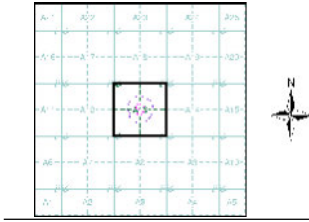
Ordnance Survey Plan
Published 1960 - 1962
Source map scale - 1:1,250

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

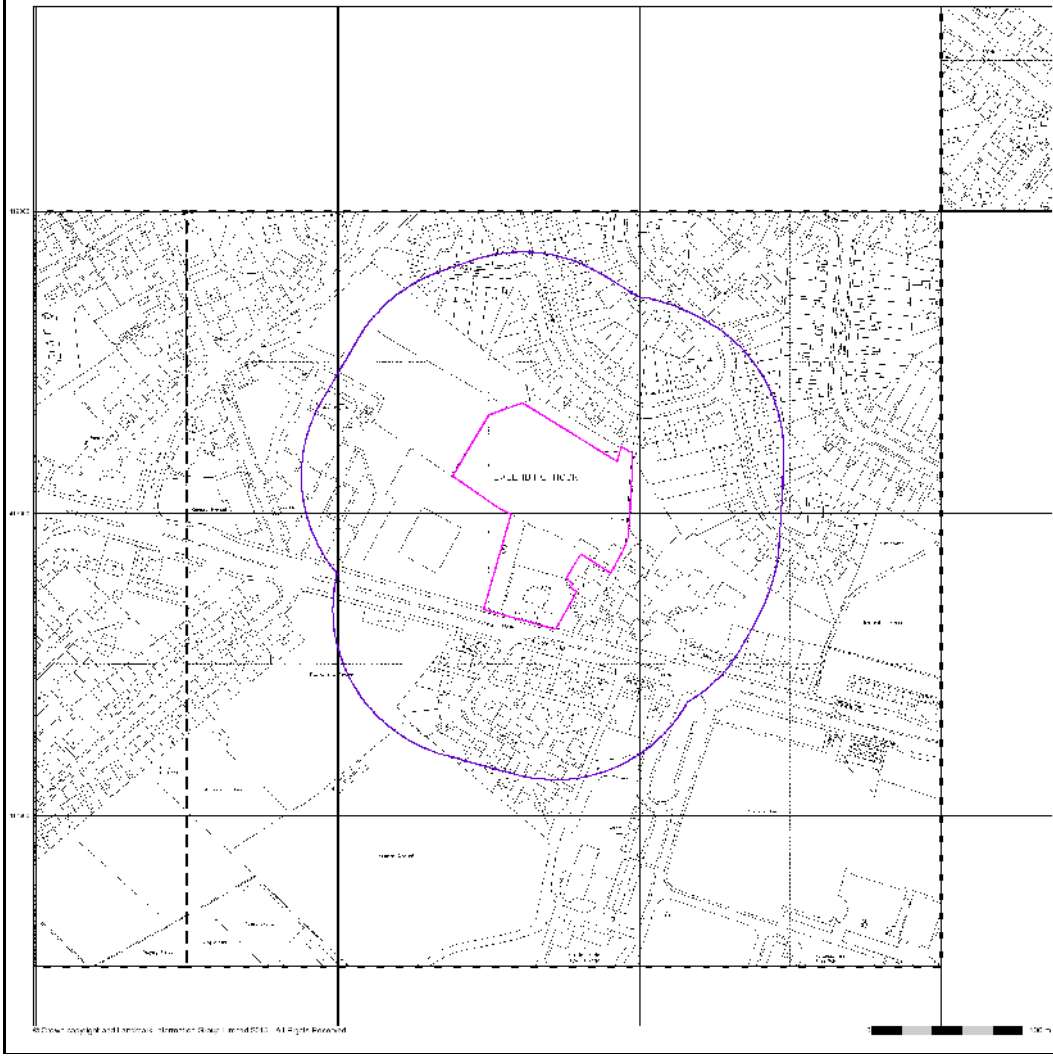


Order Details

Order Number:	97064313_1_1
Customer Ref:	16-0681 New Hay Road
National Grid Reference:	410740, 417800
Slice:	A
Site Area (Ha):	1.07
Search Buffer (m):	100

Site Details

388 New Hey Road, HUDDERSFIELD, HD3 4GP



Envirocheck

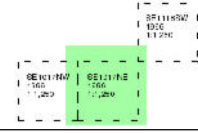
Large-Scale National Grid Data

Published 1996

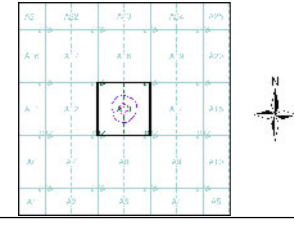
Source map scale - 1:1,250

'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)



Historical Map - Segment A13



Order Details

Order Number:	97064313_1_1
Customer Ref:	16-0681 New Hay Road
National Grid Reference:	410740, 417800
Slice:	A
Site Area (Ha):	1.07
Search Buffer (m):	100

Site Details

388 New Hey Road, HUDDERSFIELD, HD3 4GP

Appendix E

Search Responses & other Correspondence

Envirocheck® Report:

Datasheet

Order Details:

Order Number:
142420059_1_1

Customer Reference:
PO12150/2895/JEJ

National Grid Reference:
410730, 417800

Slice:
A

Site Area (Ha):
1.05

Search Buffer (m):
1000

Site Details:

The Former Spotted Cow, 404
New Hey Road
Salendine Nook
HUDDERSFIELD
HD3 4GP

Client Details:

Mr J Jones
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

Prepared For:

Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
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 the attached datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

Copyright Notice

Natural England Copyright Notice

Ove Arup Copyright Notice

Peter Brett Associates Copyright Notice

Radon Potential dataset Copyright Notice

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				8
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 3		1		4
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 4				Yes
Pollution Incidents to Controlled Waters	pg 4			1	5
Prosecutions Relating to Authorised Processes					
Registered Radioactive Substances					
River Quality	pg 5				1
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register	pg 5				4
Water Abstractions	pg 5				10 (*11)
Water Industry Act Referrals					
Groundwater Vulnerability	pg 10	Yes	n/a	n/a	n/a
Drift Deposits			n/a	n/a	n/a
Bedrock Aquifer Designations	pg 11	Yes	n/a	n/a	n/a
Superficial Aquifer Designations			n/a	n/a	n/a
Source Protection Zones	pg 11			1	
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 11				24

LITHOS CONSULTING

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 14				2
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)					
Local Authority Landfill Coverage		1	n/a	n/a	n/a
Local Authority Recorded Landfill Sites					
Potentially Infilled Land (Non-Water)	pg 14		1		11
Potentially Infilled Land (Water)	pg 15			3	15
Registered Landfill Sites	pg 16				1
Registered Waste Transfer Sites	pg 16				1
Registered Waste Treatment or Disposal Sites					
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					

LITHOS CONSULTING

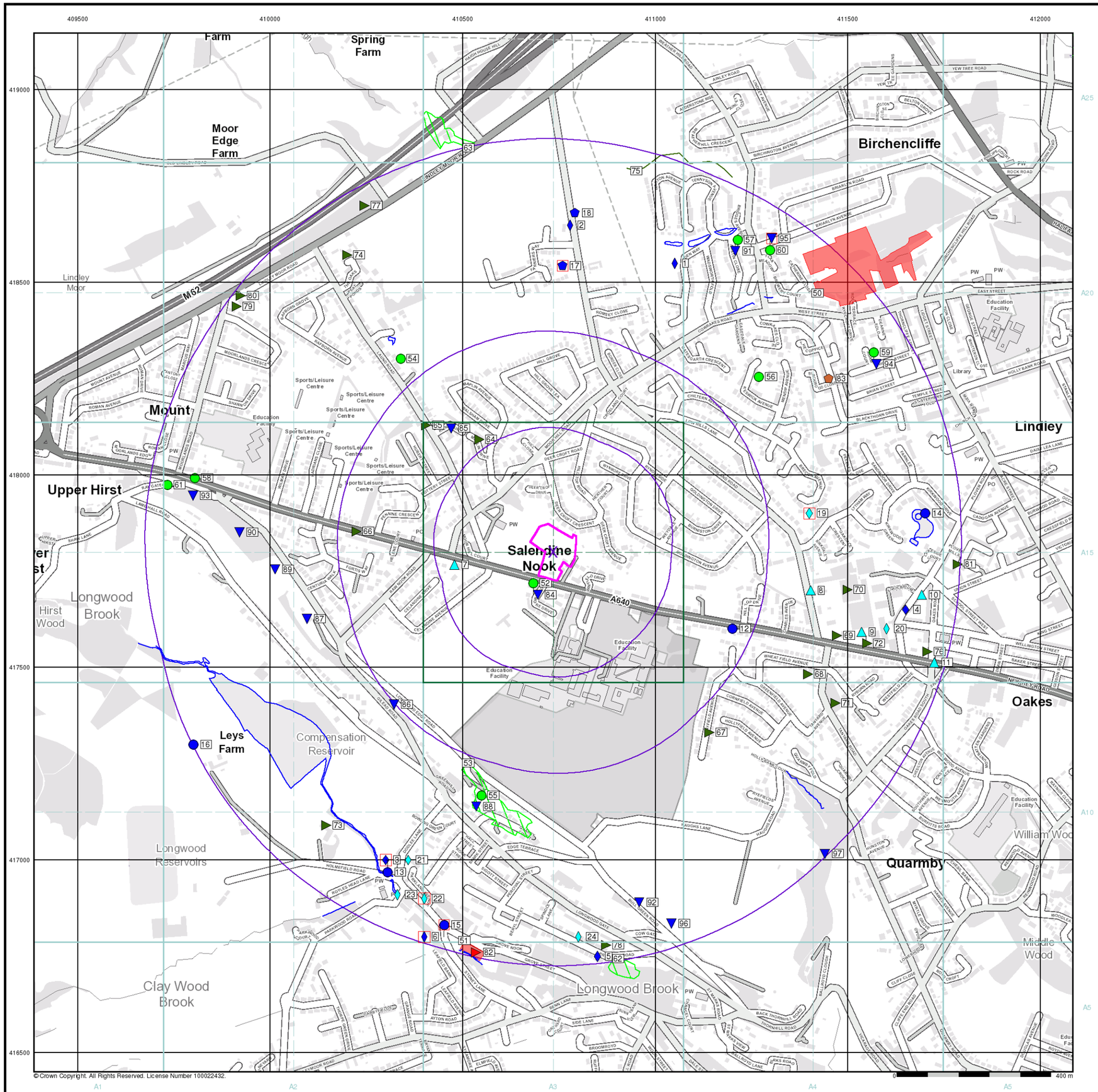
Summary

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 17	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 17	Yes	Yes	Yes	Yes
BGS Recorded Mineral Sites	pg 23		1	1	13
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
CBSCB Compensation District			n/a	n/a	n/a
Coal Mining Affected Areas	pg 25	Yes	n/a	n/a	n/a
Mining Instability	pg 25	Yes	n/a	n/a	n/a
Man-Made Mining Cavities	pg 25			2	
Natural Cavities					
Non Coal Mining Areas of Great Britain	pg 26	Yes		n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 26	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 26	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 26	Yes		n/a	n/a
Radon Potential - Radon Affected Areas			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 27		6	3	33
Fuel Station Entries	pg 30		1		
Points of Interest - Commercial Services	pg 30		2	1	7
Points of Interest - Education and Health					
Points of Interest - Manufacturing and Production	pg 31				18
Points of Interest - Public Infrastructure	pg 32		3		5
Points of Interest - Recreational and Environmental	pg 33		4	4	
Gas Pipelines					
Underground Electrical Cables					

LITHOS CONSULTING

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland					
Areas of Adopted Green Belt	pg 35				2
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					
Ramsar Sites					
Sites of Special Scientific Interest					
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					



LITHOS CONSULTING

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

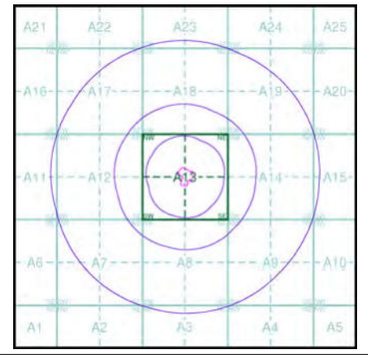
Geological

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



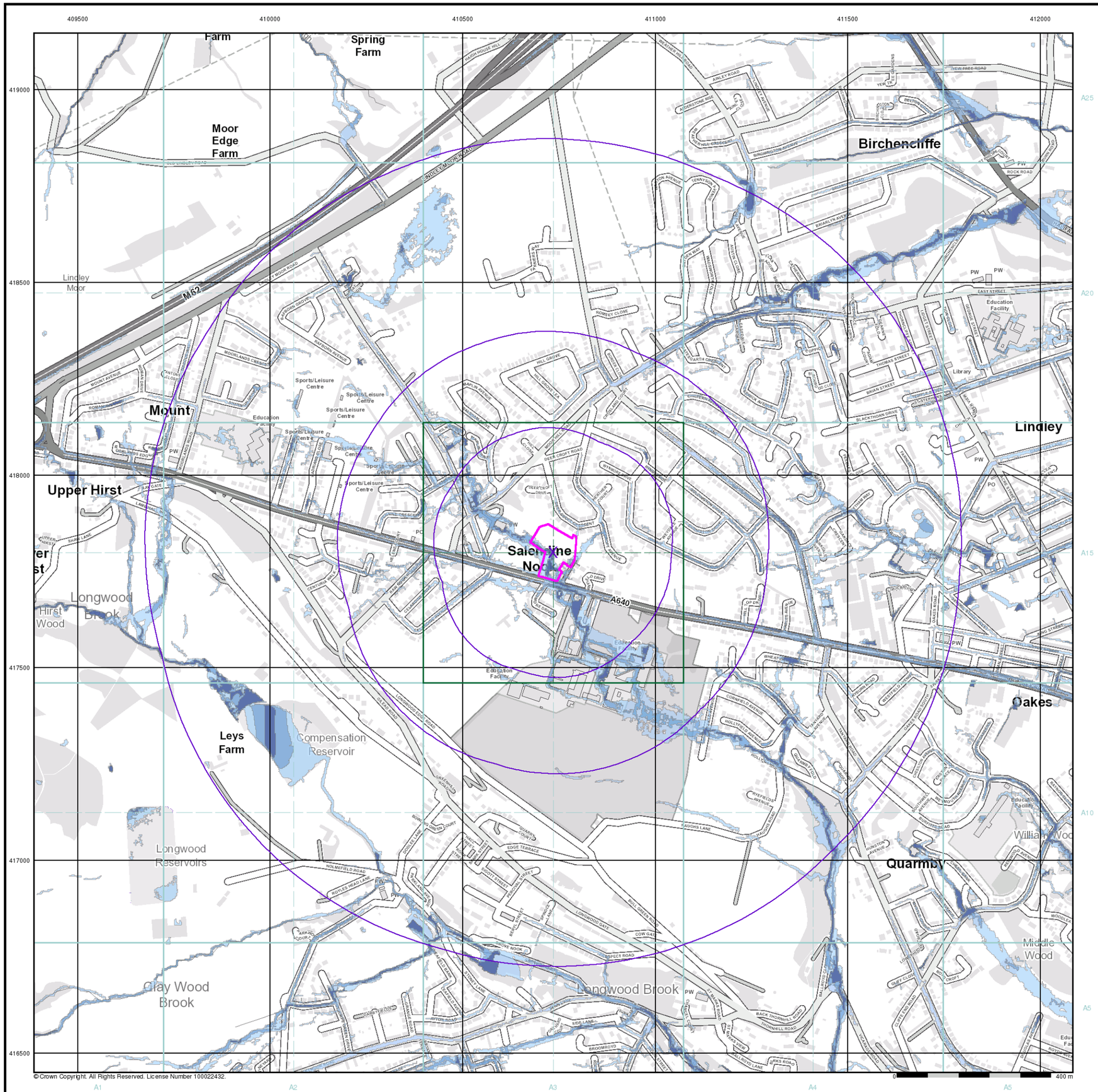
Order Details

Order Number:	142420059_1_1
Customer Ref:	PO12150/2895/JEJ
National Grid Reference:	410730, 417800
Slice:	A
Site Area (Ha):	1.05
Search Buffer (m):	1000

Site Details

The Former Spotted Cow, 404, New Hey Road, Salendine Nook, HUDDERSFIELD, HD3 4GP

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

Risk of Flooding from Surface Water

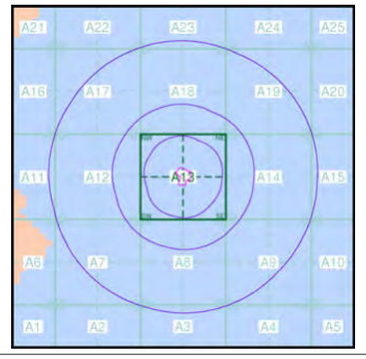
- High - 30 Year Return
- Medium - 100 Year Return
- Low - 1000 Year Return

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



Order Details

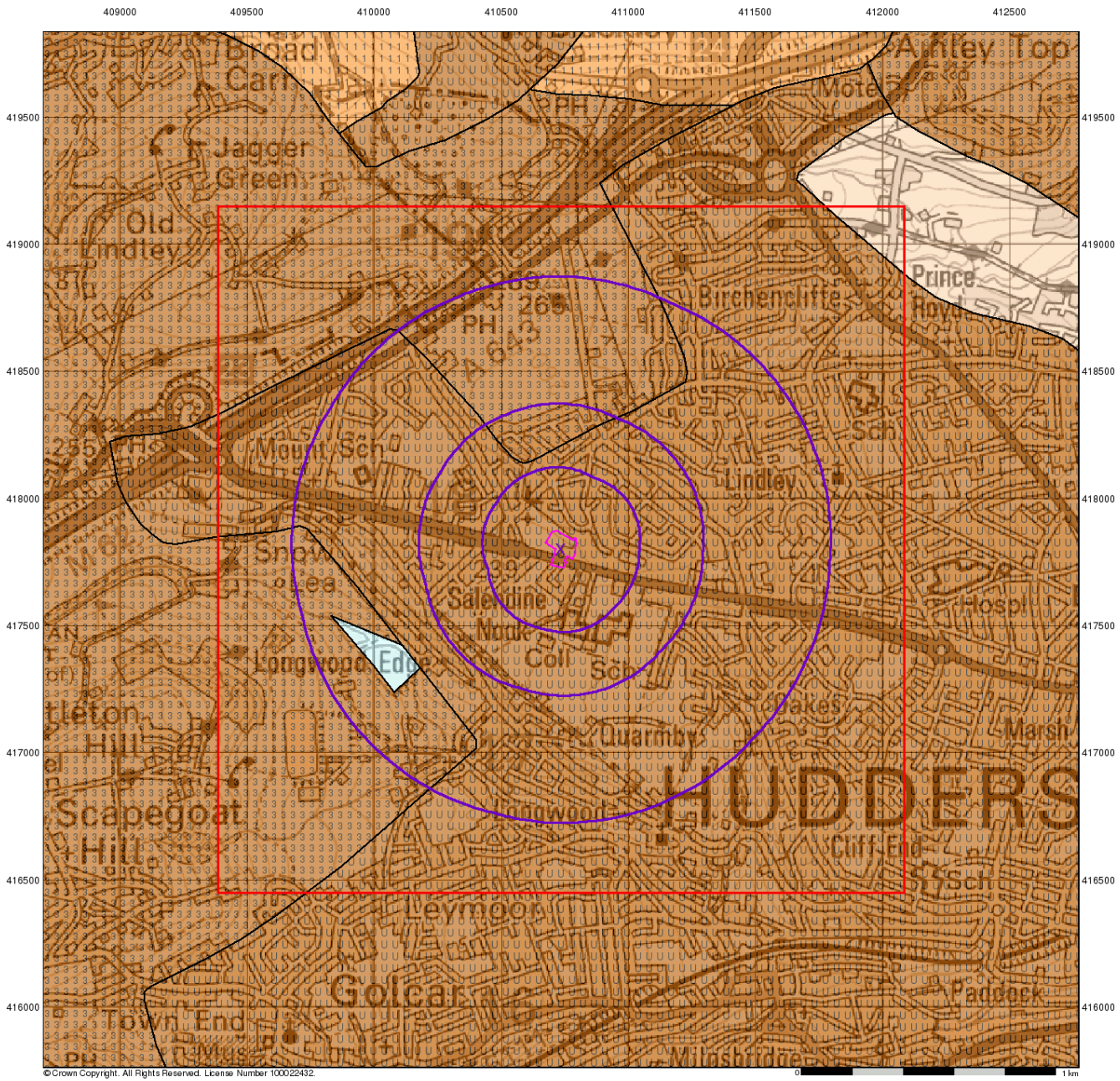
Order Number:	142420059_1_1
Customer Ref:	PO12150/2895/JEJ
National Grid Reference:	410730, 417800
Slice:	A
Site Area (Ha):	1.05
Search Buffer (m):	1000

Site Details

The Former Spotted Cow, 404, New Hey Road, Salendine Nook, HUDDERSFIELD, HD3 4GP

Landmark INFORMATION GROUP

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



LITHOS CONSULTING

Groundwater Vulnerability

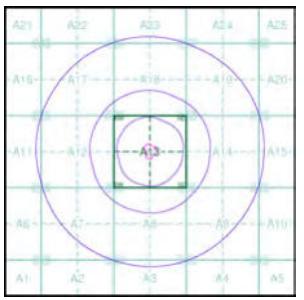
General

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

Agency and Hydrological

Geological Classes	Soil Classes
Major Aquifer (Highly Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Minor Aquifer (Variably Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Non Aquifer (Negligibly Permeable)	
Water or Sea	
Drift Deposit	

Site Sensitivity Context Map - Slice A



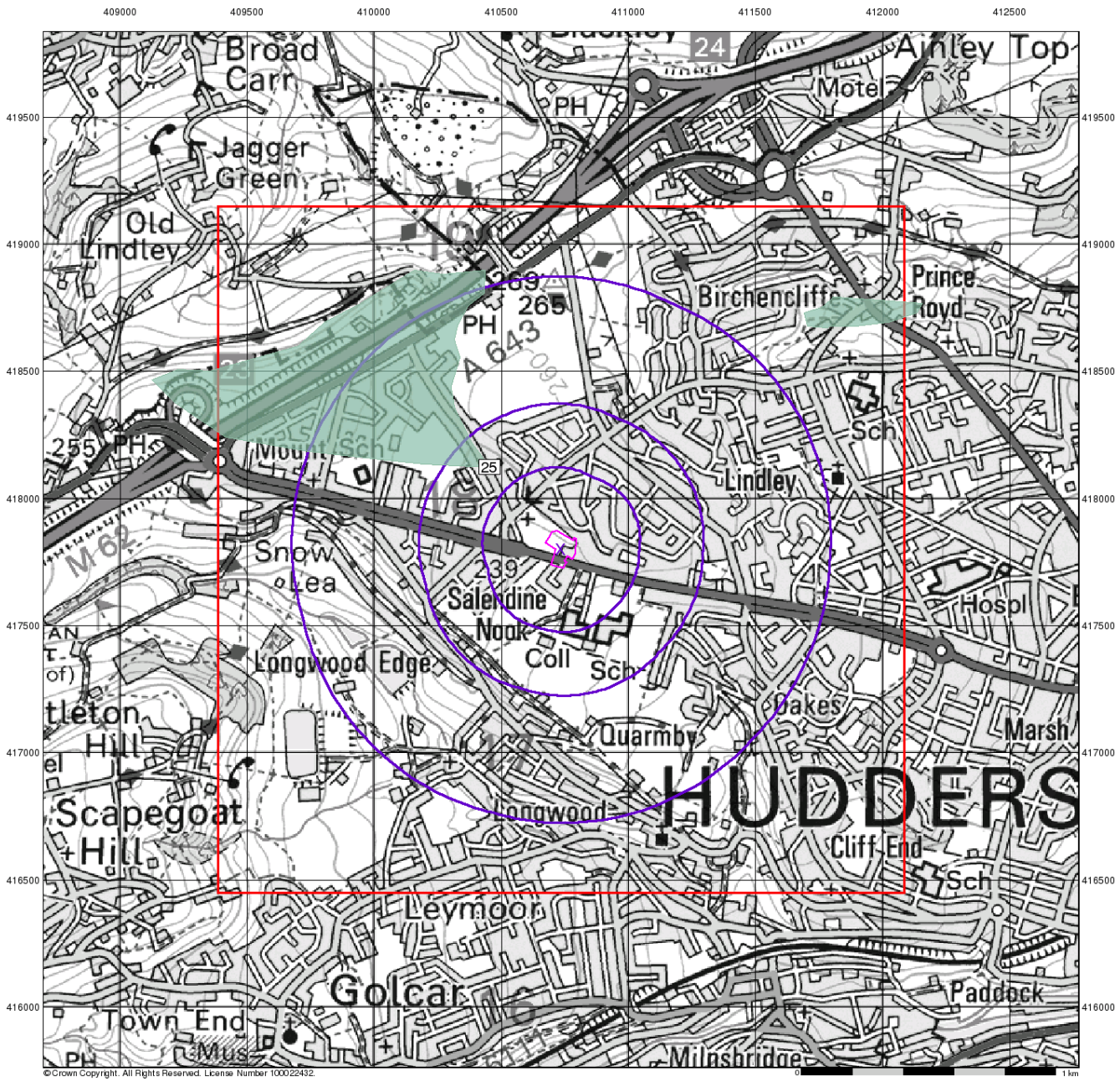
Order Details

Order Number:	142420059_1_1
Customer Ref:	PO12150/2895/JEJ
National Grid Reference:	410730, 417800
Slice:	A
Site Area (Ha):	1.05
Search Buffer (m):	1000

Site Details

The Former Spotted Cow, 404, New Hey Road, Salendine Nook, HUDDERSFIELD, HD3 4GP

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



LITHOS CONSULTING

Source Protection Zones

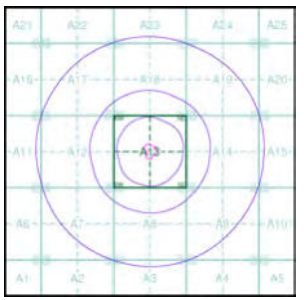
General

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)
- Source Protection Zone Borehole

Site Sensitivity Context Map - Slice A

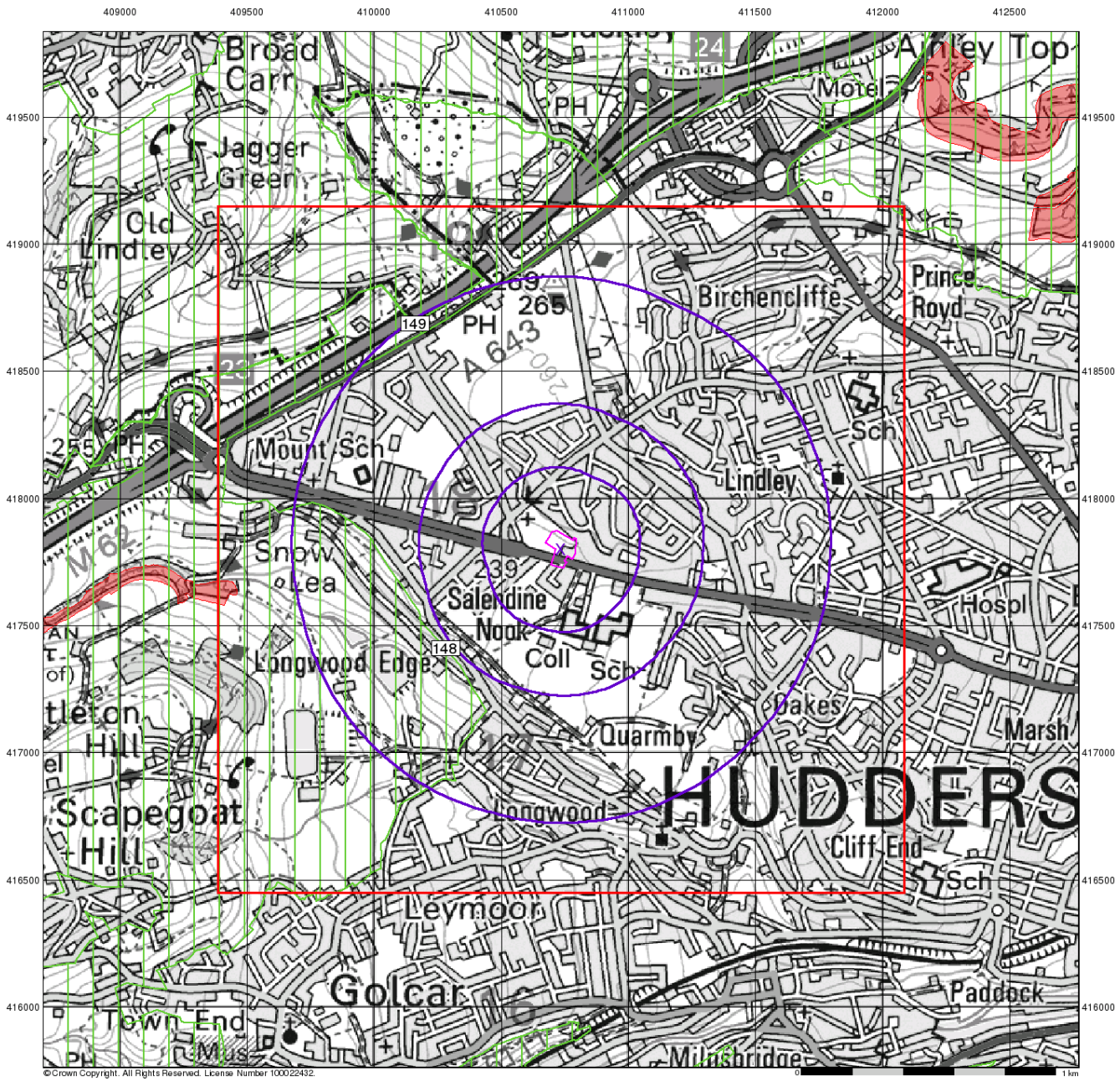


Order Details

Order Number:	142420059_1_1
Customer Ref:	PO12150/2895/JEJ
National Grid Reference:	410730, 417800
Slice:	A
Site Area (Ha):	1.05
Search Buffer (m):	1000

Site Details

The Former Spotted Cow, 404, New Hey Road, Salendine Nook, HUDDERSFIELD, HD3 4GP



LITHOS CONSULTING

Sensitive Land Uses

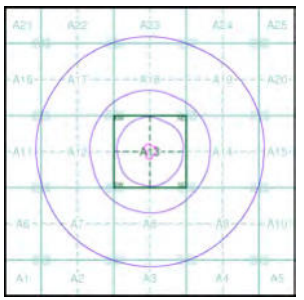
General

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

Sensitive Land Uses

- Ancient Woodland
- Area of Adopted Green Belt
- Area of Unadopted Green Belt
- Area of Outstanding Natural Beauty
- Environmentally Sensitive Area
- Forest Park
- Local Nature Reserve
- Marine Nature Reserve
- National Nature Reserve
- National Park
- Nitrate Sensitive Area
- Nitrate Vulnerable Zone
- Ramsar Site
- Site of Special Scientific Interest
- Special Area of Conservation
- Special Protection Area
- World Heritage Sites

Site Sensitivity Context Map - Slice A



Order Details

Order Number:	142420059_1_1
Customer Ref:	PO12150/2895/JEJ
National Grid Reference:	410730, 417800
Slice:	A
Site Area (Ha):	1.05
Search Buffer (m):	1000

Site Details

The Former Spotted Cow, 404, New Hey Road, Salendine Nook, HUDDERSFIELD, HD3 4GP

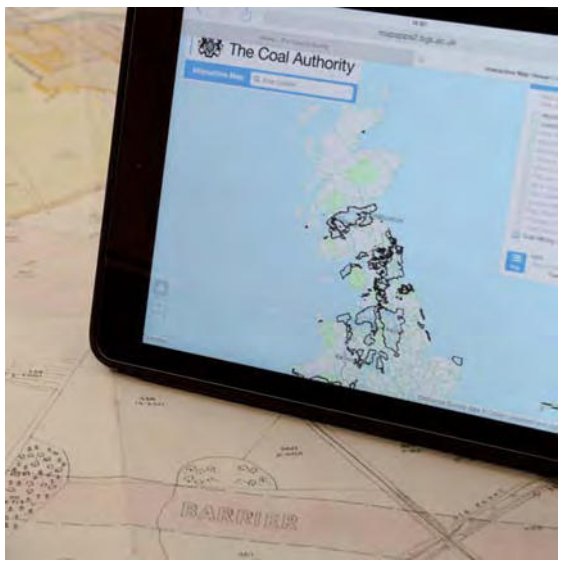
Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

The Coal Authority

Resolving the impacts of mining

CON29M Non-Residential Mining Report

THE FORMER SPOTTED COW, 404 NEW HEY ROAD SALENDINE NOOK HUDDERSFIELD WEST YORKSHIRE



Date of enquiry:	11 October 2017
Date enquiry received:	11 October 2017
Issue date:	11 October 2017
Our reference:	51001635872001
Your reference:	142420059_2|

CON29M Non-Residential Mining Report

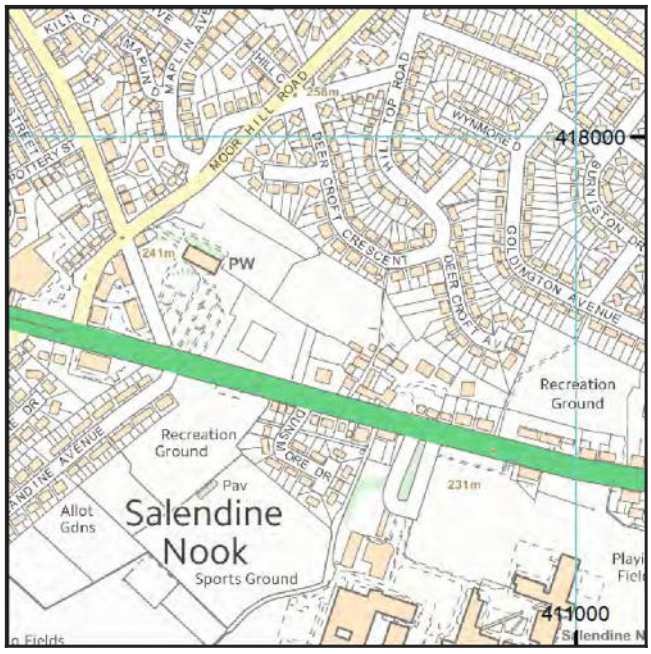
This report is based on, and limited to, the records held by the Coal Authority and the Cheshire Brine Subsidence Compensation Board's records, at the time we answer the search.

Client name

LANDMARK INFORMATION GROUP LIMITED

Enquiry address

THE FORMER SPOTTED COW, 404, NEW HEY ROAD SALENDINE NOOK, HUDDERSFIELD, WEST YORKSHIRE



Approximate position of property

Reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown copyright and database right 2017. All rights reserved.

Ordnance Survey Licence number: 100020315

How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

/company/the-coal-authority
/thecoalauthority
/coalauthority

Summary

Has the search report highlighted evidence or potential of		
1	Past underground coal mining	No
2	Present underground coal mining	No
3	Future underground coal mining	Yes
4	Mine entries	No
5	Coal mining geology	No
6	Past opencast coal mining	No
7	Present opencast coal mining	No
8	Future opencast coal mining	No
9	Coal mining subsidence	No
10	Mine gas	No
11	Hazards related to coal mining	No
12	Withdrawal of support	No
13	Working facilities order	No
14	Payments to owners of former copyhold land	No
15	Information from the Cheshire Brine Subsidence Compensation Board	No

For detailed findings, please go to page 4.

Detailed findings

1. Past underground coal mining

The property is not within a surface area that could be affected by past underground mining.

2. Present underground coal mining

The property is not within a surface area that could be affected by present underground mining.

3. Future underground coal mining

The property is not in an area where the Coal Authority has plans to grant a licence to remove coal using underground methods.

The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.

The property is not in an area likely to be affected from any planned future underground coal mining.

However, reserves of coal exist in the local area which could be worked at some time in the future.

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

4. Mine entries

There are no known coal mine entries within, or within 20 metres of, the boundary of the property.

5. Coal mining geology

The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.

6. Past opencast coal mining

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

7. Present opencast coal mining

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

8. Future opencast coal mining

There are no licence requests outstanding to remove coal by opencast methods within 800 metres of the boundary.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

9. Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres, since 31 October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

10. Mine gas

The Coal Authority has no record of a mine gas emission requiring action.

11. Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures.

12. Withdrawal of support

The property is not in an area where a notice to withdraw support has been given.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

13. Working facilities order

The property is not in an area where an order has been made, under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

14. Payments to owners of former copyhold land

The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

15. Information from the Cheshire Brine Subsidence Compensation Board

The property lies outside the Cheshire Brine Compensation District.

Additional remarks

Information provided by the Coal Authority in this report is compiled in response to the Law Society's Con29M Coal Mining and Brine Subsidence Claim enquiries. The said enquiries are protected by copyright owned by the Law Society of 113 Chancery Lane, London WC2A 1PL. Please note that Brine Subsidence Claim enquiries are only relevant for England and Wales. This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority and Cheshire Brine Board's Terms and Conditions applicable at the time the report was produced.

Disclaimer

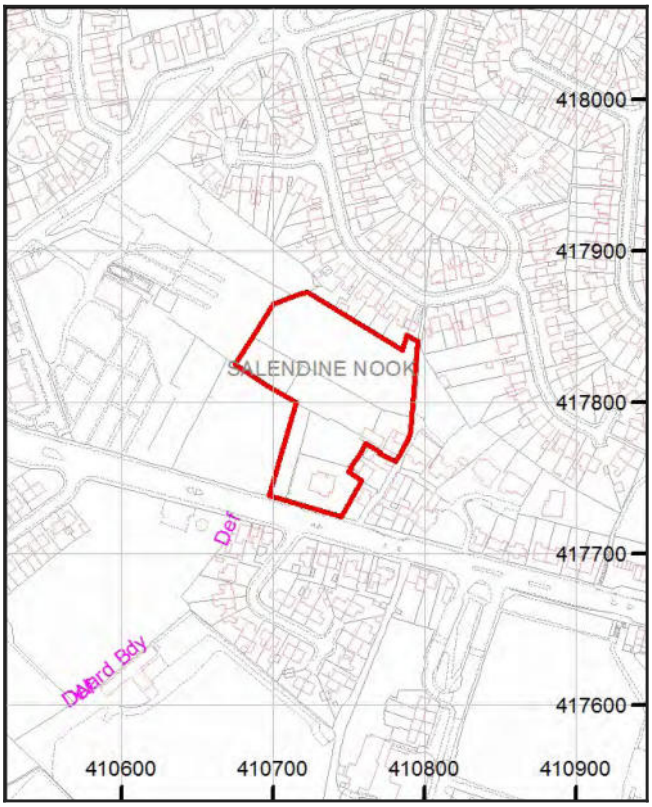
Alternative formats

If you would like this report in an alternative format, please contact our communications team.

Enquiry boundary

Key

Approximate position of enquiry boundary shown



How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

/company/the-coal-authority
/thecoalauthority
/coalauthority

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

GeoReports

Joshua Jones
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
West Yorkshire
LS22 5DZ

Natural Ground Stability report:

This report briefly describes any natural ground stability hazards ('subsidence') if they are found and gives an indication of their possible severity.

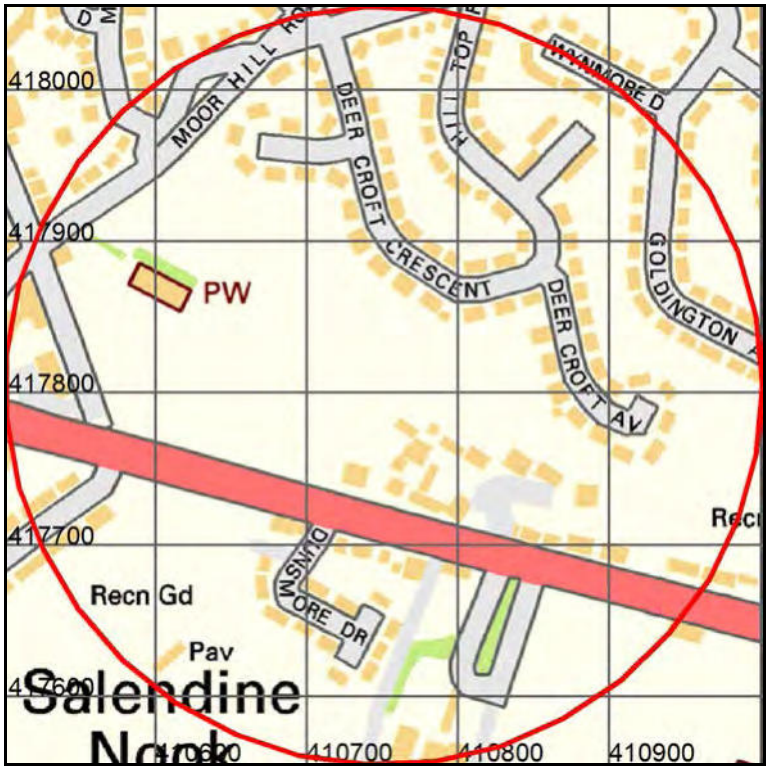
These could include swelling clay, landslip, ground dissolution, running sand, collapsible or compressible ground.

Report Id: ***GR_216997/1***

Client reference: PO12151

Search location

This product includes mapping data licensed from Ordnance Survey.
© Crown Copyright and/or database right 2017. Licence number 100021290 EUL
Scale: 1:5 000 (1cm = 50 m)



Contains Ordnance Survey data © Crown Copyright and database right 2017
OS Street View: Scale: 1:5 000 (1cm = 50 m)

This report describes a site located at National Grid Reference 410752, 417805. Note that for sites of irregular shape, this point may lie outside the site boundary. Where the client has submitted a site plan the assessment will be based on the area given.

Search location indicated in red

Natural Subsidence Professional Search

This report provides an indication of the potential for any significant NATURAL ground instability to occur within the property extent and a surrounding 50 m buffer zone. It has been generated automatically from BGS's GeoSure dataset, which is based on 1:50 000 scale digital data. It is designed for use by professionals involved in conveyancing or development of low-rise domestic properties, but it may also be useful for private individuals to help them judge whether or not further professional advice should be sought. We recommend that members of the public should consult a qualified professional about the search results in this report before making any major decisions based on it.

Contents of the report:

- **Definitions and limitations:** an explanation of what this report provides.
- **Search Results:** The first part of the report presents and answers a series of questions about the natural geological hazards that could occur in the area, and their significance.
- **Maps:** The second part of the report provides maps of where the natural geological hazards indicated may occur, and their significance in terms of a range of indicative implications. A series of maps are also provided to show the underlying geology.
- **Explanation of hazard information:** The last part of the report provides further explanation of the geological hazards that have been identified in the search (if any). In particular, information on what to look for, what to do and what not to do, is provided.

Definitions to help you understand this report:

- **Natural Geological Hazards** are shrink-swell, landslides (slope instability), soluble rocks (dissolution), compressible ground, collapsible deposits and running sand. This does not include mining related subsidence. Note that these geological hazards may occur in either natural or man-made deposits.
- **Natural Ground Instability** refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards. Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale.
- **Significant** natural ground instability has the potential to cause damage to some weaker buildings and structures. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.
- Where significant natural ground instability is indicated, its relative **level** of significance is expressed on a scale of C to E ('low' to 'high'), relating to its potential to cause subsidence damage in low-rise buildings.

Limitations of the report:

- This report provides an indication of potential near-surface ground instability related to particular natural geological hazards. These are shrink-swell clay, landslides, soluble rocks (ground dissolution), compressible ground, collapsible deposits, and running sand. They do not give an indication of potential hazards at depth as might be encountered in a borehole, for example.
- The search does not cover any man-made hazards, such as contaminated land or mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: www.coalminingreports.co.uk.
- The results in this report are generated automatically from BGS's GeoSure dataset, based on 1:50 000 digital geological maps and the interpretation of other records in the possession of BGS at the time. Their scope and accuracy is limited by the methods used to create the dataset and they may differ from a geologist's interpretation of a wider array of geological information. The answer given should therefore only be treated as indicative for the search area.
- Other more specific and detailed information may be held by BGS for the site, and an assessment of this could result in a modified assessment of ground stability potential. This more detailed assessment is available via other BGS GeoReports.
- Further important information on the data used to provide information for this search is provided at the end of the report.
- The search in this report is carried out for a rectangle or circle (centred on the grid reference or address supplied, using the Ordnance Survey AddressPoint database) covering the extent of the property and its grounds, and including a 50 m zone around it, which takes into account the spatial accuracy of the geological hazards data described above.
- The information is intended for use by suitably-qualified professionals involved in conveyancing or development of low-rise domestic properties. If in doubt users should consult a suitably-qualified professional about the search results in this report before making any major decisions based upon it.
- An indication of natural ground instability does not necessarily mean that a building will be affected by subsidence. Such an assessment can be made only by inspection of the building itself by a suitably-qualified professional. This will take into account a variety of other contributing factors, such as building type and build quality, and nearby vegetation (in particular, the proximity and type of trees).

Search Results:

Important notes

- The term '**search area**' as used throughout this report means the property extent and a 50 m buffer zone. The property extent will be defined using the original details specified by the client

Question 1	Answer
Is significant natural ground instability possible in the area?	**YES**

Question 2	Answer
What is the level of hazard on a scale A to E (low to high)? **NOTE: Only levels C, D and E are shown and described below, as Levels A & B are considered insignificant**	**Level C**

Question 3	Answer
Which natural geological hazards could be contributing to the ground instability in the area? *How much ground instability each hazard may cause is indicated by the Level C to E in brackets.*	Weak or unstable rocks that could slip downhill on steep slopes (greater than c. 5 degrees) or into excavations ('Landslides (slope instability)') (LEVEL C)

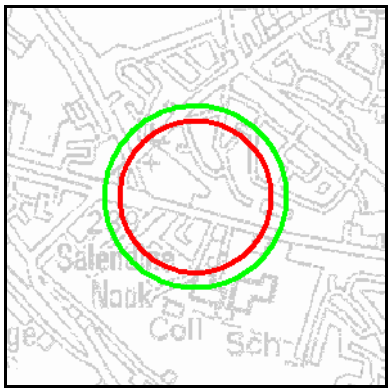
Question 4	Answer
What action should be taken?	If natural geological hazards at level C, D or E have been indicated this means there is potential ground instability in your area that may cause some properties to suffer subsidence damage. However, it does not necessarily mean that your property will be affected, and in order to find out if this is the case or not, you should obtain further advice from a qualified expert, such as a building surveyor. Show them this report and ask them to evaluate the property and its surroundings for any signs of existing subsidence damage and for advice on the likelihood for subsidence to occur in the future. The notes at the end of this report module may be useful in this regard. Note that the type of building and its surroundings (e.g. the presence of trees) are also very important when considering subsidence risk. Many types of properties, particularly newer ones, are well constructed and unlikely to be affected by subsidence, even in areas of significant ground movements.

Question 5	Answer
Where could the natural geological hazards occur in the area?	See the maps that follow.

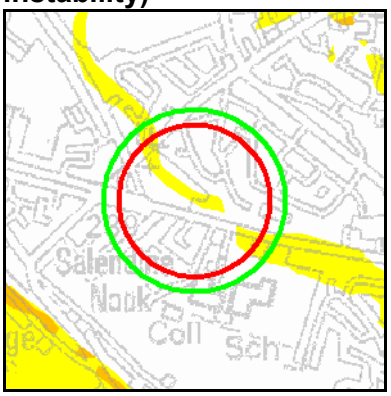
Automatically generated maps of near-surface natural geological hazards

The following maps show where significant natural ground instability at or near the surface could occur in relation to each of six geological hazards: shrink-swell, landslide (slope instability), soluble rocks (dissolution), compressible ground, collapsible deposits and running sand. The relative level of potential is indicated in colour and described in the key. Please note that a hazard is reported as significant for the property if it occurs within the specified site or the surrounding buffer zone.

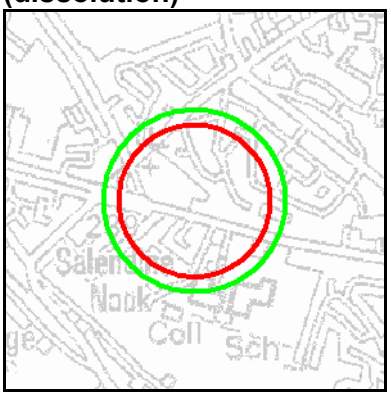
Shrink-Swell



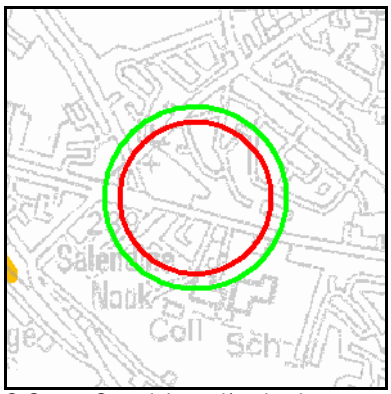
Landslides (slope instability)



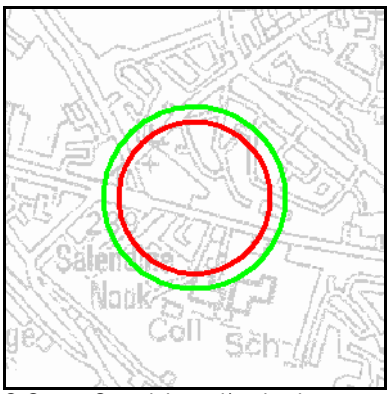
Soluble Rocks (dissolution)



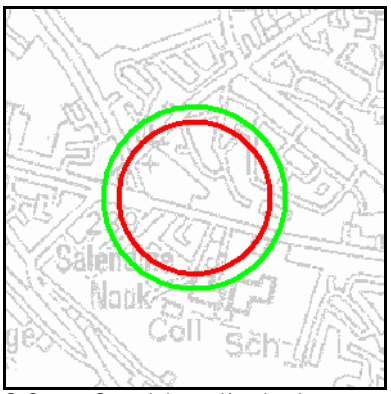
Compressible Ground



Collapsible Deposits



Running Sand



Search area indicated in red

50 m buffer indicated in green

For the key to relative level of potential for natural geological hazards see over the page

The unshaded (white) areas on the map (levels A, B or 'No hazard') represent areas where the conditions that cause natural ground movements due to the six natural geological hazards are considered to be absent or unlikely to be significant.

Key to Shrink-Swell Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Ground conditions predominantly medium plasticity.	Do not plant trees with high soil moisture demands near to buildings. Avoid increased infiltration and seek specialist advice before disposing of large amounts of water to the ground through soakaways.	**New build** – Test for plasticity index is recommended. Possible increase in construction cost to remove potential shrink-swell problems. **Existing property** – Possible increase in insurance risk in droughts or where high moisture demand vegetation is present due to shrink-swell clay problems if foundations are not suitable.
D	Ground conditions predominantly high plasticity.	Do not plant or remove trees or shrubs near to buildings without expert advice about their effect and management. Seek specialist advice before disposing of large amounts of water to the ground through soakaways.	**New build** – Test for plasticity index is necessary. Probable increase in construction cost to remove potential shrink-swell problems. **Existing property** – Probable increase in insurance risk in droughts or where high moisture demand vegetation is present due to shrink-swell clay problems if foundations are not suitable.
E	Ground conditions predominantly very high plasticity.	Do not plant or remove trees or shrubs near to buildings without expert advice about their effect and management. Seek specialist advice before disposing of large amounts of water to the ground through soakaways.	**New build** – Test for plasticity index is essential. Definite increase in construction cost to remove potential shrink-swell problems. **Existing property** – Significant increase in insurance risk in droughts or where high moisture demand vegetation is present due to shrink swell clay problems if foundations are not suitable.

Key to Landslides (slope instability) Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.	Ask about implication for stability if large changes to drainage or excavations take place near to buildings. Seek specialist advice if major changes in ground conditions are likely and before disposing of large amounts of water to the ground through soakaways.	**New build** – Consider possibility of trench side or slope movement during excavations, or consequence of changes to drainage. Possible increase in construction cost to remove potential slope stability problems. **Existing property** – No significant increase in insurance risk due to natural slope instability problems.
D	Slope instability problems are probably present or have occurred in the past. Land use should consider specifically the stability of the site.	Avoid large amounts of water entering the ground through pipe leakage or soakaways without specialist advice. Do not undercut or place large amounts of material on slopes without technical advice.	**New build** – Assess slope stability of site and consequences of excavation, loading and water content changes during and after construction. **Existing property** – Probable increase in insurance risk due to natural slope instability after changes to ground conditions such as a very long, excessively wet winter.
E	Slope instability problems almost certainly present and may be active. Significant constraint on land use.	Seek expert advice about stability of the ground and its management to maintain and increase its stability.	**New build** – Slope stability assessment necessary, special design may be necessary, construction may not be possible. **Existing property** – Significant increase in insurance risk in some cases. Site-specific consideration is necessary to separate cases where landslide s are stabilised or ancient and stable from those that may be active or may fail.

Key to Soluble Rocks (dissolution) Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Soluble rocks are present within the ground. Some dissolution features may be present. Potential for difficult ground conditions are at a level where they may be considered; localised subsidence need not be considered except in exceptional circumstances.	Consider implications for stability when changes to surface drainage or new construction are planned. Seek specialist advice before disposing of surface drainage to the adjacent ground.	**New build** – Site investigation should consider potential for dissolution problems on the site and its surroundings. Care should be taken with local drainage into the adjacent bedrock. **Existing property** – Possible increase in insurance risk due to soluble rocks. Some possibility of potential liability due to groundwater pollution may be present.
D	Soluble rocks are present within the ground. Many dissolution features may be present. Potential for difficult ground conditions are at a level where they should be considered. Potential for subsidence is at a level where it may need to be considered.	Consider obtaining specialist advice before loading the land or undertaking building work. Seek specialist advice before disposing of surface drainage to the adjacent ground. Maintain drainage infrastructure.	**New build** – Specialist site investigation and stability assessment may be necessary before construction. Construction work may cause subsidence. Isolate surface drainage from the karst system and groundwater. Increased construction costs are possible. **Existing property** – Possible increase in insurance risk due to soluble rocks. Some possibility of potential liability due to groundwater pollution may be present.
E	Soluble rocks are present within the ground. Numerous dissolution features may be present. Potential for difficult ground conditions should be investigated. Potential for localised subsidence is at a level where it should be considered.	Obtain specialist advice on need for stabilisation work and/or land management plan to maintain stability. Do not dispose of surface drainage into the adjacent ground. Maintain drainage infrastructure.	**New build** – Specialist land stability assessment necessary. Investigation, remediation and/or mitigation works may be necessary to stabilise the area. Construction work may cause subsidence. Isolate surface drainage from the karst system and groundwater. Increased construction costs. **Existing property** – Probable increase in insurance risk due to soluble rocks. Probable potential liability due to groundwater pollution.

Key to Compressible Ground Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Compressibility and uneven settlement potential may be present. Land use should consider specifically the compressibility and variability of the site.	Take technical advice regarding settlement when planning extensions to existing property or when retrofitting soakaways.	**New build** – Consider possibility of settlement during construction due to compressible deposits. Unlikely to be increase in construction costs due to potential compressibility problems. **Existing property** – No significant increase in insurance risk due to compressibility problems.
D	Compressibility and uneven settlement hazards are probably present. Land use should consider the compressibility and variability of the site.	Avoid large differential loadings of ground. Do not drain or dewater ground near the property without specialist advice.	**New build** – Assess the variability and bearing capacity of the ground. May need special foundations to avoid excessive settlement during and after construction. Consider effects of changes to drainage regime and groundwater level. Extra construction costs are likely. **Existing property** – Possible increase in insurance risk from compressibility if groundwater levels drop due to drought or dewatering.
E	Highly compressible strata present. Significant constraint on land use depending on thickness.	Avoid large differential loadings of ground. Do not drain or dewater ground near the property without specialist advice.	**New build** – Assess the variability and bearing capacity of the ground. Probably needs special foundations to avoid excessive settlement during and after construction. Consider effects of changes to drainage regime and groundwater level. Construction may not be possible at economic cost. **Existing property** – Probable increase in insurance risk from compressibility due to drought or dewatering unless appropriate foundations are present.

Key to Collapsible Deposits Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Deposits with potential to collapse when loaded and saturated are possibly present in places.	Avoid large amounts of water entering the ground through pipe leakage or soakaways without specialist advice. Do not increase loading on existing foundations without technical advice.	Contact local authorities for information on local occurrence of damage due to collapsible ground. **New build** – Assess the possibility of collapsible (loessic) deposits by ground investigation. If present do not exceed safe bearing capacity during or after construction and maintain site drainage, or carry out ground stabilisation. **Existing property** – Possible increase in insurance risk if collapsible deposits are present and if the load on the ground is increased or ground saturated by leakage or localised flooding.
D	Deposits with potential to collapse when loaded and saturated are probably present in places.	Avoid large amounts of water entering the ground through pipe leakage or soakaways without specialist advice. Do not increase loading on existing foundations without technical advice.	Contact local authorities for information on local occurrence of damage due to collapsible deposits. **New build** – Assess the possibility of collapsible deposits by ground investigation. If present do not exceed safe bearing capacity during or after construction and maintain site drainage, or carry out ground stabilisation. **Existing property** – Possible increase in insurance risk if collapsible deposits are present and if the load on the ground is increased or ground saturated by leakage or localised flooding.
E	Deposits with potential to collapse when loaded and saturated have been identified.	Avoid large amounts of water entering the ground through pipe leakage or soakaways. Do not increase loading on existing foundations without technical advice.	Contact local authorities for information on local occurrence of damage due to collapsible ground. **New build** – Assess the possibility of collapsible deposits by ground investigation. If present do not exceed safe bearing capacity during or after construction and maintain site drainage, or carry out ground stabilisation. **Existing property** – Possible increase in insurance risk if collapsible deposits are present and if the load on the ground is increased or ground saturated by leakage or localised flooding.

Key to Running Sand Hazard:

Level	Hazard description	Advice for public	Advice for specialist
C	Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water.	Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should avoid any problems due to running sands. Seek specialist advice before disposing of large amounts of water to the ground through soakaways.	**New build** – Consider possibility of running sands into trenches or excavations if water table is high. Avoid concentrated water inputs to site. Unlikely to be increase in construction costs due to potential for running sand problems. **Existing property** – No significant increase in insurance risk due to running sand problems.
D	Running sand conditions are probably present. Constraints may apply to land uses involving excavation or the addition or removal of water.	Avoid large amounts of water entering the ground through pipe leakage or soakaways without specialist advice. Do not dig (deep) holes into saturated ground near the property without technical advice.	**New build** – Assess the need for close-boarded sides to excavations and the consequences of soil and groundwater conditions during and after construction. **Existing property** – Possible increase in insurance risk from running conditions due to service leakage, high rainfall events or localised flooding.
E	Running sand conditions are almost certainly present. Constraints will apply to land uses involving excavation or the addition or removal of water.	Avoid large amounts of water entering the ground through pipe leakage or soakaways without specialist advice. Do not dig (deep) holes into saturated ground without technical advice.	**New build** – Assess the need for close-boarded sides to excavations and the consequences of soil and groundwater conditions during and after construction. Possible extra cost during construction and requirement for basements to be water proofed. **Existing property** – Possible increase in insurance risk from running conditions due to service leakage, high rainfall events or localised flooding.

Question 6	Answer
What is the geology of the area?	Please see the maps below, which show the geology underlying the area. You can compare these to the maps in Question 5 in order to understand the way that the underlying rocks and deposits are related to the potential natural geological hazards.

Geology maps

Geology maps for the area around your site are provided in this section, taken from the BGS Digital Geological Map of Great Britain at the 1:50,000 scale (DiGMapGB-50). The first two maps show separately the two main components of natural geology that may be present in an area – **superficial deposits** and **bedrock**. The third map, a "combined geology map", shows both layers superimposed.

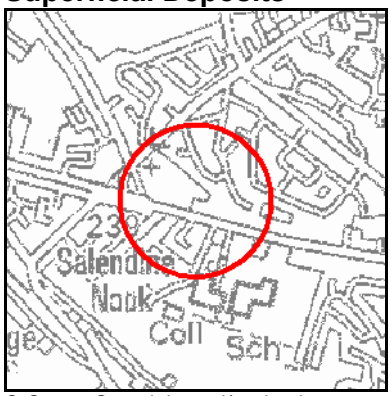
Superficial deposits: These include recent geological deposits, such as river sands and gravels, or glacial deposits, which lie on top of the bedrock in many areas (an alternative term for Superficial deposits is 'Drift Deposits')

Bedrock: Bedrock describes the rocks which underlie the whole of an area, upon which superficial deposits may lie (an alternative term for Bedrock is 'Solid Geology')

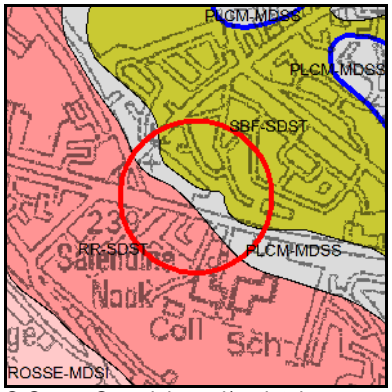
More information on DigMapGB-50 and how the various rock layers are classified can be found on the BGS website (www.bgs.ac.uk - search for DiGMap or the BGS Rock Classification Scheme). Further descriptions of the rocks listed in the map keys may also be obtained by searching against the Computer Code on the *BGS Lexicon of named Rock Units*, which is also on the BGS Website (follow the 'GeoData' link). The computer codes are labelled on the maps to try and help in their interpretation (with a dot at the bottom left hand corner of each label). However, please treat this with caution in areas of complex geology, where some of the labels may overlap several geological formations. If in doubt, please contact BGS enquiries.

The geological formations are listed broadly in order of age in the map keys (youngest first) but only to the formation level (a formation is a package of related rocks). Within formations, please be aware that individual members may not be ordered by age.

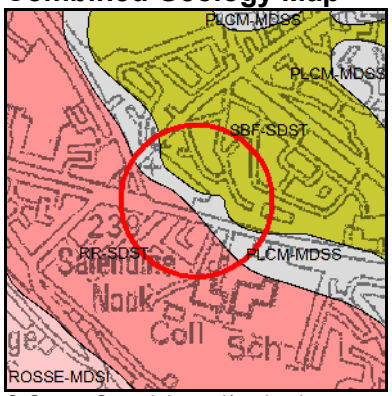
Superficial Deposits



Bedrock



Combined Geology Map



Site location indicated in red

Fault

Coal, ironstone or mineral vein

Note: Faults are shown for illustration and to aid interpretation of the map. Because these maps are generalised from more detailed versions not all such features are shown and their absence on the map face does not necessarily mean that none are present. Coals, ironstone beds and mineral veins occur only in certain rock types and regions of the UK.

Key to Superficial deposits:

No deposits recorded by BGS in the search area

Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	PLCM-MDSS	PENNINE LOWER COAL MEASURES FORMATION	MUDSTONE, SILTSTONE AND SANDSTONE
	SBF-SDST	SOFT BED FLAGS	SANDSTONE
	ROSSE-MDSI	ROSSENDALE FORMATION	MUDSTONE AND SILTSTONE
	RR-SDST	ROUGH ROCK	SANDSTONE

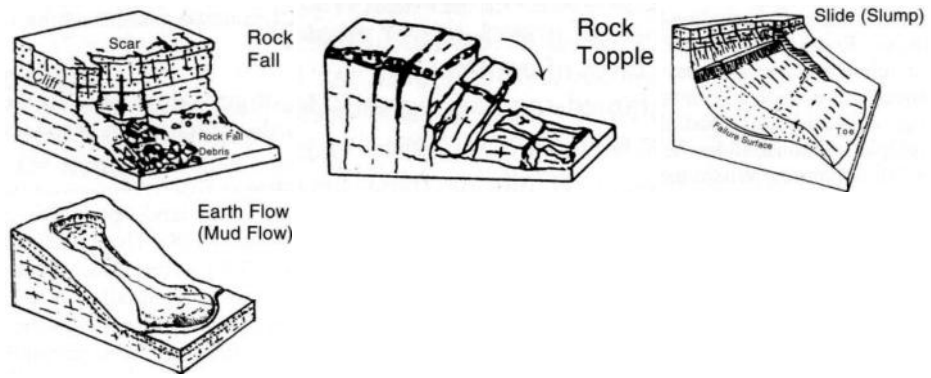
What do the geological hazards mean?

The answer to Question 3 will have pointed to one or more natural geological hazards in the area. This section provides a brief explanation of these hazards to help you understand what they mean. This includes information on what you should look for in and around the property and what you should and should not do. The hazard is only reported below if it is shown as significant within the search area.

LANDSLIDES (SLOPE INSTABILITY) HAZARD

What is a landslide?

A landslide is the outward and downward movement of rock or soil on a slope. This often takes place by falling, toppling, sliding, or flowing.



A landslide rarely comprises a single type of movement but is often the result of a combination of several types, changing its nature with changing conditions and time.

Why do landslides occur?

A slope is under stress due to the force of gravity. It does not move if the shear strength of the material that forms the slope is greater than the stress due to gravity. If the balance is altered so that stress exceeds available strength, movement down slope will occur until a stable slope profile is formed.

What problems do landslides cause?

Many landslides occurred in the past under different climatic conditions to those of the present day and, if left undisturbed, they may remain stable for many years.
Property is damaged if landslides remove ground that is supporting the property.
Property that is built on a landslide may be damaged by stretching or compression as the ground moves.
Property below a landslide may be damaged if material falls onto it from above or slides or flows into it from the side

What might I see?
Piles of debris and fallen material below steep slopes and cliffs.
Hollows in slopes with lobes of material below them.
Bulges in the ground especially at the foot of slopes.
Ridges in the ground usually along the slope but sometimes down the slope
Open cracks in the ground.
Scarps or steps in the ground surface
Patches of very wet soft ground on slopes.
Cracks in walls, paths and roadways.
Tilting of trees, walls or buildings.
Doors or windows that stick.

What action should I take?
If active landsliding appears to be happening on or near your property, inform your insurance company, mortgage lender, landlord or get specialist advice from a suitably qualified expert such as a structural surveyor, geotechnical engineer or chartered engineering geologist.
If active landsliding is not happening but the area has a potential for landslide activity, take specialist advice before starting major building or drainage work or modifying the ground around your property.

DO
Ensure water supply pipes are in good repair and are not leaking
Ensure ditches and drains are directed away from potentially unstable ground and are maintained.
Maintain gutters and down pipes and direct them to piped drainage systems.
Manage wooded slope to enhance stability.

DO NOT
Remove material from the bottom of slopes.
Place material on, or at the top of, slopes.
Dispose of rainwater or surface water to soakaways.
Allow surface drainage to discharge water on to slopes or the ground behind slopes.
Remove vegetation whose roots may be strengthening loose or weak material or which may strengthen the slope by removing soil moisture.

Contact Details

Keyworth Office
British Geological Survey
Environmental Science Centre
Nicker Hill
Keyworth
Nottingham
NG12 5GG
Tel: 0115 9363143
Fax: 0115 9363276
Email: enquiries@bgs.ac.uk

Wallingford Office
British Geological Survey
Maclean Building
Wallingford
Oxford
OX10 8BB
Tel: 01491 838800
Fax: 01491 692345
Email: hydroenq@bgs.ac.uk

Edinburgh Office
British Geological Survey
Lyell Centre
Research Avenue South
Edinburgh
EH14 4AP
Tel: 0131 6671000
Email: enquiry@bgs.ac.uk

Terms and Conditions

General Terms & Conditions

This Report is supplied in accordance with the GeoReports Terms & Conditions available on the BGS website at https://shop.bgs.ac.uk/georeports and also available from the BGS Central Enquiries Desk at the above address.

Important notes about this Report

- The data, information and related records supplied in this Report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be quite historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

Report issued by
BGS Enquiry Service

Appendix F

Trial Pit Logs

Trial Pit Log

Trialpit No **TP01**

Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 1.20	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.05	J&T		0.10			MADE GROUND: Black tarmacadam. (TARMACADAM)
				0.30			MADE GROUND: Yellowish brown slightly sandy subangular medium to coarse GRAVEL of sandstone. (SUB-BASE)
	0.50	D		0.60			MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY. Gravel is angular fine to medium of mixed lithologies. (COHESIVE MADE GROUND)
				0.90			Firm orangish brown mottled grey sandy slightly gravelly CLAY. Gravel is angular fine to coarse of sandstone. (WEATHERED ROUGH ROCK SANDSTONE) *Between 0.6m and 0.9m, too sandy for vane tests.*
				1.20			Strong orangish brown fine to medium grained SANDSTONE. Recovered as angular tabular cobbles. (ROUGH ROCK SANDSTONE) *Unable to excavate below 1.1m due to sandstone.* End of pit at 1.20 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

Trial Pit Log

Trialpit No **TP02**

Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 1.60	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.05	J&T		0.10			MADE GROUND: Black tarmacadam. (TARMACADAM)
				0.30			MADE GROUND: Yellowish brown slightly sandy subrounded medium to coarse GRAVEL of sandstone. (SUB-BASE)
				0.50			MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY. Gravel is angular fine to medium of mixed lithologies including brick and glass. (COHESIVE MADE GROUND)
	0.60	J&T					MADE GROUND: Yellowish brown sandy subangular fine to coarse GRAVEL of sandstone with occasional subrounded sandstone cobbles. (GRANULAR MADE GROUND)
							At 0.7m depth, sandstone block (0.6m across).
				1.10			Firm orangish brown slightly gravelly slightly sandy CLAY. Gravel is angular to subrounded fine to coarse of sandstone. (WEATHERED ROUGH ROCK SANDSTONE)
							Excavation stopped due to cable at 1.0m depth.
				1.60			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. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP03**

Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 2.10	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30			Black slightly sandy slightly gravelly CLAY with many rootlets. (TOPSOIL)
			HVP=40				Firm orangish brown grey mottled CLAY. (WEATHERED ROUGH ROCK SANDSTONE)
	0.90	D	HVP=50				
			HVP=50	1.60			
				1.80			Firm orangish brown mottled grey slightly sandy CLAY. (WEATHERED ROUGH ROCK SANDSTONE)
	1.90	T		2.10			Strong orangish brown fine to medium grained SANDSTONE. Recovered as angular tabular cobbles. (ROUGH ROCK SANDSTONE) *Unable to excavate below 2.1m due to sandstone.* 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. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP04
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 2.20	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30			Greyish brown sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of mixed lithologies with rare tile and glass. (TOPSOIL)
▼				0.50			Firm orangish brown grey mottled very gravelly CLAY. Gravel is angular fine to coarse of mudstone. (WEATHERED COAL MEASURES)
	0.80	T					Very weak dark grey thinly laminated MUDSTONE. Recovered as slightly clayey angular tabular coarse gravel with orange brown surface staining. (COAL MEASURES)
							Groundwater seepage and spalling at 0.5m.
				2.20			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.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP05**

Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 3.10	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30			MADE GROUND: Dark brown slightly gravelly sandy CLAY with occasional rootlets. (MADE GROUND TOPSOIL)
	1.00	J&T					MADE GROUND: Brown gravelly CLAY. Gravel is angular to subrounded fine to coarse of mixed lithologies including brick and sandstone with rare metal. (COHESIVE MADE GROUND)
							Spalling at 1.0m.
▼	1.50	T		1.40			Weak dark grey carbonaceous MUDSTONE/COAL. Recovered as clayey angular fine gravel. (CARBONACEOUS MUDSTONE)
				1.60			Firm orangish brown mottled grey CLAY. (WEATHERED ROUGH ROCK SANDSTONE)
			HVP=60				*Groundwater seepage at 1.6m.*
				2.20			Firm orangish brown mottled grey gravelly CLAY. Gravel is angular fine lithorelicts of sandstone (remoulds to clay under light pressure). (WEATHERED ROUGH ROCK SANDSTONE)
	2.40	D	HVP=55				
				3.10			End of pit at 3.10 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.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP06
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 2.20	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30			Brown slightly sandy CLAY with matted rootlets. (TOPSOIL)
	0.50	D	HVP=80	0.90			Stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is angular fine to coarse of mudstone. (WEATHERED COAL MEASURES)
▼	1.10	T		2.20			Very weak dark grey thinly laminated MUDSTONE. Recovered as slightly clayey angular coarse gravel with orange brown surface staining. (COAL MEASURES) *Spalling at 0.9m.* *Groundwater seepage at 1.6m.* 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.

Stability:

AGS

Trial Pit Log

Trialpit No **TP07** Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 2.00	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30			Brown slightly fine sandy CLAY with matted rootlets. (TOPSOIL)
	0.70	D		0.90			Firm orangish brown CLAY with some angular fine to medium gravel size lithorelicts of mudstone (remoulds to clay under light pressure). (WEATHERED COAL MEASURES) *Between 0.3m and 0.9m depth, too gravelly for vane.*
	1.20	T		2.00			Very weak dark grey thinly laminated MUDSTONE. Recovered as clayey coarse gravel with occasional tabular angular cobbles. (COAL MEASURES) *Spalling at 0.9m.* End of pit at 2.00 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.

Stability:

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP08
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 2.40	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T					Dark brown friable fine sandy CLAY with many matted rootlets. (TOPSOIL)
				0.30			Firm very gravelly CLAY. Gravel is fine to coarse angular of sandstone. (WEATHERED SOFT BED FLAGS)
	0.50	D		0.60			Weak greyish brown thinly laminated fine grained SANDSTONE. Recovered as slightly clayey angular tabular coarse gravel. (SOFT BED FLAGS) *Spalling at 0.6m.*
				2.40			End of pit at 2.40 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.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP09
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 1.90	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T					Greyish brown slightly gravelly CLAY. Gravel is angular fine of mudstone. (TOPSOIL)
	0.40	D		0.30			Firm orangish brown CLAY with many angular fine to medium gravel size lithorelicts of mudstone (remoulds to clay under light pressure). (WEATHERED COAL MEASURES)
				0.60			*Spalling at 0.5m.* Very weak dark grey thinly laminated MUDSTONE. Recovered as angular medium to coarse gravel with orangish grey surface staining. (COAL MEASURES)
				1.90			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.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP10
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 2.50	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20			Brown slightly sandy CLAY with matted rootlets. (TOPSOIL)
				0.50			Firm yellowish brown very gravelly CLAY. Gravel is angular to subrounded fine to coarse tabular of sandstone. (WEATHERED SOFT BED FLAGS)
	0.70	T					Very weak yellowish brown thinly laminated SILTSTONE & SANDSTONE. Recovered as slightly clayey angular to subrounded fine to coarse gravel. (SOFT BED FLAGS)
							Spalling at 0.6m.
				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.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP11
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 2.00	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T					Friable light brown slightly sandy CLAY with many of rootlets. (TOPSOIL)
				0.30			Firm brown very gravelly CLAY. Gravel is angular tabular fine to medium of mudstone. (WEATHERED COAL MEASURES)
	0.50	D					*Spalling at 0. m.*
				0.60			Very weak dark grey thinly laminated MUDSTONE. Recovered as slightly clayey angular fine to coarse gravel with orange surface staining. (COAL MEASURES)
				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.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP12
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 1.80	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	J&T		0.30			Friable brown slightly sandy CLAY with occasional rootlets. (TOPSOIL)
	0.70	D	HVP=54	1.10			Firm grey mottled orange brown CLAY. (WEATHERED COAL MEASURES)
				1.80			Very weak dark grey thinly laminated MUDSTONE. Recovered as slightly clayey angular tabular fine to coarse gravel. (COAL MEASURES) *Spalling at 1.2m.* End of pit at 1.80 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.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP13
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location: Huddersfield		Dimensions (m): Depth 3.20	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T					Friable brown slightly sandy CLAY with occasional rootlets. (TOPSOIL)
				0.30			Firm light orangish brown CLAY. (WEATHERED SOFT BED FLAGS)
	0.60	D	HVP=60				
				0.80			Firm light brown CLAY with some angular fine to coarse gravel size lithorelicts of mudstone (remoulds to clay under light pressure). (WEATHERED SOFT BED FLAGS) *Spalling at 0.9m.*
				1.20			Very weak orangish brown thinly laminated SILTSTONE & SANDSTONE. Recovered as angular to subangular fine to coarse gravel. (SOFT BED FLAGS)
				3.00			Very weak dark grey thinly laminated MUDSTONE with occasional nodules of ironstone (less than 20mm diameter). Recovered as slightly clayey angular to subangular fine to coarse gravel with some orange brown surface staining. (COAL MEASURES)
				3.20			End of pit at 3.20 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.

Stability:

AGS

Trial Pit Log

Trialpit No **TT01**

Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location:		Dimensions (m): Depth 0.40	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Brown sandy CLAY with occasional rootlets. (TOPSOIL)
				0.40			Firm light orangish brown CLAY. (COHESIVE RESIDUAL SOIL) *Culvert found at 0.4m depth 2.6m from wall, 0.4m deep and 0.5m wide.* End of pit at 0.40 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT02
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location:		Dimensions (m): Depth 1.00	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Brown sandy CLAY with occasional rootlets. (TOPSOIL)
				0.30			Firm light orangish brown CLAY. (COHESIVE RESIDUAL SOIL)
							Culvert not located.
				1.00			End of pit at 1.00 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT03
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location:		Dimensions (m): Depth 0.90	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.25			Brown sandy CLAY with occasional rootlets. (TOPSOIL)
							Firm light orangish brown CLAY. (COHESIVE RESIDUAL SOIL)
				0.90			*Culvert not located.* 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. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

AGS

Trial Pit Log

Trialpit No **TT04**

Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location:		Dimensions (m): Depth 0.80	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Brown sandy CLAY with occasional rootlets. (TOPSOIL)
							Firm light orangish brown CLAY. (COHESIVE RESIDUAL SOIL)
				0.80			*Culvert not located.* End of pit at 0.80 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

Trial Pit Log

LITHOS CONSULTING

Trialpit No **TT05**

Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location:		Dimensions (m): Depth 0.40	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Brown sandy CLAY with occasional rootlets. (TOPSOIL)
				0.30			Firm light orangish brown CLAY. (COHESIVE RESIDUAL SOIL) *Culvert found at 0.4m depth 1.7m from wall, 0.4m depth and 0.5m wide.*
				0.40			End of pit at 0.40 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT06
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location:		Dimensions (m): Depth 1.40	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Brown sandy CLAY with occasional rootlets. (TOPSOIL)
				0.30			Firm orangish brown slightly sandy CLAY. (WEATHERED ROUGH ROCK SANDSTONE)
				1.00			Firm orangish brown very gravelly CLAY. Gravel is lithorelics of sandstone (crumbles to clay under light pressure). (WEATHERED ROUGH ROCK SANDSTONE)
				1.30			Strong orangish brown fine to coarse grained SANDSTONE. Recovered as angular tabular cobbles. (ROUGH ROCK SANDSTONE)
				1.40			*Unable to excavate further due to hard sandstone.* End of pit at 1.40 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TT07
Sheet 1 of 1

Project Name: New Hey Road	Project No. 2895	Co-ords: - Level:	Date 06/11/2017
Location:		Dimensions (m): Depth 1.20	Scale 1:25
Client: Newett Homes			Logged JEJ

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Brown sandy CLAY with lots of rootlets and rare brick. (TOPSOIL)
				0.30			Firm orangish brown mottled grey slightly sandy CLAY with 2 bricks at 0.7m. (WEATHERED ROUGH ROCK SANDSTONE)
				0.80			Firm orangish brown mottled grey very gravelly CLAY. Gravel is lithorelics of sandstone (crumbles to clay under light pressure). (WEATHERED ROUGH ROCK SANDSTONE)
				1.00			Strong orangish brown fine to coarse grained SANDSTONE. Recovered as angular tabular cobbles. (ROUGH ROCK SANDSTONE)
				1.20			*Unable to excavate further due to hard sandstone.* End of pit at 1.20 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. The sides of the trial pit remained stable during excavation. 4. Backfilled with materials arising upon completion.

Stability:

AGS

Appendix G

Chemical Results

Certificate of Analysis

Certificate Number 17-15206-1

07-Dec-17

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference 17-15206-1

Client Reference 2895

Order No 12237/2895/JEJ

Contract Title New Hey Road

Description 19 Soil samples.

Date Received 09-Nov-17

Date Started 09-Nov-17

Date Completed 07-Dec-17

Test Procedures Identified by prefix DETSn (details on request).

Notes **This report supersedes 17-15206. 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 17-15206-1
Client Ref 2895
Contract Title New Hey Road

			Lab No	1255467	1255468	1255469	1255470	1255471	1255472
			Sample ID	TP03	TP04	TP05	TP06	TP07	TP08
			Depth	0.10	0.10	0.10	0.10	0.10	0.10
			Other ID	1	1	1	1	1	1
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	6.7		0.8	3	2.3	15
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.4		< 0.2	0.5	< 0.2	0.7
Cadmium	DETSC 2301#	0.1	mg/kg	0.1		< 0.1	< 0.1	0.2	0.7
Chromium	DETSC 2301#	0.15	mg/kg	30		32	40	27	15
Chromium III	DETSC 2301*	0.15	mg/kg	30		32	40	27	15
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0		< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	74		46	46	35	62
Lead	DETSC 2301#	0.3	mg/kg	20		17	23	20	65
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg	0.1		< 0.05	< 0.05	< 0.05	0.19
Nickel	DETSC 2301#	1	mg/kg	40		44	40	36	22
Selenium	DETSC 2301#	0.5	mg/kg	0.6		< 0.5	< 0.5	0.8	0.7
Zinc	DETSC 2301#	1	mg/kg	94		78	79	100	23
Inorganics									
Loss on Ignition at 440oC	DETSC 2003#	0.01	%						83
pH	DETSC 2008#			5.5		5.7	5.4	5.2	5.5
Calorific Value	DETSC 5008	1	MJ/kg						
Total Organic Carbon	DETSC 2002	0.1	%	1.2		0.7	0.6	0.7	> 15
Chloride Aqueous Extract	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	0.16		< 0.03	0.06	< 0.03	0.04
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	0.04	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.26		0.06	0.13	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	0.16		0.04	0.11	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	1.5		0.55	1.5	0.12	0.11
Anthracene	DETSC 3303	0.03	mg/kg	0.27		0.09	0.27	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	1.7		0.9	3.5	0.14	0.13
Pyrene	DETSC 3303#	0.03	mg/kg	1.5		0.83	3.1	0.12	0.1
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.43		0.33	1.6	0.04	0.05
Chrysene	DETSC 3303	0.03	mg/kg	0.45		0.38	1.5	0.04	0.05
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.34		0.53	1.6	< 0.03	0.04
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.13		0.2	0.64	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.22		0.39	1	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.08		0.19	0.43	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		0.04	0.11	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.1		0.22	0.44	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	7.3		4.8	16	0.46	0.52
OCPs									
alpha-BHC	DETSC 3441*	0.1	mg/kg		< 0.1				

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 17-15206-1
Client Ref 2895
Contract Title New Hey Road

	Lab No	1255467	1255468	1255469	1255470	1255471	1255472
	Sample ID	TP03	TP04	TP05	TP06	TP07	TP08
	Depth	0.10	0.10	0.10	0.10	0.10	0.10
	Other ID	1	1	1	1	1	1
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
gamma-BHC (Lindane)	DETSC 3441*	0.1	mg/kg		< 0.1				
beta-BHC	DETSC 3441*	0.1	mg/kg		< 0.1				
delta-BHC	DETSC 3441*	0.1	mg/kg		< 0.1				
Heptachlor	DETSC 3441*	0.1	mg/kg		< 0.1				
Aldrin	DETSC 3441*	0.1	mg/kg		< 0.1				
Heptachlor epoxide	DETSC 3441*	0.1	mg/kg		< 0.1				
gamma-Chlordane	DETSC 3441*	0.1	mg/kg		< 0.1				
Endosulphan I & Alpha-chlorodane	DETSC 3441*	0.1	mg/kg		< 0.1				
4,4-DDE	DETSC 3441*	0.1	mg/kg		< 0.1				
Dieldrin	DETSC 3441*	0.1	mg/kg		< 0.1				
Endrin	DETSC 3441*	0.1	mg/kg		< 0.1				
Endosulphan II & 4,4-DDD	DETSC 3441*	0.1	mg/kg		< 0.1				
Endrin aldehyde	DETSC 3441*	0.1	mg/kg		< 0.1				
4,4-DDT	DETSC 3441*	0.1	mg/kg		< 0.1				
Endosulphan sulphate	DETSC 3441*	0.1	mg/kg		< 0.1				
Methoxychlor	DETSC 3441*	0.1	mg/kg		< 0.1				
Endrin ketone	DETSC 3441*	0.1	mg/kg		< 0.1				

Summary of Chemical Analysis
Soil Samples

Our Ref 17-15206-1
Client Ref 2895
Contract Title New Hey Road

			Lab No	1255473	1255474	1255475	1255476	1255477	1255478
			Sample ID	TP09	TP11	TP12	TP13	TP01	TP02
			Depth	0.10	0.10	0.10	0.10	0.05	0.05
			Other ID	1	1	1	1	1	1
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	4.6		14	4.4		
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.2		0.4	0.3		
Cadmium	DETSC 2301#	0.1	mg/kg	0.1		0.3	0.2		
Chromium	DETSC 2301#	0.15	mg/kg	53		15	82		
Chromium III	DETSC 2301*	0.15	mg/kg	53		15	82		
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0		< 1.0	< 1.0		
Copper	DETSC 2301#	0.2	mg/kg	29		40	21		
Lead	DETSC 2301#	0.3	mg/kg	16		270	17		
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l						
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05		0.13	0.36		
Nickel	DETSC 2301#	1	mg/kg	57		16	68		
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5		< 0.5	< 0.5		
Zinc	DETSC 2301#	1	mg/kg	60		64	60		
Inorganics									
Loss on Ignition at 440oC	DETSC 2003#	0.01	%						
pH	DETSC 2008#			8.9		8.1	8.6		
Calorific Value	DETSC 5008	1	MJ/kg						
Total Organic Carbon	DETSC 2002	0.1	%	2.5		2.3	1.3		
Chloride Aqueous Extract	DETSC 2055	1	mg/l						
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l						
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l						
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	0.29	0.24
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	0.05	0.04
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.04		0.14	< 0.03	0.09	0.07
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	< 0.03	0.27	0.18
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.07		0.19	< 0.03	1.2	0.17
Pyrene	DETSC 3303#	0.03	mg/kg	0.07		0.16	< 0.03	1.9	0.51
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.04		0.05	< 0.03	1.6	0.11
Chrysene	DETSC 3303	0.03	mg/kg	0.04		0.07	< 0.03	2.7	0.47
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.04		0.07	< 0.03	4.7	1.1
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	1.3	0.33
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		0.04	< 0.03	2.8	1.2
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	1.1	0.92
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	0.25	0.21
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	1	1.2
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.14		0.73	< 0.10	19	6.8
OCPs									
alpha-BHC	DETSC 3441*	0.1	mg/kg		< 0.1				

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 17-15206-1
Client Ref 2895
Contract Title New Hey Road

	Lab No	1255473	1255474	1255475	1255476	1255477	1255478
	Sample ID	TP09	TP11	TP12	TP13	TP01	TP02
	Depth	0.10	0.10	0.10	0.10	0.05	0.05
	Other ID	1	1	1	1	1	1
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
gamma-BHC (Lindane)	DETSC 3441*	0.1	mg/kg		< 0.1				
beta-BHC	DETSC 3441*	0.1	mg/kg		< 0.1				
delta-BHC	DETSC 3441*	0.1	mg/kg		< 0.1				
Heptachlor	DETSC 3441*	0.1	mg/kg		< 0.1				
Aldrin	DETSC 3441*	0.1	mg/kg		< 0.1				
Heptachlor epoxide	DETSC 3441*	0.1	mg/kg		< 0.1				
gamma-Chlordane	DETSC 3441*	0.1	mg/kg		< 0.1				
Endosulphan I & Alpha-chlorodane	DETSC 3441*	0.1	mg/kg		< 0.1				
4,4-DDE	DETSC 3441*	0.1	mg/kg		< 0.1				
Dieldrin	DETSC 3441*	0.1	mg/kg		< 0.1				
Endrin	DETSC 3441*	0.1	mg/kg		< 0.1				
Endosulphan II & 4,4-DDD	DETSC 3441*	0.1	mg/kg		< 0.1				
Endrin aldehyde	DETSC 3441*	0.1	mg/kg		< 0.1				
4,4-DDT	DETSC 3441*	0.1	mg/kg		< 0.1				
Endosulphan sulphate	DETSC 3441*	0.1	mg/kg		< 0.1				
Methoxychlor	DETSC 3441*	0.1	mg/kg		< 0.1				
Endrin ketone	DETSC 3441*	0.1	mg/kg		< 0.1				

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 17-15206-1
Client Ref 2895
Contract Title New Hey Road

	Lab No	1255479	1255480	1255481	1255482	1255483	1255484
	Sample ID	TP02	TP05	TP04	TP06	TP07	TP03
	Depth	0.60	1.00	0.80	1.10	1.20	1.90
	Other ID	2	2	2	3	3	3
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Metals							
Arsenic	DETSC 2301#	0.2	mg/kg	13	12		
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.6	1.1		
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.2		
Chromium	DETSC 2301#	0.15	mg/kg	29	37		
Chromium III	DETSC 2301*	0.15	mg/kg	29	37		
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0		
Copper	DETSC 2301#	0.2	mg/kg	79	52		
Lead	DETSC 2301#	0.3	mg/kg	190	68		
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l			< 10	< 10	< 10	< 10
Mercury	DETSC 2325#	0.05	mg/kg	2.5	23		
Nickel	DETSC 2301#	1	mg/kg	26	23		
Selenium	DETSC 2301#	0.5	mg/kg	0.6	< 0.5		
Zinc	DETSC 2301#	1	mg/kg	72	78		
Inorganics							
Loss on Ignition at 440oC	DETSC 2003#	0.01	%				
pH	DETSC 2008#			5.5	5.1	5.2	4.6	5	4.7
Calorific Value	DETSC 5008	1	MJ/kg				
Total Organic Carbon	DETSC 2002	0.1	%	3.1	2.9		
Chloride Aqueous Extract	DETSC 2055	1	mg/l			3.7	1.1	2.9	1.2
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l			17	2.8	3.4	2.5
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l			23	< 10	< 10	< 10
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03		
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03		
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.05	< 0.03		
Fluorene	DETSC 3303	0.03	mg/kg	0.04	< 0.03		
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.34	0.09		
Anthracene	DETSC 3303	0.03	mg/kg	0.08	< 0.03		
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.56	0.18		
Pyrene	DETSC 3303#	0.03	mg/kg	0.5	0.16		
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.21	0.06		
Chrysene	DETSC 3303	0.03	mg/kg	0.21	0.08		
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.22	0.1		
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.07	< 0.03		
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.17	0.06		
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.07	0.04		
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03		
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.08	0.04		
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	2.6	0.81		
OCPs							
alpha-BHC	DETSC 3441*	0.1	mg/kg				

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 17-15206-1
Client Ref 2895
Contract Title New Hey Road

	Lab No	1255479	1255480	1255481	1255482	1255483	1255484
	Sample ID	TP02	TP05	TP04	TP06	TP07	TP03
	Depth	0.60	1.00	0.80	1.10	1.20	1.90
	Other ID	2	2	2	3	3	3
	Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Sampling Date	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17	06/11/17
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
gamma-BHC (Lindane)	DETSC 3441*	0.1	mg/kg				
beta-BHC	DETSC 3441*	0.1	mg/kg				
delta-BHC	DETSC 3441*	0.1	mg/kg				
Heptachlor	DETSC 3441*	0.1	mg/kg				
Aldrin	DETSC 3441*	0.1	mg/kg				
Heptachlor epoxide	DETSC 3441*	0.1	mg/kg				
gamma-Chlordane	DETSC 3441*	0.1	mg/kg				
Endosulphan I & Alpha-chlorodane	DETSC 3441*	0.1	mg/kg				
4,4-DDE	DETSC 3441*	0.1	mg/kg				
Dieldrin	DETSC 3441*	0.1	mg/kg				
Endrin	DETSC 3441*	0.1	mg/kg				
Endosulphan II & 4,4-DDD	DETSC 3441*	0.1	mg/kg				
Endrin aldehyde	DETSC 3441*	0.1	mg/kg				
4,4-DDT	DETSC 3441*	0.1	mg/kg				
Endosulphan sulphate	DETSC 3441*	0.1	mg/kg				
Methoxychlor	DETSC 3441*	0.1	mg/kg				
Endrin ketone	DETSC 3441*	0.1	mg/kg				

Summary of Chemical Analysis
Soil Samples

Our Ref 17-15206-1
Client Ref 2895
Contract Title New Hey Road

Lab No	1255485
Sample ID	TP05
Depth	1.50
Other ID	3
Sample Type	SOIL
Sampling Date	06/11/17
Sampling Time	n/s

Test	Method	LOD	Units	
Metals				
Arsenic	DETSC 2301#	0.2	mg/kg	
Boron, Water Soluble	DETSC 2123#	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	
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	
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				
Loss on Ignition at 440oC	DETSC 2003#	0.01	%	
pH	DETSC 2008#			6.7
Calorific Value	DETSC 5008	1	MJ/kg	3.4
Total Organic Carbon	DETSC 2002	0.1	%	
Chloride Aqueous Extract	DETSC 2055	1	mg/l	
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	20
PAHs				
Naphthalene	DETSC 3303#	0.03	mg/kg	
Acenaphthylene	DETSC 3303#	0.03	mg/kg	
Acenaphthene	DETSC 3303#	0.03	mg/kg	
Fluorene	DETSC 3303	0.03	mg/kg	
Phenanthrene	DETSC 3303#	0.03	mg/kg	
Anthracene	DETSC 3303	0.03	mg/kg	
Fluoranthene	DETSC 3303#	0.03	mg/kg	
Pyrene	DETSC 3303#	0.03	mg/kg	
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	
Chrysene	DETSC 3303	0.03	mg/kg	
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	
OCPs				
alpha-BHC	DETSC 3441*	0.1	mg/kg	

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 17-15206-1
Client Ref 2895
Contract Title New Hey Road

Lab No	1255485
Sample ID	TP05
Depth	1.50
Other ID	3
Sample Type	SOIL
Sampling Date	06/11/17
Sampling Time	n/s

Test	Method	LOD	Units	
gamma-BHC (Lindane)	DETSC 3441*	0.1	mg/kg	
beta-BHC	DETSC 3441*	0.1	mg/kg	
delta-BHC	DETSC 3441*	0.1	mg/kg	
Heptachlor	DETSC 3441*	0.1	mg/kg	
Aldrin	DETSC 3441*	0.1	mg/kg	
Heptachlor epoxide	DETSC 3441*	0.1	mg/kg	
gamma-Chlordane	DETSC 3441*	0.1	mg/kg	
Endosulphan I & Alpha-chlorodane	DETSC 3441*	0.1	mg/kg	
4,4-DDE	DETSC 3441*	0.1	mg/kg	
Dieldrin	DETSC 3441*	0.1	mg/kg	
Endrin	DETSC 3441*	0.1	mg/kg	
Endosulphan II & 4,4-DDD	DETSC 3441*	0.1	mg/kg	
Endrin aldehyde	DETSC 3441*	0.1	mg/kg	
4,4-DDT	DETSC 3441*	0.1	mg/kg	
Endosulphan sulphate	DETSC 3441*	0.1	mg/kg	
Methoxychlor	DETSC 3441*	0.1	mg/kg	
Endrin ketone	DETSC 3441*	0.1	mg/kg	

Summary of Asbestos Analysis
Soil Samples

Our Ref 17-15206-1
Client Ref 2895
Contract Title New Hey Road

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1255467	TP03 1 0.10	SOIL	NAD	none	Colin Patrick
1255469	TP05 1 0.10	SOIL	NAD	none	Colin Patrick
1255470	TP06 1 0.10	SOIL	NAD	none	Colin Patrick
1255471	TP07 1 0.10	SOIL	NAD	none	Colin Patrick
1255472	TP08 1 0.10	SOIL	NAD	none	Colin Patrick
1255473	TP09 1 0.10	SOIL	NAD	none	Colin Patrick
1255475	TP12 1 0.10	SOIL	NAD	none	Colin Patrick
1255476	TP13 1 0.10	SOIL	NAD	none	Colin Patrick
1255479	TP02 2 0.60	SOIL	NAD	none	Colin Patrick
1255480	TP05 2 1.00	SOIL	NAD	none	Colin Patrick

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.

Information in Support of the Analytical Results

Our Ref 17-15206-1
Client Ref 2895
Contract New Hey Road

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1255467	TP03 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255468	TP04 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255469	TP05 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255470	TP06 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255471	TP07 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255472	TP08 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255473	TP09 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255474	TP11 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255475	TP12 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255476	TP13 0.10 SOIL	06/11/17	GJ 250ml, PT 1L		
1255477	TP01 0.05 SOIL	06/11/17	GJ 250ml, PT 1L		
1255478	TP02 0.05 SOIL	06/11/17	GJ 250ml, PT 1L		
1255479	TP02 0.60 SOIL	06/11/17	GJ 250ml, PT 1L		
1255480	TP05 1.00 SOIL	06/11/17	GJ 250ml, PT 1L		
1255481	TP04 0.80 SOIL	06/11/17	PT 1L		
1255482	TP06 1.10 SOIL	06/11/17	PT 1L		
1255483	TP07 1.20 SOIL	06/11/17	PT 1L		
1255484	TP03 1.90 SOIL	06/11/17	PT 1L		
1255485	TP05 1.50 SOIL	06/11/17	PT 1L		

Key: G-Glass P-Plastic J-Jar 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

Certificate of Analysis

Certificate Number 17-16552

04-Dec-17

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference 17-16552

Client Reference 2895

Order No 12337

Contract Title New Hey Road

Description One Soil sample.

Date Received 24-Nov-17

Date Started 24-Nov-17

Date Completed 04-Dec-17

Test Procedures Identified by prefix DETSn (details on request).

Notes 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 17-16552
Client Ref 2895
Contract Title New Hey Road

Lab No	1263266
Sample ID	TP10
Depth	0.70
Other ID	1
Sample Type	SOIL
Sampling Date	06/11/17
Sampling Time	n/s

Test	Method	LOD	Units	
Inorganics				
pH	DETSC 2008#			9.3
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	25

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 17-16552
Client Ref 2895
Contract New Hey Road

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1263266	TP10 0.70 SOIL	06/11/17	PT 1L	pH + Conductivity (7 days)	

Key: P-Plastic 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

Lithos Job No.	**2895**
Engineer	**ASw**
Site Name	**New Hey Road**
Made Ground Type	**Topsoil**

Analytical Data		Mean Value Test			Outlier Test	
Data (mg/kg)	**Log Data**	**n**	**t**	**t value**	**T_{crit} 10%**	**T_{crit} V**
20	1.3010	2	6.3138			
17	1.2304	3	2.9200			
23	1.3617	4	2.3534		1.425	
20	1.3010	5	2.1318		1.602	
65	1.8129	6	2.0150		1.729	
16	1.2041	7	1.9432		1.828	
270	2.4314	8	1.8946	1.895	1.909	1.909
17	1.2304	9	1.8595		1.977	
		10	1.8331		2.036	
		11	1.8125		2.088	
		12	1.7959		2.134	
		13	1.7823		2.176	
		14	1.7709		2.213	
		15	1.7613		2.248	
		16	1.7531		2.279	
		17	1.7459		2.309	
		18	1.7396		2.336	
		19	1.7341		2.361	
		20	1.7291		2.385	
		21	1.7247		2.408	
		22	1.7207		2.429	
		23	1.7171		2.449	
		24	1.7139		2.468	
		25	1.7109		2.486	
		26	1.7081		2.503	
		27	1.7056		2.520	
		28	1.7033		2.536	
		29	1.7011		2.551	
		30	1.6991		2.565	
		31	1.6973		2.579	
		32	1.6955		2.592	
		33	1.6939		2.605	
		34	1.6924		2.618	
		35	1.6909		2.630	
		36	1.6896		2.641	
		37	1.6883		2.652	
		38	1.6871		2.663	
		39	1.6860		2.674	
		40	1.6849		2.684	
		41	1.6839		2.694	
		42	1.6829		2.704	
		43	1.6820		2.713	
		44	1.6811		2.722	
		45	1.6802		2.731	
		46	1.6794		2.739	
		47	1.6787		2.748	
		48	1.6779		2.756	
		49	1.6772		2.764	
		50	1.6766		2.772	

Determinand:	**Lead**
No. of samples:	**8**
Tier 1 Value:	**450**
Log Tier 1 Value:	2.653
t value:	1.895
mean of log data (x):	1.484
st.dev of log data (s):	0.4
95% ile of log data:	1.772
95% ile:	**59.18**

Is the Mean Value Higher or Lower than the SGV?	
Higher or Lower	**Lower**
Y max:	2.431
Y mean:	1.484
Y st.dev.:	0.430
T value	2.203
Comparator	1.909
Maximum Value Test Result:	
Outlier Test?	**Maximum is an Outlier**

Outlier Values	Sample Number

Lithos Job No.	**2895**
Engineer	**ASw**
Site Name	**New Hey Road**
Made Ground Type	**Topsoil**

Determinand:	Lead

No. of samples:	**6**
Tier 1 Value:	**450**
Log Tier 1 Value:	2.653

t value:	2.015
mean of log data (x):	1.271
st.dev of log data (s):	0.1
95% ile of log data:	1.321
95% ile:	**20.92**

Is the Mean Value Higher or Lower than the SGV?	
Higher or Lower	**Lower**

Y max:	1.362
Y mean:	1.271
Y st.dev.:	0.060
T value	1.513
Comparator	1.729

Maximum Value Test Result:	
Outlier Test?	**laximum is within a Normal Distributio**

Outlier Values	Sample Number
270	**TP12 at 0.1m**
65	**TP08 at 0.1m**

Analytical Data

Data (mg/kg)	Log Data
20	1.3010
17	1.2304
23	1.3617
20	1.3010
16	1.2041
17	1.2304

Mean Value Test

n	t	t value
2	6.3138	
3	2.9200	
4	2.3534	
5	2.1318	
6	2.0150	2.015
7	1.9432	
8	1.8946	
9	1.8595	
10	1.8331	
11	1.8125	
12	1.7959	
13	1.7823	
14	1.7709	
15	1.7613	
16	1.7531	
17	1.7459	
18	1.7396	
19	1.7341	
20	1.7291	
21	1.7247	
22	1.7207	
23	1.7171	
24	1.7139	
25	1.7109	
26	1.7081	
27	1.7056	
28	1.7033	
29	1.7011	
30	1.6991	
31	1.6973	
32	1.6955	
33	1.6939	
34	1.6924	
35	1.6909	
36	1.6896	
37	1.6883	
38	1.6871	
39	1.6860	
40	1.6849	
41	1.6839	
42	1.6829	
43	1.6820	
44	1.6811	
45	1.6802	
46	1.6794	
47	1.6787	
48	1.6779	
49	1.6772	
50	1.6766	

Outlier Test

T_{crit} 10%	T_{crit} V
1.425	
1.602	
1.729	1.729
1.828	
1.909	
1.977	
2.036	
2.088	
2.134	
2.176	
2.213	
2.248	
2.279	
2.309	
2.336	
2.361	
2.385	
2.408	
2.429	
2.449	
2.468	
2.486	
2.503	
2.520	
2.536	
2.551	
2.565	
2.579	
2.592	
2.605	
2.618	
2.630	
2.641	
2.652	
2.663	
2.674	
2.684	
2.694	
2.704	
2.713	
2.722	
2.731	
2.739	
2.748	
2.756	
2.764	
2.772	

Appendix H

Geotechnical Test Results

LABORATORY REPORT

4043

Contract Number: PSL17/5443

Report Date: 20 November 2017

Client's Reference: 2895

Client Name: Lithos Consulting
Parkhill
Walton Road
Wetherby
North Yorkshire

For the attention of: Alan Swales/Josh Jones

Contract Title: New Hey Road, Huddersfield

Date Received: 8/11/2017
Date Commenced: 8/11/2017
Date Completed: 20/11/2017

Notes: Opinions and Interpretations are outside the UKAS Accreditation

Checked and Approved Signatories:

R Gunson (Director)	A Watkins (Director)	R Berriman (Quality Manager)
L Knight (Senior Technician)	S Eyre (Senior Technician)	A Fry (Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rgunson@prosoils.co.uk
awatkins@prosoils.co.uk

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP03	2	D	0.90		Brown mottled grey very silty CLAY.
TP06	2	D	0.50		Brown highly weatherd MUDSTONE.
TP07	2	D	0.70		Brown highly weatherd MUDSTONE.
TP08	2	D	0.50		Brown weatherd MUDSTONE.
TP11	2	D	0.50		Brown highly weatherd MUDSTONE.
TP12	2	D	0.70		Brown mottled grey very silty CLAY.
TP13	2	D	0.60		Brown highly weatherd MUDSTONE.

UKAS TESTING 4043	PSL Professional Soils Laboratory	New Hey Road, Huddersfield	Contract No: PSL17/5443 Client Ref: 2895

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
TP03	2	D	0.90		58			87	38	49	100	Very high plasticity CV.
TP06	2	D	0.50		36			70	33	37	94	Very high plasticity CV.
TP07	2	D	0.70		22			59	30	29	92	High plasticity CH.
TP08	2	D	0.50		14				NP			
TP11	2	D	0.50		22			56	29	27	91	High plasticity CH.
TP12	2	D	0.70		46			89	39	50	100	Very high plasticity CV.
TP13	2	D	0.60		28			46	26	20	91	Intermediate plasticity CI.

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL Professional Soils Laboratory

New Hey Road, Huddersfield

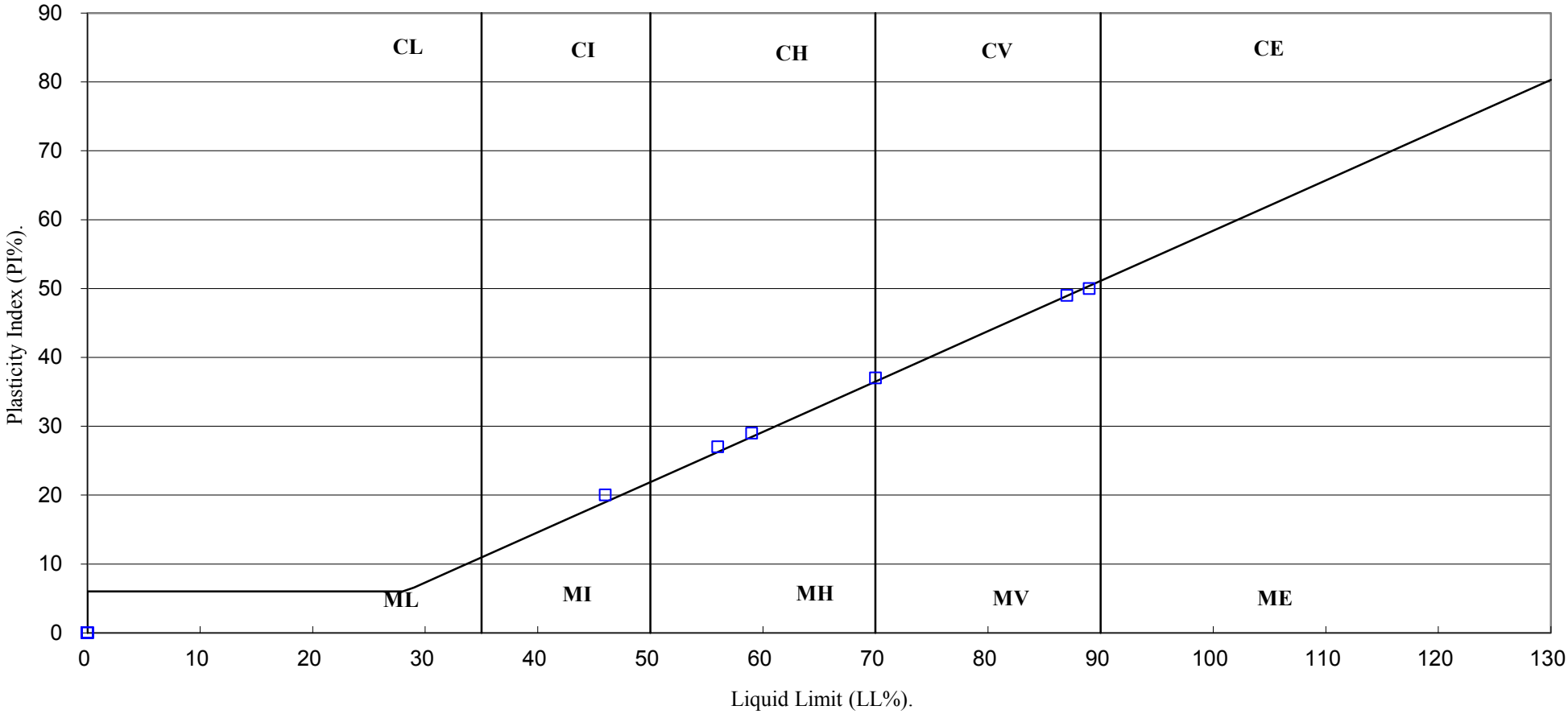
Contract No:

PSL17/5443

Client Ref:

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



UKAS TESTING 4043	PSL Professional Soils Laboratory	New Hey Road, Huddersfield	**Contract No:** PSL17/5443 **Client Ref:**

Certificate of Analysis

Certificate Number 17-15628

20-Nov-17

Client Professional Soils Laboratory Ltd
5/7 Hexthorpe Road
Hexthorpe
DN4 0AR

Our Reference 17-15628

Client Reference PSL17/5443

Order No (not supplied)

Contract Title New Hay Road, Huddersfield

Description 7 Soil samples.

Date Received 14-Nov-17

Date Started 14-Nov-17

Date Completed 20-Nov-17

Test Procedures Identified by prefix DETSn (details on request).

Notes 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 17-15628
Client Ref PSL17/5443
Contract Title New Hay Road, Huddersfield

			Lab No	1257940	1257941	1257942	1257943	1257944	1257945	1257946
			Sample ID	TP03	TP06	TP07	TP08	TP11	TP12	TP13
			Depth	0.90	0.50	0.70	0.50	0.50	0.70	0.60
			Other ID	2	2	2	2	2	2	2
			Sample Type	D	D	D	D	D	D	D
			Sampling Date	n/s	n/s	n/s	n/s	n/s	n/s	n/s
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Inorganics										
pH	DETSC 2008#			6.3	5.7	5.9	5.9	5.9	5.9	6.3
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	18	20	< 10	< 10	< 10	12	21

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 17-15628
Client Ref PSL17/5443
Contract New Hay Road, Huddersfield

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1257940	TP03 0.90 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1257941	TP06 0.50 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1257942	TP07 0.70 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1257943	TP08 0.50 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1257944	TP11 0.50 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1257945	TP12 0.70 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
1257946	TP13 0.60 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	

Key: P-Plastic 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