Geoenvironmental Appraisal

Land at Lower Edge Road, Elland

For Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth

Report no:	4246/1
Date:	May 2022

SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	4246	**Site area/ha**	8.04ha (19.9 acres)
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth	**NGR:**	SE 120 215
Site:	Lower Edge Road, Elland	**Nearest postcode:**	HX5 9PL

The site is located off Shaw Lane (east) and Lower Edge Road (south), approximately 1.2km northeast of Elland town centre and comprises a single grassed field. The site has remained essentially undeveloped throughout its history (open, likely arable farmland), although three mineshafts and a clay pit are shown on Coal Authority records and historical OS plans. Shaw Laithe Farm was also present in the centre east until c. 1990.

Lithos were commissioned via Titchmarsh & Bagley to provide a geoenvironmental appraisal of the site, which it is understood 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 57 trial pits, 21 rotary probeholes and 18 mini percussive boreholes with monitoring well installations.

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

Issue	Remarks
Made ground	**Made ground** is typically restricted to one of 4 areas: • Within the former **farmyard**, made ground was recorded between 0.25m and 0.8m depth and predominantly comprised Granular Made Ground (sandy Clay) together with localised thin beds of Ash & Clinker (up to 0.25m thick). • Along the line of the former **tramway;** Cohesive Made Ground/Reworked Natural up to 0.6m depth. • Made Ground, up to 2.4m depth, comprising Reworked Coal Measures (gravelly Clay and clayey Gravel), together with Ash & Clinker (100mm thick), recorded within a backfilled **clay pit** in the southwest. • Made Ground, to >2.6m depth, comprising Granular Made Ground (gravelly Clay of coal and mudstone) recorded at the location of a former **mine shaft**. Made Ground Topsoil (sandy slightly gravelly Clay with occasional glass, ceramic etc) typically overlies the above made ground types. Made ground was typically absent across the remainder of the site, with only a localised veneer of Made Ground Topsoil
Natural ground	Topsoil (typically 300mm thick) is present beyond areas of made ground. Drift materials comprise Glaciofluvial Deposits (sandy Clay) identified in the north, with Sand & Gravels in the far northeast, Cohesive and Granular Residual Soils comprising firm/stiff gravelly Clay and clayey Gravel respectively from the complete weathering of bedrock was identified in the majority of exploratory holes. Coal Measures bedrock was encountered from between 1.6m to 2.8m depth, typically around 2.5m, in 12 of the 75 exploratory holes. Typically recovered as tabular Gravel of mudstone or sandstone. The soil/rock interface could be considered as gradational as the effects of weathering become less pronounced with depth. Thin highly weathered Coal (between 0.2m to 0.5m thick) identified in two trial pits from 1.6m depth.
Contamination	Elevated concentrations of a number of organic determinands have been identified in the Made Ground, including Made Ground Topsoil, together with materials (e.g. brick, glass and ceramic), which would generally be considered undesirable as a near-surface material in garden areas.
Mining & quarrying	The Halifax Hard Bed coal (known to have been extensively worked) and Middle Band Coal, both outcrop on site. The Halifax Soft Bed coal outcrops c. 100m to the northwest and underlies the site from around 23m depth. As a consequence of these shallow coal seams, the site is located within a Coal Mining Development High Risk Area. Lithos' mining investigation identified evidence of workings (voids, broken ground) in the Halifax Hard Bed coal. An insufficient thickness of competent cover was recorded above the workings, as such, drilling & grouting will be required across approximately 70% of the site. No evidence of workings was recorded in the Middle Band Coal or Halifax Soft Bed Coal. Three shafts are shown within the site boundary on CA records, with a further 6 shafts and 7 adits within 100m of the site boundary. Although not specifically targeted during this investigation, evidence (comprising Cohesive made ground – gravelly clay) of one shaft located in the northeast was encountered.
Hazardous gas	The site is in an area where less than 1% of homes are estimated to be above the radon action level. As such, no protection measures against radon are required There are former landfills located to the north from around 25m, and the site is also underlain by shallow mineworkings. Consequently, wells have been installed and a period of gas monitoring underway.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	4246	**Site area/ha**	8.04ha (19.9 acres)
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Site:	Lower Edge Road, Elland	**Nearest postcode:**	HX5 9PL

Issue	Remarks
Preparatory works	• General site clearance of surface materials and vegetation. • Topsoil strip & stockpile. • Treatment (drilling & grouting) of shallow mine workings. • Location of the three mine entries shown on site with grouting and/or capping. • Excavation and disposal off site of made ground or isolation beneath hardstand, or a minimum 600mm clean cover in gardens/POS.
Foundations	Plots at the site will be founded on traditional strip footings founded in Glaciofluvial deposits (firm to stiff Clay) or Residual Soils (firm to stiff gravelly Clay and clayey Gravel). Additional reinforcement may be required for any plots founded over shallow coal workings, even after treatment. Alternative foundations such as piles may be required for any plots within the footprint of the former clay pit where made ground is in excess of 2.5m. However, it is recommended that this area is utilised as POS.
Groundwater & excavations	It is considered unlikely that major groundwater flows will be encountered in shallow excavations. Excavations should remain stable in the short term but if left open for any significant period of time may require shoring most notably in granular soils and made ground.
Flooding & drainage	The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. Soakaways will not provide a suitable means of surface water disposal at the site. Consequently, there is likely to be a need for surface water balancing.
Highways	The Cohesive Glaciofluvial Deposits and Residual Soils should provide a CBR value of at least 3%. This value should be verified prior to or during construction.

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

- Treatment (drilling & grouting) of shallow coal workings within the Halifax Hard Bed
- Location of existing three mine entries with grouting and/or capping.
- No build standoff required adjacent to mine entries and the existing high voltage power lines
- Diversion or incorporation into the proposed layout of the existing 11kV overhead and underground electricity cables
- Placement of a minimum 600mm clean cover in garden/landscaped areas underlain by made ground

Some further work is required, most notably:

- Consideration should be given to further rotary probing to confirm the extent of shallow coal workings and allow contractors to submit a fixed price for drilling and grouting works.
- Geophysical survey, trenching and/or rotary probing to locate the shafts shown on CA plans.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

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Appendix A - General notes

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02	Ground investigation fieldwork
03	Geotechnical testing
04	Contamination laboratory analysis & interpretation
05	Hazardous gas

Appendix B - Drawings

Drawing	Revision	Title
4246/1	-	Site location plan
4246/2	-	Proposed site layout
4246/3	-	Site features
4246/3A	-	Historic site features
4246/4	-	Site photographs
4246/5	-	Preliminary conceptual site model
4246/6	A	Exploratory hole locations (TPs & WS)
4246/6A	-	Exploratory hole locations (PHs)
4246/6B		Site areas
4246/7	-	Revised conceptual site model
4246/8	-	Mine shafts, coal seams & workings
4246/9A	-	Abandonment Plan: Halifax Hard Clay
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4246/9C	-	Abandonment Plan: Halifax Soft Coal
4246/9D	-	Abandonment Plan: Halifax Soft Coal
4246/10	-	Monitoring well locations

Appendix C - Commission

Appendix D - Historical OS plans#

Appendix E - Search responses#

From	Date	Content
Landmark	21st Feb 2022	Environmental search data
Coal Authority	21st Feb 2022	Mining report
BGS	-	Borehole log (SE12SW35C)

Appendix F to H - Exploratory records

Appendix F	TP01 to TP07 & TP101 to TP150
Appendix G	WS101 to WS118
Appendix H	PH101 to PH121

Appendix I - Chemical test results

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

Appendix K - Geotechnical test results

Appendix L - Gas monitoring results

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

FOREWORD (geoenvironmental appraisal report)

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

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

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

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

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

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

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

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

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

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

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

GEOENVIRONMENTAL APPRAISAL
of land at
LOWER EDGE ROAD, ELLAND

1 INTRODUCTION

1.1 The commission and brief

1.1.1 Lithos Consulting Limited were commissioned by Titchmarsh & Bagley on behalf of Mr Steven Boyle to carry out a geoenvironmental appraisal of land at Shaw Lane, Elland.

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

- A review of third party reports
- 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 57 trial pits, 21 probeholes and 18 mini percussive boreholes with monitoring well installations
- Assessment of the geotechnical properties of the near surface deposits to enable provision of foundation and highway recommendations
- A qualitative assessment of contamination risks
- Recommendations for the necessary site preparatory and remediation works

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

1.2 The proposed development

1.2.1 It is understood that consideration is being given to redevelopment of the site with two and three storey domestic dwellings, associated gardens, POS, adoptable roads, and sewers.

1.2.2 A site layout has been provided by Titchmarsh & Bagley (Drawing reference SK05, dated January 2020) showing 211 units. However, this is likely to be revised prior to development.

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
- Hazardous gas

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 4246/1 presented in Appendix B to this report. Site details are summarised in the table below.

Detail	**Remarks**
Location	1.2 km northeast of Elland town Centre
NGR	SE 120 215
Approximate area	8.04 ha (19.9 acres)
Known services	Underground electric (11kV), gas & water along the eastern boundary and underneath Shaw Lane (East). High voltage overhead electric utility hung on steel pylons crossing northwest-southeast through the centre of the site. One pylon base is present in the centre north of the site. 11kV electric utility on single timber poles crosses northeast-southwest through the centre of the site, passing underground as it crosses the path of the high voltage overheads.

2.2 Site features

2.2.1 Lithos completed a walkover survey of the site on 14th March 2022.

2.2.2 Existing salient features, at the time of the walkover are presented on Drawing 4246/3 in Appendix B to this report and summarised in the table below.

Feature	**Remarks**
Current Access	Off Shaw Lane
Topography	Gentle slope down towards the north. The northeastern corner is undulating and dips down towards the tunnel under the railway to the northeast (beyond site boundary).
Approximate areas	76,600m² grass 3,800m² overgrown coppice (approximately covering the former Shaw Laithe Farm)
Approximate areas of historic features	2,000m² (600m² onsite) Old clay pit 1,100m² Shaw Laithe Farm Single tramline crossing northeast-southwest in the northern half of the site
Nature of boundaries	North – Metal palisade fencing with mature trees and the embankment of railway cutting. East & south – Mature trees and hedgerow with post and wire fencing Southwest – Mature trees and hedgerow with a gateway to Old Earth Primary School West – Mature trees and hedgerow with metal palisade fenced boundary and footpath entrance
Surrounding land uses	North - Railway with caravan storage, warehouses and the River Calder beyond East – Concrete hardstanding (Former Calder Brick Works), disused shale quarry and residential properties South – Lower Edge Road with a housing estate and open grassed fields beyond Southwest – Old Earth Primary School with housing beyond West – Sports ground (football club) and housing beyond

2.2.3 Access is off Shaw Lane, via a locked yellow barrier, a metal palisade gate, and a farm gate into the field in the northeast corner of the site.

2.2.4 The site is roughly 'T'-shaped and predominantly comprises grassland, with mature trees, hedgerows, dilapidated drystone walls or rough, overgrown grass strips, creating 3 separate fields (west, east, and south).

2.2.5 Rough ground (dense bramble overgrowth, mature self-seeded trees and bushes) was noted in the south of the eastern field; likely associated with the former Shaw Laithe Farm which has been demolished.

2.2.6 Land falls gently towards the north, with the northwestern and central areas relatively flat lying. The northeastern corner is undulating and falls northeast towards a tunnel passing under the railway adjacent to the northern boundary.

2.2.7 A semi-dry ditch is present in the centre north, oriented north-south. A second ditch is present adjacent to the site's eastern boundary with water flowing north towards the River Calder, passing underneath the railway, via a culvert adjacent to the tunnel.

2.2.8 The tunnel is used for pedestrian access to land north of the railway. It comprises a brick lined structure c. 10m long and 5m wide. Along with the public footpath, a gas and electric utility also pass under the railway in the tunnel.

2.2.9 In the area of a former clay pit, shown on historical OS plans in the southwest, the terrain is undulating, likely as a result of backfilling of the clay pit.

2.2.10 No evidence (hollows, spoil heaps, surface buildings etc) of any of the mineshafts shown on CA records was visible at surface.

2.2.11 A high voltage powerline with associated steel pylons crosses the centre of the site in a northwest-southeast orientation. One of the supporting pylons is located within the northern boundary.

2.2.12 A three-phase electric utility crosses the centre of the site in a southwest-northeast orientation and is hung on single timber poles. The cable is routed underground where it passes beneath the high voltage powerline.

2.2.13 'Old Earth Primary School' is located immediately beyond the southwest boundary, with associated single storey classrooms, hardstand (playgrounds and car parking), landscaped areas, all weather sports pitch and running track and a caretaker's residential dwelling.

2.2.14 The boundary with the primary school, is defined by a dry-stone wall, hedgerow, and sporadic mature trees. The western boundary adjacent to existing houses is defined by a variety of fencing including metal palisade and wooden panel. A selection of mature trees and hedgerows form the northwestern boundary.

2.2.15 A signposted public footpath enters the site from the west (north of the adjacent primary school) and passes east, exiting at Shaw Lane. Further unofficial but well-trodden paths were noted around the site.

2.2.16 Several of the houses along the western boundary have extended their gardens into the site, with grassed lawns, landscaping and a small allotment/vegetable garden. At the time of the walkover chickens were also kept within the allotment.

2.2.17 Anecdotal evidence suggests that a fee is paid to the landowner as rent for use of the 'allotment'. It is unclear if the remaining properties also pay rent, or have purchased land, for the extended gardens.

2.2.18 A number of grassed sports pitches, associated with Huddersfield amateur football club, lie beyond the northwest boundary.

2.2.19 The northern boundary is defined by a metal palisade fence and mature trees with a steeply sloping railway cutting immediately beyond. There is an industrial estate (on land formerly occupied by Elland power station) comprising warehouses, scrubland, scrap yards and caravan storage further north, beyond the railway.

2.2.20 The River Calder flows east approximately 130m beyond the northeast corner of the site.

2.2.21 The eastern, southern, and northwestern boundaries are defined by mature trees and hedgerows together with post and wire fencing.

2.2.22 To the east, beyond Shaw Lane, the land is predominantly densely wooded, with an area of concrete hardstanding (former brick works) covering approximately 21,000m^2 c. 60m to the northeast.

2.2.23 A former shale quarry, now mostly overgrown with mature trees and bushes, is located approximately 200m to the east. The quarry has not been fully backfilled.

2.2.24 South of the site is Lower Edge Road with residential properties beyond. Three detached residential properties are also present at the junction of Shaw Lane and Lower Edge Road, beyond the southeastern corner of the site.

2.2.25 A selection of site photographs is included on Drawing 4246/4.

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 Significant historic features are presented on Drawing 4246/3 in Appendix B.

3.3 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	Site split into 6 (likely arable) fields. **Mine shaft** in centre-northeast. 'Billy Mellor Bridge' in northwest over the railway. **Shaw Laithe Farm** in the east.	**Lancashire and Yorkshire Railway in cutting** immediately beyond northern boundary with fields, a single mine **shaft** and the river Calder beyond. **Mine shaft** to northeast immediately beyond site boundary. Shaw Lane along the eastern boundary, leading to Shaw Laithe Farm. Strangstry Wood c. 250m east. **Two mine shafts** south of Lower Edge Road To the west fields and Gled Hall, with a 'well'. Elland town centre c. 1km west.
1893 & 1894	**Mine shaft** in the centre. **Old clay pit** in southwest (extending of site to the south). A **tramway** runs through the centre of the site from the clay pit to the fire clay works to the east. Footpath crossing the site from Gled Hall to Shaw Lane.	**Fireclay Works** to the east with associated buildings, clay pits, a mine shaft, and tramways. A small **quarry** c. 100m south. **New Hall Fireclay Works** c. 200m southwest with associated buildings and clay pits. 'Strawberry Lodge' c. 50m south. Expansion east of Elland town centre.
1907 & 1908	Old clay pit, tramway and central mine shaft no longer shown. **Mine Shaft** in the west of the site.	Expansion of Fire Clay Works to the east (now denoted as Calder Fire Clay Works). Expansion of New Hall Fire Clay Works to the southwest. Expansion of quarry to the south. **Sewage Works** and **Electric Generating Station** c. 450m northwest. Expansion east of Elland town centre.
1930 – 1931 & 1933	New outbuilding to the north of Shaw Laithe Farm.	Railway renamed as the 'London, Midland & Scottish Railway'. Expansion of clay pits to the east (Calder Fireclay Works). Expansion of Sewage Works east (now including ponds and settling tanks). Electric Generating station no longer shown. Expansion east of Elland town centre.
1938 – 1948	No significant changes.	Strawberry Lodge to the south replaced with housing estate.
1956		Large **sand and gravel pits** within c. 500m northeast of the site (on northern bank of the River Calder).
1959	Billy Mellor Bridge no longer shown (only abutments shown). Ditch flowing from Issues (south) to Sink (north) along the centre west site boundary.	Calder Fireclay Works labelled as '**disused works'** and shafts to the east labelled 'disused shafts'. New Hall Fireclay Works labelled as **disused works.** Embankments, railway sidings and a crane labelled north of railway.

Date	Site	Surrounding land
1965 – 1972	Erection of electric overheads on **pylon towers**, oriented northwest-southeast across the centre of the site.	Calder Fireclay Works buildings demolished and replaced with a single large building labelled **Calder Works** with a separate access track from Lower Edge Road. **Elland Power Station** to the north with large ponds, stockpiles, and conveyor belt network to move coal from the expanded railway sidings (numerous tracks and loading stations). Also known as 'Low Fields'. New Hall Fireclay Works now labelled as '**New Hall Works'**, with electric substation. Removal of Glen Hall to the west. New housing estate to the west with sports ground to northwest.
1969	No significant change on site	Expansion of sand and gravel pits to the northeast.
1974 – 1976		Elland 'Old Earth Junior & Infant School' constructed adjacent to the southwestern boundary. Housing development to the west nearing completion.
1977 – 1989		Removal of most railway sidings for Elland Power Station, but ponds & lakes still present.
1978		**Shale quarry** denoted east of the site within Stranstry Wood (associated with Calder Works). Elland Power Station ponds & lakes denoted as **Ash Ponds**. Infilling of furthest sand and gravel pit to the northeast.
1982		Expansion of Shale quarry south. Infilling of nearest sand and gravel pit to the northeast. Expansion of Sewage Works to the northwest.
1990		Demolition of Sewage Works to the northwest.
1992	**Shaw Laithe Farm** no longer shown.	Quarry to the south infilled.
1994	No significant changes.	Ponds and Lakes of Elland Power Station infilled.
2000 (Aerial photo)	Several unmade paths across the site.	Elland Power station demolished with industrial warehouses now shown. Extensive expansion of shale quarry to south and west.
2006	No significant changes.	Expansion of Low Fields industrial estate.
2021		

3.1.2 Elland Power Station was coal fired and designed to generate 180MW of power. It first started generating power in 1959 (officially opened and at full capacity by 1961).

3.1.3 During its life span of 32 years, it primarily burnt coal from the neighbouring active Yorkshire coalfields. The coal was delivered by rail and shunted around the yard on wagons. In 1971, a conveyor belt was destroyed in a fire and by 1991, the power station was closed and demolished, with the vacant land being repurposed as 'Low Fields Industrial Estate'.

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. Reference has been made to publicly available Government held digital data via QGIS (an Open-Source Geographic Information System). Extracts from the response received from Landmark, and responses from the Coal Authority, the BGS and the Environment Agency are presented in Appendix E. These responses are summarised below, together with the findings of our own "desk study" investigation.

Issue	**Data reviewed**	**Summary**
Geology	1:50,000 BGS map (Sheet 77) 1:10,000 BGS map (Sheet SE12SW) BGS Memoir Sheet 77	Drift soils – Glaciofluvial Deposits (sand and gravel) present in the north. No drift shown in the south. Solid (bedrock) – Pennine Lower Coal Measures (Mudstone, Siltstone and Sandstone). Shallowest coal seam – Halifax Hard Bed & Middle Band outcropping in the centre-west and west, dipping beneath the south of the site. See further details in Section 4.3 below. Strata dip – 5° southeast. Faults – none.
Mining	Coal Authority	This site is located wholly within a Coal Mining Development High Risk Area. Further details in Section 4.3 below.
Quarrying	Historical OS plans	Former clay pit in the southwest of the site, with infilled sand and gravel pits c. 250 northeast, and former shale quarry and clay pits to the east and south (partially backfilled).
Radon	Public Health England	The site lies in an area where less than 1% of homes are estimated to be above the action level. Further details in Section 12.5.
Hydrogeology	Environment Agency electronic open data via QGIS	Groundwater Source Protection Zone – No. Aquifer Secondary A (Drift); Secondary A (Solid). Vulnerability – High. Groundwater abstractions – None within 750m; One, c. 880m north - Ashday Ltd, Drinking, Cooking, Sanitary, Washing; active from June 1994. Pollution incidents – None affecting groundwater within 750m of the sites boundary. One event in August 1997, c. 880m southeast; category 3 (minor incident) - Spillage of poultry waste (solids) affecting a fishery (no fish killed.
Hydrology	Environment Agency Envirocheck Report	Dry ditches cutting north-south through the east and west of the site, feeding into the river Calder. Nearest watercourse – River Calder (130m, northeast). Water quality – Moderate ecological status. Pollution incidents – Two events within 250m of the sites boundary; June 1992, c. 80m northeast; category 2 (significant incident) – construction materials entered a river. August 1998, c. 110m northeast; category 3 (minor incident) – animal carcasses enter the River Calder: no pollution found, no fish killed. Abstractions – Nearest is 160m northeast for the former Calder Brick Works, dated December 2001. No potable abstractions within 1km of the site. Discharge consents – None of significance within 500m of the site.
Flood risk	Environment Agency electronic open data via QGIS	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 14 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. BGS groundwater flooding varies from '*limited potential for groundwater flooding to occur*' in the south to '*potential for groundwater flooding to occur at surface*' in the north.
SSSI\Ecology	Environment Agency electronic open data via QGIS	SSSI – None within 500m. Local nature reserve – Cromwell Bottom (149m, north-east).

4.2 Landfills

4.2.1 Known or suspected areas of landfill in the vicinity of the proposed development site are summarised below:

Location	**NGR (Proximity to site)**	**Remarks**	**Source of data**
Calder Works	SE 12066 21532 (on site)	Deposited Waste included Inert, Industrial and Commercial Waste 31st December 1990 - 31st December 1994 Current land use: grassland field and infilled land	EA electronic open data via QGIS* Envirocheck Report
Ash Lagoons, Land at Low Fields	SE 12042 21692 (24m north)	Deposited Waste included Industrial Waste 31st December 1959 - 31st December 1991 Current land use: Caravan storage facility	EA electronic open data via QGIS* Envirocheck Report
Ash Lagoons, Land at Low Fields	SE 11876 21703 (81m north-west)	Deposited Waste included Inert and Industrial Waste, and Liquid Sludge 2nd December 1991 - 24th March 1994 Current land use: Wasteland	EA electronic open data via QGIS* Envirocheck Report

* QGIS is an Open-Source Geographic Information System.

4.2.2 Calder Works landfill is shown on EA records to encompass the site, extending off site to the east. However, no evidence of landfilling (deposited wastes, disturbed ground etc) was encountered during the fieldwork; see Section 9. As such it is assumed whilst the licence for the Calder Works landfill covers the site, wastes were not deposited within the boundary of the proposed development.

4.2.3 However, there is potential for generation of hazardous gas from materials deposited off site within the Calder Works landfill.

4.2.4 The Ash Lagoons associated with the former Elland Power Station were infilled to allow the construction of ‘Low Fields Industrial Estate’.

4.2.5 The majority of the lagoons have been built over, with one small portion to the northwest of the site having been left as grass scrubland.

4.2.6 It is considered that there is potential for hazardous gas generation from the ash lagoon backfill.

4.3 Coal & mining

General

4.3.1 Coal has been mined in Yorkshire for centuries; the first mining probably took place in the fifteenth century. Early mining methods included drifts or adits from outcrop. Where mining extended further from the crop, bell pits were often sunk, and as the coal got deeper still, shafts were used to access gallery workings (pillar & stall).

4.3.2 The shafts associated with bell pits are typically only about 1.2m in diameter, and the bell pit itself was typically 5m to 10m in diameter (bell pit size would have been constrained by roof stability). Consequently, bell pits are often closely spaced; the most intensive concentration of shafts recorded to date (66 per acre) was at the Middleton Broom Opencast site.

4.3.3 As coal was removed during bell pitting, the unsupported strata above formed a bee-hive shape around the base of the shaft which forms the characteristic vertical section. The depth limit of bell pit mining is almost certainly 15m, and this is considered a deep bell pit; the vast majority were probably less than half this depth.

4.3.4 At greater depths, pillar and stall workings appear to have been the preferred method, and such workings were often accessed via a single shaft. Consequently, shafts associated with such workings are more widely spaced; but rarely exceeded one quarter of a mile (400m) shaft to shaft, due to problems with ventilation and underground haulage. It was customary to view the life expectancy of an individual pit as about three to five years and at any one time several new pits would be sinking to replace those currently operating.

4.3.5 Up until the last decades of the eighteenth century, coal mining almost always represented a short-term interruption to ongoing use of land for agricultural. The right to sink shafts and extract coal was usually conditional upon restoration of the surface after coal extraction was complete. This not only involved filling the shaft, but also required that any subsequent settlement of shaft fill material did not result in depressions in the field surface. Consequently, it was usual to fill the shaft and heap excess arisings into a dome over the shaft eye. Over subsequent years, the dome supplied material to compensate for settlement of the shaft fill. In the normal course of events, at the conclusion of the recovery period, any remaining spoil accumulations above ground level would have been planed off to leave a relatively stable, level surface where the shaft had been.

4.3.6 In general plan, gallery workings consisted of a series of parallel, rectangular working chambers separated by long piers or pillars of coal, colloquially referred to as benks or banks. The major axis of the galleries was generally up the dip although strike working was not uncommon.

4.3.7 Although the broad direction of the stalls was adhered to, there tended to be considerable wandering in the alignment of the pillars, which followed the natural partings provided by the cleat of the coal. There is no sense of the disciplined influence of a surveyed pre-plan, but rather it would appear that the skill of individual miners conditioned the degree to which the workings approached formal regularity. The fact that some pillars drifted into adjacent stalls implies a lack of formal control of progress. It may be that the intermittent cross headings that penetrated laterally through the pillars were intended to provide a check upon the extent to which parallel headings were being preserved.

4.3.8 Usually, the length of the stall extended for up to 10m, but some were extremely attenuated, occasionally running uninterruptedly for 15m or more. There was considerable variation in the width of the stalls, ranging between 2m and 6m and an even more noticeable variation in the width of the pillars. The most substantial pillars were about 2.5m in width but many were reduced to less than 0.5m in width. It is possible that this reduction in pillar with was a result of robbing.

4.3.9 Timber props supported the roof where the stall span was greater than about 2m. Prop withdrawal on closure of a mine does not seem to have been prevalent.

4.3.10 From the late 18th century onwards, packing of mineworkings became common practice. Packing of workings (known as 'goaf' packing) was done using unwanted materials associated with mining of the target seam (e.g. dirt partings, dark mudstone, clay, poor quality coal etc). This material was then 'packed' by hand into the stalls (voids) from which the coal had been removed, as mining of 'fresh' coal progressed.

4.3.11 As mining continued, the 'roof' of the stall often lost support and would sag/subside, coming to rest on, and compressing, the packed material. This process was done systematically, meaning that the vast majority (if not all) of the stalls were fully packed come the end of mining. However, a small area around the shaft (also known as a 'shaft porch'), tramways and waterways (used to drain workings towards a pumping shaft) would not be packed. Tramways and waterways are linear and of limited width (unlike 'open' stalls), making them very difficult to target during an intrusive investigation.

4.3.12 Compression of the packed materials, and the fact that they comprise re-worked Coal Measures rock, make such former mineworkings very difficult to identify in rotary open probeholes (and possibly even in a cored boreholes).

Coal Authority & BGS information

4.3.13 In July 2011 the Coal Authority (CA) formalised their requirements in relation to planning applications and introduced some new terminology relating to coal mining development areas. This Section (and Section 9.8) provide the necessary mining risk assessment required by the proposed planning application.

4.3.14 This site is located wholly within a Coal Mining Development **High Risk Area** - an area with specific mining legacy risks to the surface, including mine entries; shallow coal workings etc)

4.3.1 BGS mapping shows that solid geology beneath the site lies within one fault block and bedrock comprises Pennine Lower Coal Measures (undifferentiated mudstones, siltstones and sandstones). Strata dip at about 3° southeast.

4.3.2 The BGS map suggests **three seams** underlie the site at shallow depths. These are (youngest/shallowest first):

- **Halifax Hard Coal** (also known as the Hard Bed Coal), between 0.6m and 0.8m thick, outcropping in the west and north of the site (same location as the CA have recorded). The Listeri Marine Band is associated with the Halifax Hard Bed.
- **Middle Band Coal**, about 0.3m thick, outcropping in the northwest corner of the site.
- **Halifax Soft Coal** (also known as the Soft Bed Coal), about 0.5m thick and outcropping c. 100m northwest of the site boundary.

4.3.3 The Halifax Soft Coal is underlain by at least 35m of Coal Measures bedrock within which there are no further significant coal seams.

4.3.4 Approximate outcrops are shown on Drawing 4246/8. However, it should be noted that seam outcrops plotted on geological maps have been known to be inaccurate by distances in excess of 100m.

4.3.5 The BGS Technical Report notes that both the Halifax Hard Bed and Halifax Soft Bed seams were **widely worked**, with the associated **seatearth** (fireclay and ganister) also worked. The Halifax Hard Bed is reported to be 0.5m to 1.0m thick with the Halifax Soft Bed reported to be 0.2m to 0.9m thick.

4.3.6 Given dip and topography, the Halifax Hard Coal is expected to underlie an area of about 56,000m^2 (70% of the site); the Middle Band Coal an area of about 79,000m^2 (98% of the site); and the Halifax Soft Coal the entire site.

4.3.7 The CA **mining report** suggest that two coal seams underlie the site at shallow depth. These are the:

- **Halifax Hard Coal** (0.76m to 1.68m thick) up to 12m depth below the site, outcropping in the west and north.
- **Halifax Soft Coal** (0.46m thick) between 43m and 44m deep, outcropping c. 100m northwest of the site boundary.

4.3.8 However, only one outcrop is shown (in the northwest) on the plot included with the CA mining report, likely the Halifax Hard Coal; the Middle Band coal is not shown. The CA mining report states that:

- The site is underlain by shallow workings *(the Halifax Hard Coal)*.
- There are probable unrecorded workings *(likely associated with the Halifax Hard Coal and possibly the Halifax Soft Coal)*
- There are no recorded spine roadways at shallow depth.
- There are three shafts within the site and numerous shafts and adits beyond the boundary.
- There are recorded coal outcrops within the site boundary *(Halifax Hard Coal).*
- There are no faults, fissures or break lines.
- There is a former opencast pit within 500m of the sites boundary.
- There are no CA managed tips within 500m of the sites boundary.
- There is no recorded mine gas within 500m of the sites boundary.
- There are no recorded mine water treatment schemes within 500m of the sites boundary.
- No notices or claims of subsidence in the area.
- Not in an area where notice to withdraw support has been given.

4.3.9 The mining reports suggests there are shallow workings (i.e. at less than 30m depth) within the Halifax Hard Coal.

4.3.10 However, it should be noted that it did not become a statutory requirement to maintain and preserve plans of abandoned mines until the Mine (Coal) Regulations Act of 1872 and consequently there may be mineworkings beneath the site for which the Coal Authority have no records.

4.3.11 **Abandonment plans** for workings have been obtained from the Coal Authority. These plans show **underground** workings within:

- **Halifax Hard Bed Clay**. These workings (dated 1938 &1939) are north of the railway, but the plan includes reference to 'old workings' beneath the site itself. Strata dip at 1 in 25 (2.3°) to the south-east. A section on the plan suggests the Clay was up to c. 1.5m thick, and was overlain by 150mm of Ganister and 0.75m of coal (**not** worked). See Drawings 4246/9A.
- **Halifax Hard Bed Coal**. These workings (dated between 1886 and 1905) underlie about 3.5 ha of land (c. 45% of the total site area). Many of the details usually included on an abandonment plan (e.g. coal sections, seams worked, seam dip, depths etc) are not included on this plan. See Drawings 4246/9B.
- **Halifax Soft Bed Coal**. These workings (dated between 1901 and 1907) underlie about 2.7 ha of land (c. 33%); see Drawings 4246/9C & 4246/9D. Strata dip at 1 in 18 (3.2°) to the south-east. The plan copied as Drawing 4246/9D includes a section from surface to c. 67m bgl which shows:
    - At 11m: 0.15m coal, over 1.4m of blue clay, over 0.3m coal (Hard Bed Band), over 0.9m of Seggar Clay
    - At 44m: 0.7m coal (Hard Bed), over 0.75m Seatearth
    - At 56m: 0.25m coal (Soft Bed Band)
    - At 67m: 0.46m coal (Soft Bed).

  These workings extend c. 600m beyond the site to the east. It is not clear where the above Section is located, but given reference to the Hard Bed Band coal (which lies c. 40m above the Hard Bed coal), it seems likely the Section is located well beyond the site to the east (beyond the outcrop of the Hard Bed Band coal).

4.3.12 Of the above, only workings in the Halifax Hard Bed Clay and the immediately underlying Halifax Hard Bed Coal have the potential to affect surface stability. Known workings in the Soft Bed Coal are deep enough not to be of concern.

4.3.13 There may also be unrecorded workings in the Halifax Hard Bed Clay & Coal beyond the extents shown on abandonment plans, and in the Middle Band Coal (if present).

Mine entries

4.3.14 Of the three mine entries shown on CA records within the site boundary, no detail regarding shaft depth, diameter or treatment (e.g. filling/capping) has been provided.

4.3.15 Prior to development it will be necessary confirm the location of the shafts shown on CA records. The CA will expect the developer's layout to assume a potential no-build "zone of influence" around each shaft based on the following calculation:

(0.5 x assumed shaft diameter) + departure + drift depth = zone of influence

4.3.16 In essence, departure relates to the degree of certainty with respect to the entry's location. The zones of influence here are:

Shaft Ref.	**Source**	**Approximate date Sunk**	**Departure (m)**	**Diameter (m)**	**Depth to bedrock (m)**	**Zone of influence (circle of radius) (m)**	**Remarks**
411421-008 (411945, 421461)	Abandonment plan & CA Report	1907 (OS Plan)	8	2.5	10	19.25	Assumed depth to bedrock from BGS BH log.
412421-012 (412066, 421532)	Abandonment plan & CA Report	1901 (OS Plan)	8	2.5	10	19.25	Assumed depth to bedrock Likely Halifax Hard Coal
412421-037 (412088, 421601)	Abandonment plan, CA Report & OS Plan	Pre – 1854 (OS Plan)	8	2.5	10	19.25	Assumed depth to bedrock Likely Halifax Hard Coal

4.3.17 It is worth noting that CA shaft positions are often only approximate, and in some cases the same shaft has been recorded in multiple locations, or some other feature such as a chimney has erroneously been recorded as a shaft.

4.3.18 Two of the shafts shown on CA records (Shaft Refs 412421-012 and 412421-037) roughly correspond to circular features (likely shafts) shown on the abandonment plan for the Halifax Hard Coal (see Drawing 4246/9B)

4.3.19 It should be possible to reduce the zone of influence after accurate location of the shafts.

4.3.20 The CA report also references a further 6 shafts and 7 adits, within 100m of the site boundary, most notably to the north (1 shaft and 7 adits), with 3 shafts to the northeast and 2 shafts to the southwest.

4.3.21 Given the shallow depth to coal, further unrecorded shafts and/or bell pits cannot be discounted at this stage.

4.4 Mineral safeguarded areas

4.4.1 The site is underlain by coal and might therefore be considered by the Local Authority to lie within a Mineral Safeguarding Area (MSA).

4.4.2 MSAs are areas of known mineral resources that are of sufficient economic or conservation value to warrant protection for generations to come. The purpose of MSAs is not to preclude automatically other forms of development, but to make sure that mineral resources are adequately and effectively considered in land-use planning decisions.

4.4.3 Specialist guidance on Mineral Safeguarding "A Guide to Mineral Safeguarding in England" has been produced by The Coal Authority and the British Geological Survey.

4.4.4 Paragraph 204 of the National Planning Policy Framework (NPPF) requires Local Authorities, when preparing Local Plans to:

- Define Minerals Safeguarding Areas and adopt appropriate policies in order that known locations of specific minerals resources of local and national importance are not needlessly sterilised by non-mineral development, whilst not creating a presumption that resources defined will be worked; and define Minerals Consultation Areas based on these Minerals Safeguarding Areas.
- Set out policies to encourage the prior extraction of minerals, where practicable and environmentally feasible, if it is necessary for non-mineral development to take place.

4.4.5 NPPF Paragraph 144 notes that when determining planning applications, local planning authorities should give weight to the benefits of the mineral extraction.

4.4.6 As a consequence of the NPPF, and the presence of coal beneath the site, the Local Authority may require the Developer to consider the opportunity to recover (extract) the coal. Applicants submitting planning applications may need to demonstrate to the Local Authority that they will extract the coal, unless:

- It can be shown it is not economically viable to do so, or
- It is not environmentally acceptable to do so, or
- The need for the development outweighs the need to extract the coal, or
- The coal will not be sterilised by the development

4.4.7 The viability of coal extraction at this site is considered later in this Report (Section 15.7) in light of the findings of Lithos' intrusive mining investigation, which comprised the drilling of 21 rotary probeholes to depths of between 15m and 33m (see Section 9.8).

4.5 Agriculture

4.5.1 Historical plans show that the site has been occupied by arable farmland. Generally farming is not considered likely to have caused significant ground contamination. However, activities such as slurry spreading, the discharge of chemicals to ground, and unregulated burial are known to have occurred on farmland. Potential contaminants associated with farming activity could include any of the following.

Agricultural activity	**Potential contaminant**
Sewage farming, slurry spreading	Methane, metals, nitrates, oxygen depletion
Plant & animal protection	Pesticides & herbicides
Soil conditioners	Metals, sulphates, PAH
Equipment maintenance	Hydrocarbons, metals
Derelict buildings	Asbestos
Waste burial, land levelling, backfilling ponds/quarries	Methane, metals, PAH etc
Naturally occurring contaminants	Arsenic, metals

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

5 PREVIOUS INVESTIGATION FINDINGS

5.1 General

5.1.1 Titchmarsh & Bagley have provided Lithos with a copy of the following report:

- 'Phase 1 Environmental Assessment for a Proposed Mixed Residential and Education Land Allocation for Land off Lower Edge Road and Shaw Lane, Elland' (Ref. 7587), issued by CoDa on the 26th of February 2016.

5.1.2 The report includes a review of data from a Landmark Envirocheck report, BGS geological maps, Coal Search Plus+ report and historical OS maps dating back to 1854. A site walkover was also undertaken on the 24th of February 2016. Sections 1 to 4 of this Lithos Report include similar content to the CoDa's report, but with further detail.

5.1.3 Lithos' also undertook a preliminary intrusive investigation on the 28th of October 2021 which comprised 7 trial pits. This preliminary phase of ground investigation was to establish if the site was underlain by made ground (waste) associated with the Calder Works Landfill and to briefly examine the backfill material of the former clay pit present in the west.

5.2 Summary of CoDa's findings

5.2.1 CoDa's findings were consistent with the environmental setting and site features and history summarised in Sections 2, 0, & 4 above.

5.2.2 CoDa's desk study comprised:

- A site walkover and inspection undertaken on the 24th of February 2016.
- An assessment of the land use history using extracts of historic OS plans dated back to 1854.
- Determination of the site's environmental setting, including anticipated ground conditions.
- Examination of historic mining beneath the site, based off a mining report prepared by D Bellis Consulting Surveyors.
- Consideration of hydrogeology and hydrology of the site.
- The production of an inclusive site conceptual model.
- Recommendations for the necessary intrusive ground investigation works.

5.3 Lithos comments

5.3.1 CoDa's report is comprehensive including a well-documented site history, environmental search, and careful consideration towards the conceptual site model. This has led to a clear identification of potential sources, pathways, and receptors, with proposals for intrusive site investigation presented.

5.3.2 The proposed ground investigation design includes trial pitting and window sampling to collect soil samples for contamination testing and to install gas monitoring wells with a minimum of six visits proposed. Rotary probeholes area also proposed to check for the presence of shallow coal workings.

5.3.3 CoDa also suggest cable percussion boreholes if deep made ground or landfill material is encountered during the pitting.

5.3.4 However, CoDa's desk study is now over 5 years old and as such, new environmental search data and historical OS maps should be obtained with a new walkover undertaken.

5.3.5 The recommended intrusive works will now also be required to confirm ground conditions and provide recommendations for the necessary site preparatory and remediation works.

5.4 Lithos investigation (2021)

5.4.1 A Lithos engineer visited the site on 28th October 2021 to undertake an exploratory phase of investigation comprising the excavation of 7 trial pits to between 1.9m and 2.7m depth.

5.4.2 The trial pits were excavated across the site to determine the nature and extent of any backfill materials associated with the Calder Works landfill recorded on site.

5.4.3 Typically, the trial pits encountered a veneer of Topsoil (up to 300mm thick), over Cohesive Glaciofluvial Deposits (firm gravelly Clay) and Cohesive Residual Soils (firm to stiff gravelly Clay, from the complete weathering of bedrock). Coal Measures bedrock (mudstone) was encountered from around 2.5m depth.

5.4.4 A thin veneer of Made Ground (reworked Topsoil) was encountered within the footprint of the former farm buildings. Deeper Made Ground (including Ash & Clinker) was encountered to 2.4m depth within the footprint of the former clay pit in the southwest.

5.4.5 No evidence of landfilling (anthropogenic materials, disturbed ground) was noted in any of the remaining trial pits suggesting that, although EA records show the site to lie within the permitted area of the Calder Works landfill, no disposal has taken place within the site boundary.

5.4.6 The findings of the Lithos trial pitting are incorporated into this report, with trial pit logs included in Appendix F. Trial pit & mini-WS borehole locations are shown on Drawing 4246/6A; probehole locations are shown on Drawing 4246/6B.

6 PRELIMINARY CONCEPTUAL SITE MODEL

6.1 An assessment of potential contaminants associated with the former uses has been undertaken with reference to CLR8 and the following DETR Industry Profiles:

- Waste recycling, treatment, and disposal sites: *landfills and other waste treatment or waste disposal sites.*
- Power Stations *(excluding Nuclear Power)*.

6.2 As a consequence of this assessment, anticipated potential contaminants, within soil and/or groundwater include:

- Inorganics (metals, asbestos associated with made ground, airborne emissions)
- TPH & PAH (fuels, oils associated with machinery use and maintenance)
- Pesticides (whilst these may have been used it is unlikely these will be detected in soil samples)

6.3 Historical plans show a former clay pit (now infilled) in the southwest, with Shaw Laithe farm (now demolished) in the east; these areas should be targeted during the investigation.

6.4 A preliminary conceptual site model, presented as Drawing 4246/5 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 4.

6.5 Clearly, the conceptual model will be subject to modification in light of data arising from the proposed intrusive ground investigation.

6.6 Potential contaminant linkages are shown on the preliminary conceptual site model. The most significant receptor is the end-users through the inhalation pathway.

7 GROUND INVESTIGATION DESIGN

7.1 Anticipated ground conditions & potential issues

7.1.1 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	Deep made ground likely within the footprint of the backfilled clay pit. Shallow Made Ground in footprint of the former Shaw Laithe Farm.
Natural soils	Topsoil Glaciofluvial deposits (slightly gravelly Clay) in the north. Cohesive Residual Soils (firm to stiff gravelly Clay) and Granular Residual Soils (slightly clayey Gravel) from the complete weathering of bedrock in the south.
Bedrock	Coal Measures (Mudstone and Siltstone), from c. 2mbgl.
Mineworkings	Workings anticipated in the Halifax Hard coal at shallow depth (<30m) Three mine shafts shown within the site boundary on CA records; further unrecorded shafts/bell pits may be present.
Groundwater	Possible perched water in granular soils. Deeper groundwater within Coal Measures bedrock. Abandonment plans suggest the mineworkings underlying the site (Halifax Soft Bed) are likely to be flooded (Soft Bed Coal mine was abandoned in 1914 when the water pumps malfunctioned and the mine flooded).

7.1.2 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. reworked topsoil (inorganics, organics) 2. backfilled clay pit 3. former farmyard. 4. former tramway	1. farming activities, construction of pylons. 2. inorganic and organic contaminants 3. inorganic and organic contaminants 4. spillage/leakage of organics
Potential off-site contamination sources	1. Calder Works (east) and the former Elland Power Station 2. historic landfills	1. windblown debris (dust, demolition works), emissions (inorganic contaminants) 2. gas generation potential
Potential geotechnical hazards	1. relict buried obstructions 2. deep made ground 3. steep slopes 4. shallow coal workings 5. mine shafts	1. within the former farmyard 2. backfilled clay pit 3. railway embankment along the northern boundary 4. shallow coal workings may require treatment (drilling & grouting) 5. shafts will require locating with grouting and/or capping
Other potential constraints	1. surface watercourse 2. underground and overhead utilities	1. in the northwest and centre north (ditches that lead into the River Calder) – the site will require a silt management plan 2. accommodation into the site layout unless they can be relocated

7.2 Ground investigation design & strategy

7.2.1 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**
c. 45 Trial Pits	To determine the general nature of soils underlying the site, including the: • Nature, distribution, and thickness of made ground • Nature, degree, and extent of contamination • Proportion of undesirable elements e.g., biodegradable matter, foundations etc • Suitability of the ground for founding structures and highways
18 Window Sampling Boreholes	To install monitoring wells across the site in order to: • Monitor for hazardous gas • Determine shallow groundwater levels
20 deep Probeholes	To check for the presence of voids or broken ground associated with possible unrecorded shallow mine workings To install deep groundwater and gas monitoring wells in selected holes (c. 8 wells)

7.2.2 Proposed exploratory hole locations were selected to provide a representative view of the strata beneath the site and to target historic features presented on Drawing 4246/3A in Appendix B.

7.2.3 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.

8 FIELDWORK

8.1 Objectives

8.1.1 The original investigation strategy is outlined in Section 7.2 above.

8.2 Exploratory hole location constraints

8.2.1 Exploratory holes could not be excavated within 10m of existing electricity overheads and within 3m from underground services. Furthermore, probeholes could not be advanced within 50m of the northern boundary due to network rail infrastructure.

8.2.2 Ground conditions are unlikely to vary significantly where access was restricted. However, one of the recorded mineshafts (CA Ref. 412421-012) is shown to conflict with an existing electric cable which will rule out further trenching to locate it.

8.3 Scope of works

8.3.1 Fieldwork was supervised by Lithos on the 28th October 2021 (TPs 1 to 7), between 21st and 24th of March 2022 (TPs 101 to 150 & WSs 101 to 118), and between the 4th and 7th of April 2022 (PHs 01 to 21), and comprised the exploratory holes listed below:

Technique	Exploratory holes	Final depth(s)	Remarks
Trial pitting (machine dug)	TPs 01 to 07	1.9m to 2.7m	Previous exploratory phase of SI.
	TPs 101 to 147	1.7m to 2.8m	-
	TPs 147 to 150	0.8m to 0.9m	Additional shallow trial pits to delineate made ground associated with former farm.
Window sample boreholes	WSs 101 to 118	3m	Shallow monitoring wells installed in each hole.
Rotary open-hole probeholes	PHs 101 to 121	15m to 33m	To check for shallow coal workings
	PHs 105A, 107A, 109A, 113A, 115A, 120A &121A.	6.0m	Monitoring wells installed

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

8.3.3 Exploratory hole logs are presented in Appendices F to H to this Report. These logs include details of the:

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

8.3.4 Exploratory hole locations are shown on Drawings 4246/6A (TPs & WS) and 4246/6B (PHs) presented in Appendix B; exploratory holes were picked-up by a surveyor and co-ordinates/ground levels are included on the logs.

9 GROUND CONDITIONS

9.1 General

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

9.1.2 The site can be divided into areas based on former use. These areas are shown on Drawing 4246/6B and are summarised below:

Site area	General location	Area (m²)
A#	Former Clay Pit (west)	850
B	Former Shaw Laithe Farmyard (east)	3,750
C	Former Tramway (oriented approximately southwest-northeast through centre of site)	1,100
D	Remainder of site – (grassed fields)	74,600

Notes: # clay pit extends off site; total footprint c. 2,000m².

9.1.3 Typical ground conditions encountered in each of these areas are described below in Sections 9.2 (made ground) and 9.4 (natural ground), with a summary provided in the table on pages 23 to 26.

9.2 Made ground

9.2.1 The made ground on site is a heterogeneous mixture of materials and it is unlikely, even with a huge amount of sampling, that it could be accurately characterised.

9.2.2 Made ground was identified locally across the site, predominantly in areas with a former historical use as described in the above table. The table below tabulates the areas of made ground recovered:

Site area	Exploratory locations	Former use	Nature of made ground & typical depth (m)
A	TPs 05, 111 & 115	Clay Pit	Made Ground, up to 2.4m depth, comprising **Reworked Coal Measures** (gravelly Clay and clayey Gravel), together with **Ash & Clinker** (0.1m thick).
B	TPs 02, 119-123	Farmyard	Made Ground to between 0.25m and 0.8m depth, predominantly comprising **Made Ground Topsoil** (sandy Clay) and **Cohesive Made Ground** (gravelly, sandy Clay), together with localised thin beds of **Ash & Clinker** (up to 0.3m thick).
C	TPs 116, 125, 133 & 148	Tramway	**Cohesive Made Ground** (gravelly clay) and **Granular Made Ground** (clayey Gravel) recorded in two pits (TP125 & 148) up to 0.7m depth. TPs 116 & 133 are in the path of the former tramway but made ground was not encountered.
Within D	TPs 114, 124 &135 (North & South)	Mineshafts	**Granular Made Ground** (gravelly Clay of coal and mudstone) to >2.6m depth (TP135), at the location of a former mine shaft (possible shaft backfill). **Colliery Spoil**, up to 0.6m depth comprising gravel of mudstone identified in TP114. TP124 did not encounter any evidence of shaft backfill or made ground.

9.2.3 **Made Ground Topsoil** (sandy, slightly gravelly Clay with occasional glass, ceramic etc) was identified overlying each of the made ground types summarised in the above table.

9.2.4 Made ground was typically absent across the majority of the site (Area D), with only a localised veneer of Made Ground Topsoil and occasional Granular Made Ground (up to 1.5m depth, typically < 0.6m) recorded in the northeast, adjacent to the former Shaw Laithe Farm (TPs 131, 132, 149, 150 & WS109). TP 112, encountered Made Ground Topsoil to 0.5m depth, possibly associated with the construction of the residential housing estate to the west in the late 1970's.

9.2.5 Deep made ground, to 2.4m depth, was encountered within the clay pit.

9.2.6 The made ground encounter within TP135(N) extended beyond 2.6m, but could not be bottomed out due to the limited reach of the excavator. This made ground comprised a black, gravelly Clay, with gravel comprising angular tabular fragments of coal and mudstone.

9.2.7 Made ground in excess of 2m deep was only encountered in three of the exploratory holes excavated within the footprint of the former clay pit and the mine shaft.

9.2.8 No evidence of landfill material (industrial or household waste, reworked ground etc) was noted in any of the exploratory holes suggesting that whilst the licensed boundary of Calder Works encompasses the site, landfilling was likely restricted to former quarries to the east, beyond the area of current interest.

9.3 Obstructions

9.3.1 It is apparent from a review of historical OS Plans (see Section 3) that buildings have been present on about 1% of the site area (Shaw Laithe farm), with the surrounding farmyard covering c. 5% of the site. Drawing 4246/3A shows the footprints of the former structures.

9.3.2 Trial pits have been excavated at locations where relict foundations were anticipated (based on superimposition of the 1974 OS Plan on the current site layout).

9.3.3 Other than a few tabular sandstone cobbles, no significant obstructions were encountered although some redundant services (pipes, drains etc) may remain.

9.3.4 Trial pits excavated along the route of the former tramway did not encounter any significant buried obstructions (former rails, signalling infrastructure etc).

9.3.5 No significant obstructions or oversize materials (stonework, masonry etc) were encountered within the backfilled clay pit.

Summary of Ground Conditions

Hole ID	Final depth (m)	Depth to base of Made Ground (m)	Depth to Base of: (m bgl)									Depth to Bedrock (m) Mudstone, Sandstone & Siltstone	Remarks
			Made Ground Topsoil	Ash & Clinker	Granular Made Ground	Cohesive Made Ground	Topsoil	Cohesive Glaciofluvial Deposits	Granular Glaciofluvial Deposits	Cohesive Residual Soil	Granular Residual Soil		
			Sandy Clay	Sand/ Gravel	Clayey Gravel	Gravelly Clay	Sandy Clay	Gravelly Clay	Clayey Gravel	Gravelly Clay	Clayey Gravel		
AREA A: Clay pit (trial pits excavated within the footprint of a former clay pit)													
TP05	2.7	2.4	0.25	-	2.4	-	-	-	-	>2.7	-	-	-
TP111	2.7	2.1	0.2	0.3	-	2.1	-	-	-	-	> 2.7	-	-
TP115	2.6	-	-	-	-	-	0.3	1.2	-	2.1	-	-	**Coal** 2.1m to 2.6m.
AREA B: Farmyard (trial pits excavated within the boundary of a former farmyard)													
TP02	1.9	0.25	0.25	-	-	-	-	0.7	-	1.5	> 1.9	-	-
TP119	2.5	0.7	0.3	-	-	0.7	-	1.6	-	2.0	>2.5	-	-
TP120	2.4	0.4	0.4	-	-	-	-	1.6	-	-	>2.4	-	-
TP121	2.6	0.6	0.3	0.6	-	-	-	1.1	-	1.5	>2.6	-	-
TP122	2.7	0.8	0.05	0.3	-	0.8	-	1.2	-	2.5	>2.7	-	Redundant lead and clay pipes at 0.2m and 0.6m respectively.
TP123	2.5	-	-	-	-	-	0.3	0.5	-	2.1	>2.5	-	-
AREA C: Tramway (trial pits excavated along the route of a former tramway)													
TP116	2.3	-	-	-	-	-	0.3	1.2	-	>2.3	-	-	-
TP125	2.3	0.6	0.3	-	-	0.6	-	1.5	-	>2.3	-	-	-
TP133	2.2	-	-	-	-	-	0.2	1.0	-	-	1.9	1.9	Mudstone at 1.9m.
TP148	0.9	0.7	0.3	-	0.7	-	-	> 0.9	-	-	-	-	-
AREA D: Remainder of site (grassed farmland)													
TP01	2.3	-	-	-	-	-	0.3	1.3	-	1.9	> 2.3	-	-
TP03	2.5	-	-	-	-	-	0.3	1.2	-	2.2	> 2.5	-	-
TP04	2.2	-	-	-	-	-	0.3	1.2	-	2.0	> 2.2	-	-
TP06	1.9	-	-	-	-	-	0.25	0.8	-	1.7	> 1.9	-	-
TP07	2.3	-	-	-	-	-	0.3	0.9	-	2.3	-	-	-
TP101	2.7	-	-	-	-	-	0.2	-	-	2.2	>2.7	-	-

Hole ID	Final depth (m)	Depth to base of Made Ground (m)	Depth to Base of: (m bgl)									Depth to Bedrock (m) Mudstone, Sandstone & Siltstone	Remarks
			Made Ground Topsoil	Ash & Clinker	Granular Made Ground	Cohesive Made Ground	Topsoil	Cohesive Glaciofluvial Deposits	Granular Glaciofluvial Deposits	Cohesive Residual Soil	Granular Residual Soil		
			Sandy Clay	Sand/ Gravel	Clayey Gravel	Gravelly Clay	Sandy Clay	Gravelly Clay	Clayey Gravel	Gravelly Clay	Clayey Gravel		
TP102	2.6	-	-	-	-	-	0.3	-	-	1.0, 2.3	1.7, > 2.6	-	At 1.1m, sandstone boulder in east of pit.
TP103	3.2	-	-	-	-	-	0.3	-	-	1.8	>3.2	-	-
TP104	2.6	-	-	-	-	-	0.3	-	-	1.9	>2.6	-	-
TP105	2.5	-	-	-	-	-	0.3	-	-	>2.5	-	-	-
TP106	2.4	-	-	-	-	-	0.2	-	-	1.3	> 2.4	-	-
TP107	2.5	-	-	-	-	-	0.3	-	-	2.0	>2.5	-	-
TP108	2.5	-	-	-	-	-	0.3	-	-	1.8	>2.5	-	At 0.7m, terracotta field drain, no flow.
TP109	2.4	-	-	-	-	-	0.3	1.2	-	> 2.4	-	-	-
TP110	2.8	-	-	-	-	-	0.3	0.6	-	> 2.8	-	-	-
TP112	2.5	0.5	0.5	-	-	-	-	-	-	> 2.5	-	-	From 2.2m, difficult to excavate.
TP113	2.0	-	-	-	-	-	0.3	0.6	-	> 2.0	-	-	-
TP117	2.5	-	-	-	-	-	0.3	0.9	-	> 2.5	-	-	-
TP118	2.6	-	-	-	-	-	0.3	0.7	-	>2.6	-	-	-
TP126	2.3	-	-	-	-	-	0.3	1.0.	-	> 2.3	-	-	-
TP127	2.1	-	-	-	-	-	0.3	1.4	-	> 2.1	-	-	-
TP128	2.5	-	-	-	-	-	0.3	1.2	-	> 2.5	-	-	-
TP129	2.4	-	-	-	-	-	0.3	1.2	-	1.9	>2.4	-	-
TP130	2.3	-	-	-	-	-	0.3	0.6	-	> 2.3	-	-	-
TP131	2.6	0.4	0.4	-	-	-	-	2.0	-	>2.6	-	-	-
TP132	1.8	1.5	0.4	-	1.5	-	-	> 2.3	-	-	-	-	-
TP134	2.5	-	-	-	-	-	0.4	1.5	-	-	>2.5	-	-
TP136	2.3	-	-	-	-	-	0.3	0.9	-	> 2.3	-	-	-
TP137	2.4	-	-	-	-	-	0.3	1.0	-	> 2.4	-	-	-
TP138	2.5	-	-	-	-	-	0.3	1.3	-	> 2.5	-	-	-

Hole ID	Final depth (m)	Depth to base of Made Ground (m)	Depth to Base of: (m bgl)									Depth to Bedrock (m) Mudstone, Sandstone & Siltstone	Remarks
			Made Ground Topsoil	Ash & Clinker	Granular Made Ground	Cohesive Made Ground	Topsoil	Cohesive Glaciofluvial Deposits	Granular Glaciofluvial Deposits	Cohesive Residual Soil	Granular Residual Soil		
			Sandy Clay	Sand/ Gravel	Clayey Gravel	Gravelly Clay	Sandy Clay	Gravelly Clay	Clayey Gravel	Gravelly Clay	Clayey Gravel		
TP139	1.7	-	-	-	-	-	0.3	0.8	-	> 1.7	-	-	From 1.3m to 1.7m sandstone boulder in pit, unable to excavate further.
TP140	2.4	-	-	-	-	-	0.3	1.1	-	> 2.4	-	-	-
TP141	2.3	-	-	-	-	-	0.3	1.0	-	> 2.3	-	-	-
TP142	2.4	-	-	-	-	-	0.3	0.7	-	> 2.4	-	-	-
TP143	2.4	-	-	-	-	-	0.4	1.4	-	> 2.4	-	-	-
TP144	2.2	-	-	-	-	-	0.2	1.4	-	2.0	-	2.0	Mudstone at 2.0m.
TP145	2.4	-	-	-	-	-	0.3	-	0.9	-	>2.4	-	-
TP146	2.4	-	-	-	-	-	0.3	1.3	-	> 2.4	-	-	-
TP147	2.2	-	-	-	-	-	0.2	-	0.9	-	>2.2	-	-
TP149	0.9	0.6	0.6	-	-	-	-	> 0.9	-	-	-	-	-
TP150	0.8	0.6	0.6	-	-	-	-	-	> 0.8	-	-	-	-
WS101	3.0	-	-	-	-	-	0.2	-	-	0.7, 1.55	0.75	1.55	Mudstone at 1.55m.
WS102	3.0	-	-	-	-	-	0.25	-	-	1.7		1.7	Mudstone at 1.7m.
WS103	3.0	-	-	-	-	-	0.3	-	-	>2.0	-	-	No recovery 2.0m to 3.0m, likely due to a cobble.
WS104	3.0	-	-	-	-	-	0.3	-	-	1.8, >3.0	2.0	-	-
WS105	3.0	-	-	-	-	-	0.3	-	-	1.0, 2.0	1.1	2.0	Mudstone at 2.0m.
WS106	3.0	-	-	-	-	-	0.3	1.0	-	1.8	-	1.8	No recovery 1.0m to 1.3m, likely due to a cobble with mudstone at 1.8m.
WS107	3.0	-	-	-	-	-	0.3	0.5	-	0.8	> 3.0	-	-
WS108	3.0	-	-	-	-	-	0.2	0.9	-	1.9	1.2	1.9	Mudstone at 1.9m.
WS109	3.0	0.5	0.3	-	0.5	-	-	-	0.8	1.9	1.6	1.9	Mudstone at 1.9m.
WS110	3.0	-	-	-	-	-	0.2	-	0.6	>3.0	1.9	-	-
WS111	3.0	-	-	-	-	-	0.3	0.65	-	2.0	0.85	2.0	Mudstone at 2.0m.
WS112	3.0	-	-	-	-	-	0.2	0.5	-	>3.0	-	-	-

Hole ID	Final depth (m)	Depth to base of Made Ground (m)	Depth to Base of: (m bgl)									Depth to Bedrock (m) Mudstone, Sandstone & Siltstone	Remarks
			Made Ground Topsoil	**Ash & Clinker**	**Granular Made Ground**	**Cohesive Made Ground**	**Topsoil**	**Cohesive Glaciofluvial Deposits**	**Granular Glaciofluvial Deposits**	**Cohesive Residual Soil**	**Granular Residual Soil**		
			Sandy Clay	**Sand/ Gravel**	**Clayey Gravel**	**Gravelly Clay**	**Sandy Clay**	**Gravelly Clay**	**Clayey Gravel**	**Gravelly Clay**	**Clayey Gravel**		
WS113	3.0	-	-	-	-	-	0.3	0.9	-	1.1, >3.0	1.2	-	-
WS114	3.0	-	-	-	-	-	0.2	0.4	-	2.6	-	2.6	Siltstone at 2.6m.
WS115	3.0	-	-	-	-	-	0.2	0.3	-	2.85	-	2.85	Sandstone at 2.85m.
WS116	3.0	-	-	-	-	-	0.2	0.4	-	>3.0	-	-	No recovery 0.4m to 1.3m.
WS117	3.0	-	-	-	-	-	0.25	0.5	-	2.8	-	2.8	Sandstone at 2.8m.
WS118	3.0	-	-	-	-	-	0.2	0.45, 1.1	0.6	>3.0	-	-	Cobble at 0.45m.
WITHIN AREA D: Mine shafts (trial pits excavated at the anticipated location of mineshafts based on CA records)													
TP114	2.4	0.6	0.3	-	0.6	-	-	-	-	1.6, >2.4	-	-	**Colliery Spoil** (gravel of mudstone) to 0.6m. Black **Coal** at 1.6m to 1.8m.
TP124	2.5	-	-	-	-	-	0.3	1.7	-	2.1	>2.5	-	-
TP135 (N)	2.6	> 2.6	0.3	-	-	> 2.6	-	-	-	-	-	-	Possible **shaft** in north of pit. Limit of excavator reached at 2.6m
TP135 (S)	2.6	-	-	-	-	-	0.3	1.2	-	>2.6	-	-	-

9.4 Natural ground

9.4.1 Natural ground was encountered in the all of the exploratory holes beyond the backfilled clay pit, and typically comprised the following strata:

- **Topsoil:** slightly sandy, slightly gravelly Clay identified across the site beyond areas of made ground to a typical depth of 300mm.
- **Cohesive Glaciofluvial Deposits:** comprising firm to stiff slightly sandy, slightly gravelly Clay to a typical depth of 1.6m in the north.
- **Granular Glaciofluvial Deposits:** typically comprising clayey, slightly gravelly Sand to 0.9m in the far northeast.
- **Cohesive and Granular Residual Soils:** firm/stiff gravelly Clay and clayey Gravel from the complete weathering of bedrock, identified in the majority of exploratory holes.
- **Coal Measure Bedrock:** from between 1.6m to 2.8m depth, typically around 2.5m, recorded in 12 of the 75 of the shallow exploratory holes (TPs and WS). Typically recovered as tabular Gravel of mudstone or sandstone.

  The soil/rock interface could be considered as gradational as the effects of weathering become less pronounced with depth.

9.4.2 The **Halifax Hard Coal,** between 0.2m to 0.5m thick, was identified in two trial pits (TPs 114 & 115) from 1.6m depth. These pits are located just south of the outcrop shown on BGS plans suggesting it is reasonably accurate.

9.4.3 Coal was also identified in 8 probeholes during the mining investigation, further detail is provided in Section 9.8

9.5 Visual & olfactory evidence of organic contamination

9.5.1 No visual or olfactory evidence of gross organic contamination was encountered during the site investigation in any of the exploratory holes.

9.6 Stability

9.6.1 Stability of excavations within the natural ground was ground was generally good. However, some spalling and overbreak was recorded in the Granular Made Ground (primarily in the vicinity of the former Shaw Laithe Farm).

9.7 Groundwater

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

9.7.2 Groundwater levels recorded to date in the monitoring wells are summarised below.

Hole ID	**Response zone (depth range & strata)**	**Groundwater body**	**Typical standing water level**	
			m bgl	**m AoD#**
WS101	1.5m - 3.0m (Cohesive Residual & Coal Measures)	Shallow (drift)	1.35	87.73
WS102	1.5m - 3.0m (Cohesive Residual & Coal Measures)		ND	-
WS103	1.5m - 3.0m (Cohesive Residual)		ND	-
WS104	1.5m - 3.0m (Cohesive & Granular Residual)		ND	-
WS105	1.5m - 3.0m (Cohesive Residual & Coal Measures)		ND	-
WS106	1.5m - 3.0m (Cohesive Residual & Coal Measures)		ND	-
WS107	1.5m - 3.0m (Granular Residual)		ND	-
WS108	1.5m - 3.0m (Cohesive Residual & Coal Measures)		ND	-
WS109	1.5m - 3.0m (Granular & Cohesive Residual & Coal Measures)		2.62	70.71
WS110	1.5m - 3.0m (Granular Residual & Weathered Coal Measures)		ND	-
WS111	1.5m - 3.0m (Cohesive Residual & Coal Measures)		ND	-
WS112	1.5m - 3.0m (Cohesive Residual)		ND	-
WS113	1.5m - 3.0m (Cohesive Residual)		2.99	70.91
WS114	1.5m - 3.0m (Cohesive Residual & Coal Measures)		1.55	79.11
WS115	1.5m - 3.0m (Cohesive Residual & Coal Measures)		2.40	76.68
WS116	1.5m - 3.0m (Cohesive Residual)		2.75	74.64
WS117	1.5m - 3.0m (Cohesive Residual & Coal Measures)		3.07	73.29
WS118	1.5m - 3.0m (Cohesive Residual)		ND	-
PH101	2.0m – 4.0m (Cohesive Residual & Coal Measures)		ND	-
PH105A	3.0m – 6.0m (Coal Measures)		5.60	85.10
PH107A	3.0m – 6.0m (Cohesive Residual & Coal Measures)		ND	-
PH109A	3.0m – 6.0m (Cohesive Residual & Coal Measures)		ND	-
PH113A	3.0m – 6.0m (Cohesive Residual)		5.59	70.26
PH115A	3.0m – 6.0m (Cohesive Residual, Granular Residual & Coal Measures)		ND	-
PH120A	3.0m – 6.0m (Coal Measures)		ND	-
PH121A	3.0m – 6.0m (Cohesive Residual & Coal Measures)		ND	-

Note: # levelled-in by survey to enable groundwater risk assessment

9.7.3 Dip data to date suggests a deep water table with the majority of the wells dry.

9.7.4 After an initial dip to record standing water level, selected wells were bailed-out to establish an approximate rate of **recharge**. Findings were:

Hole	Vol. removed /litres	Water level lowered by /m	From / to m bgl	Water level recovered to /m bgl	After / mins	Recovery rate
WS101	5	1.64	1.35 to 2.99	2.03	253	Slow
WS114	4	1.36	1.55 to 2.91	2.79	155	Slow

Note: In a 50mm diameter well pipe there is approximately 2 litres of water per metre of water column.

9.7.5 It is apparent from the above that permeability of the ground is quite low – unsurprising given that all well response zones intercepted cohesive soils and Coal Measures bedrock.

9.7.6 These results will be required by the foundation designer, drainage designer, and groundworker (especially if/where deep excavation is required).

9.8 Mining investigation

Shallow workings (rotary probeholes)

9.8.1 It is clear from the desk study that the site is underlain by shallow mineworkings associated with the Halifax Hard Coal. Although recorded as worked, the Halifax Soft Coal lies at sufficient depth to not pose a risk to surface stability of the site.

9.8.2 The conjectured outcrop of the Halifax Hard, Middle Band and Halifax Soft coal seams are shown on Drawings 4246/6A and 4246/8 in Appendix B to this report.

9.8.3 Consequently, a mining investigation has been undertaken, comprising the drilling of 21 deep rotary open-hole probeholes. The investigation identified coal, soft ground, broken ground, and voids as summarised in the table on page 30.

9.8.4 Analysing the data obtained from the 21 mining investigation probeholes, it is apparent that:

- **Halifax Hard Coal** outcrop is close to that shown on BGS maps and underlies c. 56,00m^2 (70%) of the site in the centre, south and east.
- 13 of the 21 holes drilled advanced through the **Halifax Hard** encountered solid coal, between 0.6m and 3.0m thick (avg. 1.5m)
- Evidence of workings, primarily broken ground, with a void (c. 0.6m thick) in PH111 from 7.8m depth, were recorded in 9 of the holes (40%) in the **Halifax Hard**
- The thickness of competent (rock) cover above the **Halifax Hard** is typically less than 6 times seam thickness.
- The **Middle Band Coal** was recorded in 3 of the 11 probeholes and found to be between 0.1m to 0.3m thick (avg. 0.2m). No evidence of workings was recorded in the Middle Band Coal
- The **Halifax Soft Coal** was only encountered in one probehole (PH113) as solid coal (0.5m thick) from 22.7m depth
- Linear triangulation suggests the Halifax Hard coal seams dip at about 3^0 to the southeast.

9.8.5 It seems unlikely the Middle Band Coal has been worked due to its limited thickness (typically < 0.2m).

9.8.6 Known workings within the **Halifax Soft** are at great enough depth to not be of concern with regards to surface stability.

Summary of Ground Conditions (Mining Investigation)

Hole ID	**Final depth (m)**	**Depth to Rock head (m)**	**Halifax Hard Coal**				**Middle Band Coal**				**Halifax Soft Coal**				**Remarks**
			Depth to base (m)	**Thickness (m)**	**Worked?**	**Cover Ratio**	**Depth to base (m)**	**Thickness (m)**	**Worked?**	**Cover Ratio**	**Depth to base (m)**	**Thickness (m)**	**Worked?**	**Cover Ratio**	
PH101	33.0	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-
PH102	15.0	6.5	8.4	0.9	Yes (BG)	**1.1**	-	-	-	-	-	-	-	-	Loss of flush 7.5m to 8.4m
PH103	24.0	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-
PH104	21.0	3.0	14.4	1.7	Yes (BG)	**6.8**	-	-	-	-	-	-	-	-	Loss of flush 12.7m to 14.4m
PH105	27.0	3.5	19.6	1.0	Yes (BG)	**9.6**	-	-	-	-	-	-	-	-	Loss of flush 18.6m to 19.6m
PH106	24.0	2.2	18.5	1.5	Yes (BG)	**9.7**	-	-	-	-	-	-	-	-	Loss of flush 17.0m to 18.5m
PH107	33.0	4.5	-	-	-	-	-	-	-	-	-	-	-	-	Loss of flush 27.7m due to groundwater
PH108	21.0	4.0	15.7	3.0	Yes (BG)	**7.0**	-	-	-	-	-	-	-	-	Loss of flush 12.7m to 15.7m
PH109	18.0	4.5	11.8	2.2	Yes (Soft)	**4.3**	-	-	-	-	-	-	-	-	Partial loss of flush 9.6m to 11.8m
PH110	33.0	5.7	-	-	-	-	17.5	0.1	No (Solid)	39	-	-	-	-	-
PH11	17.0	2.7	10.5	2.7	Yes (BG)	**4.6**	-	-	-	-	-	-	-	-	Loss of flush 7.8m to 8.4m
			8.4	0.6	Yes (Void)	**5.0**	-	-	-	-	-	-	-	-	-
PH112	24.0	5.5	-	-	-	-	11.3	0.2	No (Solid)	19	-	-	-	-	-
PH113	33.0	6.4	-	-	-	-	-	-	-	-	23.2	0.5	No (Solid)	34	-
PH114	24.0	4.6	-	-	-	-	-	-	-	-	-	-	-	-	-
PH115	24.0	4.5	-	-	-	-	17.3	0.3	No (Solid)	43	-	-	-	-	-
PH116	27.0	2.3	8.5	0.7	No (Solid)	**3.7**	-	-	-	-	-	-	-	-	-
PH117	21.0	3.1	9.7	0.7	No (Solid)	**3.9**	-	-	-	-	-	-	-	-	Partial flush from 9.1m due to groundwater
PH118	21.0	4.4	11.8	1.0	No (Solid)	**4.4**	-	-	-	-	-	-	-	-	-
PH119	21.0	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-
PH120	21.0	3.0	10.5	0.9	No (Solid)	**4.5**	-	-	-	-	-	-	-	-	-
PH121	21.0	4.3	11.9	2.2	Yes (Soft)	**4.5**	-	-	-	-	-	-	-	-	Loss of flush 10.7m to 11.9m

Note: Cover ratio in **red** less than 10 times seam thickness over identified workings. Cover ratio in **bold** less than 10 times seam thickness over solid coal. Cover ratio (over solid coal) based on maximum published thickness (1.7m in Halifax Hard, 0.3m in Middle Band and 0.5m in Halifax Soft Coals) where workings have been identified

9.8.7 Based on the findings of the investigation it is considered that workings identified in the **Halifax Hard Coal** will require treatment (drilling & grouting) prior to redevelopment given the insufficient thickness of cover over the workings. Abandonment plans suggest workings underlie c. 3.5 ha, but Lithos' intrusive mining investigation has found evidence of further workings in the south suggesting workings underlie a further c. 6,200m^2.

9.8.8 Treatment (drilling & grouting)will likely be required across an area of c. 5.6 ha (70%) of the site, to the south and east of the conjectured outcrop; see Drawing 4246/8.

9.8.9 Consideration should be given to the drilling of additional probeholes to confirm /refine the extent of workings and allow contractors to provide a more accurate fixed price proposal for the anticipated drilling and grouting.

9.8.10 Given the number of probeholes drilled, and the absence of any evidence of voids or broken ground within the **Middle Band Coal**, it is considered unlikely that this seam has been worked. Although consideration could be given to further drilling to remove any residual uncertainty.

9.8.11 A further 7 probeholes were taken to shallow depth to allow the installation of gas monitoring wells.

Mine entry search

9.8.12 As discussed in Section 4.3 there are three known mine entries within the site's boundary. A dedicated mine shaft search (extensive trenching/topsoil strip) was beyond the scope of this investigation. However, trial pits were excavated at/adjacent to each shaft location, based on the co-ordinates and positions shown on CA records.

9.8.13 Prior to any excavation, each mine entry was set out by a handheld GPS (typically accurate to +/- 3m).

9.8.14 Cohesive Made Ground comprising gravelly clay was encountered to greater than 2.6m depth in TP135N (Shaft Ref. 412421-037). The made ground formed a partially circular feature approximately 2.8m in diameter. The base of the made ground could not be proven as the limit of the excavator had been reached.

9.8.15 After excavation TP135 was accurately positioned by a surveyor; co-ordinates are: 412086.16E, 421598.99N, which compare with the CA co-ordinates for the shaft of 412088E, 421601N.

9.8.16 A detailed shaft search using a larger machine, possibly after a geophysical survey, should be undertaken prior to redevelopment of the site.

9.8.17 Colliery Spoil, up to 0.6m depth comprising gravel of mudstone identified in TP114 which was excavated in the vicinity of Shaft Ref. 411421-008. This suggests a shaft might be nearby.

9.8.18 TP124 (excavated in the vicinity of Shaft Ref. 412421-012) did not encounter any evidence of shaft backfill or made ground.

9.9 Revised conceptual ground model (ground conditions)

9.9.1 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
- The presence of coal/shallow workings
- The nature and distribution of contamination (based on visual/olfactory evidence only)

9.9.2 Further refinement of the Conceptual Site Model is presented in Section 11.3, where the results of laboratory testing for contaminants have been considered.

10 CONTAMINATION (ANALYSIS)

10.1 General

10.1.1 The site has predominantly comprised open field (likely arable farmland). However, the following historical uses have also been identified:

- Shaw Laithe Farm (east) between pre 1854 and 1992
- Clay pit (southwest) between 1893 and 1908
- Tramline running from the clay pit to a clay works to the east between 1893 and 1908
- Three mine shafts (centre north and west), shown from c. 1854
- Underground and overhead electric, including steel pylons, shown from c. 1965

10.1.2 The site is also shown as an EA landfill (Calder Works). However, findings of the intrusive investigation would suggest that no waste was deposited within the boundary of the development site.

10.1.3 No known potentially contaminative materials are known to have been stored or used at the site, although some fuels, oils etc associated with the former farmyard could be anticipated.

10.1.4 As such, the site's former usage may have given rise to some ground contamination. Furthermore, significant thicknesses of made ground were encountered within the footprint of the former clay pit during the ground investigation, with shallow made ground within the former farmyard and locally around the site (area of mine shafts, tramway).

10.1.5 Sampling of the made ground and the topsoil beyond the areas of made ground has been undertaken to confirm there suitability for re-use.

10.1.6 An assessment of potential contaminants associated with the former uses has been undertaken; see Section 6.

10.1.7 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.

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

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

10.2 Testing scheduled

10.2.1 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, inc. Made Ground Topsoil	17	pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) Asbestos ID Water soluble sulphate, chloride, nitrate and magnesium Total Organic Carbon (TOC) Speciated Polycyclic Aromatic Hydrocarbons (PAH)
	9	Banded Total Petroleum Hydrocarbons (TPH)
	4	Calorific Value (CV)
Topsoil	13	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)
	7	Clay/sand/silt content and visible contaminants, sharps (glass etc) to check compliance with BS3882:2015

10.2.2 Account was taken of previous uses in specific areas, with analysis concentrated on samples recovered from the vicinity of the former clay pit, and the former areas of Shaw Laithe Farm.

10.3 Soil contamination results

10.3.1 The soil contamination test results are summarised in the tables on pages 35 to 38.

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

Inorganic determinands

10.3.3 Of the 18 samples of made ground analysed for inorganic parameters, 11 can be classified as uncontaminated and 7 could be classified as contaminated.

10.3.4 Of the 13 samples of Topsoil analysed for inorganic parameters, 12 can be classified as uncontaminated and one could be classified as contaminated.

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

10.3.6 Concentrations of arsenic, copper, lead, and zinc were all recorded at levels above the relevant Tier 1 Soil Screening Value.

Hole ID	Depth (m)	Material	Arsenic	Lead	Copper	Zinc
TP111	0.3	Ash & Clinker	✓		✓	
TP122	0.2	Ash & Clinker			✓	
TP148	0.5	Granular Made Ground	✓			
TP111	0.1	Made Ground Topsoil	✓	✓	✓	✓
TP112	0.3	Made Ground Topsoil	✓			✓
TP121	0.2	Made Ground Topsoil		✓		✓
TP131	0.1	Made Ground Topsoil			✓	
TP132	0.2	Made Ground Topsoil	✓	✓	✓	✓
TP143	0.3	Topsoil				✓

Note: ✓ determinand tested for was above the Tier 1 value in that sample.

10.3.7 Zinc and copper are phytotoxic metals; phytotoxicity describes the inhibitive and toxic effect high concentrations of some substances can have on plant growth.

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

10.3.9 Allowable concentrations of heavy metals in arable soils are set out in Defra's Code of Good Agricultural Practice 2009. The values for zinc and copper are 200mg/kg and 100mg/kg respectively based on a continued annual application of heavy metal rich fertiliser (sludge); as such it is not representative of activity in a standard UK garden.

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

10.3.11 Similar logic applies to copper (human health Tier of 2,400mg/kg), and consequently on balance, the slightly elevated concentrations of copper and zinc recorded at this site are not considered significant, and no special remedial measures are considered necessary with regards to copper and zinc.

Summary of degree of soils contamination (inorganics)

Expl Hole	Depth (m)	Material	Concentrations in mg/kg unless otherwise stated. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in **BLUE** and assume a **residential with gardens** end-use.													
			pH	As ∞	B~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg*	Ni	Se	Vn	Zn$	CV	Asbestos
				37	5	26	4000	100	200	199	109	434	584	200	2 MJ/kg	
TP111	0.1	Made Ground Topsoil	5.6	**71**	1.2	1.5	534	**160**	**216**	0.9	36	2.2	69	**276**	-	N.D.
TP112	0.3	Made Ground Topsoil	6.5	**42**	1.5	1.0	157	89	150	0.6	30	1.4	55	188	-	N.D.
TP114	0.2	Made Ground Topsoil	5.5	19	0.7	1.1	48	48	73	<0.1	30	1.3	43	126	-	N.D.
TP119	0.2	Made Ground Topsoil	6.9	30	1.0	0.8	38	53	123	0.3	23	1.6	49	136	-	N.D.
TP120	0.2	Made Ground Topsoil	7.8	16	0.8	0.7	36	60	133	0.3	34	<0.5	48	113	-	N.D.
TP121	0.2	Made Ground Topsoil	7.6	23	1.5	0.8	32	83	**243**	0.3	35	0.9	43	**219**	-	N.D.
TP131	0.1	Made Ground Topsoil	5.7	34	1.1	1.0	192	**102**	162	0.9	30	1.2	62	190	-	N.D.
TP132	0.2	Made Ground Topsoil	6.8	**44**	1.3	1.6	57	**139**	**269**	0.4	42	2.2	70	**809**	-	N.D.
TP148	0.2	Made Ground Topsoil	5.0	21	0.9	0.7	63	55	69	0.2	33	1.3	51	122	-	N.D.
TP149	0.4	Made Ground Topsoil	4.6	33	0.6	0.9	37	33	37	0.2	19	4.6	54	45	-	N.D.
TP150	0.4	Made Ground Topsoil	6.1	28	1.0	0.9	37	91	125	0.2	42	2.4	63	125	-	-
TP111	0.3	Ash & Clinker	5.9	**92**	0.6	1.4	99	**140**	49	0.2	75	1.7	102	164	**3.8**	N.D.
TP121	0.5	Ash & Clinker	7.9	14	0.6	0.4	16	53	54	<0.1	41	<0.5	36	48	**5.0**	N.D.
TP122	0.2	Ash & Clinker	6.5	36	0.7	1.2	42	**330**	195	<0.1	93	0.8	68	189	**3.2**	N.D.
TP119	0.5	Cohesive Made Ground	6.2	6.9	0.3	0.6	32	23	23	<0.1	20	1.2	42	86	-	N.D.
TP122	0.5	Cohesive Made Ground	6.0	11	0.7	0.5	27	38	55	<0.1	27	1.0	41	79	-	N.D.
TP114	0.5	Colliery Spoil	5.7	6.4	0.4	1.1	38	43	31	<0.1	47	<0.5	35	90	<1.0	N.D.
TP148	0.5	Granular Made Ground	5.5	**44**	1.0	0.8	140	89	143	0.7	27	1.4	38	161	-	N.D.
TP125	0.4	Reworked Natural	5.2	12	0.4	0.9	37	54	34	<0.1	37	1.4	43	88	-	N.D.
TP101	0.1	Topsoil	6.5	35	1.7	1.1	49	59	116	0.4	36	1.6	71	170	-	N.D.
TP105	0.1	Topsoil	6.2	25	0.9	1.0	51	43	78	<0.1	31	2.1	59	118	-	N.D.
TP107	0.2	Topsoil	6.2	29	1.1	0.9	61	93	99	0.2	29	1.6	58	153	-	N.D.
TP109	0.1	Topsoil	5.6	32	0.8	0.7	64	60	104	0.4	23	1.6	56	102	-	N.D.
TP116	0.2	Topsoil	6.3	34	1.5	1.2	51	80	134	0.2	38	1.3	60	166	-	N.D.
TP123	0.2	Topsoil	4.7	31	0.7	0.5	38	57	129	0.4	19	1.8	46	72	-	N.D.

Expl Hole	**Depth (m)**	**Material**	Concentrations in mg/kg unless otherwise stated. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in **BLUE** and assume a **residential with gardens** end-use.													
			pH	As ∞	B~	Cd ∞	Cr x	Cu♣$	Pb ∞	Hg*	Ni	Se	Vn	Zn$	CV	Asbestos
				37	5	26	4000	100	200	199	109	434	584	200	2 MJ/kg	
TP127	0.2	Topsoil	5.8	22	0.8	0.9	51	56	91	0.1	27	1.7	52	114	-	N.D.
TP129	0.1	Topsoil	-	-	-	-	-	-	-	-	-	-	-	-	-	N.D.
TP136	0.2	Topsoil	6.4	34	1.1	0.9	53	83	177	0.3	37	1.1	49	197	-	N.D.
TP139	0.2	Topsoil	5.7	23	1.1	1.1	61	65	100	0.2	29	1.1	51	130	-	N.D.
TP143	0.3	Topsoil	5.3	35	1.0	1.2	122	97	129	0.6	31	1.6	58	**203**	-	N.D.
TP145	0.2	Topsoil	5.7	32	1.6	1.0	78	95	183	0.2	27	1.4	48	174	-	N.D.

Key	
36	Parameter tested for and found to be in excess of Tier 1 concentration
179	Parameter tested for and found to be > 5 x Tier 1 concentration
12	Parameter tested for but not found to be in excess of Tier 1 concentration
-	Parameter not tested for
♣	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.
N.D.	Not detected, applicable to asbestos I.D. screen only

Summary of degree of soils contamination (organics)

Expl Hole	**Depth (m)**	**Material**	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in **BLUE** and assume a **residential with gardens (and no cover)** end use					
			% TOC	PAH		TPH - C6 to C40		
				B(a)P ∞	Naphthalene	GRO~ (C_6 to C_{10})	DRO◊ (C_{10} to C_{21})	LRO (C_{21} to C_{40})
				5	6	22	215	3299
TP111	0.1	Made Ground Topsoil	9.9	1.1	0.5	-	-	-
TP112	0.3	Made Ground Topsoil	8.6	0.6	0.3	-	-	-
TP114	0.2	Made Ground Topsoil	4.7	0.3	0.1	-	-	-
TP119	0.2	Made Ground Topsoil	7.2	0.4	0.5	<1	6	15
TP120	0.2	Made Ground Topsoil	5.9	0.5	0.6	<1	<3	7
TP121	0.2	Made Ground Topsoil	8.9	0.8	0.7	<1	17	23
TP131	0.1	Made Ground Topsoil	7.6	0.6	1.3	-	-	-
TP148	0.2	Made Ground Topsoil	5.0	0.4	0.2	-	-	-
TP149	0.4	Made Ground Topsoil	6.0	1.6	1.6	-	-	-
TP111	0.3	Ash & Clinker	22	<0.1	2.3	<1	8	17
TP121	0.5	Ash & Clinker	23	<0.1	0.3	<1	7	6
TP122	0.2	Ash & Clinker	16	0.2	0.5	<1	24	61
TP119	0.5	Cohesive Made Ground	1.7	<0.1	<0.1	<1	<3	13
TP122	0.5	Cohesive Made Ground	4.8	<0.10	<0.1	<1	<3	4
TP114	0.5	Colliery Spoil	3.7	<0.1	<0.1	-	-	-
TP148	0.5	Granular Made Ground	7.6	<0.1	0.1	-	-	-
TP125	0.4	Reworked Natural	1.5	<0.1	<0.1	<1	6	15
TP101	0.1	Topsoil	8.4	0.9	0.1	-	-	-
TP105	0.1	Topsoil	6.2	0.1	0.1	-	-	-
TP107	0.2	Topsoil	6.2	0.2	0.1	-	-	-
TP109	0.1	Topsoil	6.3	0.6	0.7	-	-	-
TP116	0.2	Topsoil	12	0.4	0.2	-	-	-
TP123	0.2	Topsoil	11	0.5	0.2	-	-	-
TP127	0.2	Topsoil	6.3	2.1	0.4	-	-	-

Expl Hole	**Depth (m)**	**Material**	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Trigger Level Concentrations are shown in **BLUE** and assume a **residential with gardens (and no cover)** end use					
			% TOC	PAH		TPH - C6 to C40		
				B(a)P ∞	Naphthalene	GRO~ (C_6 to C_{10})	DRO◊ (C_{10} to C_{21})	LRO (C_{21} to C_{40})
				5	6	22	215	3299
TP129	0.1	Topsoil	-	0.3	0.4	-	-	-
TP132	0.2	Topsoil	10	0.7	0.3	-	-	-
TP136	0.2	Topsoil	8.7	0.2	0.2	-	-	-
TP139	0.2	Topsoil	6.2	0.4	0.8	-	-	-
TP143	0.3	Topsoil	7.7	0.5	0.4	-	-	-
TP145	0.2	Topsoil	7.7	0.2	0.1	-	-	-

Key	
0.3	Parameter tested for but not in excess of Tier 1 concentration
60	Parameter tested for and in excess of Tier 1 concentration
-	Contaminant not tested for

Source of Guidance Trigger Level	
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). Assumes **no soil cover**, see Generic Notes 04 in Appendix A.	
~	Assumes all GRO is aromatic fraction C7 to C8
◊	Assumes all DRO is aliphatic fraction C10 to C12
∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE\Defra)

10.3.12 Current UK guidance regarding the statistical analysis of soil contamination data obtained during a site investigation is provided by CL:AIRE[1], and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

10.3.13 The difference between the old and new approaches, including how Lithos apply the statistical assessment is detailed in Generic Note 04, included as Appendix A to this report.

10.3.14 Statistical assessment of the made ground is not appropriate here because:

- Made Ground is considered too heterogenous
- There are insufficient samples from Made Ground Topsoil, Ash & Clinker and Granular Made Ground
- Sampling locations were typically clustered around localised areas associated with former use (clay pit, farmyard, tramway)

Calorific value

10.3.15 The Calorific Value (CV) of 3 samples of Ash & Clinker and one of Colliery Spoil, have yielded an average CV of 4.0 MJ/kg for the Ash & Clinker and a value of <1.0 MJ/kg for the Colliery Spoil. Materials whose CVs exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn.

10.3.16 As such, the Ash & Clinker and the Colliery Spoil are unlikely to combust and as such are not considered a significant risk to the site.

Asbestos

10.3.17 No asbestos fibres were identified in any of the 30 samples screened. As such, asbestos is not considered to be a significant risk to this site.

Organic determinands

10.3.18 This 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 placed in gardens/landscaped areas (Lithos Scenario A).

10.3.19 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.

10.3.20 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.

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[1] *CL:AIRE, 2020.Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.*

10.3.21 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	>5%	No
Ash & Clinker		
Made Ground Topsoil		
Granular Made Ground		
Reworked Natural Ground	1.5%	Yes, but no significant organic contamination was recorded in this soil type. All determinands well below "6%" screening value; most below limit of detection.
Cohesive Made Ground	3.3%	
Colliery Spoil	3.7%	

Hydrocarbons (TPH)

10.3.22 Given the previous uses of the site and absence of visual/olfactory evidence of any hydrocarbon contamination, only a simple banded TPH (cf full speciation) was scheduled on 9 samples.

10.3.23 Assessment of TPH associated with a fuel/oil source would normally be undertaken in accordance with a 3-step approach, (outlined in Generic Note 04 in Appendix A) on fully speciated TPH results. However, although only banded TPH analysis has been scheduled here, none of the fractions exceed their respective Tier 1 criteria, even if it is conservatively assumed all of each fraction is either aliphatic or aromatic.

10.3.24 Consequently, no significant petroleum hydrocarbon concentrations have been identified, and there is no risk to human health from these hydrocarbons.

Polycyclic Aromatic Hydrocarbons (PAH)

10.3.25 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.

10.3.26 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).

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

BS3882 Topsoil testing

10.3.28 The presence of visible contaminants, sharps (glass etc) was assessed by the Engineer in the field (inspection of initial trial pit arisings); none were identified. BS3882 considers visual contaminants to comprise 'undesirable potentially injurious foreign object(s) visible to the naked eye'.

10.3.29 The clay/sand/silt content of 7 topsoil samples have been determined to check compliance with BS3882[2] requirements.

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

10.3.31 The results are summarised below:

Parameter	**BS3882 Specification**	**TP102 @ 0.2m**	**TP108 @ 0.2m**	**TP113 @ 0.2m**	**TP117 @ 0.2m**	**TP130 @ 0.2m**	**TP139 @ 0.1m**	**TP146 @ 0.2m**
Retained on 2mm sieve	< 30%	13	10	9	16	18	9	21
Retained on 20mm sieve	< 10%	0	0	0	4	4	0	6
Retained on 50mm sieve	0%	0	0	0	0	0	0	0
Clay content	5 to 35%	13	10	9	16	18	9	21
Silt content	0 to 65%	13	10	9	16	18	9	21
Sand content	0 to 90%	13	10	9	16	18	9	21
Visible contaminants	< 0.5%	0	0	0	0	0	0	0

10.3.32 The above results suggest that the topsoil at this site complies to the standards set out in BS3882. In terms of textural classification, the topsoil falls into the 'Sandy Loam' class.

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[2] *BS3882:2015. Specification for topsoil. Published by BSI Standards Limited.*

11 CONTAMINATION (QUALITATIVE RISK ASSESSMENT)

11.1 Topsoil

11.1.1 Topsoil, typically 300mm thick is present across the majority of the site, beyond areas of made ground. Testing suggests this material is chemically suitable for re-use.

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

11.1.3 However, Made Ground Topsoil, overlying areas of made ground, has recorded elevated concentrations of inorganic contaminants and has been found to contain gravel size fragments of glass, ceramic etc. Consequently, the Made Ground Topsoil is not considered suitable for re-use near surface in garden or landscaped areas.

11.2 Summary of significant contamination

11.2.1 Made Ground has been identified locally (within the footprints of the former clay pit, Shaw Laithes Farm, mineshafts and the former tramway).

11.2.2 No significant remediation should be necessary, but some preparatory works will be required to render the site suitable for development; see Section **Error! Reference source not found.**.

11.2.3 The made ground at this site, including the Made Ground Topsoil, contains elevated concentrations of a number of organic determinands and contains materials (e.g. brick, glass and ceramic), which would generally be considered undesirable as a near-surface material in garden areas.

11.2.4 No elevated concentrations of organic (hydrocarbon) contamination have been identified.

11.3 Revised conceptual ground model (contamination)

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

11.3.2 A revised Conceptual Site Model is presented as Drawing 4246/7 in Appendix B. The Model includes the contaminants described in Section 11.2 above, and potential contaminant linkages (summarised below in Section 11.5) to receptors.

11.4 Environmental setting & end use

11.4.1 As discussed in Section 11.2 above, contamination exists in the soil beneath this site. In order to assess the significance of this contamination, consideration must be given to the site's environmental setting and the proposed end use.

11.4.2 The underlying coal measures strata (mudstone, siltstone and sandstone) is classified as a Secondary A aquifer. The nearest surface watercourse is the River Calder, which flows in an easterly direction, approximately 130m beyond the site's northeastern boundary. Therefore, the site's environmental setting is considered to be of **moderate sensitivity**.

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

11.4.4 Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures, see Section 15.6.

11.5 Contaminant linkages

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

Contaminants

11.5.2 Contaminants have been summarised in Section 11.2 above.

Pathways

11.5.3 Potential contaminant pathways include:

- Ingestion
- Dermal contact
- Inhalation of contaminated particulates
- Surface water run-off, including existing drainage infrastructure

Receptors

11.5.4 Potential contaminant receptors include:

- The environment – Surface Waters (River Calder), Secondary A Aquifer (Coal Measures)
- End users of the site (residents)

11.5.5 It can be concluded that there are plausible pathways between the soil contaminants summarised in Section 11.2 above and potential receptors. Consequently, some remediation will be required; either treatment/removal of the contaminant, or "breakage" of the pathway.

11.6 Potential remediation options

General

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

Asbestos

11.6.2 No asbestos fibres were identified in any of the 30 samples screened. Consequently, in line with the principles of sustainable development, there should be no need to export any soil from site.

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

11.6.4 Any fragments of asbestos cement sheeting encountered during the excavation works, should be gathered by hand and placed in double sealed bags. Personnel involved in this activity must be equipped with an appropriate respirator (i.e. a FFP3 or better), in addition to their "standard" PPE. The bags of asbestos waste should be placed in a sealed skip for off-site disposal at a suitably licensed landfill site; such material will be classified as hazardous waste.

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

Combustibility

11.6.6 The Ash & Clinker at this site yielded an average CV of 4.0 MJ/kg. This is at the lower end of the range where the potential for combustion exists and it is not considered a significant hazard, especially since beds of Ash & Clinker are typically less than 300mm thick and/or overlain by at least 300mm of inert made ground.

Inorganic contamination

11.6.7 The made ground and Made Ground Topsoil have yielded elevated concentrations of a number of metals; most notably, lead and arsenic. Therefore, where residual **made ground** remains beneath garden and landscaped areas (i.e. not beneath hardstanding) a **600mm** thick surface cover of "clean" soil comprising 500mm subsoil and 100mm topsoil is recommended. This cover will break potential contaminant linkages between the contaminated made ground and future end-users.

11.6.8 Alternatively, the made ground types, excluding the Made Ground Topsoil, are considered suitable for redistribution beneath concrete oversite or areas of hardstanding, where they would be satisfactorily isolated from end users.

11.6.9 Given the compressible nature and gas-generating potential of **Made Ground Topsoil** if buried at depth, it is recommended that it is placed in garden areas and/or POS, immediately beneath the proposed 600mm cover, and that it is overlain by no more than 1m of soil.

11.6.10 Care will be required when stripping 'clean' Topsoil during the site preparatory works to avoid any mixing with Made Ground Topsoil. Failure to exercise due care could lead to mixing of 'clean' and unsuitable materials, which could in turn render all the Topsoil unsuitable for re-use.

Organic contamination

11.6.11 No areas of gross organic contamination were encountered during the site works. However, localised areas of more onerous contamination than that identified to date may be present on site.

11.7 Summary of potential contaminant linkages & mitigation

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

Receptors	Pathways	Contaminants	Plausible contaminant linkage? (and remediation options where required)
Human health (Future residents) ◊	Consumption of contaminated vegetables	Metals in the Made Ground and Made Ground Topsoil	**Yes:** Isolation beneath at least 600mm clean soil cover in garden and landscaped areas
	Ingestion		
	Dermal contact		
	Inhalation (dust and/or vapours)		
Buildings	Migration & accumulation of explosive gas	Methane	To be assessed on completion of monitoring and gas risk assessment
River Calder	Surface water run-off	Metals in the Made Ground and Made Ground Topsoil	**Yes:** Isolation beneath at least 600mm clean soil cover in garden and landscaped areas

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

11.8 Waste classification

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

11.8.2 Off-site disposal of surplus clean naturally occurring soils to landfill is not recommended. In accordance with the CL:AIRE Code of Practice[3] 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, without the need for waste legislation to be applied.

11.8.3 Disposal of the made ground off site is generally not considered appropriate, economically viable, nor in line with current Government philosophy regarding sustainable development. However, some excess arisings may be generated by excavations for foundations, sewers etc. Disposal to landfill (or an appropriate soil / aggregate transfer station) may be the most practical solution, if redistribution and retention on site is not feasible.

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

11.8.5 As there is no WRAP protocol for soils, the characterisation, sampling and classification of soils arising from brownfield sites has been incorporated within the Environment Agency's Technical Guidance WM3[4]. Classification of soils as non-hazardous or hazardous in accordance with WM3 is quite a complex process, although it ultimately results in a simple classification as hazardous or non-hazardous. Note: inert is not a class under WM3; WAC testing is required to determine whether a waste soil can be considered inert.

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

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

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

11.8.9 Soil treatment facilities (STFs) provide an alternative to landfill. STFs are regulated by the Environment Agency and allow soils to be treated and screened (effectively recycled to be used at other sites). Export to an STF does not require WAC testing and suitability of various soil types will be dependent on material waste codes, which may be allocated after consideration of the data in Section 10 but will often need supplementing with further testing after soils have been stockpiled (see also advice in Section 15.3).

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

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[3] *The Definition of Waste: Development Industry Code of Practice. CL:AIRE, 2011.*

[4] *Technical Guidance WM3 – Guidance on the classification and assessment of waste. Environment Agency 2015*

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

12 HAZARDOUS GAS

12.1 General

12.1.1 Consideration of the conceptual site model and potential linkages has enabled a preliminary qualitative assessment of risks associated with gas:

Source	Receptors	Hazard	Pathway	Initial risk
On-site made ground	Human health	Asphyxiation & explosion	Vertical migration, ingress & accumulation	**Negligible**: made ground essentially inert, with little degradable matter
	Buildings	Explosion		
Off-site landfills (Calder Works, Ash Lagoons at Low Fields)	Human health	Asphyxiation & explosion	Lateral migration, ingress & accumulation	**Low**: natural strata to at least 5m depth are generally of low permeability
	Buildings	Explosion		
Shallow mineworkings	Human health	Asphyxiation & explosion	Vertical migration, ingress & accumulation	
	Buildings	Explosion		

12.1.2 Given the above, gas monitoring wells have been installed in 26 boreholes across the site. Details of the installations are given on the window sample and probehole logs presented in Appendices G & H to this the report.

12.1.3 The generation potential of the gas source was considered to be Moderate in light of the underlying shallow coal workings. Consequently, in accordance with CIRIA Report C665, given the proposed residential end use, 12 visits have been scheduled over a 6-month period.

12.2 Scope of works

12.2.1 To date, the wells have been monitored on one occasion for groundwater levels and soils-gases, and the results are presented in Appendix L.

12.2.2 A standard procedure was followed, in accordance with CIRIA guidance:

- Ambient oxygen concentration
- Atmospheric temperature & pressure
- Methane, oxygen and carbon dioxide concentrations and flow rates using a Gas Data GFM436 infra-red gas analyser
- Standing water level using a dipmeter
- Ambient oxygen concentration (check for instrument drift)

12.3 Monitoring results

12.3.1 The results of the monitoring completed to date (May 2022) are summarised below.

Well	Response zone	Range of methane concentrations (% v/v)	Range of carbon dioxide concentrations (% v/v)	Range of steady flow rates (litre/hour)
WS101	1.5m - 3.0m (Cohesive Residual Soils & Coal Measures)	ND	1.5	ND
WS102	1.5m - 3.0m (Cohesive Residual Soils & Coal Measures)	ND	0.2 - 2.5	ND
WS103	1.5m - 3.0m (Cohesive Residual Soils)	ND	0.8 - 1.3	ND
WS104	1.5m - 3.0m (Cohesive & Granular Residual Soils)	ND	3.6	0.9
WS105	1.5m - 3.0m (Cohesive Residual Soils & Coal Measures)	ND	1.8 - 1.9	ND
WS106	1.5m - 3.0m (Cohesive Residual Soils & Coal Measures)	ND	0.3 - 0.4	ND
WS107	1.5m - 3.0m (Granular Residual Soils)	ND	0.1 - 2.4	ND
WS108	1.5m - 3.0m (Cohesive Residual Soils & Coal Measures)	ND	1.8 - 1.9	ND
WS109	1.5m - 3.0m (Granular & Cohesive Residual Soils & Coal Measures)	ND	2.5 - 2.8	ND
WS110	1.5m - 3.0m (Granular Residual Soils & Coal Measures)	ND	1.6 - 2.4	ND
WS111	1.5m - 3.0m (Cohesive Residual Soils & Coal Measures)	ND	0.9	ND
WS112	1.5m - 3.0m (Cohesive Residual Soils)	ND	0.5 - 1.4	ND
WS113	1.5m - 3.0m (Cohesive Residual Soils)	ND	1.7 - 2.2	ND
WS114	1.5m - 3.0m (Cohesive Residual Soils & Coal Measures)	ND	0.7 - 0.8	ND
WS115	1.5m - 3.0m (Cohesive Residual Soils & Coal Measures)	ND	0.4	ND
WS116	1.5m - 3.0m (Cohesive Residual Soils)	ND	0.6	ND
WS117	1.5m - 3.0m (Cohesive Residual Soils & Coal Measures)	ND	1.5 - 2.0	ND
WS118	1.5m - 3.0m (Cohesive Residual Soils)	ND	1.6 - 2.1	ND
PH101	2.0m – 4.0m (Cohesive Residual Soils & Coal Measures)	ND	2.6 - 3.1	ND
PH105A	3.0m – 6.0m (Coal Measures)	ND	5.4	1.3
PH107A	3.0m – 6.0m (Cohesive Residual Soils & Coal Measures)	ND	2.3 - 2.4	ND
PH109A	3.0m – 6.0m (Cohesive Residual Soils & Coal Measures)	ND	0.4 - 2.8	1.5
PH113A	3.0m – 6.0m (Cohesive Residual Soils)	ND	1.6 - 2.3	ND
PH115A	3.0m – 6.0m (Cohesive Residual, Granular Residual Soils & Coal Measures)	ND	0.4 - 0.8	1.5
PH120A	3.0m – 6.0m (Coal Measures)	ND	2.2	ND
PH121A	3.0m – 6.0m (Cohesive Residual Soils & Coal Measures)	ND	2.3 - 2.8	ND

12.4 Discussion

12.4.1 Generic Note 05 in Appendix A outlines how monitoring results are interpreted.

12.4.2 No concentrations of methane or positive flow rates have been recorded during the first visit. Concentrations of carbon dioxide were all below 2.8% which are not considered significant.

12.4.3 However, a hazardous gas risk assessment incorporating all of the results will be issued on completion of monitoring in September 2022.

12.5 Radon

12.5.1 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.

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

12.5.3 Information from Landmark suggests that radon protection measures are not required. This is confirmed by the Public Health England UK radon map which indicates that the site lies in an area where **less than 1%** of homes are estimated to be above the action level.

12.5.4 As such, **no** special precautions against radon are required on this site.

13 GEOTECHNICAL TESTING

13.1 General

13.1.1 A total of 44 samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.

13.1.2 The geotechnical laboratory test results are presented in Appendix K to this report.

13.2 Atterberg limits

13.2.1 The plasticity indices of 30 samples of cohesive soil have been determined; results are summarised below.

Soil type	**No. samples tested**	**Moisture content range % (average)**	**Range of Plasticity Indices % * (average)**	**Shrinkability**
Cohesive Glaciofluvial Deposits	8	15 – 32 (23)	6 – 29 (19)	Low
Cohesive Residual Soil	16	22 – 25 (23)	16 – 42 (29)	Medium
Granular Residual Soil (Gravelly Clay)	4	15 – 33 (24)	17 – 30 (25)	Medium

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

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

13.2.2 The range of plasticity indices proved variable, with two results above 40% i.e. high shrinkability). However, the majority of results were all <40%, therefore, for the purposes of foundation design, it is recommended that all cohesive soils be regarded as being of **Medium** shrinkability.

13.3 Particle size distribution

13.3.1 The grading of two samples of Glacial Deposits (cohesive and granular) has been determined by wet sieving to assist with classification and the results are summarised in the table below:

Sample & depth	**Field description**	**% passing 37.5mm sieve**	**% passing 20mm sieve**	**% passing 2mm sieve**	**% fines**	**Material description (based on grading & plasticity)**
TP134 @ 0.7m	Slightly gravelly, very sandy Clay	100	98	95	59	Slightly gravelly, sandy Clay
TP145 @ 0.7m	Slightly gravelly, clayey Sand	95	88	67	37	Slightly gravelly, sandy Clay *

Note: * means the field description on the log has been amended in light of grading data received.

13.3.2 NHBC Chapter 4.2 considers shrinkable soils to be those containing more than 35% fines and having a Modified Plasticity Index greater than 10%.

13.3.3 The Cohesive Glaciofluvial deposits encountered on this site can therefore be regarded as shrinkable.

13.3.4 The logs have been amended to reflect the results in the above table with strata at 0.7m in TP145 now recognised as cohesive, and as such shrinkable.

13.4 Soluble sulphate and pH

13.4.1 Although the site is essentially greenfield, localised areas of made ground associated with former use have been identified. Therefore, in accordance with BRE SD1[5], this site has been classified as brownfield with a mobile groundwater regime.

13.4.2 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), acid-soluble sulphate and total sulphur

13.4.3 The concentrations of sulphate in the aqueous natural soil extracts of 30 samples were determined. In addition, 10 samples of made ground were tested as part of the contamination suite. The pH value of each sample has also been determined.

13.4.4 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)**
Made Ground Topsoil	1	6.9	10
Ash & Clinker	3	5.9	70
Cohesive Made Ground	1	6.0	<10
Granular Made Ground	1	5.5	60
Made Ground: Colliery Spoil	1	5.7	<10
Cohesive Glaciofluvial Deposits	7	5.5	260
Cohesive Residual Soil	15	5.1	40
Granular Residual Soil	7	4.7	60

13.4.5 Samples of Cohesive Residual Soils and Granular Residual Soils yielded pH values below 5.5. Therefore, supplementary analysis to determine the concentrations of magnesium, chloride and nitrate was scheduled.

13.4.6 The samples yielded magnesium, chloride, and nitrate results of less than 10mg/l, and consequently the equivalent sulphate concentrations are negligible.

13.4.7 In accordance with Tables C1 and C2 of SD1, sub-surface concrete placed within the granular or cohesive residual soils should be Design Sulphate Class **DS-1**, with the site allocated an ACEC Classification of **AC-2**.

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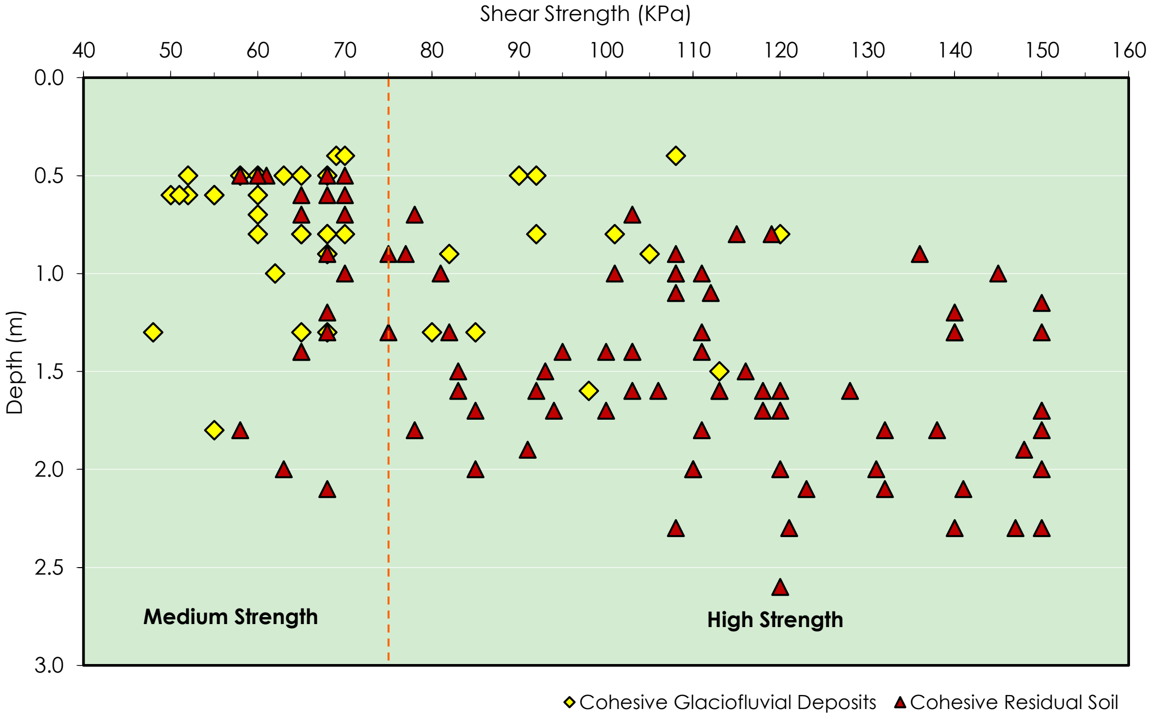
[5] *BRE Special Digest 1 (2005) – Concrete in aggressive ground.*

13.5 Undrained shear strength testing

Hand shear vane testing

13.5.1 Hand shear vane testing was undertaken within trial pits in-situ to around 1.0m depth and from larger blocks of excavated clay below that depth.

13.5.2 The results are summarised within the plot below and illustrate a broad spread of results in undrained shear strength (Su) with depth within the Cohesive Glaciofluvial deposits (between 48kPa & 119kPa). Below approximately 1.0m depth Su is typically greater than 60kPa within the Cohesive Glacial Deposits. Undrained Shear Strength is greater than 58kPa within the Cohesive Residual Soils, typically greater than 75kPa in the majority of tests.



14 GEOTECHNICAL ISSUES

14.1 Conceptual site model

14.1.1 Localised made ground was identified in areas of former use (clay pit, farmyard, tramway, and mine shafts). It was typically < 0.6m deep in the farmyard and tramway but was deeper (2.4m depth) in the clay pit and vicinity of the northeastern mine shaft (CA ref: 412421-037).

14.1.2 Natural soils comprise Glaciofluvial Deposits comprising sandy Clay in the north, with Sand & Gravel in the far northeast.

14.1.3 Cohesive and Granular Residual Soils (completely weathered bedrock) comprising medium to high strength gravelly Clay and clayey Gravel were encountered in the majority of exploratory holes.

14.1.4 Coal Measures bedrock was encountered from between 1.6m to 2.8m depth, typically from around 2.5m, in 12 of the 75 shallow exploratory holes. Typically recovered as tabular Gravel of mudstone or sandstone. The soil/rock interface could be considered as gradational as the effects of weathering become less pronounced with depth.

14.1.5 The Halifax Hard Coal (between 0.2m to 0.5m thick) was identified in two trial pits (TPs 114 & 115) from 1.6m depth. These pits are located just south of the outcrop shown on BGS plans suggesting it is reasonably accurate.

14.2 Mining & quarrying

14.2.1 This majority of the site is located within a Coal Mining Development High Risk Area and is underlain at shallow depth by the Halifax Hard Coal and the Middle Band Coal which outcrop on site. The Halifax Soft coal outcrops approximately 100m to the northwest and dips below the site.

14.2.2 The BGS Technical Report notes that both the Halifax Hard Bed and Halifax Soft Bed seams were **widely worked**, with the associated **seatearth** (fireclay and ganister) also worked. The Halifax Hard Bed is reported to be 0.5m to 1.0m thick and the Halifax Soft Bed is reported to be 0.2m to 0.9m thick.

14.2.3 No workings are recorded in the Middle Band Coal on CA records.

14.2.4 There are no known quarries on, or within 50m of the site. However, an infilled clay pit is present in the far southwest, extending off site to the south.

14.2.5 Lithos' mining investigation identified evidence of workings (broken ground, voids) within the Halifax Hard Coal in 9 of the 21 holes drilled within the outcrop, c.40% of total holes drilled. A further six holes were drilled beyond the outcrop of the **Halifax Hard Coal** and did not encounter coal associated with this seam as would be expected.

14.2.6 The maximum thickness of Halifax Hard Coal recorded was 1.0m, typically 0.7m, which is consistent with published BGS plans (c.0.8m thick).

14.2.7 Loss of flush returns often accompanied the areas of broken ground, soft ground and voids

14.2.8 Where an insufficient thickness of competent cover overlies the workings, consolidation through drilling and grouting will be required. Based on available data this equates to a central band covering c. 5.6 ha (70%) of the site, though this figure might be revised following further drilling.

14.2.9 Given the number of probeholes drilled, and the absence of any evidence of voids or broken ground within the **Middle Band Coal**, it is considered unlikely that this seam has been worked. Although consideration could be given to further drilling to remove any residual uncertainty.

Shallow mineworkings

14.2.10 CIRIA SP32:1984[6] suggests voids resulting from mineral extraction are unlikely to migrate more than 10 times the seam thickness through competent bedrock. CIRIA C758D[7] notes that the use of this 10 times 'rule-of-thumb', as the design basis for treatment depth, has been observed to be successful over many years for a wide range of mineworkings and overlying rock/soil strata scenarios. However, consideration must always be given to site specifics such as nature of roof strata, strata dip, groundwater, extraction ratio etc.

14.2.11 Mitigation against the risk of subsidence associated with the shallow mineworkings will be required across c. 5.6 ha (70%); see Drawing 4246/8. This will likely involve consolidation by drilling and grouting; see also Section 15.7 regarding coal extraction.

14.2.12 Based on the findings of this investigation and the anticipated nature of the workings, it is considered that the necessary consolidation (grouting) would require drilling holes on a 4.5m grid. A viscous grout composed of appropriate proportions of OPC, PFA, sand or pea gravel would then be injected into the workings via these holes.

14.2.13 Further holes would need to be drilled in areas of high grout take (to confirm filling of void space), and in areas where several adjacent holes encountered solid coal (to confirm that the local area is underlain by no workings, rather than pillars).

14.2.14 Drilling and grouting operations should be carried out with engineering supervision and be undertaken in accordance with a revision of Lithos' "General Specification for the Treatment of Shallow Mineworkings" tailored to the site-specifics.

Mine entries

14.2.15 As discussed in Section 4.3 there are three known mine entries within the site's boundary.

14.2.16 A dedicated mine shaft search (extensive trenching/topsoil strip) was beyond the scope of this investigation. However, pits (TPs 114, 124 & 135) were excavated at/adjacent to each shaft location based on the co-ordinates and positions shown on CA records.

14.2.17 Trial pits 114 and 124 did not encounter any evidence of backfill material signifying a shaft. The made ground encountered in TP114 bottomed out into natural strata at 0.6m depth, this is more likely associated with the former clay pit, but might suggest the shaft is nearby.

14.2.18 Cohesive Made Ground comprising gravelly clay was encountered to greater than 2.6m depth in TP135N (shaft ref 412421-037). The made ground formed a partially circular feature approximately 2.8m in diameter.

14.2.19 A detailed shaft search using a larger machine, possibly after a geophysical survey, should be undertaken prior to redevelopment of the site.

14.2.20 Until the shafts are positively located and surveyed in the CA will expect the developer's layout to assume potential no-build "*zones of influence*" around each shaft; see Section 4.3.

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[6] *CIRIA SP32 (1984) - Construction over abandoned mine workings*

[7] *CIRIA C758D (2019) – Abandoned mine workings manual*

14.2.21 It is possible that unrecorded "shallow" shafts (possibly bell pits) may be present at this site, and consideration should be given to a geophysical survey, although success would be dependent on the "contrast" between shaft backfill and the surrounding ground (i.e. the survey is likely to be more successful if shaft backfill is significantly different material or less dense than the surrounding ground). Follow-up intrusive investigation (pitting) would be recommended to determine the cause of any anomalies identified by the geophysics.

14.2.22 If bell pits are present, given the likely depth constraints discussed in Section 4.3, it seems likely they will be limited to a central east – west band near to outcrop of the Halifax Hard Coal; perhaps about 15% of the total site area.

14.2.23 A topsoil strip could also be considered and will be required anyway across the proposed build footprints prior to construction.

14.2.24 Given the absence of significant loose superficial deposits across the majority of the site, it is considered unlikely that such mine entries would have been lined.

14.2.25 Whilst the Coal Authority (and NHBC) discourage development over or adjacent to all mine entries, Lithos consider such features to pose a low risk to surface stability where they only extend to relatively shallow workings that require treatment (grouting). Consequently, we would not expect any (previously unrecorded) shallow shafts, encountered during site preparatory works and/or the subsequent construction phase, to result in the need for "no-build" zones and/or revision of the planning-approved layout although the developer may choose to do this.

14.2.26 However, where build over a shaft(s) is proposed, the developer will need to discuss proposed treatment (which is likely to include both grouting of the shaft backfill, and a cap at rockhead) and bespoke foundation design (by a suitably qualified structural engineer) with the Coal Authority. A Permit to Enter or Disturb Coal Authority Mining Interests will be required prior to construction of any shaft cap.

14.2.27 Proposals to treat the mineworkings and shafts will need to be discussed with both the Local Authority (most notably Highways), the Coal Authority and the warranty provider (e.g. NHBC) well in advance of starting works on site.

14.2.28 Any shafts encountered during the development of this site should be made safe by treatment in accordance with an appropriate Specification (Lithos can prepare this) and a Coal Authority Permit to Enter or Disturb Coal Authority Mining Interests.

14.3 Site regrade and/or ground improvement

14.3.1 Localised areas of made ground, including Made Ground Topsoil, have been identified across the site associated with areas of historical use (clay pit, farmyard, tramway and mineshafts).

14.3.2 This made ground is of variable and poor strength and is therefore not considered a suitable foundation material. It has also yielded elevated concentrations of a number of inorganic determinands and contains materials (e.g. brick, clinker, glass, etc), which would generally be considered undesirable as a near-surface material in garden areas.

14.3.3 Given the volume of made ground present, export to landfill is not considered economically viable.

14.3.4 Consideration could be given to turnover (excavation, screening and replacement in engineered layers) of the full thickness of made ground beneath the site.

14.3.5 Turnover enables inspection of the full thickness of fill, the developer and their prospective property purchasers, are provided with the reassurance that no significant hazard is left undetected. This is considered advantageous from a perception viewpoint. Furthermore, any potential for surface water infiltration, which would drive potential leaching of contaminants, should be reduced by compaction.

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

14.3.7 Excavation of the uppermost 500mm or so of natural soils beneath made ground could be undertaken in order to generate a sufficient volume of 'clean' subsoil for placement across the proposed development in gardens and landscaped areas. This subsoil would be best placed during the construction phase; i.e. it should be left in stockpile(s) on completion of the site preparatory works.

14.3.8 There are a number of advantages to such a 'soil inversion' operation; most notably:

- Ground levels will remain essentially as existing (i.e. there is no need to raise levels by 600mm to accommodate soil cover).
- Reduced traffic movements - there should be no need to export any significant volume of made ground off-site, and no need to import subsoil to site.

14.3.9 The above solution is considered to be in line with current government philosophy regarding sustainable development. Turnover works should be undertaken in accordance with the CL:AIRE Code of Practice (v2, March 2011), and a Materials Management Plan (MMP) should be prepared prior to commencement.

14.3.10 Any digital terrain modelling undertaken, or commissioned, by the developer should consider implications for the foundation recommendations outlined below.

14.3.11 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.

14.3.12 Wherever possible, Lithos recommend that excavated soils are retained on site. However, if this is not possible the comments in Section 11.8 should apply.

14.4 Foundation recommendations

General

14.4.1 It is understood that consideration is being given to redevelopment of the site with two and three storey domestic dwellings, associated gardens, POS, adoptable roads, and sewers.

14.4.2 A site layout has been provided by Titchmarsh & Bagley (Drawing reference SK05, dated January 2020) showing 211 units. However, this is likely to be revised prior to development.

14.4.3 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.

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

14.4.5 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.

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

Strip/trench fill footings

14.4.7 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for the majority of two or three storey houses constructed at the site. Footings will be founded in Cohesive Glaciofluvial Deposits or Cohesive Residual Soils. This solution is viable where the made ground is less than about 2.5m thick, and medium to high strength clay is the founding material.

14.4.8 Granular Glaciofluvial Deposits and Granular Residual Soils may be encountered in the far northeast. However, granular soils are limited in thickness and extent and as such plots are unlikely to be founded in granular soils.

14.4.9 Even after consolidation, foundations should be "beefed-up" to accommodate any potential time dependant differential settlement.

14.4.10 Further advice regarding reinforcement should be sought from the appointed Structural Engineer, but in the meantime reference should be made to the table below.

Rock cover above grouted seam	Preferred Foundation
<5 x seam thickness [8]	Raft - designed to span 3m over potential soft spots and cantilever 1.5m at corners. Either stiffened, flat-bottomed rafts a minimum of 300mm thick, on 450mm of compacted Type 1 material, with reinforcement top and bottom. Or, rafts could be of 300mm concrete with a 150mm upstand to allow for wall construction provided that the base of compacted type 1 material lies at a depth of at least 600mm
>5 x seam thickness – 10m	Strip footing OK, but thickened (300mm), and reinforced top and bottom
>10m	Strip footing OK, but needs to be 300mm thick reinforced with one layer of mesh

14.4.11 Where the former farm buildings have been demolished, all footings 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, or (probably better) chased-out and removed during the necessary site preparatory works; see Section 14.3.

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

14.4.13 Deepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.3.

14.4.14 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).

14.4.15 The developer 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.

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[8] *See s5.6 of Structural Foundations Manual (M F Atkinson) 2nd Ed.*

14.4.16 Alternative foundations such as piles may be required in areas of deep made ground (>2.5m) which may be encountered within the footprint of the former clay pit.

14.4.17 It may be necessary to extend piled foundations through the base of any underlying coal workings, even after treatment, which will require pre-boring. As such, it is strongly recommended that any areas of deep made ground associated with the former clay pit are utilised as POS.

Clay/cohesive soils

14.4.18 Atterberg tests suggest that natural cohesive soils at the site are of medium shrinkability. A minimum founding depth of 900mm (not accounting for any existing or proposed vegetation) is therefore required for all cohesive soils on the site where strip footings are proposed.

14.4.19 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.

14.4.20 Foundations should be deepened near trees in accordance with NHBC Standards Chapter 4.2. It is estimated that up to 30% of the site may be affected by trees.

14.4.21 A number of immature (likely self-seeded) trees were noted in the area of the former farmyard during the site walkover, and these will require removal prior to construction. A number of these trees lie within the footprint of proposed plots. In theory, this could result in foundation depths of >2.5m. However, in accordance with NHBC Standards Chapter 4.2, if the trees are <50% of their mature height at the time of removal, a default distance to the proposed foundation of 2m can be applied to foundation depth calculations.

14.4.22 This should be confirmed by a detailed tree survey prior to vegetation removal, and removal should take place as soon as possible.

14.4.23 The current layout also suggests some plots will be built on ground from which hedgerows will be removed. Whilst the hedgerows at the site are relatively low (<2.5m height) and appear to have been maintained at that height by trimming, it is often difficult to definitively prove that they have not desiccated soils to significant depth. In theory, if mature Hawthorn is removed from within the footprint of a plot, founding depth (in medium shrinkability clay) would be >2.5m.

14.4.24 However, bedrock which is non shrinkable, was encountered from 1.6m depth, typically from around 2.5m. This will likely result in few (if any) foundation depths of >2.5m.

14.4.25 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.

14.4.26 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).

14.4.27 It would therefore be prudent to prepare a detailed foundation schedule and seek approval from NHBC in order to determine likely foundation abnormals.

14.4.28 A safe bearing capacity of at least 160kPa, allowing a maximum foundation line load of 90kN/m run, can be assumed if the following are true

- A foundation length of 8m
- A foundation breadth of 0.6m
- A foundation thickness of 225mm
- A foundation depth of 0.9m depth
- An undrained shear strength of 65kPa for the clay soils (typical minimum recorded on site)

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

Coal

14.4.30 Some excavations for foundations may come into contact with coal, particularly near outcrop of the Halifax Hard Coal and Middle Band Coal. Care should be taken not to unnecessarily overdeepen foundations, in order to minimise the chance of encountering coal.

14.4.31 Where foundation excavations do come into contact with coal, the foundation should be taken through the coal seam, into underlying natural in-situ strata of adequate bearing. The full thickness of coal 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.

14.4.32 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).

14.5 Floor slabs

14.5.1 Where shallow foundations are within the influence of existing or proposed trees (and are underlain by shrinkable soils), 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. Ground-bearing and cast in-situ suspended slabs (other than those cast on a void former) are not acceptable where foundations are within the influence of trees.

14.5.2 In accordance with NHBC Standards Chapter 4.2, a minimum void height of 250mm 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 100mm should be adopted; of course, the actual thickness of the void former will be significantly greater.

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

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

14.5.5 In the event that coal is exposed beneath the floor void, it would be prudent to prevent air ingress and the potential for spontaneous combustion by blinding with concrete or removing the coal.

14.5.6 Floor slab design should be finalised/take account of the results of the gas monitoring and protection measures required, which will be detailed in Lithos' gas risk assessment, to be issued on completion of monitoring in September 2022.

14.6 Designated concrete mixes

14.6.1 Designated mixes are considered in BRE SD1[9] and BS 8500[10]. 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.

14.6.2 Consequently, the developer should seek advice from their appointed Structural Engineer.

14.7 Excavations

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

14.7.2 Groundwater should be controlled in accordance with CIRIA Report R113[11].

14.7.3 Excavations should remain stable in the short term but if left open for any significant period of time may require shoring most notably in granular soils and made ground.

14.7.4 Weak mudstone bedrock was encountered in 12 of the shallow exploratory holes (trial pits and window samples) from between 1.6m and 2.8m depth, typically from around 2.5m. Based on the exploratory hole logs, excavation greater than 2.5m is likely to prove difficult across about 25% of the site. It would therefore be prudent to allow for excavation of hard rock in any deep excavations such as those that may be required for drainage etc.

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[9] *BRE Special Digest 1 (2005) – Concrete in aggressive ground.*

[10] *BS 8500-1&2:2015+A2:2019. Concrete. Complementary British Standard to BS EN 206. Method of specifying and guidance for the specifier (1) & Specification for constituent materials and concrete (2).*

[11] *CIRIA Report R113 (1986) - Control of Groundwater for Temporary Works.*

14.8 Drainage

14.8.1 Based on observations made during the investigation, soakaways will not provide a suitable drainage solution for surface water run-off at the site. Consequently, it will be necessary to consider alternative sustainable drainage systems (SUDS), and there may be a need for surface water balancing.

14.8.2 Alternative SUDS options (see CIRIA C753[12] 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.
- Basins - a ground depression designed to store surface water that is normally dry, except during and immediately following a rainfall event. There are two types:
    - Infiltration – basin designed to store runoff and infiltrate it gradually into the ground.
    - Detention – an outlet restricts flows, so that the basin fills and provides attenuation.
- Ponds – designed to have permanent pool of water, but with capacity to provide temporary storage-controlled discharge.

14.8.3 Yorkshire Water have published a guide[13] for developers and designers outlining their design requirements for surface water attenuation assets.

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

14.8.5 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.

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

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

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

14.8.9 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*".

14.8.10 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.

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[12] *CIRIA C753 (2015) – The SuDS Manual.*

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

14.9 Highways

14.9.1 The natural soils present at shallow depth (anticipated formation) are predominantly cohesive (with some granular soils in the far northeast). Based on visual inspection and the recorded plasticity indices at the site, published guidance[14] and tables[15] indicate that the cohesive deposits would be expected to provide a CBR value of at least 3%, whilst a CBR value of at least 10% should be achievable in the granular soils. These values should be verified prior to or during construction.

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

14.9.3 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
- 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.

14.9.4 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.

14.9.5 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.

14.9.6 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.

14.9.7 If any new highway spans a 'high-wall' associated with the former clay pit in the southwest, the following precautions are recommended to protect highway and 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 1.0m 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 (i.e. nominally 75mm aggregate, geogrid, 150mm aggregate, geogrid and then another 75mm aggregate).

14.9.8 A minimum length of 5m either side of any highwalls associated with the former clay pit should be treated to the above specification, although the final specification should be agreed with the adopting authority.

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[14] *CD225 Design for new pavement foundations Revision 1 (Design Manual for Roads and Bridges)*

[15] *The Structural Design of Bituminous Road, TRRL Laboratory Report 1132 (Table C1, page 36)*

14.9.9 Geogrid reinforcement may be required for any highways spanning known mineshafts subject to final treatment and capping details. Where recorded shafts have not been positively identified through intrusive investigation it would be prudent to incorporate a geogrid reinforcement to highways adjacent to the assumed shaft location to prevent collapse post development.

14.9.10 Although the geogrid reinforcement would not prevent damage to the highway it would reduce the risk of complete collapse by spanning the void resulting from any shaft collapse post development.

14.10 External works

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

15 REDEVELOPMENT ISSUES

15.1 General

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

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

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

15.2 Remediation strategy

15.2.1 Redevelopment of this site will almost certainly be subject to planning conditions relating to remediation and validation. Once a specific, preferred development strategy has been decided, Lithos could liaise with local Planning Authority and Warranty Provider and prepare a detailed Remediation Strategy document for approval.

15.2.2 The Remediation Strategy document would include:

- General background information, including site location, site description and a summary of ground investigation data
- An overview of existing constraints on development and the aims of the proposed remediation works
- Specific details of the anticipated site remediation/preparatory works
- Details of site supervision and verification
- A summary of implications for redevelopment

15.2.3 The Remediation Strategy will describe what is required, but not how it is achieved; the appointed Contractor would normally be expected to undertake an Options Appraisal, and then prepare a Method Statement.

15.2.4 The anticipated remediation works are summarised below:

- General site clearance of surface materials and vegetation
- Consolidation (drill & grout) of shallow mineworkings
- Location and treatment of mine entries
- Turnover (excavation, screening and replacement in engineered layers, with nominal compaction) of the full thickness of made ground to enable:
    - Inspection of the made ground
    - Removal of below ground obstructions and oversize
    - Preparation of the ground for highway construction
- Excavation of natural soils from beneath made ground to source 'clean' subsoil
- Backfill of all resultant excavations, with appropriate compaction
- Re-grade of site to levels specified by the developer (approximately 600mm below final "soft" end use areas underlain by residual made ground and 600mm below proposed slab levels)
- Excavation of up to a maximum depth of 2m beneath proposed adoptable road footprints and controlled re-engineering of selected materials in layers to approximately 650mm below final road levels
- Provision of a minimum 300mm thick cover layer of 'clean' soils in all garden and landscaped areas, increased to 600mm where residual made ground remains

15.2.5 The remediation contractor should survey reduced levels during the proposed turnover, prior to the placement of any fill.

15.2.6 Subsoil excavated during the site preparatory works for subsequent use as cover in gardens and landscaped areas, would be best placed during the construction phase; i.e. it should be left in stockpile(s) on completion of the site preparatory works.

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

15.3 Control of excavation arisings

15.3.1 Excavations into made ground are likely to yield contaminated arisings. 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.

15.3.2 The groundworker should appreciate 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; Made Ground Topsoil; Made Ground; excess clean, natural soil arisings; general construction waste etc.

15.3.3 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed. See also comments in Section 11.8 regarding asbestos.

15.3.4 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; only if suitable (i.e. not compressible, rich in deleterious matter etc)
- Exported from site to a suitably licensed landfill facility

15.4 Good practice guidance

15.4.1 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 C741[16]
- EA Pollution Prevention Guidelines[17]:
    - PPG6 - Working at construction and demolition sites
    - PPG2 - Above ground oil storage tank
    - PPG7 – The safe operation of refuelling facilities.
    - PPG21 – Incident Response Planning

15.4.2 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) [18].

15.4.3 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.

15.5 New utilities

15.5.1 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.

15.5.2 Drainage and other utilities should not be placed within any coal seam; the seam should either be removed to below the base of the lowest service, or services should be placed in oversize trenches cut into the seam & backfilled with inert material.

15.5.3 This site is essentially greenfield, with only localised areas of made ground associated with former historical use (farmyard, clay pit, tramway and mineshafts) resulting in some inorganic contamination.

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

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

15.5.6 However, given the site's history and the relatively consistent ground conditions reported, the use of 'standard' polyethylene water supply pipes should be acceptable, although the developer should consult Yorkshire Water at the earliest opportunity to confirm this.

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[16] *CIRIA C741 (2015) - Environmental Good Practice on Site*

[17] *Whilst this has formally been withdrawn it can still be accessed via the EA archives and provides useful information on managing risks.*

[18] *The Definition of Waste: Development Industry Code of Practice. CL:AIRE, 2011.*

15.6 Health & safety issues - construction workers

15.6.1 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.

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

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

15.6.4 Although workers will only be exposed to the contaminated soil for a relatively short time, the contaminants represent a risk, and simple precautionary measures are required, i.e. good personal hygiene and basic personal protective equipment.

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

15.7 Coal extraction

15.7.1 The Halifax Hard Coal (c. 1.5m thick) and the Middle Band Coal (c 0.3m thick) outcrop on site and dip to the southeast.

15.7.2 Prior extraction of coal is encouraged by both the Coal Authority and Planning Authorities, largely because a potential mineral resource will not be sterilised by the development. However, it is worth noting that the UK market for coal is changing (driven by government carbon emission targets) – most notably very few power stations are still burning coal. Consequently, prior extraction of coal has become less attractive in recent times.

15.7.3 There can be financial benefits to extraction, since the extraction contractor would pay the landowner a disturbance allowance for the coal (likely to be between £2 and £4 per tonne), and there would be a saving because grouting would not be required.

15.7.4 Furthermore, any unrecorded mine entries would also be found and removed. Traffic movements (associated with coal export) are expected to be similar to those associated with grouting (import of PFA and cement).

15.7.5 However, coal extraction is not without drawbacks; these include:

- The creation of 'high-walls' around the margins of the extraction area (essentially the whole of the site's perimeter).
- The time required to ensure significant settlement of the replaced overburden (anticipated residual settlement must be less than 25mm) is typically at least 12 months. However, the actual delay to build programme might be longer, since it is impossible to predict the actual time required for ongoing creep settlements to fall to tolerable levels. Prediction is hampered by uncertainties associated with groundwater rebound and the nature of the excavated material with respect to suitability for compaction.
- Local environmental issues associated with noise and dust.
- Public perception issues.
- Concerns that once an initial excavation has been opened, the coal extraction contractor might decide there is insufficient coal remaining and abort further work, or even run into financial difficulties, leaving the developer with increased foundation abnormals and no royalties.

15.7.6 It is worth noting that the UK market for coal is changing (driven by government carbon emission targets) – most notably very few power stations are still burning coal. Consequently, prior extraction of coal has become less attractive in recent times.

15.7.7 Assuming the above factors do not preclude further consideration at the 'first hurdle', the viability of extraction is influenced by physical factors, most notably:

- the presence (or not) of old mineworkings;
- seam thickness (greater the better); and
- seam depth (shallower the better).

15.7.8 As discussed in Section 9.8, existing abandonment plans for the Halifax Hard Coal and the probehole results suggest old mineworkings exist beneath about 70% of this site.

15.7.9 The intrusive ground investigation only encountered solid coal in 4 of the 21 probeholes drilled within the outcrop of the Halifax Hard Coal.

15.7.10 This suggests that significant extraction has already occurred, reducing the potential yield from further extraction prior to redevelopment. However, the average thickness of the Halifax Hard Coal is around 1.5m, at depths of 8m (at outcrop) to around 20m on the southeastern boundary as the seam dips towards the northeast.

15.7.11 Lithos' probeholes recorded a maximum thickness of 1.0m of solid coal within the Halifax Hard Coal seam, however the CA have recorded a worked extraction thickness of 1.68m beneath the site within the Halifax Hard Coal Seam. This discrepancy is likely due to the removal of the seat earth along with the coal.

15.7.12 Probeholes that encountered workings (1.76m avg. thickness) concur with the CA's extraction thickness of 1.68m.

15.7.13 Extraction is generally considered possible where the overburden above a seam is less than 12 times the seam's thickness.

15.7.14 However, given the rates of existing extraction (c. 60%), increasing depth of coal towards the east and the demise of coal fired power stations in the UK, it is considered unlikely that prior extraction of coal from this site would be economically viable.

15.8 Shallow coal in garden areas

15.8.1 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.

15.8.2 In theory this could be an issue for about 15% of the total site area, immediately down dip of the conjectured outcrop of the Middle Band Coal and Halifax Hard Coal seams. However, given seam dip and topography it seems likely that coal will only be present at such shallow depth beneath less than 5% of the area.

15.8.3 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.

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

15.9 Potential development constraints

15.9.1 Sterile 'no build' zones will be required around the three recorded mine shafts. The no-build zone should be derived by assuming a 45° line from the outer edge of the shaft cap at rockhead, running up to the finished ground level. The extent of the no build zone will be dependent on the accurate location of the shafts.

15.9.2 Given the thickness of made ground (up to 2.4m) recorded within the footprint of the former clay pit in the far southwest, it is recommended that this area be utilised as POS to avoid the need for trenchfill footings and/or piles for plots or geogrid reinforcement for highways.

15.9.3 The River Calder flows east c. 130m from the site's northeast boundary. Therefore, it is recommended that a silt and surface water management plan be produced prior to construction activities commencing.

15.9.4 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.

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

15.9.6 Northern Power, Cadent Gas and Yorkshire Water may seek to restrict changes in site level if the depth of cover above their utilities were adversely affected by any development proposals. This aspect requires further clarification.

15.9.7 The line of the high voltage electric overheads and associated pylon will have a significant impact on the plot layout as these are unlikely to be re-routed.

15.9.8 It is almost certain that Northern Power will have restrictions with respect to development in the vicinity of the high voltage electric overheads; an easement will probably be required.

16 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

16.1 General

16.1.1 The site is located off Shaw Lane (east) and Lower Edge Road (south), approximately 1.2km northeast of Elland town centre and comprises a single grassed field. The site has remained essentially undeveloped throughout its history (open, likely arable farmland), although three mineshafts and a clay pit are shown on CA records and historical OS plans. Shaw Laithe Farm was also present in the centre east until c. 1990

16.1.2 It is understood that consideration is being given to redevelopment of the site with 2 storey domestic dwellings, associated gardens, POS, adoptable roads, and sewers.

16.1.3 Localised made ground was identified in areas of former use (clay pit, farmyard, tramway, and mine shafts). Made ground was typically < 0.6m deep in the farmyard and tramway but was deeper (2.4m depth) in the clay pit and vicinity of the northeastern mine shaft (CA ref: 412421-037).

16.1.4 Topsoil (typically 300mm thick) is present across the site beyond areas of made ground. Natural soils comprise Glaciofluvial Deposits comprising sandy Clay in the north with Sand & Gravel in the far northeast.

16.1.5 Cohesive and Granular Residual Soils (completely weathered bedrock) comprising medium to high strength gravelly Clay and clayey Gravel were encountered in the majority of exploratory holes.

16.1.6 Coal Measures bedrock was encountered from between 1.6m to 2.8m depth, typically from around 2.5m, in 12 of the 75 shallow exploratory holes. Typically recovered as tabular Gravel of mudstone or sandstone. The soil/rock interface could be considered as gradational as the effects of weathering become less pronounced with depth.

16.1.7 The Halifax Hard Coal (between 0.2m to 0.5m thick) identified in two trial pits (TPs 114 & 115) from 1.6m depth. These pits are located just south of the outcrop shown on BGS plans suggesting it is reasonably accurate.

16.2 Mining

16.2.1 This majority of the site is located within a Coal Mining Development High Risk Area and is underlain at shallow depth by the Halifax Hard Coal and the Middle Band Coal which outcrop on site.

16.2.2 The BGS Technical Report notes that both the Halifax Hard Bed and Halifax Soft Bed seams were widely worked, with the associated seatearth (fireclay and ganister) also worked. The Halifax Hard Bed is reported to be 0.5m to 1.0m thick with the Halifax Soft Bed reported to be 0.2m to 0.9m thick.

16.2.3 The Halifax Soft coal outcrops approximately 100m to the northwest and dips below the site. Known workings in the Soft Bed Coal are deep enough not to be of concern.

16.2.4 An intrusive mining investigation has been undertaken, comprising the drilling of 21 deep rotary open-hole probeholes. The investigation identified coal, soft ground, broken ground, and voids in the Halifax Hard Coal in 9 of the 21 probeholes drilled to the south and east of the outcrop (c. 40% of holes drilled).

16.2.5 It is considered that workings identified in the Halifax Hard Coal will require treatment (drilling and grouting) prior to redevelopment given the thickness of insufficient cover over the workings. This is likely to affect c. 5.6 ha (70%), to the south and east of the conjectured outcrop; see Drawing 4246/8.

16.2.6 Given the number of probeholes drilled, and the absence of any evidence of voids or broken ground within the Middle Band Coal, it is considered unlikely that this seam has been worked. Although consideration could be given to further drilling to remove any residual uncertainty.

16.2.7 There are three known mine entries within the site's boundary. To date, one has been identified with reasonable certainty in TP135N (Shaft Ref. 412421-037).

16.2.8 No evidence of a shaft was noted in the remaining two trial pits.

16.3 Hazardous gas

16.3.1 The site is in an area where less than 1% of homes are estimated to be above the radon action level. As such, no protection measures against radon are required.

16.3.2 However, the entire site is recorded by the EA as a landfill (Calder Works), albeit no evidence of this has been encountered in any of the exploratory holes. Furthermore, former landfills are located to the north from around 24m (ash Lagoons associated with the former Elland Power Station) and the site is also underlain by shallow mineworkings, encountered during the probing.

16.3.3 As such, wells have been installed in 26 holes with monitoring for hazardous gas underway.

16.3.4 A hazardous gas risk assessment incorporating all of the results will be issued on completion of monitoring in September 2022.

16.4 Contamination & remediation

16.4.1 Made Ground has been identified locally (within the footprints of the former clay pit, Shaw Laithes Farm, mineshafts and the former tramway).

16.4.2 This made ground, including the Made Ground Topsoil, contains elevated concentrations of a number of organic determinands and contains materials (e.g. brick, glass and ceramic), which would generally be considered undesirable as a near-surface material in garden areas.

16.4.3 No elevated concentrations of organic (hydrocarbon) contamination have been identified

16.4.4 Therefore, where residual made ground remains beneath garden and landscaped areas (i.e. not beneath hardstanding) a **600mm** thick surface cover of "clean" soil comprising 500mm subsoil and 100mm topsoil is recommended.

16.4.5 Alternatively, the made ground types, excluding the Made Ground Topsoil, are considered suitable for redistribution beneath concrete oversite or areas of hardstanding, where they would be satisfactorily isolated from end users.

16.4.6 Given the compressible nature and gas-generating potential of topsoil if buried at depth, it is recommended that it is placed in garden areas and/or POS, immediately beneath the proposed 600mm cover, and that it is overlain by no more than 1m of soil.

16.5 Foundations

16.5.1 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for the majority of two or three storey houses constructed at the site. Footings will be founded in Cohesive Glaciofluvial Deposits or Cohesive Residual Soils. This solution is viable where the made ground is less than about 2.5m thick, and medium to high strength clay is the founding material.

16.5.2 Granular Glaciofluvial Deposits and Granular Residual Soils may be encountered in the far northeast. However, granular soils are limited in thickness and extent and as such plots are unlikely to be founded in granular soils).

16.5.3 Additional reinforcement may be required for any plots founded over shallow coal workings, even after treatment.

16.5.4 Alternative foundations such as piles may be required in areas of deep made ground (>2.5m) which may be encountered within the footprint of the former clay pit.

16.5.5 Construction over mineshafts is not recommended, even after backfilling and capping. A no build zone will be required around the anticipated location of each shaft, with a worst case assumed unless the shaft can be positively located.

16.6 Flooding

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

16.7 Drainage

16.7.1 Based on observations made during the investigation, soakaways will not provide a suitable means of surface water disposal at the site. Consequently, there is likely to be a need for surface water balancing.

16.8 Highways

16.8.1 The natural soils present at shallow depth (anticipated formation) are predominantly cohesive (with some granular soils in the far northeast). Based on visual inspection and the recorded plasticity indices at the site, the cohesive deposits would be expected to provide a CBR value of at least 3%, whilst a CBR value of at least 10% should be achievable in the granular soils. These values should be verified prior to or during construction

16.8.2 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.

16.8.3 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 or screened before being replaced in engineered layers

16.8.4 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.

16.8.5 Should highways span the boundary between shallow natural soils and deep made ground associated with the former clay pit then a geogrid reinforcement is recommended to prevent excessive differential settlements.

16.8.6 Geogrid reinforcement may be required for any highways spanning known mineshafts subject to final treatment and capping details.

16.9 Further works

16.9.1 Consideration should be given to the drilling of additional probeholes to confirm the extent of workings and allow contractors to provide a more accurate fixed price proposal for the drilling and grouting works.

16.9.2 Two of the 3 known shafts have not yet been located; a search using a larger machine (tracked excavator of at least 20t), possibly after a geophysical survey, should be undertaken prior to redevelopment of the site.

16.9.3 It is possible that unrecorded “shallow” shafts (possibly bell pits) may be present at this site, and consideration should be given to a geophysical survey across the wider site (most notably adjacent to the conjectured outcrops of the Halifax Hard Coal and Middle Band Coal where coal is shallowest), although success would be dependent on the “contrast” between shaft backfill and the surrounding ground (i.e. the survey is likely to be more successful if shaft backfill is significantly different material or less dense than the surrounding ground).

16.9.4 Follow-up intrusive investigation (pitting) would be recommended to determine the cause of any anomalies identified by the geophysics.

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

Reference is made to publicly available Government held digital data via **QGIS** (an Open Source Geographic Information System), data from Landmark or Groundsure, and sometimes 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 & Target Levels should also be applied to non-domestic buildings with public occupancy exceeding 2,000 hrs/yr and to all schools.

Hydrogeology

Reference is made to publicly available Government held digital data via QGIS, 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.

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[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

Reference is made to publicly available Government held digital data via QGIS, 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. Allows a thorough inspection of the ground; especially the uppermost 1m or so (but able to reach depths of up to c. 4m), with the recovery of representative, disturbed samples. Also used to conduct soakaway testing.
- **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).
- **Cable percussive** (Shell & Auger) boreholes, typically using 150mm diameter tools and casing. Enables the recovery of soil samples and data from greater depth than is possible via trial pitting or a mini-percussive drill rig. Also enables the installation of better/deeper monitoring wells (cf use of a mini-percussive drill rig) due to the utilisation of temporary steel casing during drilling.
- **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. Often used to penetrate bedrock to investigate abandoned shallow mineworkings
- **Rotary cored** boreholes. A rock core is cut by a bit, passes up into the inner barrel and, at the end of the coring run, the core barrel assembly is lifted to the surface. Core drilling is relatively expensive, but essential if quality data is required to assess issues associated with deep excavation, rock slope stability etc.

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).

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	1000ml plastic tub
pH & metals	1000ml plastic tub or 250ml glass jars
non-volatile organics	250ml glass jars
Speciated TPH	250ml & 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.

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

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 (e.g. 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 to provide technical guidance in support of Defra's revised Statutory Guidance for Part 2A of the Environmental Protection Act 1990 (Part 2A). The revised Statutory Guidance, published in April 2012, introduced a new four-category system for classifying land under Part 2A where Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is acceptably low. Project SP1010 aimed to deliver:

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

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

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

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

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

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

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

* *For a residential end use*

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

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

---

[1] SP1010 Appendix E, Provisional C4Sls 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 (e.g. 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 (e.g. 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

05 – Hazardous gas
Generic notes – geoenvironmental investigations

General

Hazardous gas is considered to be any mixture of potentially explosive, toxic or asphyxiating gases, most notably methane, carbon dioxide and oxygen (deficiency). In addition, radon, a naturally occurring radioactive gas is also considered. Further information about radon is included in Notes 01 – Environmental Setting.

Assessment of potential risks associated with hazardous gas are based on a review of data obtained from the Landmark Information Group, the Environment Agency and the Local Authority and the British Geological Survey. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Where landfilling has occurred within 250m of the site boundary, the Local Planning Authority may request a landfill gas investigation in accordance with the Town and Country Planning General Development Order, 1988.

Sources

Potential sources of hazardous gas include:

- Landfill sites
- Made ground, especially where significant depths are present
- Shallow mineworkings associated with coal extraction
- Geological strata, including peat, organic silts, coal and limestone (reaction with acidic waters), granite (radon)
- Groundwater can sometimes act as a "carrier" for hazardous gas
- Leakages from pipelines or storage tanks
- Sewers, septic tanks and cess pits

Generation

Wherever biodegradable material is deposited, landfill gas (principally a mixture of methane and carbon dioxide) is likely to be generated by microbial activity. Carbon dioxide is an asphyxiant and toxic; methane is flammable and a mixture containing between 5% and 15% methane by volume in air is explosive. Landfill gas in the ground is unlikely in itself to pose a significant risk, though it may damage vegetation. However, infiltration of landfill gas into confined spaces (e.g. cellars, services, etc) may give rise to considerable risk.

There is no typical figure for the length of time that landfill gas will be evolved, but at many sites significant gas generation continues for at least 15 years after the last deposit of waste.

Migration

Gas migration from a landfill site may occur in several ways. It may migrate through adjacent strata; the distance of migration being dependent on the pressure gradients, volume of gas and permeability of the strata. Where there are faults, cavities and fissures within the strata, gas may move considerable distances. Other migration pathways for gas include man-made features such as mine shafts, roadways and underground services.

Gas migration is influenced by a number of climatic factors, such as atmospheric pressure variations, water table level variations and the influence of a covering of snow or ice over the surface of the site and surrounding area.

Gas monitoring procedure

Lithos adopt a standard gas monitoring procedure, in accordance with CIRIA guidance. This procedure involves the measurement, in the following order of:

- Atmospheric temperature, pressure and ambient oxygen concentration
- Gas emission rate
- Methane, oxygen and carbon dioxide concentrations using an infra-red gas analyser
- Standing water level using a dipmeter.

In addition, ground conditions at each sampling location are recorded together with prevailing weather conditions and any other observations such as any vandalism. Where samples of gas are required for laboratory analysis, Gresham Tubes or multi-layer Tedlar / ALTEF sampling bags are used. Gas concentrations in the well are typically recorded immediately before and after retrieval of a sample.

Current guidance

CIRIA Report 151 (1995)[i] identified that there was inadequate guidance on trigger concentrations for ground gases. CIRIA concluded that the most important aspect of a gas regime below or adjacent to a site was the surface emission rate, i.e. how quickly the gas is coming out of the ground. The lower the surface emission rate the lower the risk. CIRIA Report C665 (2007)[ii] advocates two methodologies for characterising sites:

A – All developments except low rise housing. The advocated methodology is that proposed by Wilson & Card, 1999[iii]

B – Low rise housing. An alternative (traffic light) methodology, derived by Boyle and Witherington, 2006[iv] for NHBC

Both methodologies refer to Gas Screening Values (GSV); previously referred to as limiting borehole gas volume flow.

A – All developments except low rise housing

(Wilson & Card, 1999)[v] revised Table 28 of CIRIA 149[v] in terms of borehole gas volume flow rate (now GSV) in order to achieve a more consistent design of protection measures. This was done to reflect the importance of recognising the gas surface emission rate. Wilson & Card then developed a method for classifying gassing sites (Table 1 below), which took into account the combined gas concentration and GSV.

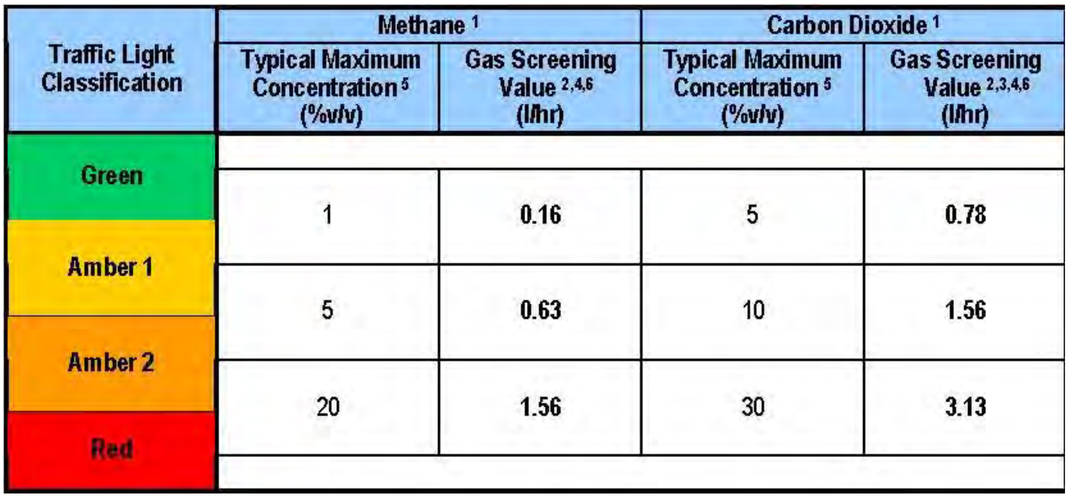
Characteristic Situation	Gas Screening Value, CH_4 or CO_2 (l/hr)	Additional limiting factors	Typical source of generation
1	<0.07	Methane not to exceed 1% v/v and carbon dioxide not to exceed 5% v/v	Natural soils with low organic content
2	<0.7	Borehole air flow rate not to exceed 70 litre/hr otherwise increase to Characteristic Situation 3	Natural soil, high peat/organic content
3	<3.5		Old landfill, inert waste, mineworkings flooded.
4	<15	Quantitative Risk Assessment required to evaluate scope of protection measures.	Mineworkings – susceptible to flooding, completed landfill, inert waste
5	<70		Mineworkings unflooded, inactive
6	>70		Recent landfill site

Notes: Borehole flow rate = volume of gas (regardless of composition) which is escaping from well (l/hr). Gas Screening Value (litre/hour) = gas concentration (%) / 100 x borehole flow rate (l/hr). To facilitate design implementation, the limiting values for both methane and carbon dioxide are identical.

B – Low rise housing.

NHBC have developed a characterisation system similar to that of Wilson & Card above, but specific to low-rise housing development (Boyle and Witherington) (Table 8.7). This approach compares measured gas emission rates with generic "Traffic Lights". The Traffic Lights include "Typical Maximum Concentrations" for initial screening, and risk-based Gas Screening Values (GSVs) for consideration of situations where the Typical Maximum Concentrations are exceeded. Calculations are carried out for both methane and carbon dioxide and the worst case adopted in order to establish the appropriate protection measures.

Table 8.7 NHBC Traffic light system for 150 mm void



Traffic Light Classification	Methane [1]		Carbon Dioxide [1]	
	Typical Maximum Concentration [5] (%v/v)	Gas Screening Value [2,4,6] (l/hr)	Typical Maximum Concentration [5] (%v/v)	Gas Screening Value [2,3,4,6] (l/hr)
Green				
	1	0.16	5	0.78
Amber 1				
	5	0.63	10	1.56
Amber 2				
	20	1.56	30	3.13
Red				

Notes:

1. The worst gas-regime identified at the site, either methane or carbon dioxide, recorded from monitoring in the worst temporal conditions, will be the decider for which Traffic Light and GSV is allocated.
2. Generic GSVs are based on guidance contained within "The Building Regulations: Approved Document C" (2004) and assume a sub-floor void of 150 mm thickness.
3. A leak of gas from the sub-floor void into a small room (e.g. downstairs toilet with soil pipe potentially passing into sub-floor void) of dimensions 1.50m × 1.50m × 2.50m, with a total room volume of 5.63m^3 has been considered.
4. The GSV, in litres per hour, is as defined in Wilson and Card (1999) as the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered.
5. The Typical Maximum Concentrations can be exceeded in certain circumstances should the conceptual site model indicate it is safe to do so. This is where professional judgment will be required, based on a thorough understanding of the gas regime identified at the site where monitoring in the worst temporal conditions has occurred.
6. The GSV thresholds should not generally be exceeded without completion of a detailed gas risk assessment taking into account site-specific conditions.

---

[i] *Harries CR, Witherington PJ and McEntee JM (1995). Interpreting measurements of gas in the ground. CIRIA Report 151*

[ii] *CIRIA (2007) – Assessing risks posed by hazardous ground gases to buildings.*

[iii] *Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.*

[iv] *Boyle & Witherington (2006) – 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*

[v] *Wilson SA and Card GB (February 1999). Reliability and Risk in Gas Protection Design. Ground Engineering.*

Appendix B

Drawings

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CLIENT
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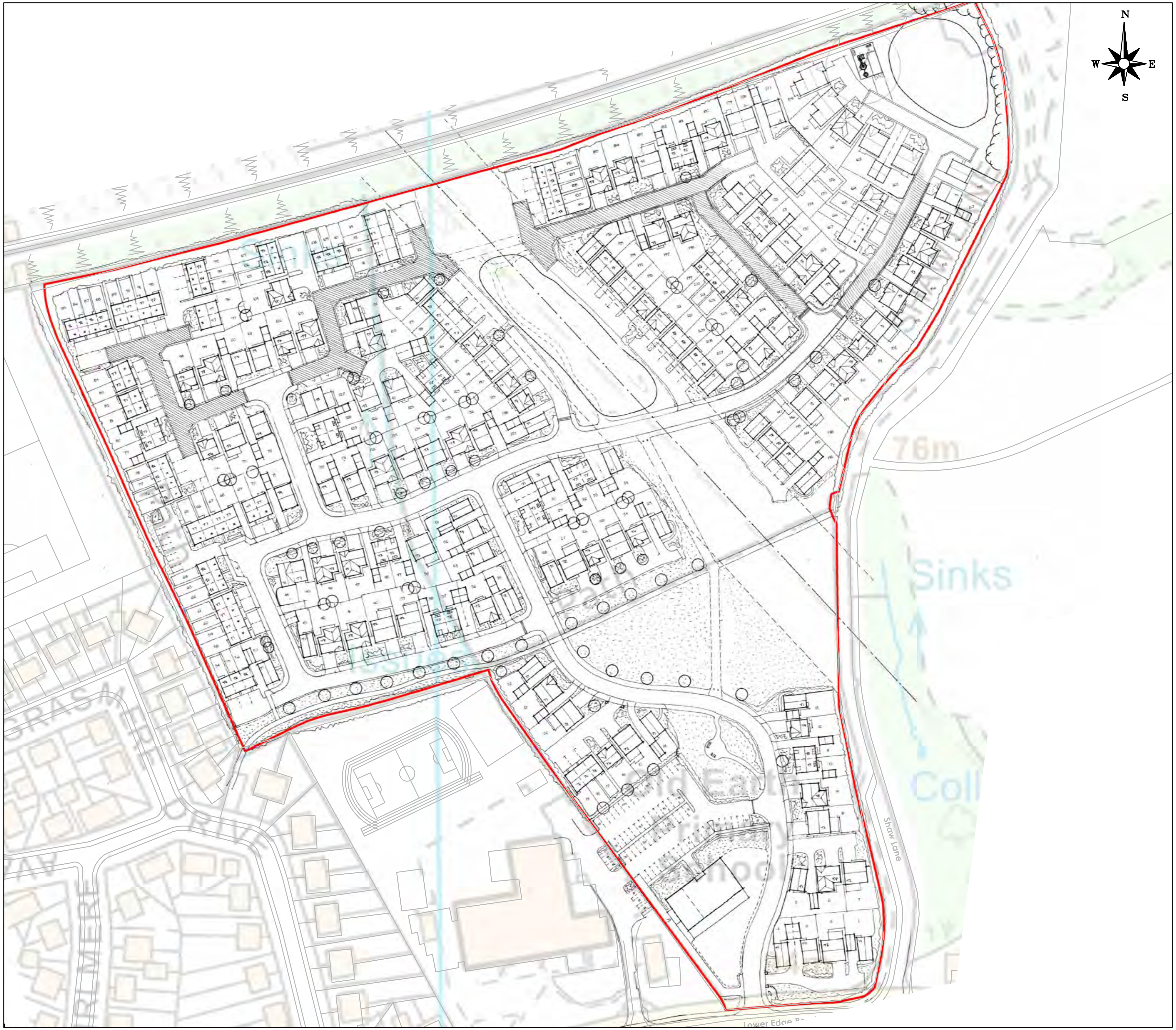
JOB TITLE
SHAW LANE, ELLAND

DRAWING TITLE
SITE LOCATION PLAN

DRAWN AP
DATE 21/02/2022
CHECKED ASw
DATE 21/02/2022
STATUS
FOR COMMENT ☐
FOR APPROVAL ☐
DRAFT ☐
FINAL ☑
SCALE 1:25,000
SHEET A4
DRAWING NO. 4246/1
REVISION



NOTES

APPROXIMATE SITE BOUNDARY

REPRODUCED FROM TITCHMARSH & BAGLEY DRAWING REFERENCE SK05, DATED JANUARY 2020

REV.	DESCRIPTION	DATE

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JOB TITLE

SHAW LANE, ELLAND

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
AP	21/02/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	DRAFT ☐ FINAL ☑
ASw	21/02/2022	

SCALE	SHEET	DRAWING NO.	REVISION
1:1500	A3	4246/2	

NOTES

🟩 GRASS & OVERGROWN AREAS
— DRAINAGE DITCH
- - LINE OF SIGNPOSTED PUBLIC FOOTPATH
— LINE OF ELECTRICITY UTILITY
— LINE OF GAS UTILITY
— LINE OF WATER UTILITY
— APPROXIMATE SITE BOUNDARY

NOTE: SEVERAL WELL TRODDEN UNOFFICIAL FOOTPATHS CROSS THE SITE

REV.	DESCRIPTION	DATE

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JOB TITLE

SHAW LANE, ELLAND

DRAWING TITLE

SITE FEATURES

DRAWN	DATE	STATUS
AP	09/03/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	09/03/2022	DRAFT ☐ FINAL ☑

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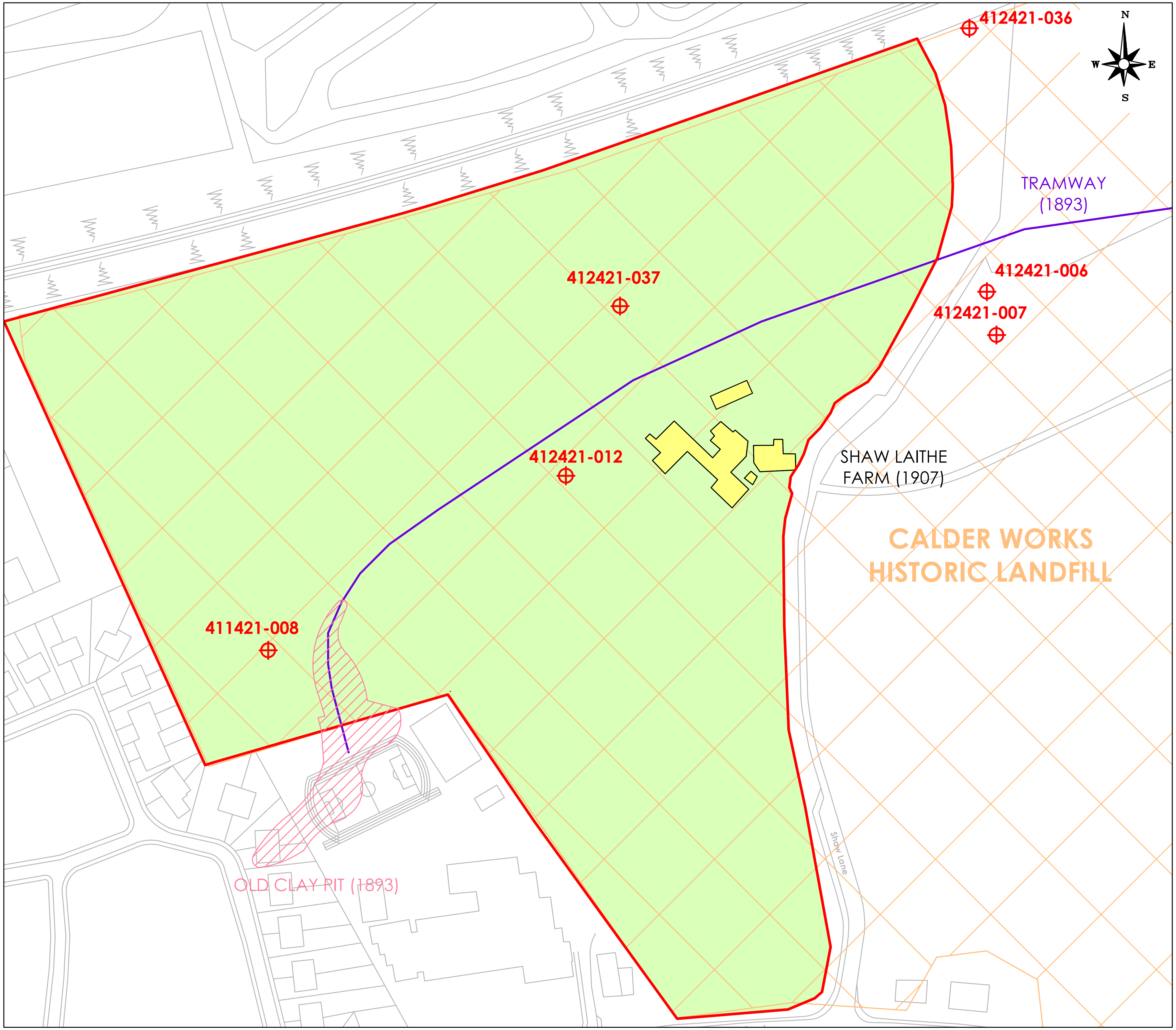

NOTES

🟩	GRASS & OVERGROWN AREAS
🟨	BUILDING
☒	HISTORIC LANDFILL
⊕	MINE SHAFT (FROM OS PLANS)
—	LINE OF OLD TRAMWAY
—	OUTLINE OF OLD CLAY PIT
—	APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

SHAW LANE,
ELLAND

DRAWING TITLE

HISTORIC SITE FEATURES

DRAWN AP	DATE 09/03/2022	STATUS	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED ASw	DATE 09/03/2022		DRAFT ☐ FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1500	A3	4246/3A	

NOTES

🟩 GRASS & OVERGROWN AREAS

╌ LINE OF PUBLIC FOOTPATH

— LINE OF ELECTRICITY UTILITY

— APPROXIMATE SITE BOUNDARY

◁ LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE

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JOB TITLE

SHAW LANE,
ELLAND

DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	DATE	STATUS
AP	15/03/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	15/03/2022	DRAFT ☐ FINAL ☑

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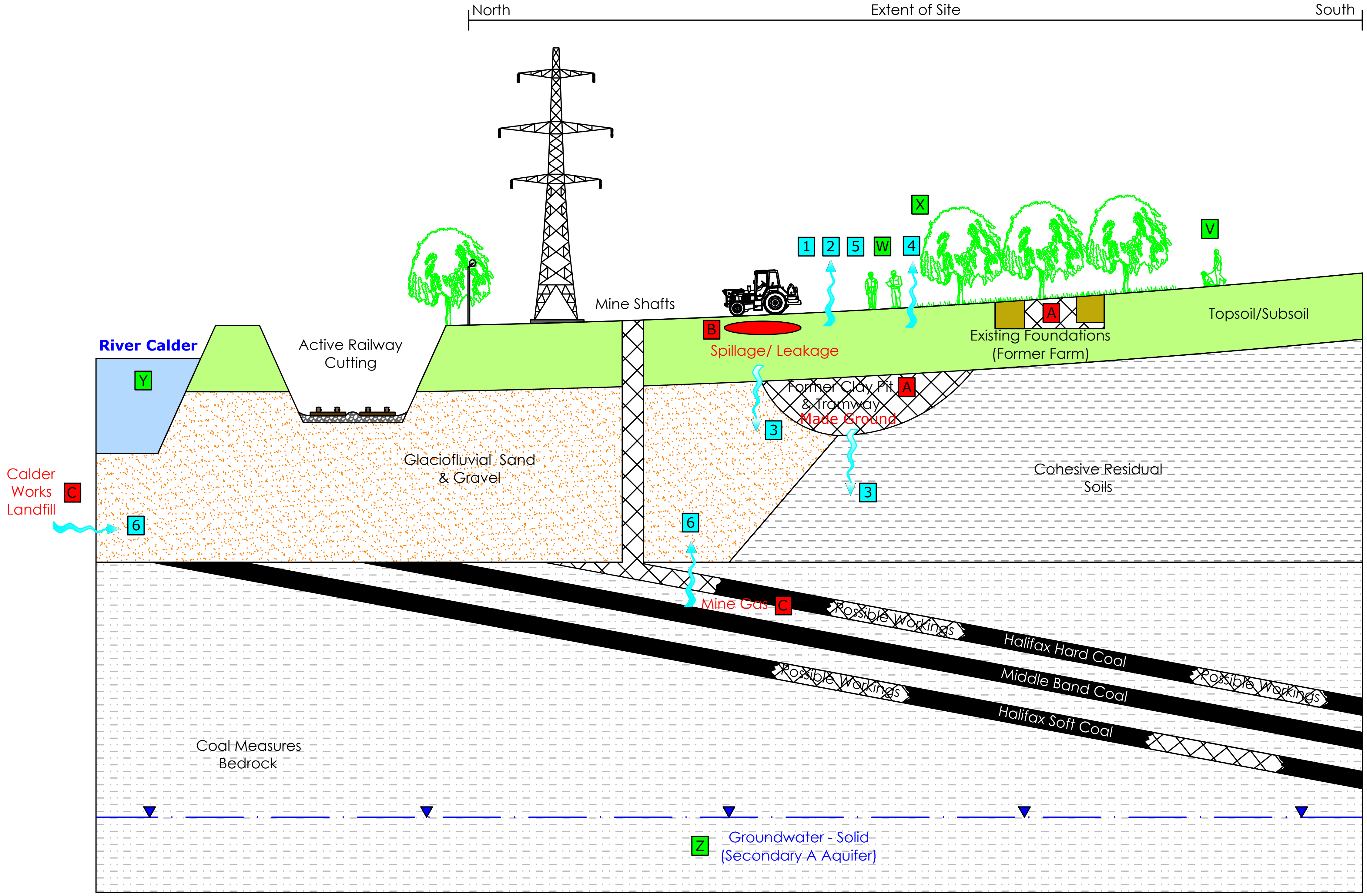

SOURCES	
A	MADE GROUND (INORGANICS)
B	LEAKAGE/SPILLAGE (ORGANICS)
C	HAZARDOUS GAS

PATHWAYS	
1	DERMAL CONTACT
2	INGESTION/INHALATION
3	LEACHING OF CONTAMINANTS
4	UPTAKE BY PLANTS
5	VOLATILISATION
6	MIGRATION OF GAS

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

NOTES

REV.	DESCRIPTION	DATE

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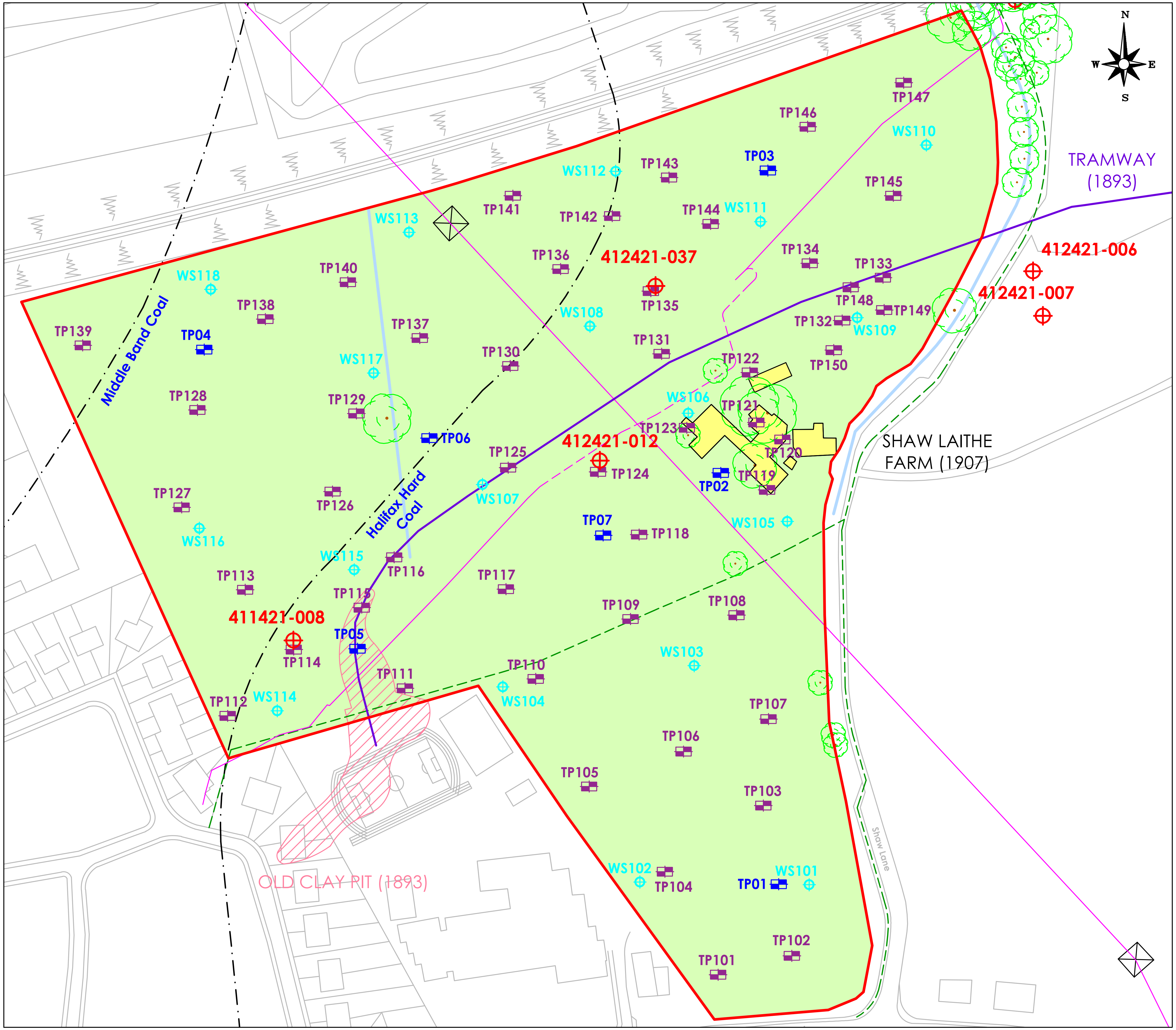
JOB TITLE
SHAW LANE, ELLAND

DRAWING TITLE
PRELIMINARY CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
AP	09/03/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	09/03/2022	DRAFT ☐ FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
Not to scale	A3	4246/5	



NOTES

▬	TRIAL PIT LOCATION (LITHOS 2021)
▬	TRIAL PIT LOCATION (LITHOS 2022)
⊕	WINDOW SAMPLE LOCATION (LITHOS 2022)

ALL EXPLORATORY HOLE LOCATIONS SURVEYED IN (CO-ORDINATES AND LEVELS INCLUDED ON LOGS)

🟩	GRASS & OVERGROWN AREAS
🟨	FORMER BUILDING
⊕	MINE ENTRIES (FROM CA REPORT)
-·-	COAL OUTCROP (FROM BGS PLANS)
- -	LINE OF PUBLIC FOOTPATH
—	LINE OF OVERHEAD ELECTRICITY UTILITY
—	APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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CLIENT

MESSRS STEPHEN & GARY BOYLE, AND MRS SUSAN ILLINGWORTH

JOB TITLE

SHAW LANE, ELLAND

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS (TRIAL PITS & WINDOW SAMPLE BOREHOLES)

DRAWN	DATE	STATUS
AP	12/04/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	12/04/2022	DRAFT ☑ FINAL ☐

SCALE	SHEET	DRAWING NO.	REVISION
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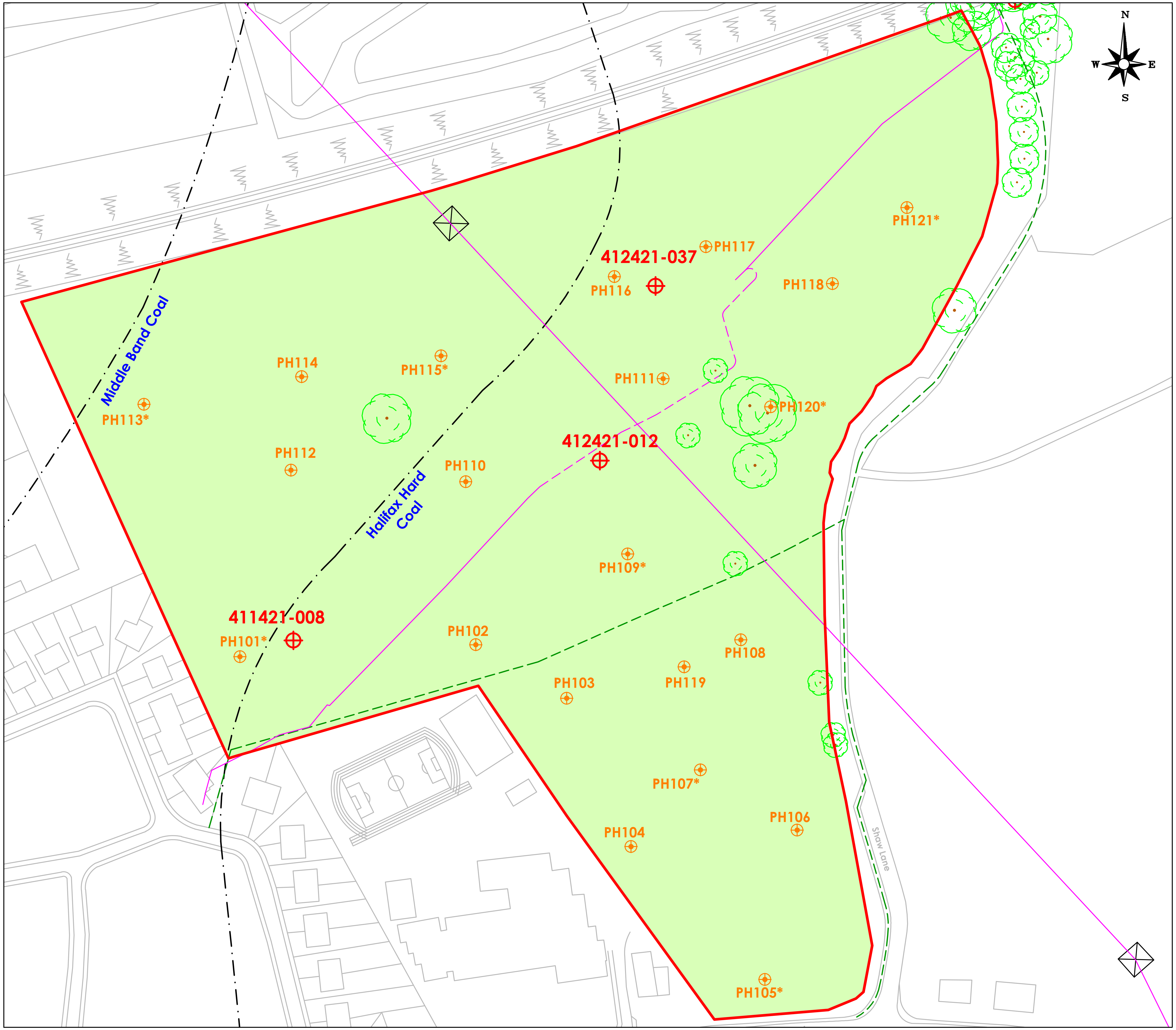

NOTES

⊕ PROBEHOLE LOCATION (LITHOS 2022)
NB: * SIGNIFIES A MONITORING WELL INSTALLATION

ALL EXPLORATORY HOLE LOCATIONS SURVEYED IN (CO-ORDINATES AND LEVELS INCLUDED ON LOGS)

🟩 GRASS & OVERGROWN AREAS

⊕ MINE ENTRIES (FROM CA REPORT)

—·— COAL OUTCROP (FROM BGS PLANS)

– – LINE OF PUBLIC FOOTPATH

— LINE OF OVERHEAD ELECTRICITY UTILITY

— APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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SHAW LANE,
ELLAND

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS
(PROBEHOLES)

DRAWN	DATE	STATUS
AP	12/04/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	12/04/2022	DRAFT ☑ FINAL ☐

SCALE	SHEET	DRAWING NO.	REVISION
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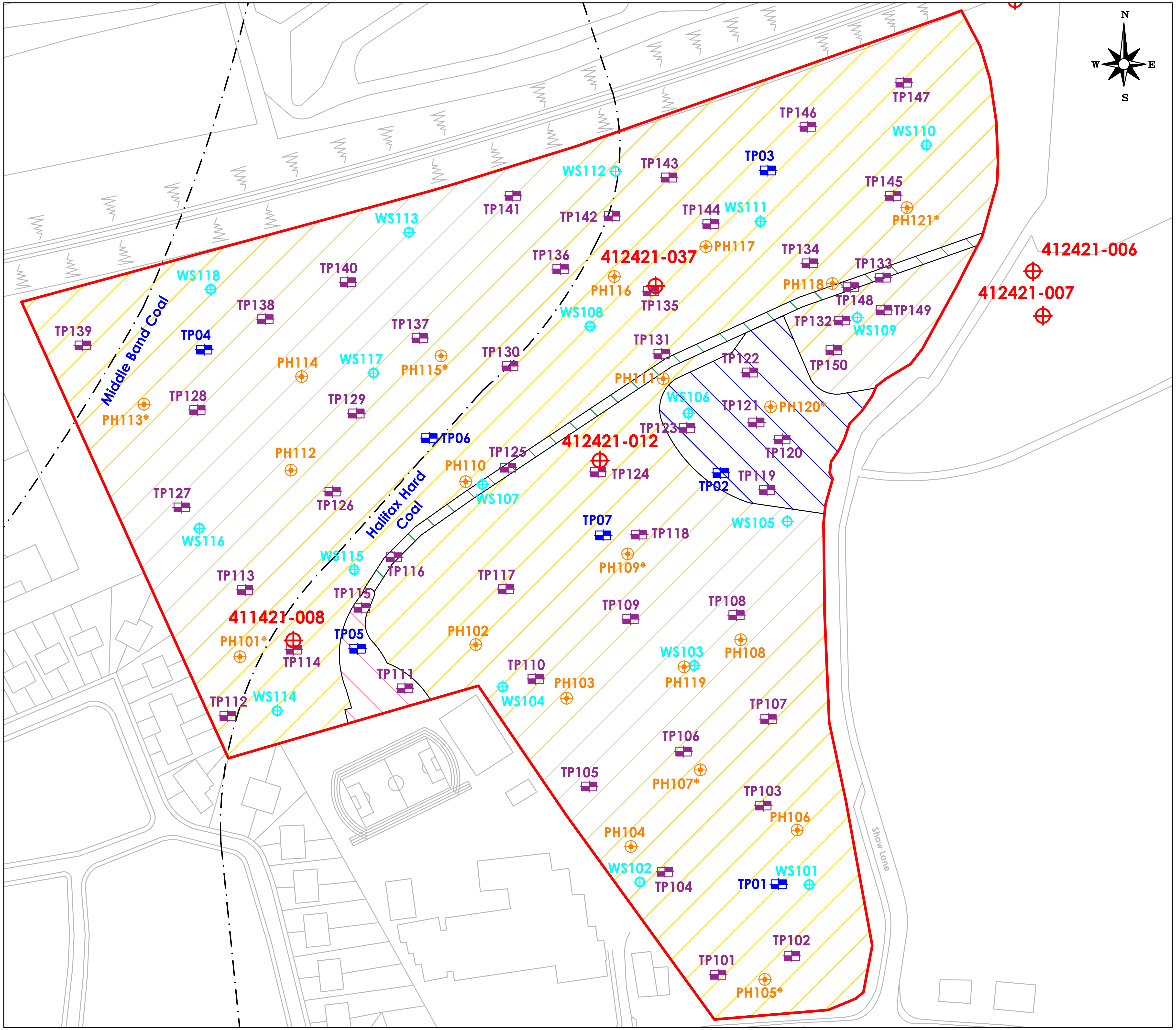

NOTES

APPROXIMATE SITE AREAS

- ▨ AREA A (FORMER CLAY PIT)
- ▨ AREA B (FORMER SHAW LAITHE FARM)
- ▨ AREA C (FORMER TRAMWAY)
- ▨ AREA D (REMAINDER OF SITE - FARM LAND)

EXPLORATORY HOLES

- ▭ TRIAL PIT LOCATION (LITHOS 2021)
- ▭ TRIAL PIT LOCATION (LITHOS 2022)
- ⊕ WINDOW SAMPLE LOCATION (LITHOS 2022)
- ⊕ PROBEHOLE LOCATION (LITHOS 2022)
- 🟩 GRASS & OVERGROWN AREAS
- ⊕ MINE ENTRIES (FROM CA REPORT)
- —·— COAL OUTCROP (FROM BGS PLANS)
- — APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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SHAW LANE,
ELLAND

DRAWING TITLE

SITE AREAS

DRAWN	DATE	STATUS
AP	12/04/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	12/04/2022	DRAFT ☑ FINAL ☐

SCALE	SHEET	DRAWING NO.	REVISION
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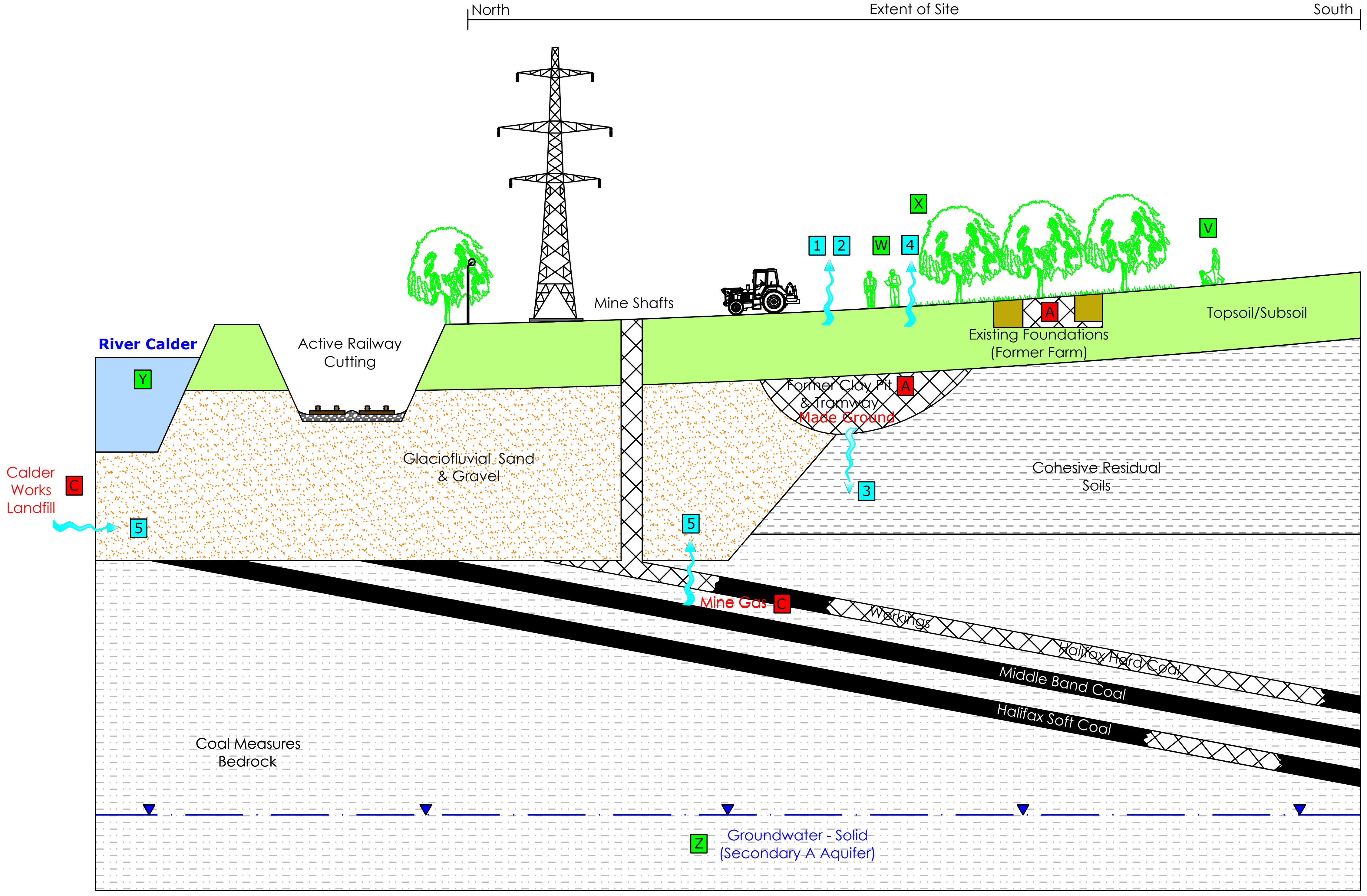

SOURCES

A	MADE GROUND (INORGANICS)
C	HAZARDOUS GAS

PATHWAYS

1	DERMAL CONTACT
2	INGESTION/INHALATION
3	LEACHING OF CONTAMINANTS
4	UPTAKE BY PLANTS
5	MIGRATION OF GAS

RECEPTORS

V	END USERS (RESIDENTS)
W	SITE WORKERS
X	VEGETATION
Y	SURFACE WATERS
Z	GROUNDWATER

NOTES

REV.	DESCRIPTION	DATE

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JOB TITLE
SHAW LANE,
ELLAND

DRAWING TITLE
REVISED CONCEPTUAL SITE MODEL

DRAWN	DATE	STATUS
AP	18/04/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	18/04/2022	DRAFT ☐ FINAL ☑

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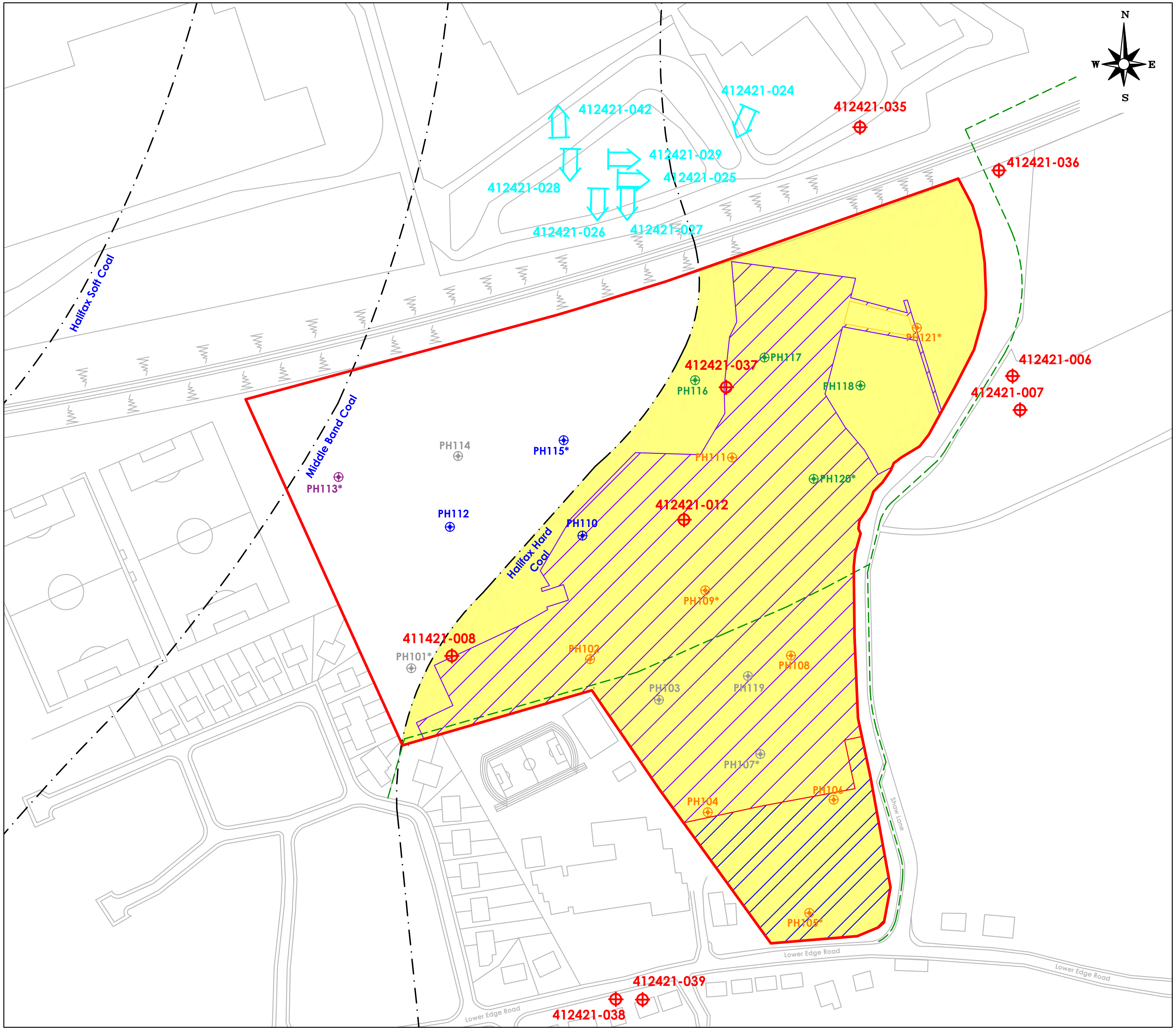

NOTES

⊕ WORKINGS ENCOUNTERED WITHIN HALIFAX HARD COAL
⊕ SOLID COAL ENCOUNTERED WITHIN HALIFAX HARD COAL
⊕ SOLID COAL ENCOUNTERED WITHIN MIDDLE BAND COAL
⊕ SOLID COAL ENCOUNTERED WITHIN HALIFAX SOFT COAL
⊕ NO WORKINGS OR SOLID COAL ENCOUNTERED
▨ AREA OF WORKINGS FROM ABANDONMENT PLAN
▨ AREA OF WORKINGS FROM DRILLING INVESTIGATION
🟨 AREA REQUIRING TREATMENT OF WORKINGS
⇨ ADIT ENTRIES (FROM CA REPORT)
⊕ MINESHAFT ENTRIES (FROM CA REPORT)
-·- COAL OUTCROP (FROM BGS PLANS)
- - LINE OF PUBLIC FOOTPATH
— LINE OF OVERHEAD ELECTRICITY UTILITY
— APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

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DRAWING TITLE

MINE SHAFTS, COAL SEAMS &
WORKINGS

DRAWN	DATE	STATUS
AP	09/03/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	09/03/2022	DRAFT ☐ FINAL ☑

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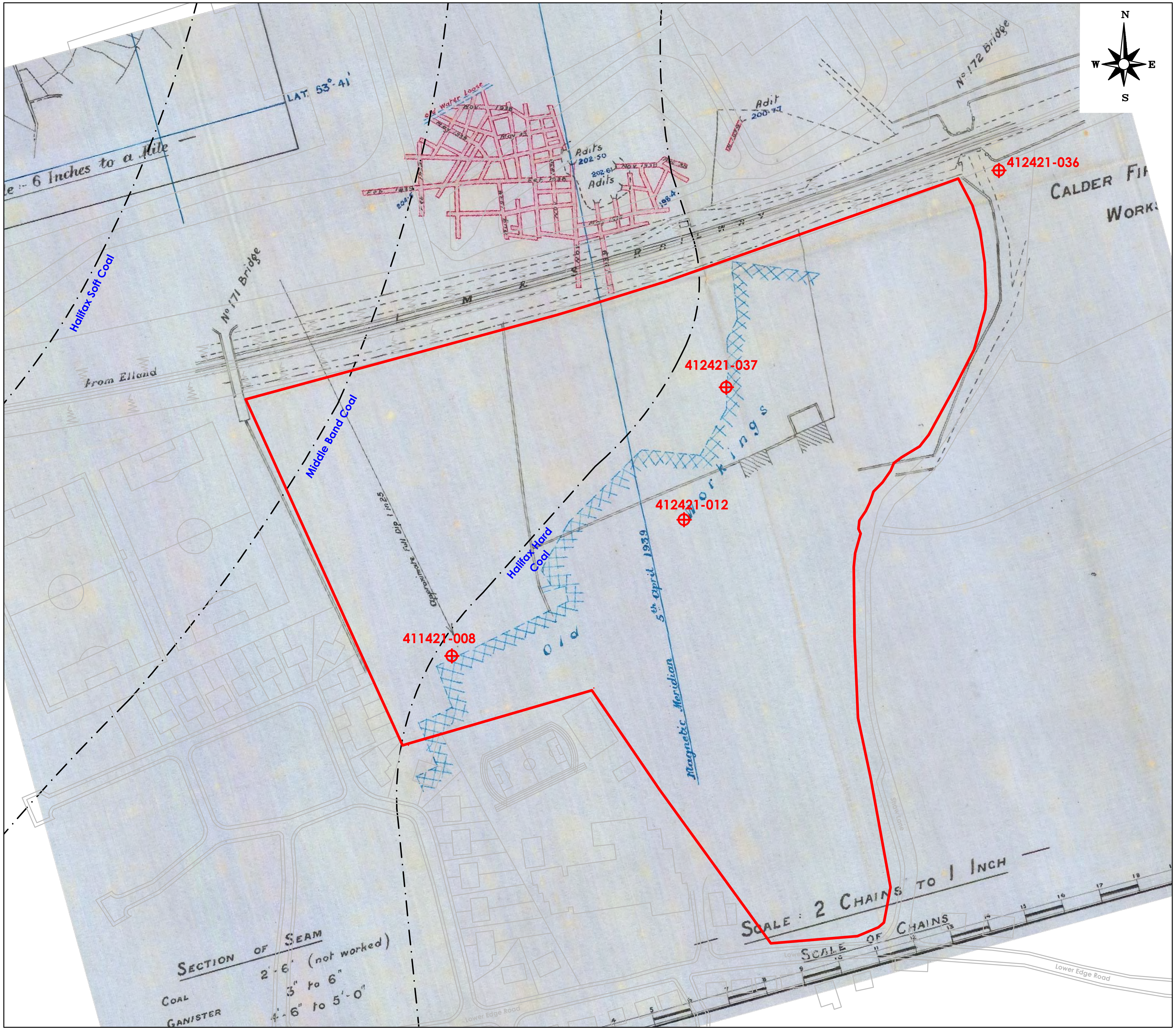

NOTES

HALIFAX HARD BED CLAY ABANDONMENT PLAN - 4th SEPTEMBER 1941

— · — COAL OUTCROP (FROM BGS PLANS)

⊕ MINE SHAFT (FROM CA MINING REPORT)

— APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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SHAW LANE,
ELLAND

DRAWING TITLE

ABANDONMENT PLAN:
HALIFAX HARD BED CLAY

DRAWN	DATE	STATUS
AP	09/03/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	09/03/2022	DRAFT ☐ FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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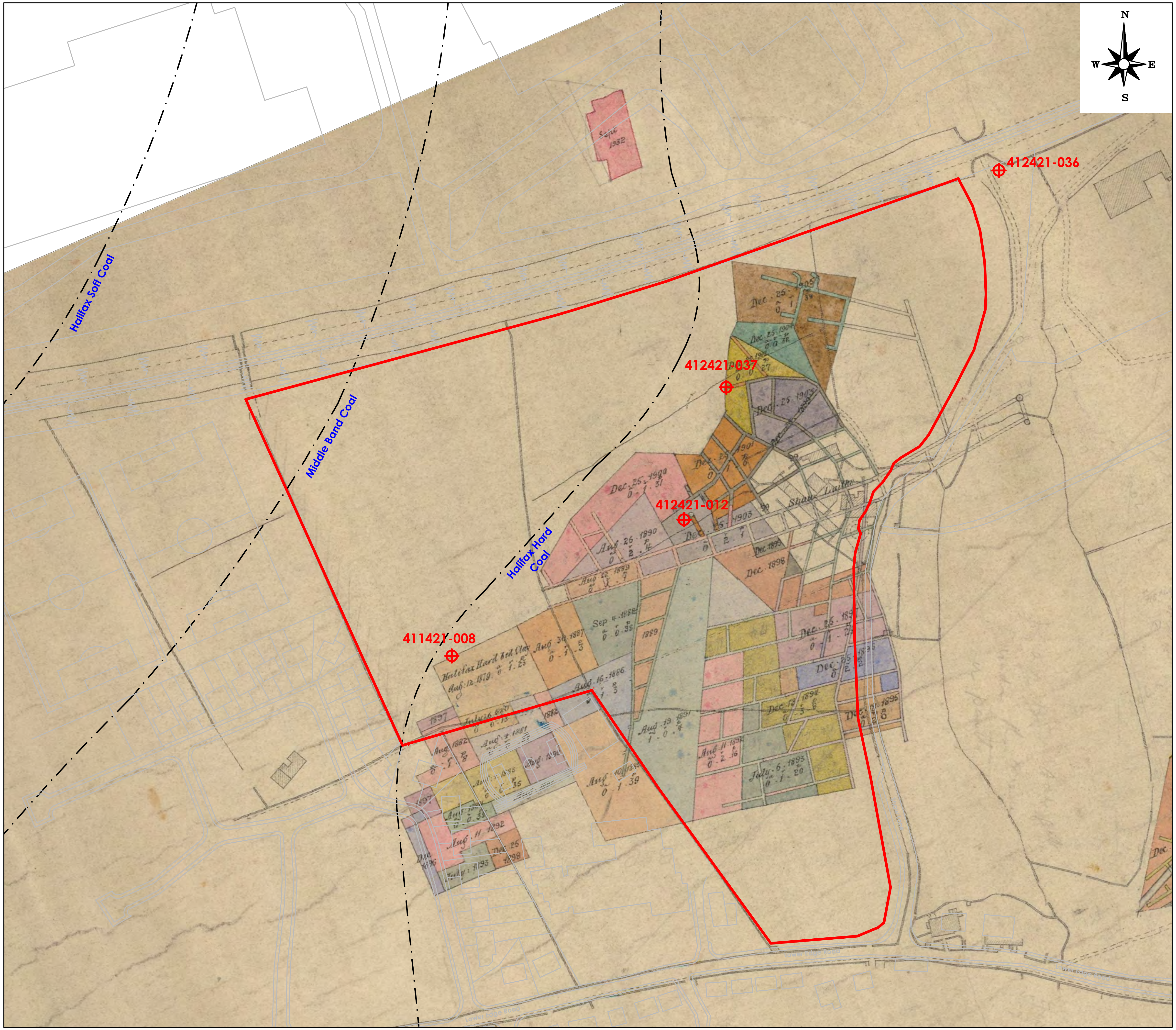

NOTES

HALIFAX HARD BED COAL ABANDONMENT PLAN

-·- COAL OUTCROP (FROM BGS PLANS)

⊕ MINE SHAFT (FROM CA MINING REPORT)

— APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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DRAWING TITLE

ABANDONMENT PLAN: HALIFAX HARD BED COAL

DRAWN	DATE	STATUS
AP	09/03/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	09/03/2022	DRAFT ☐ FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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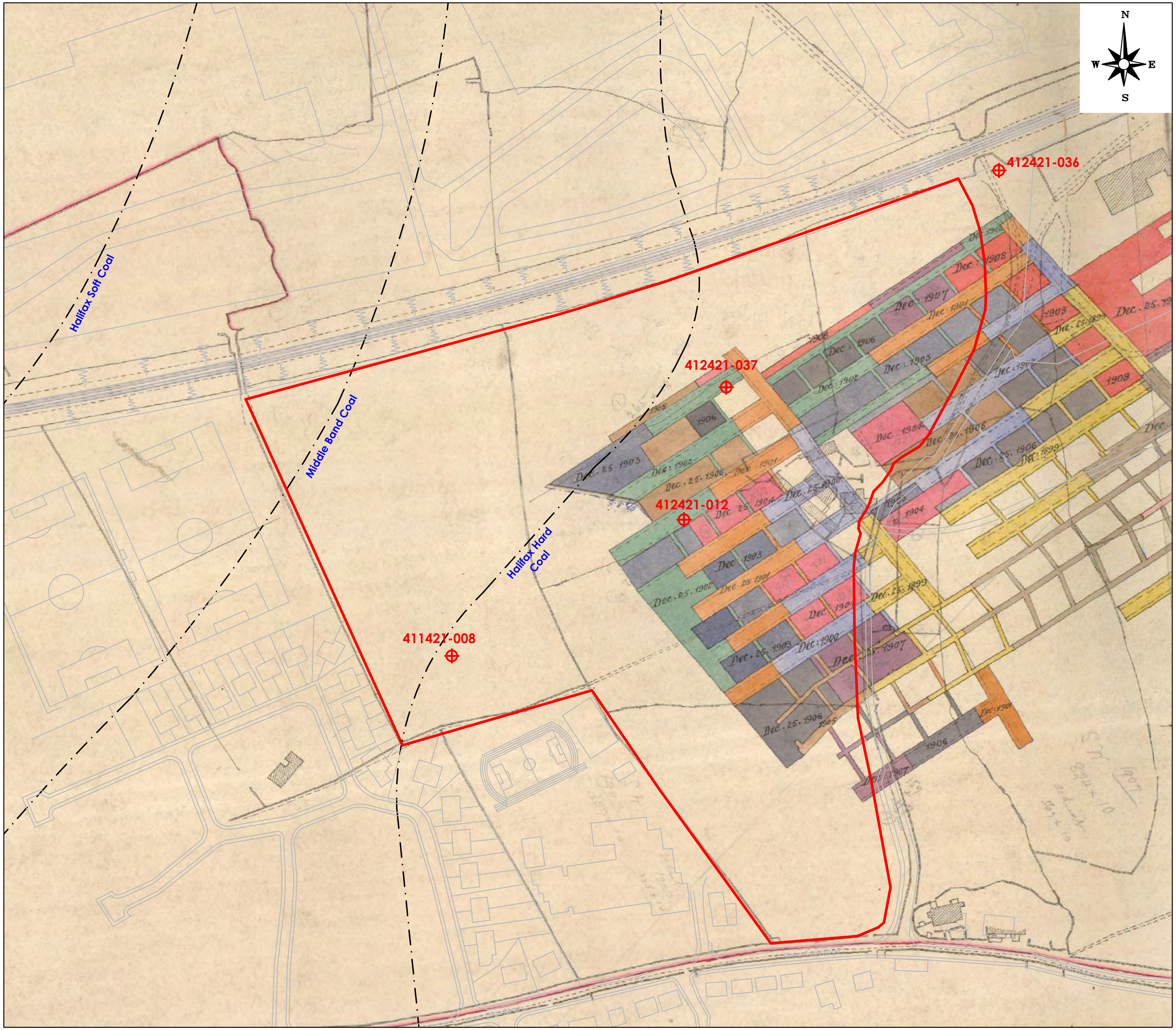

NOTES

HALIFAX SOFT BED COAL ABANDONMENT PLAN - DECEMBER 1914

-·- COAL OUTCROP (FROM BGS PLANS)

⊕ MINE SHAFT (FROM CA MINING REPORT)

— APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

SHAW LANE, ELLAND

DRAWING TITLE

ABANDONMENT PLAN: HALIFAX SOFT BED COAL

DRAWN	AP	DATE	09/03/2022	STATUS FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	ASw	DATE	09/03/2022	DRAFT ☐ FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
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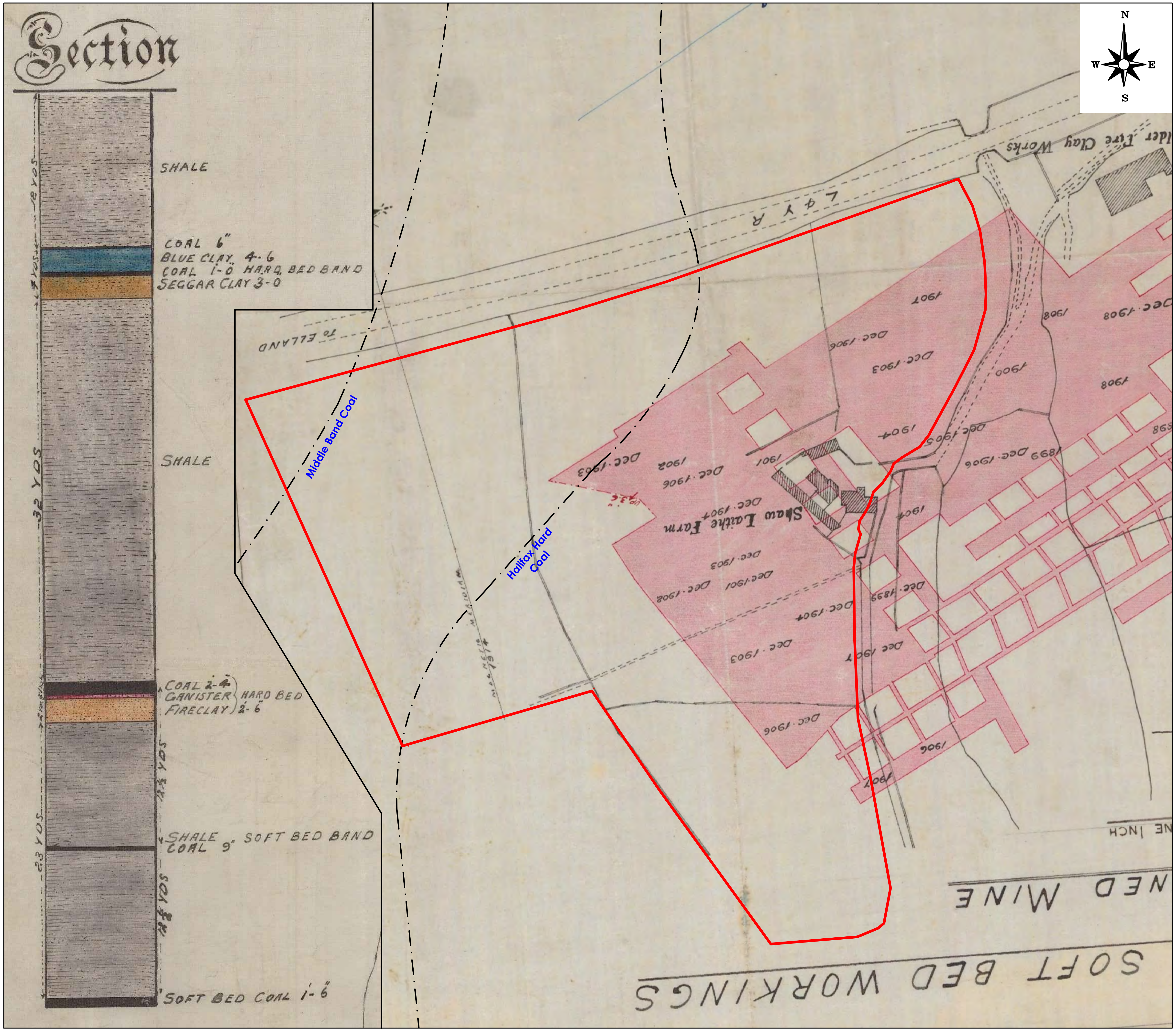

NOTES

HALIFAX SOFT BED COAL ABANDONMENT PLAN - SEPTEMBER 1922

—·— COAL OUTCROP (FROM BGS PLANS)

⊕ MINE SHAFT (FROM CA MINING REPORT)

— APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

SHAW LANE, ELLAND

DRAWING TITLE

ABANDONMENT PLAN: HALIFAX SOFT BED COAL

DRAWN	DATE	STATUS
AP	09/03/2022	FOR COMMENT ☐ FOR APPROVAL ☐ DRAFT ☐ FINAL ☑
CHECKED	DATE	
ASw	09/03/2022	

SCALE	SHEET	DRAWING NO.	REVISION
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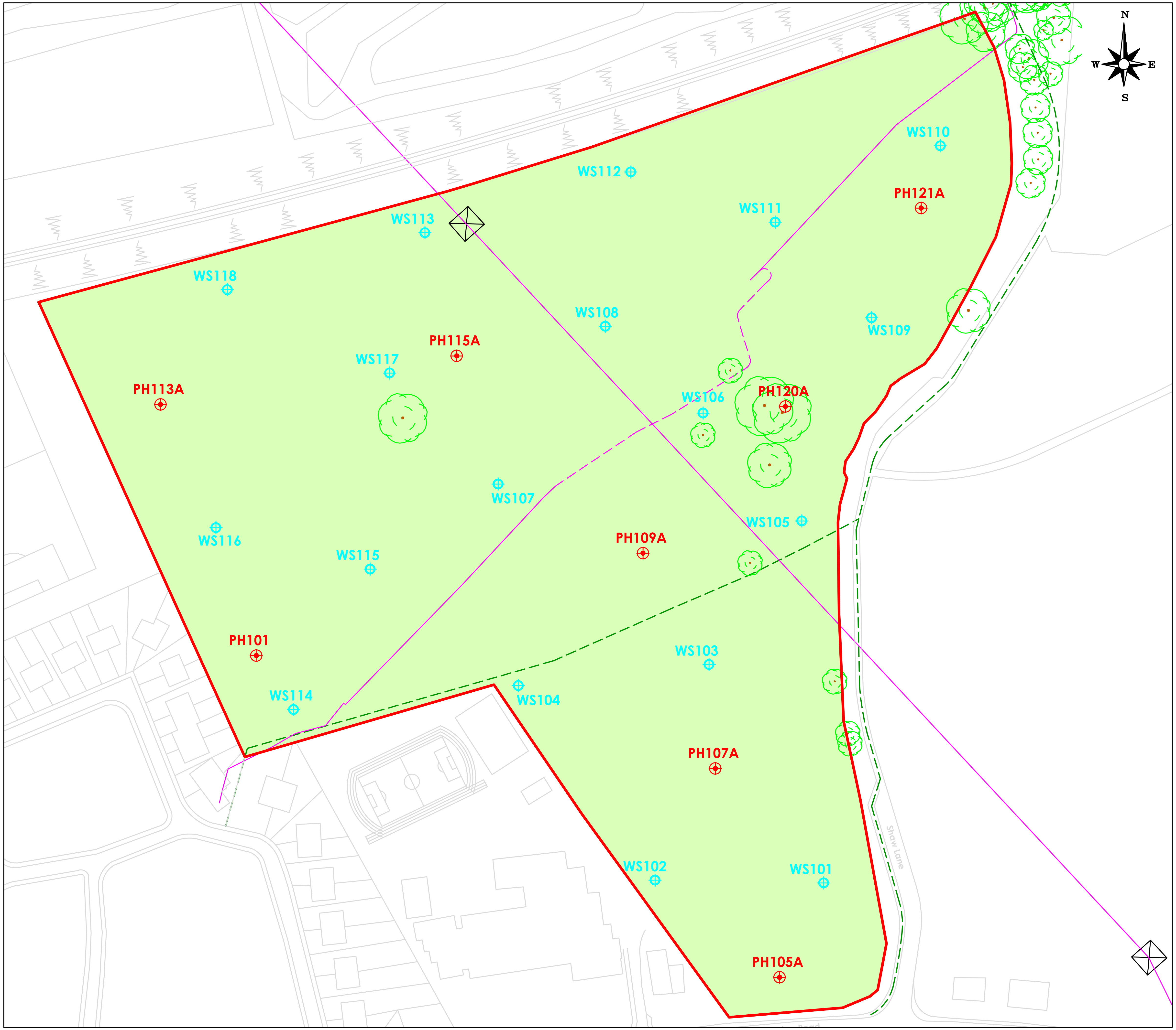

NOTES

⊕ WINDOW SAMPLE LOCATION (LITHOS 2022)

⊕ PROBEHOLE LOCATION (LITHOS 2022)

🟩 GRASS & OVERGROWN AREAS

– – LINE OF PUBLIC FOOTPATH

— LINE OF ELECTRICITY UTILITY

— APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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JOB TITLE

SHAW LANE, ELLAND

DRAWING TITLE

MONITORING WELL LOCATIONS

DRAWN	DATE	STATUS
AP	12/04/2022	FOR COMMENT ☐ FOR APPROVAL ☐
CHECKED	DATE	
ASw	12/04/2022	DRAFT ☑ FINAL ☐

SCALE	SHEET	DRAWING NO.	REVISION
1:1,500	A3	4246/10	

Appendix C

Commission

007a/4246/REG

28th January 2022

LITHOS CONSULTING

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Mr G Titchmarsh
Titchmarsh & Bagley
First Floor, Kenneth Hodgson House
18 Park Row
Leeds
LS1 5JA

Dear Guy

Lower Edge Road, Elland

Further to your recent invitation, please find attached our updated proposal (additions in blue text); reduced cost to reflect provision of excavator by Mr Boyle and exclusion of a Remediation Strategy.

We understand that proposed development will include traditional 2 storey domestic dwellings with associated gardens, POS and adoptable roads and sewers; although no layout is available yet.

Review of the information supplied suggests that the site consists of a single parcel of land of approximately 8.5 hectares off Shaw Lane (to the east) and Lower Edge Road (south). Review of Google Maps suggests the site is rough grassland.

Brief review of the 2016 CoDA desk study report supplied (and our own research) suggests:

- Appears to have remained essentially undeveloped throughout its history, although **mineshafts** & a **clay pit** in centre-west are shown on old maps in the late 1800s / early 1900s. Shaw Laithe **farmyard & buildings** were present in the centre east (late 1800s until around 1990).
- The entire site is a **known landfill** site (Calder Works, tipped in the early 1990s). Evidence of extensive tipping is not obvious on old OS maps viewed to date, and the former clay pit only appears to have occupied a relatively small sub-area. It might be that the wider area was licensed to accept waste, but only a limited area was actually tipped – pitting will tell us.
- Is not within a groundwater source protection zone.
- Is in an area where the risk of encountering UXO is considered low.
- Is located within a Coal Mining Development **High Risk** Area.

Brief examination of the relevant geological map suggests the site is underlain by Glaciofluvial Deposits (north only), over Coal Measures bedrock. The site is underlain at shallow depth (<30m) by 3 seams of coal – the Hard Bed (up to 0.8m thick) crops in the east, the Middle Band (0.3m) crops in the northwest and Soft Bed (0.5m) off-site to the west; all dip to the east.

A total of 7 pits were excavated on the morning of 28th October and found the majority of the site appears to be essentially greenfield; ground conditions comprise a veneer of Topsoil, over firm Glaciofluvial clays and firm to stiff Cohesive Residual Soils, with Coal Measures bedrock from around 2.5m depth.

Significant Made Ground (including Ash & Clinker) was only encountered in the vicinity of former farm buildings and footprint of the former clay pit.

There was no evidence of landfilling or tipping of waste/excess soils and it seems likely that whilst the licensed boundary of Calder Works encompasses the site and adjacent land to the east, landfilling was restricted to former quarries to the east, beyond the area of current interest.

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

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

Our site investigation will be undertaken in accordance with UK good practice (as outlined in BS5930, BS10175, LCRM 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 CoDA report. However, given that the existing Desk Study is over 5 years old, we will obtain "new" environmental search data and historical maps (from Landmark or Groundsure). In addition, published geological plans of the area will be examined.

Given the site's location within a Coal Mining High Risk Area, a Consultant's mining report will be obtained. Review of the CA's interactive viewer suggests **abandonment plans** should be available for known shallow mineworkings beneath the site and we will obtain copies of these plans.

We will also visit site to undertake a walkover survey.

Fieldwork: We have allowed for the excavation of c. 45 no. trial pits, 2 day's dynamic sampling using a mini percussion drilling rig, and 5 day's drilling of rotary probeholes to check for the presence of mineworkings. All trial pits and boreholes will be supervised and logged by an experienced geoenvironmental engineer.

Trial pitting will enable us to determine the:

- Nature of made ground, including:
    - the depth & lateral extent of any historic landfill;
    - the location and extent of the former clay pit, with some trenching to locate the quarry high wall;
    - visual/olfactory evidence of potential contamination and the proportion of undesirable elements e.g. biodegradable matter, relict foundations etc;
    - the proportion of "oversize", boulder-sized material.
- Nature, distribution and thickness of shallow soils
- Suitability of the ground for founding structures and highways

Given nature of the land, the time of year, and anticipated ground pits would best be dug using a tracked 360° excavator, and we understand that the landowner (Mr Boyle) is able to provide an excavator. Consequently, Item C no longer allows for hire of plant.

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.

We will make every effort to compact arisings and 'sweep' them over each trial 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 etc.

If the pitting encounters significant thicknesses of made ground or very soft/loose deposits (the former is considered likely), cable percussion boreholes will be required to obtain geotechnical data from greater depth. We will advise you of any need for boreholes within 2 days of completion of the pitting.

Based on anticipated ground and topography, **soakaways** are considered unlikely to provide a satisfactory solution for surface water drainage, and no allowance has been made for soakaway testing at this stage.

Mini-boreholes are proposed here in order to:

- Allow the installation of gas monitoring wells.
- Assess of the density of granular soils (Glacial drift in the north) either via discrete SPTs or dynamic probing.

However, dynamic sampling can typically only reach depths of 3m to 4m due partly rig capacity and partly to hole instability (unlike drilling using a cable percussion rig, steel casings are not used as a temporary liner to prevent borehole collapse).

Furthermore, SPT results might be less reliable (cf those obtained by cable percussion drilling) because the borehole cannot be lined during drilling with temporary steel casing.

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.

The site is underlain by 3 coal seams, and therefore we have allowed for 5 days' drilling of **rotary probeholes** to check for the presence of mineworkings. This drilling should be sufficient to determine whether old mineworkings are present and pose a significant risk to surface stability of the site. However, if a potential risk is perceived to exist, further probeholes may be required to delineate the extent of workings in order to obtain fixed price quotations for the necessary consolidation works.

It will be necessary to submit an application (with the associated fee) to the Coal Authority (CA) for 'Permission to enter CA mining interests'; and we have allowed for this. Given the proximity of surrounding housing (within 50m of some of the site area), and in accordance with CA requirements we have had to assume that at least some of the probeholes will need to be advanced using water as the flushing medium (as reinforced by recent CA guidance on managing the risk of hazardous gas). Our drilling sub-contractor will need to locate the wash outs close to the site, and procure a standpipe and licence from Yorkshire Water.

With reference to the control, management and disposal of surplus water and flush arising from the 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 made provision for a sand bag bund at the foot of the drilling mast, at each borehole to contain the majority of the drill cuttings. However, we have assumed that potentially discoloured surplus water will be allowed to flow and settle into the field.

At this stage, we have assumed that overnight security will not be required, but this will be reviewed following a site visit. If required, security would be an E\O of £ per night. We have allowed for overnight security (guard) for plant outside normal working hours (nights & weekends).

We have allowed for all exploratory holes to be picked-up by a **surveyor** (co-ordinates/ground levels will be included on the logs).

Given the potential for shallow mineworkings, clay pit backfill and historic landfill on site, we have allowed for the installation of wells in about 20 boreholes and monitoring for hazardous **gas** (and any shallow groundwater).

The generation potential of this gas source is considered likely to be Moderate. Therefore, in accordance with CIRIA Report C665, we have initially allowed for 12 visits over a 6-month period. A hazardous gas risk assessment will be issued on completion of monitoring.

We strongly recommend that groundwater / gas wells be decommissioned after monitoring has been completed. Decommissioning involves removal of the metal covers, unscrewing the upper 1m to 2 m of pipework and filling the void / remaining well with bentonite.

Decommissioning of monitoring wells prevents gas migration into sub-floor voids. Subject to your instruction, we will decommission accessible wells after the last monitoring visit for an E\O price of £+VAT. We will contact you to seek instruction following issue of our gas risk assessment.

Testing: This will comprise routine **geotechnical** soils analysis, including 25 moisture content & Atterberg limits, and 20 pH & water-soluble sulphate.

This site is greenfield and therefore we could obtain in-situ CBR values from plate tests on site. However, at this stage, we will simply estimate CBR values from strata descriptions and classification test results.

At this stage, we have no reason to expect wide areas of the site, beyond the former farm buildings and clay pit, to be underlain by significant thicknesses of made ground. Consequently, we have only allowed for **contaminant** testing of up to 20 made ground samples, plus a further 12 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).

Within in our proposal we have allowed for the screening (ID) of 32 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.

Visible contaminants, sharps and the clay/sand/silt content of 8 topsoil samples will be determined to check compliance with BS3882 requirements.

If landfill is found to be more extensive than anticipated (i.e. site wide, rather than limited to the backfilled clay pit), we will inform you immediately and provide costs for the recommended chemical testing.

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, factual and interpretative report will be issued. This will contain exploratory hole logs, 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.

At the time of writing, fieldwork could be commenced within 4 weeks of receipt of your written instruction to proceed. Our comprehensive geoenvironmental appraisal report will be issued within 5 weeks of fieldwork completion. This report will comment on issues associated with hazardous gas, but the gas risk assessment will not be issued until monitoring is completed.

This report will include a **mining risk assessment** in accordance with Coal Authority guidance.

A completed copy of the **YW** Contaminated Land Assessment Form will be included in an Appendix to our Report. However, the proposed route(s), and total length, of water supply pipes are not currently known and no allowance has been made for laboratory testing of soil samples in line with UKWIR guidance.

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

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

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

We will submit invoices for this project on completion of each Item(s) instructed.

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 at least 5 working days and therefore this proposal includes for provision of a Welfare Unit, with the benefit of full canteen facilities, hot water with full size sink, toilet and drying room.

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.

If no other designers or contractors have been appointed, Lithos could perform the role of Principal Contractor but only for the duration of the site investigation outlined in this proposal. If you require us to perform the role of Principal Contractor, please make this clear in your instruction. It should be noted that we are not suitably qualified to perform either role where other designers or contractors are also appointed.

It is anticipated that the site investigation outlined in this proposal will be undertaken several months before any construction is commenced on site. Consequently, our works can be considered in isolation and, given the anticipated number of person days on site, this site investigation is not notifiable to the HSE.

Further work: In addition to the investigation outlined above, the following further works may ultimately be required:

- **Cable percussion boreholes**, in areas of deep made ground (including landfill if found to be more extensive) the retrieval of geotechnical data from depth to inform pile design. Boreholes would also allow the installation of groundwater wells. The need for boreholes is considered almost certain, but at this stage it is not possible to sensibly estimate the number required or their depth.
- If landfill is found to be more extensive than anticipated, further trial pitting to 'tighten' the grid.
- **Soakaway** testing in order to assess suitability of the ground for house and highway surface water drainage if ground conditions suggest a chance of success (considered unlikely at this stage).
- Preparation of a **Remediation Strategy**.

Terms & conditions: This work will be undertaken in accordance with our Standard Terms and Conditions, a copy of which are enclosed. Given the likely need for a subsequent letter(s) of reliance in favour of a Developer(s), your attention is drawn to Clause 10.1 which relates to capped liability. If this Clause is of concern you should inform us prior to instruction; revision may be possible.

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

Yours sincerely

Mark Perrin
Director
for and on behalf of
LITHOS CONSULTING LIMITED

Terms and Conditions for the Appointment of Lithos Consulting Limited

V007.20

1 DEFINITIONS AND INTERPRETATION

1.1 In this Agreement, unless the context otherwise requires, the following words and expressions have the following meanings:

"Agreement" shall mean these Terms (entitled "Terms and Conditions for the Appointment of Lithos Consulting"), the Proposal, any document recording the Client's unequivocal acceptance of the Proposal and any other documents or parts of other documents expressly referred to in any of the foregoing:

"Client" shall mean the party for whom the Services are being provided by Lithos;

"Documents" shall mean all documents of any kind and includes plans, drawings, reports, programmes, specifications, Bills of Quantities, calculations, letters, e-mails, faxes, memoranda, films and photographs (including negatives), or any other form of record prepared or provided or received by, or on behalf of Lithos, and whether in paper form or stored electronically or on disk, or otherwise;

"Lithos" shall mean Lithos Consulting Limited whose registered office is at Parkhill, Walton Road, Wetherby, West Yorkshire, LS22 5DZ.

"Intellectual Property" includes all rights to, and any interests in, any patents, designs, trade marks, copyright, know-how, trade secrets and any other proprietary rights or forms of intellectual property (protectable by registration or not) in respect of any technology, concept, idea, data, programme or other software (including source and object codes), specification, plan, drawing, schedule, minutes, correspondence, scheme, programme, design, system, process logo, mark, style, or other matter or thing, existing or conceived, used, developed or produced by any person;

"Parties" shall mean the Client and Lithos

"Project" shall mean the project described in the Proposal and any enquiry from the Client on which Lithos has based its Proposal;

"Proposal" means the offer document prepared by Lithos in response to an enquiry or otherwise, in connection with the proposed provision of the Services;

"Services" means the work and services relating to the Project to be provided by Lithos pursuant to the Agreement and as set out in the Proposal and shall include any additions or amendments thereto made in accordance with these Terms;

"Terms" means these terms entitled "Lithos Consulting Terms of Appointment".

1.2 Words importing the singular only shall also include the plural and vice versa, where the context requires.

1.3 Words importing persons or parties shall include firms, corporations and any organisation having legal capacity and vice versa, where the context requires; and words importing a particular gender include all genders.

1.4 The sub-headings to the clauses of these Terms are for convenience only and shall not affect the construction of the Agreement.

1.5 A reference to legislation includes that legislation as from time to time amended, re-enacted or substituted and any Orders in Council, orders, rules, regulations, schemes, warrants, by-laws, directives or codes of practice issued under any such legislation.

1.6 In the event of conflict between the documents forming part of the Agreement, the Proposal shall prevail, followed by the Terms.

2 APPOINTMENT

2.1 The Client agrees to engage Lithos and Lithos agrees to provide the Services in accordance with the provisions of the Agreement.

3 OBLIGATIONS OF LITHOS

3.1 Lithos shall perform the Services using the reasonable standard of skill and care normally exercised by similar professional Environmental firms in performing similar services under similar conditions.

3.2 Lithos shall use all reasonable endeavours to perform the Services in accordance with all relevant environmental and safety legislation.

4 OBLIGATIONS OF THE CLIENT

4.1 Throughout the period of this Agreement the Client shall afford to Lithos or procure the affording to Lithos of access to any site where access is required for the performance of the Services.

4.2 The Client accepts responsibility for ensuring that Lithos is notified in writing of all special site and/or plant conditions, including without prejudice to the generality of the foregoing, the existence and precise location of all underground services, cables, pipes, drains or underground buildings, constructions or any hazards known or suspected by the Client, which the Client shall clearly mark on the ground or identify on accurate location plans supplied to Lithos prior to the commencement of the Services. The Client shall also inform Lithos in writing of any relevant operating procedures including any site safe operating procedures and any other regulations relevant to the carrying out of the Services. The Client shall indemnify Lithos against all costs, claims, demands and expenses arising as a result of any non-disclosure in this respect, including but not limited to indemnification against any action brought by the owner of the land or otherwise.

4.3 If the Client discovers any conflict, defect or other fault in the information or designs provided by Lithos pursuant to the Agreement, he will advise Lithos in writing of such defect, conflict or other fault and Lithos shall have the right to rectify the same or where necessary, to design the solution for rectification of any works carried out by others pursuant the conflicting, defective or in any other way faulty information or designs.

5 INTELLECTUAL PROPERTY

5.1 The copyright in all Intellectual Property prepared by or on behalf of Lithos in connection with the Project for delivery to the Client shall remain vested in Lithos.

5.2 The Client shall have a non-exclusive licence to copy and use such Intellectual Property for purposes directly related to the Project. Such licence shall enable the Client to copy and use the Intellectual Property but solely for its own purposes in connection with the Project and such use shall not include any licence to reproduce any conceptual designs or professional opinions contained therein nor shall it include any license to amend any drawing, design or other Intellectual Property produced by Lithos.

5.3 Should the Client wish to use such Intellectual Property in connection with any other works or for any other purpose not directly related to the Project or wish to pass any Intellectual Property to any third party, it must obtain the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and shall be upon such terms as may be required by Lithos. Lithos shall not be liable for the use by any person of such Intellectual Property for any purpose other than that for which the same were prepared by or on behalf of Lithos.

5.4 Ownership of any proposals submitted to the Client that are not subsequently confirmed as part of the Services to be provided for the Client remain with Lithos and such proposals must not be used as the basis for any future work undertaken by the Client or a third party and no liability can be accepted howsoever arising from such proposals.

5.5 In the event of the Client being in default of payment of any fees or other amounts due, Lithos may suspend further use of the licence on giving 2 days' notice of the intention to do so. Use of the licence may be resumed on receipt of the outstanding amounts.

6 TITLE

6.1 Lithos shall transfer only such title or rights in respect of the Documents as it has, and if any part is purchased from a third party Lithos shall transfer only such title or rights as that party had and has transferred to Lithos.

6.2 Title in the Documents shall remain with and shall not pass to the Client until the amount due under the invoice(s) (including interest and costs) has been paid in full.

6.3 Until title passes, the Client shall hold the Documents as bailee for Lithos and shall store or mark them so that they can at all times be identified as the property of Lithos.

6.4 At any time before title passes (save and except where payment is not due), but only after prior consultation with the Client, Lithos may without any liability to the Client repossess and use or sell all or any of part of the Documents and by doing so terminate the right of the Client to use, sell or otherwise deal in the Documents.

6.5 Lithos may maintain an action for the price of the Documents notwithstanding that title in them has not passed to the Client.

7 CONFIDENTIALITY AND DATA PROTECTION

7.1 Lithos undertakes not to divulge or disclose to any third party without the written consent of the Client information which is designated confidential by the Client or which can reasonably be considered to be confidential and arises during the performance of the Services unless required to do so by law or necessary in the proper performance of its duties in relation to the Project, or in order to make full frank and proper disclosure to its insurers or intended insurers, or to obtain legal or accounting advice.

7.2 Subject to the above and Lithos' Privacy Policy which can be found on www.lithos.co.uk, Lithos shall be permitted to use information related to the Services it provides in connection with the Project for the purposes of marketing its services and in proposals for work of a similar type.

8 THIRD PARTIES

8.1 The Agreement or any part thereof or any benefit or interest thereunder may not be assigned by the Client without the prior written consent of Lithos. The giving of such consent shall be at the discretion of Lithos and Lithos will only agree to an assignment on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any assignment.

8.2 The Agreement shall not confer and shall not purport to confer on any third party any benefit or any right to enforce any term of this Agreement for the purposes of the Contracts (Rights of Third Parties) Act 1999 or otherwise.

8.3 Lithos will consider and may consent to any request from the Client for Lithos to enter a collateral warranty with a third party with regard to the Services provided under the Agreement. The giving of such consent shall be at the discretion of Lithos and Lithos will only enter a collateral warranty on its terms and in return for payment of a fee by the Client to Lithos to cover Lithos' legal and other costs associated with any collateral warranty.

9 INSURANCE

9.1 Lithos warrants to the Client that there is in force a policy of Professional Indemnity insurance covering its liabilities for negligence under this Agreement, with a limit of indemnity of £5,000,000 (FIVE MILLION POUNDS) any one claim, save for pollution and contamination claims and asbestos claims both of which carry £2,000,000 (TWO MILLION) in the aggregate cover. This policy is annually renewable and whilst renewal is not automatic, Lithos agrees to use reasonable endeavours to maintain such insurance at all times until six years from the date of the completion (or termination) of the Services under the Agreement, provided such insurance is available at commercially reasonable rates having regard, inter alia, to premiums required and policy terms obtainable.

9.2 If for any period such insurance is not available at commercially reasonable rates, Lithos shall forthwith inform the Client and shall obtain in respect of such period such reduced level of Professional Indemnity insurance as is available and as would be fair and reasonable in the circumstances for Lithos to obtain.

10 LIMITATIONS ON LIABILITY

10.1 Unless otherwise agreed in writing, Lithos' liability under or in connection with the Agreement whether in contract, tort, negligence, breach of statutory duty or otherwise (other than in respect of personal injury or death) shall be limited to and shall not exceed the lesser of either the level of insurance cover referred to within clause 9.1 above, or 20 times the total value of invoices issued to the Client for consultancy work instructed under the Agreement.

10.2 No action or proceedings under or in respect of the Agreement whether in contract, tort, negligence, under statute or otherwise shall be commenced against Lithos after the expiry of a period of six years from the date of the completion (or termination) of the Services under the Agreement.

10.3 Whilst Lithos will scan all potential exploratory locations with a Cable Avoidance Tool, Lithos shall not be liable for any damage to underground services, cables, pipes, drains or underground buildings, constructions and the like which were either not marked on site or for which accurate plans were not provided.

10.4 Lithos shall not be liable for the cost of rectifying any defect, conflict or other fault in the information or designs provided by Lithos or for the cost of designing a solution for and rectifying any subsequent works carried out by others pursuant to the conflicting, defective or in any other way faulty information or designs, unless Lithos has been advised in writing of the same by the Client and has been given the opportunity to rectify the same or where necessary, to design the solution for rectification of any subsequent works carried out by others pursuant to the same.

11 PAYMENT

11.1 Invoices for services rendered will be submitted for payment in accordance with the Proposal.

11.2 The due date for payment is the date of the invoice and the final date for payment is 28 days from the date of the invoice.

11.3 If the Client disputes the amount included for payment in an invoice a written notice must be served on Lithos by the Client not later than 14 days before the final date for payment. If no notice is given the amount due shall be the amount stated in the invoice.

11.4 In the event of failure on the part of the Client to pay any monies in accordance with the foregoing payment provisions, Lithos will be entitled to charge interest on any monies owed to it by the Client, such interest to be at a rate of 8% above the base rate of a clearing bank from time to time calculated from the final date for payment to the date of actual payment on a compound basis.

12 DELAY

12.1 Lithos will comply with any timescale agreed for completion of the Services unless delayed or prevented by circumstances beyond its reasonable control and in the event of any such circumstances arising Lithos undertakes to complete the Services within a reasonable period, but will not be liable to the Client for any delay as a result.

13 TERMINATION

13.1 The Agreement may be terminated by either party in the event of the other making a composition or arrangement with its creditors, becoming bankrupt, or being a company, making a proposal for a voluntary arrangement for a composition of debts, or has a provisional liquidator appointed, or has a winding-up order made, or passes a resolution for voluntary winding-up (except for the purposes of a bona fide scheme of amalgamation or reconstruction), or has an administrator or an administrative receiver appointed to the whole or any part of its assets. Notice of termination must be given to the party which is insolvent by the other party.

13.2 If for any reason the performance of the Services by Lithos is suspended for a period in excess of three calendar months then Lithos shall be entitled to terminate its appointment in respect of the Services by seven days written notice to the Client.

13.3 If the Client shall fail to pay in full any sum due under the terms of the Agreement by the final date for payment for that sum and no effective notice of intention to withhold payment has been issued, Lithos may serve written notice on the Client demanding payment within 14 days of such notice. If the Client shall fail to comply with such notice, Lithos shall be entitled to terminate its employment under the Agreement forthwith.

13.4 Any termination of the appointment of Lithos howsoever caused shall be without prejudice to the right of Lithos to require payment for all services performed up to the date of such termination including but not limited to payment of a fair and reasonable proportion of any figure identified in the Proposal or otherwise for fees in respect of a particular service which Lithos has started, but not completed.

14 NOTICES

14.1 Any notice provided for in the Agreement shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post to the address of the relevant party as may have been notified by each party to the other or, in the absence of notification, to the address of Lithos set out above or to the registered address of the Client.

14.2 Such notice shall be deemed to have been received on the day of delivery if delivered by hand or on the second working day after the day of posting if sent by first class post.

15 ENTIRE AGREEMENT

15.1 The Agreement constitutes the complete and entire agreement between the Client and Lithos with respect to the Services and supersedes any prior oral and/or written warranties, terms, conditions, communications and representations, whether express or implied and any claim against Lithos in respect of the Services can only be made in contract under the provisions of the Agreement and not otherwise under the law or tort or otherwise.

15.2 No amendments, modifications or variation of the Agreement shall be valid unless made in writing and agreed to by both the Client and Lithos; such agreement must be recorded in writing by at least one of the Parties.

15.3 Lithos will not be bound by any standard or printed terms or conditions furnished by the Client in any of its documents unless Lithos specifically states in writing separately from such documents that it intends such terms and conditions to apply.

16 DISPUTES AND GOVERNING LAW

16.1 The Agreement shall be governed by and construed in accordance with English law and the Parties irrevocably and unconditionally submit to the jurisdiction of the English Courts.

16.2 Where the Housing Grants, Construction and Regeneration Act 1996 applies, any dispute between the Parties may be referred to adjudication in accordance with The Scheme for Construction Contracts Regulations 1998 or any amendment or modification thereof being in force at the time of the dispute, as applicable to England, Wales, Scotland and Northern Ireland.

Reg

Subject: FW: 4246, Site Investigation Shaw Lane, Elland

From: Reg
Sent: 08 February 2022 15:37
To: Titchmarsh & Bagley <info@titchmarshandbagley.com>
Cc: stephen boyle <steveboyle@live.co.uk>; Alan Swales <Alan@lithosconsulting.co.uk>
Subject: 4246, Site Investigation Shaw Lane, Elland

Afternoon Guy

Thanks for your instruction, we'll make a start on the desk study shortly, and Alan will advise shortly with regards to fieldwork dates (but likely mid-March).

We note your comment regarding Clauses 10.1 & 10.2 of our T&C and can confirm that we are able to provide £5M PI with a liability period of 12 years for our proposed works.

Any queries, please call.

Regards

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

www.lithos.co.uk

From: Titchmarsh & Bagley <info@titchmarshandbagley.com>
Sent: 07 February 2022 10:45
To: Reg <Reg@lithos.co.uk>
Cc: stephen boyle <steveboyle@live.co.uk>
Subject: Geo-technical Site Investigation Shaw Lane, Elland

Reg

As per this morning's conversation please take the email as instruction to proceed with the Intrusive Site Investigation on the basis of your revised quote below and attached T&Cs above.

We would however, like you to address points 10.1 and 10.2. Please can you confirm that Lithos are willing to put their full £5M PI cover in place for this job (not 20x price of the work as per the T&Cs) and also that the cover is valid for 12 years and not the 6 referred to in the same at 10.2.

As discussed, if you could let us know (as much notice as possible please) when you will need Mr Boyle's team on site with the equipment to help with the trial pits and soak aways that would be much appreciated.

Best

Guy.

Guy Titchmarsh

Director

TITCHMARSH
& BAGLEY

First Floor, Kenneth Hodgson House, 18 Park Row, Leeds LS1 5JA - **PLEASE NOTE OUR CHANGE OF ADDRESS**

Telephone: 0113 898 0745 – **PLEASE NOTE OUR CHANGE OF TELEPHONE NUMBER**

Mobile: 07946 510 343

www.titchmarshandbagley.com

From: Reg <Reg@lithos.co.uk>
Sent: 28 January 2022 10:34
To: Guy Titchmarsh <guy@titchmarshandbagley.com>
Subject: Shaw Lane, Elland

Morning Guy

Revised quote (now £***; down by £***) “discounted” to reflect no need for excavator hire or Remediation Strategy.

Hope this OK.

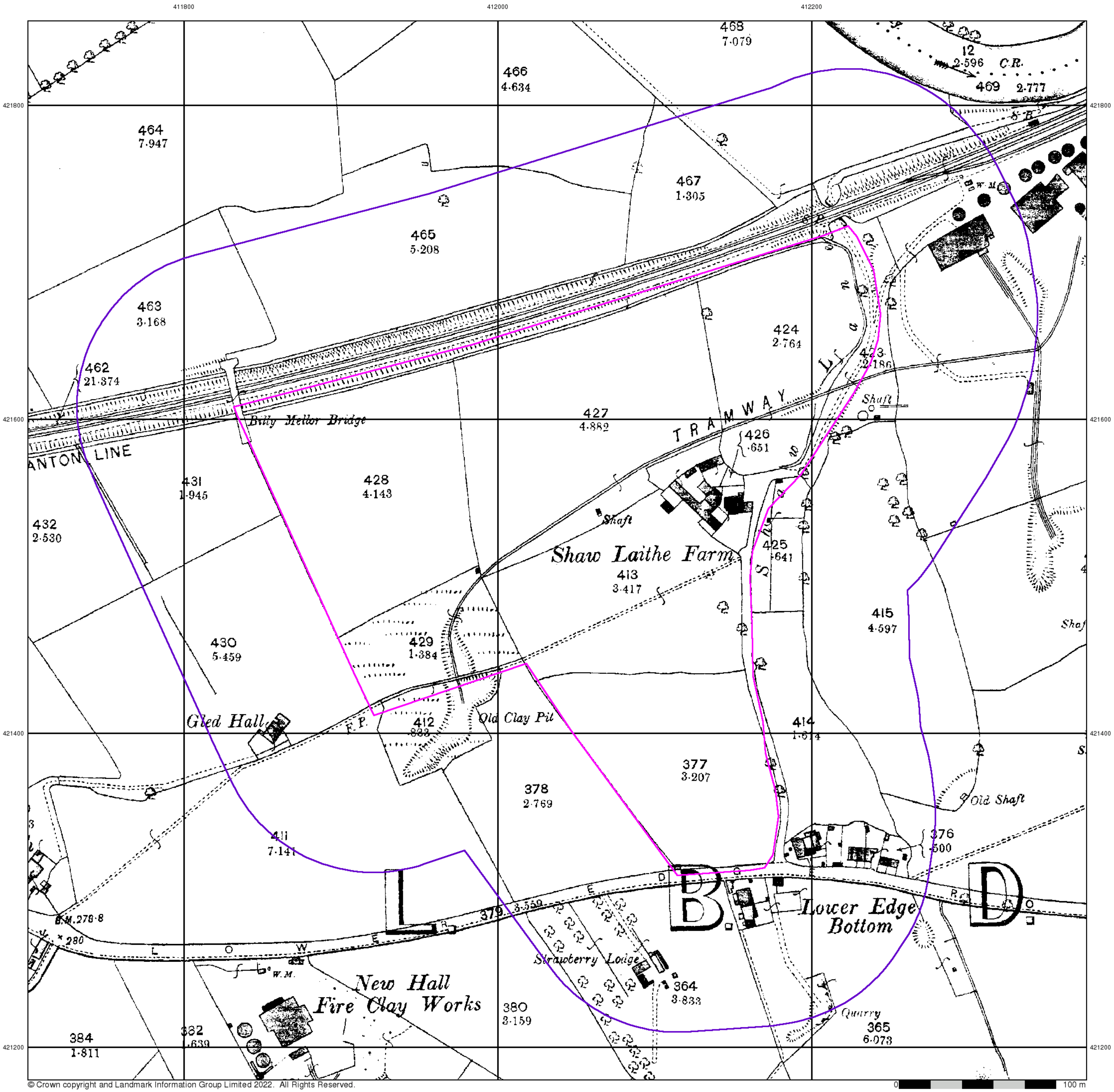
Regards

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

LITHOS CONSULTING
www.lithos.co.uk

Appendix D

Historical OS Plans



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LITHOS CONSULTING

Yorkshire

Published 1893

Source map scale - 1:2,500

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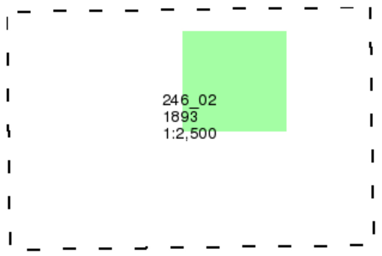
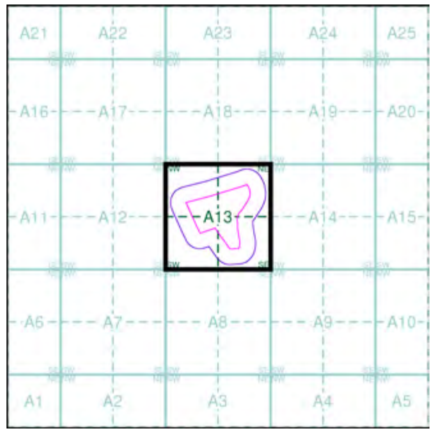
Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

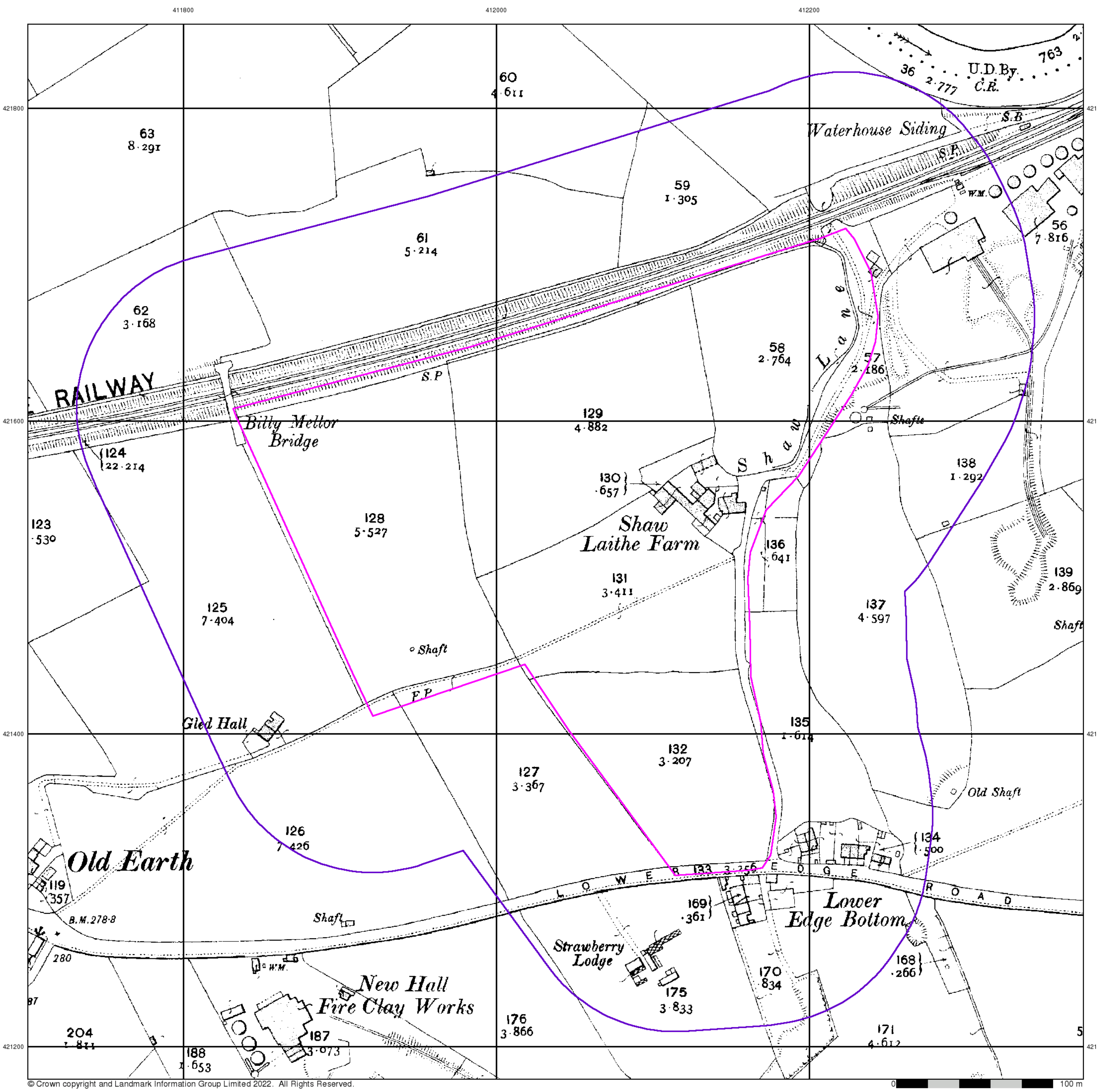
Order Number:	291485538_1_1
Customer Ref:	PO18803/JW/4246
National Grid Reference:	412070, 421530
Slice:	A
Site Area (Ha):	8.96
Search Buffer (m):	100

Site Details

Lower Edge Road, Elland, HX5 9PL

Landmark INFORMATION GROUP

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



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Yorkshire

Published 1907

Source map scale - 1:2,500

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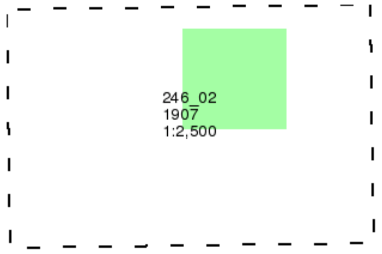
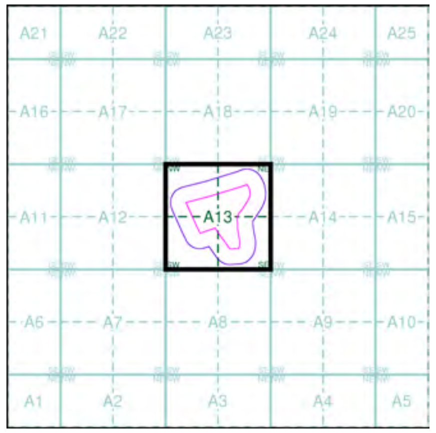


Historical Map - Segment A13



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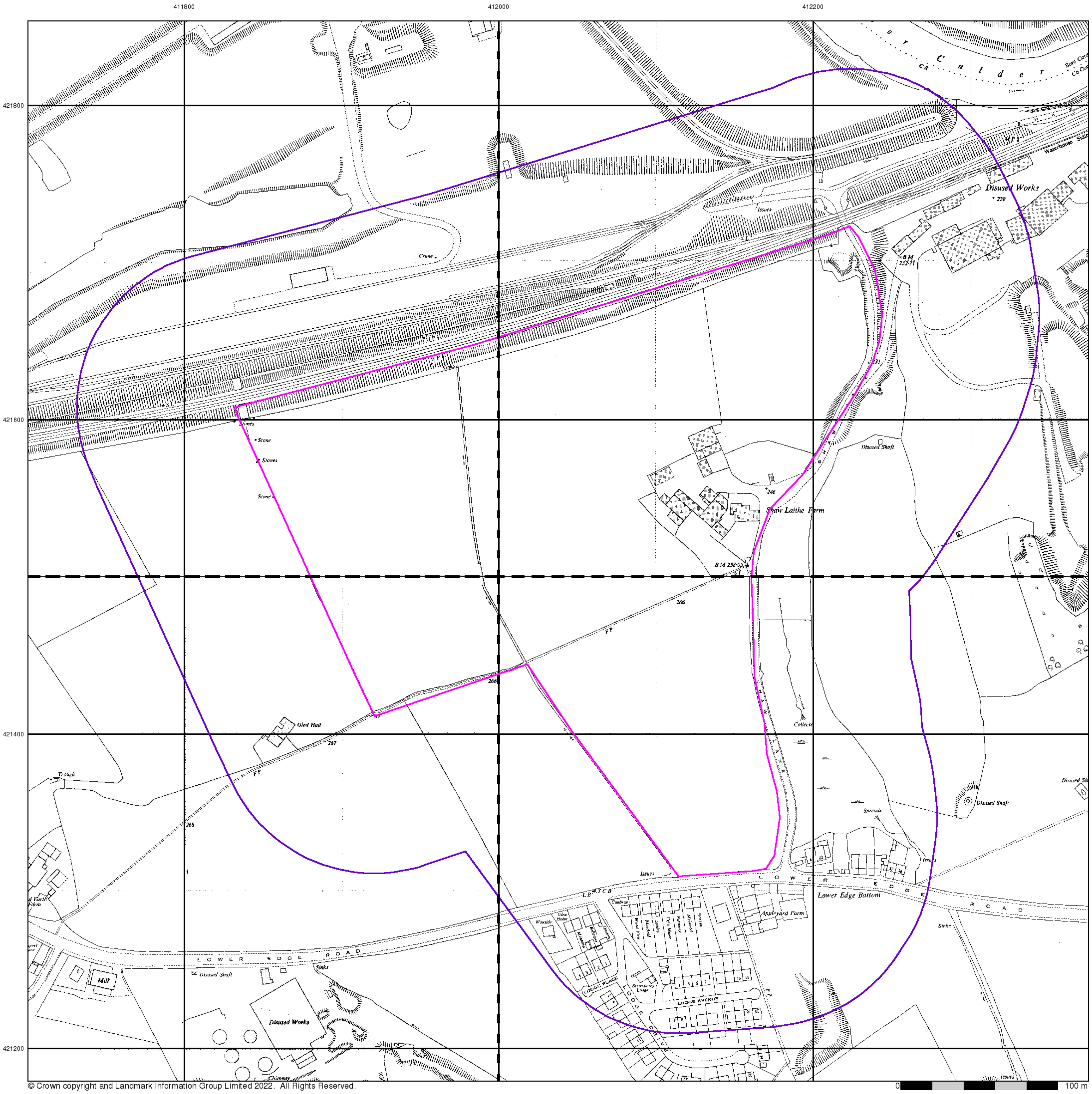


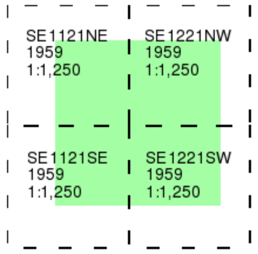
Ordnance Survey Plan

Published 1959

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)



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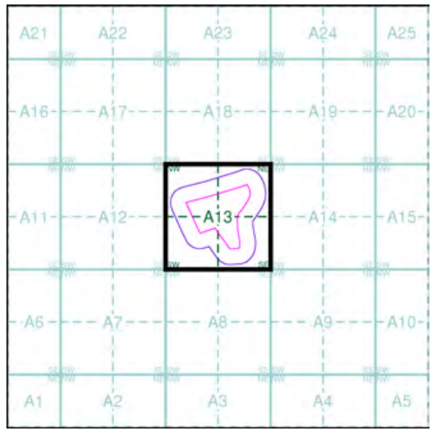
SE1121SE 1959 1:1,250	SE1221SW 1959 1:1,250

Historical Map - Segment A13



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Slice:	A
Site Area (Ha):	8.96
Search Buffer (m):	100

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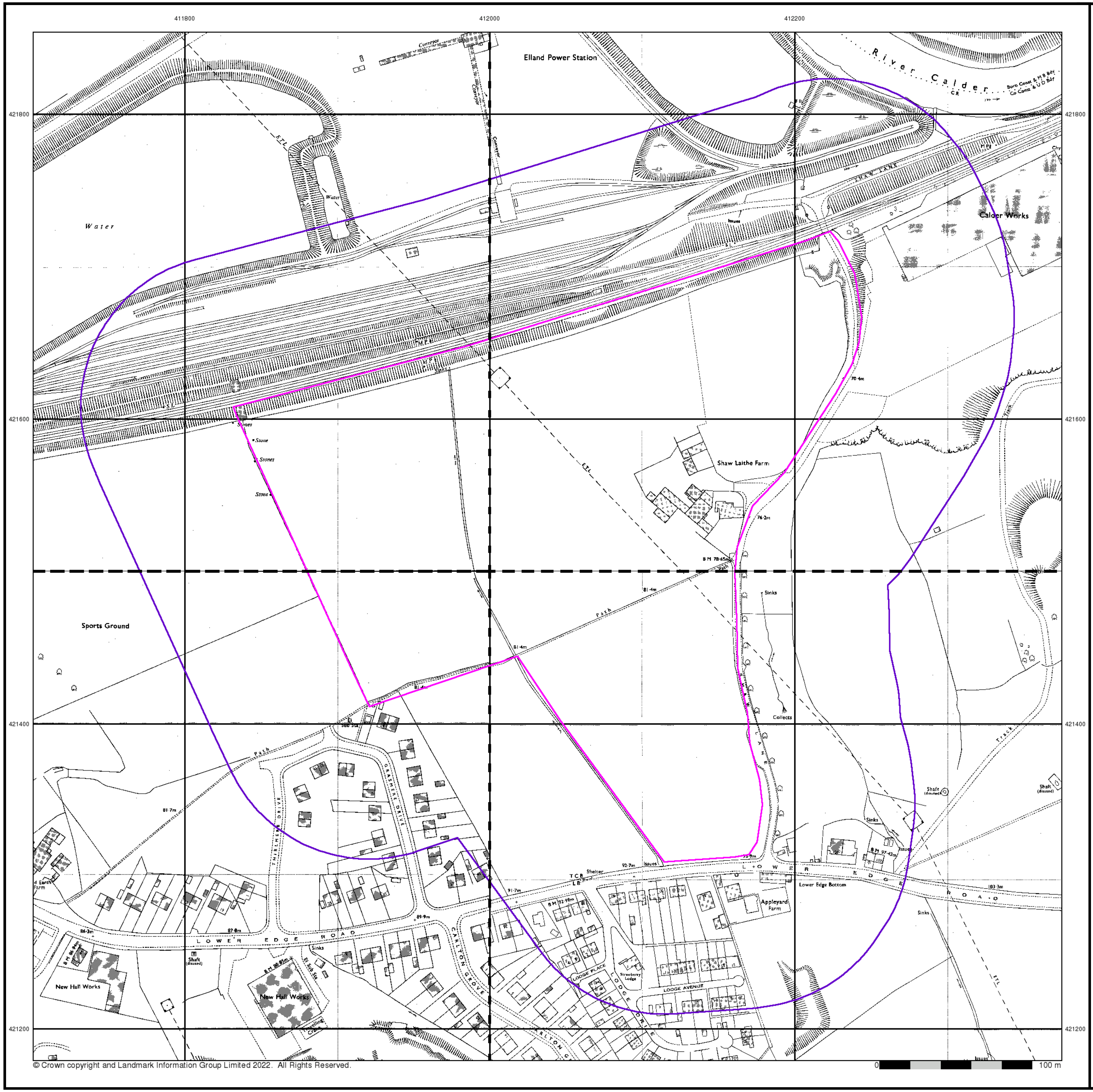

LITHOS CONSULTING

Ordnance Survey Plan

Published 1965 - 1972

Source map scale - 1:1,250

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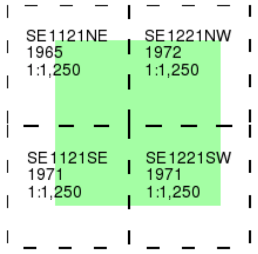
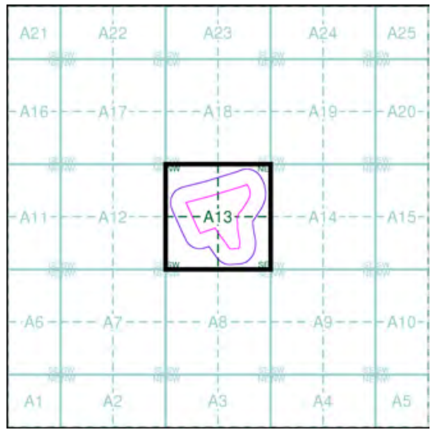


SE1121NE 1965 1:1,250	SE1221NW 1972 1:1,250
SE1121SE 1971 1:1,250	SE1221SW 1971 1:1,250

Historical Map - Segment A13



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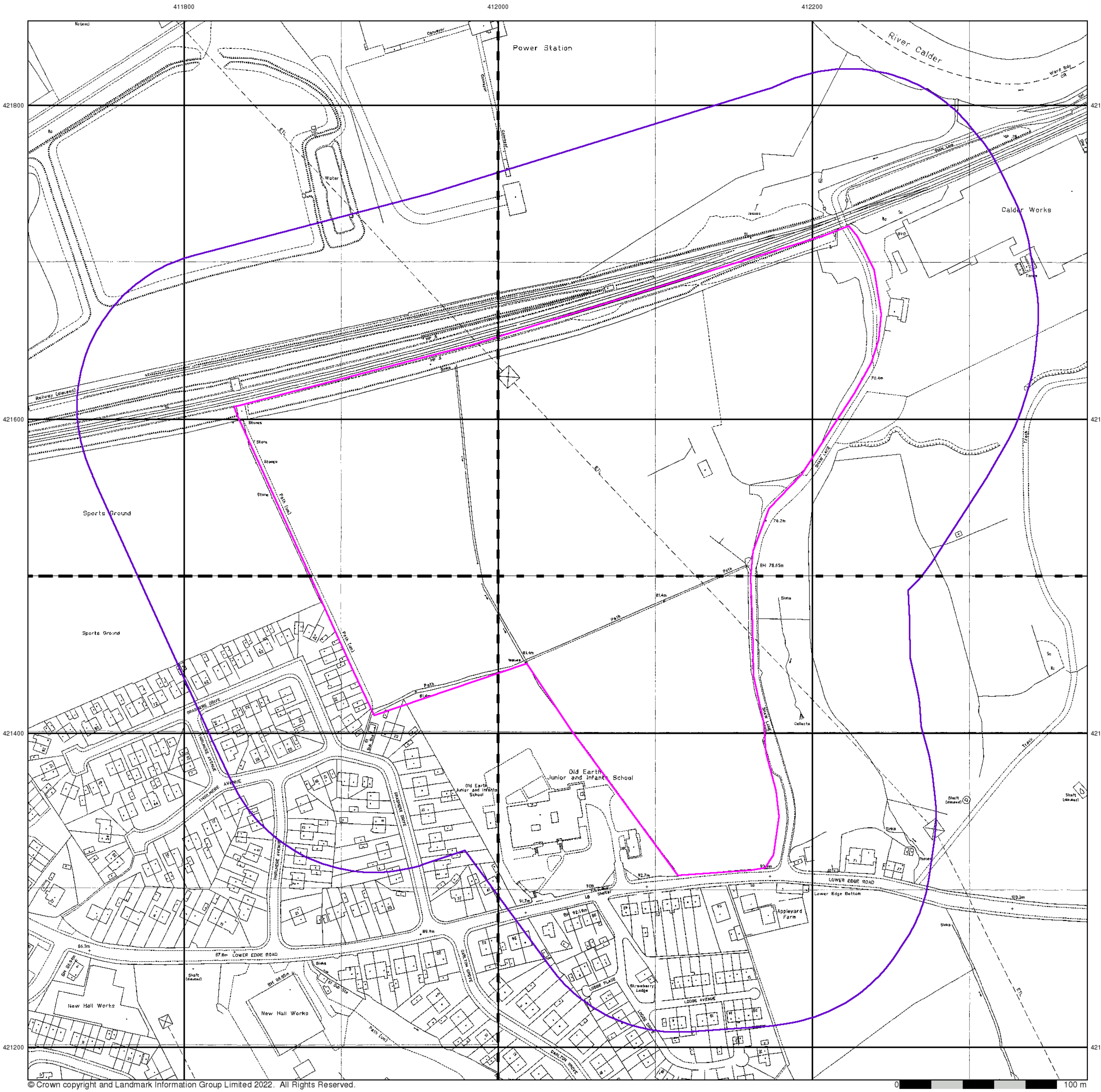

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LITHOS CONSULTING

Large-Scale National Grid Data

Published 1992

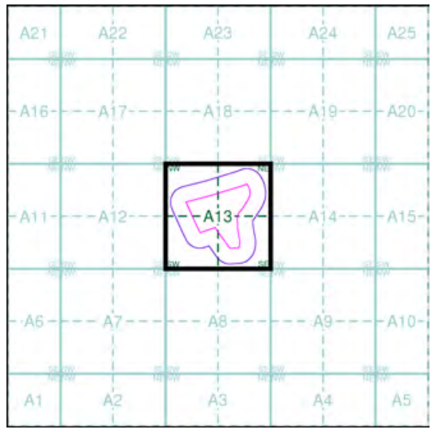
Source map scale - 1:1,250

'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)

SE1121NE 1992 1:1,250	SE1221NW 1992 1:1,250
SE1121SE 1992 1:1,250	SE1221SW 1992 1:1,250

Historical Map - Segment A13



Order Details

Order Number:	291485538_1_1
Customer Ref:	PO18803/JW/4246
National Grid Reference:	412070, 421530
Slice:	A
Site Area (Ha):	8.96
Search Buffer (m):	100

Site Details

Lower Edge Road, Elland, HX5 9PL

Landmark INFORMATION GROUP

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Appendix E

Search Responses & other Correspondence

Envirocheck® Report:

Datasheet

Order Details:

Order Number:
291485538_1_1

Customer Reference:
PO18803/JW/4246

National Grid Reference:
412070, 421530

Slice:
A

Site Area (Ha):
8.96

Search Buffer (m):
1000

Site Details:

Lower Edge Road
Elland
HX5 9PL

Client Details:

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

Contents

Report Section	Page Number
Summary	-
Agency & Hydrological	1
Waste	42
Hazardous Substances	60
Geological	61
Industrial Land Use	80
Sensitive Land Use	111
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Data Suppliers	118
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Introduction

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

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Information supplied from a joint dataset compiled by The British Geological Survey and Public Health England.

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Report Version v53.0

Summary

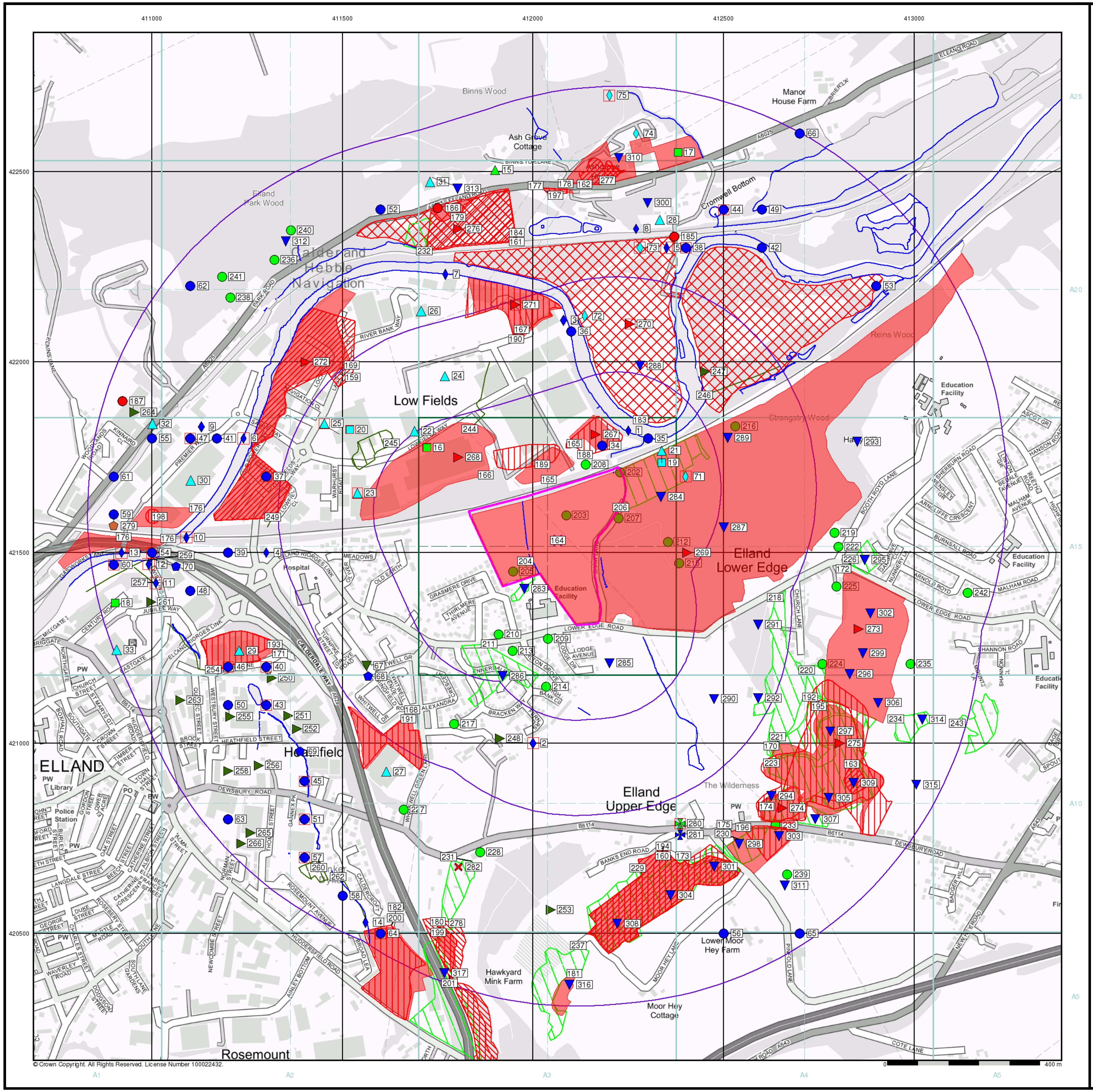
Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1	Yes	Yes	Yes	n/a
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 5		1	3	23
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls	pg 11				1
Integrated Pollution Prevention And Control	pg 12		3		2
Local Authority Integrated Pollution Prevention And Control	pg 13		1	2	
Local Authority Pollution Prevention and Controls	pg 14		1	6	8
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 16	Yes			
Pollution Incidents to Controlled Waters	pg 16		2	1	48
Prosecutions Relating to Authorised Processes	pg 24			1	
Registered Radioactive Substances					
River Quality	pg 24		1		2
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register	pg 25			1	2
Water Abstractions	pg 25		3	1	6 (*11)
Water Industry Act Referrals					
Groundwater Vulnerability Map	pg 31	Yes	n/a	n/a	n/a
Groundwater Vulnerability - Soluble Rock Risk			n/a	n/a	n/a
Groundwater Vulnerability - Local Information			n/a	n/a	n/a
Bedrock Aquifer Designations	pg 31	Yes	n/a	n/a	n/a
Superficial Aquifer Designations	pg 31	Yes	n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences	pg 31		Yes	n/a	n/a
Flooding from Rivers or Sea without Defences	pg 32		Yes	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 32	6	11	8	58

Data Type	**Page Number**	**On Site**	**0 to 250m**	**251 to 500m**	**501 to 1000m (*up to 2000m)**
Waste					
BGS Recorded Landfill Sites	pg 42			1	4
Historical Landfill Sites	pg 42	1	2	3	13
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)	pg 46		1		1
Licensed Waste Management Facilities (Locations)	pg 46				3
Local Authority Landfill Coverage	pg 47	1	n/a	n/a	n/a
Local Authority Recorded Landfill Sites	pg 47		2	2	10
Potentially Infilled Land (Non-Water)	pg 49	5	9	3	25
Potentially Infilled Land (Water)	pg 51		1	4	18
Registered Landfill Sites	pg 53		3	6	7
Registered Waste Transfer Sites	pg 59				1
Registered Waste Treatment or Disposal Sites					
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)	pg 60				2
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)	pg 60				1
Planning Hazardous Substance Consents	pg 60				1
Planning Hazardous Substance Enforcements					

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 61	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 61	Yes	Yes	Yes	Yes
BGS Recorded Mineral Sites	pg 70		4	6	25
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
CBSCB Compensation District			n/a	n/a	n/a
Coal Mining Affected Areas	pg 76	Yes	n/a	n/a	n/a
Mining Instability	pg 76	Yes	n/a	n/a	n/a
Man-Made Mining Cavities	pg 76				7
Natural Cavities					
Non Coal Mining Areas of Great Britain	pg 77	Yes		n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 77	Yes		n/a	n/a
Potential for Compressible Ground Stability Hazards	pg 77	Yes	Yes	n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 78	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 78	Yes	Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 78	Yes	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 80		10	26	161
Fuel Station Entries	pg 97				1
Points of Interest - Commercial Services	pg 97		2	4	27
Points of Interest - Education and Health	pg 100			4	
Points of Interest - Manufacturing and Production	pg 100		11	10	62
Points of Interest - Public Infrastructure	pg 107		2	4	20
Points of Interest - Recreational and Environmental	pg 109			2	6
Gas Pipelines					
Underground Electrical Cables	pg 110			2	

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland	pg 111			1	2
Areas of Adopted Green Belt	pg 111	1			
Areas of Unadopted Green Belt	pg 111	1			
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves	pg 111		1		
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones					
Ramsar Sites					
Sites of Special Scientific Interest	pg 111				1
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					



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LITHOS CONSULTING

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point
- 8 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

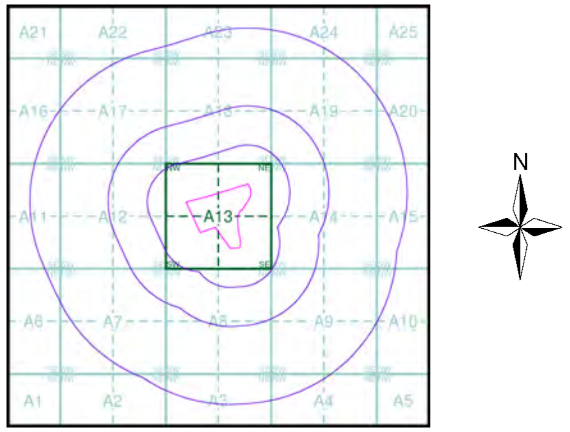
Geological

- ▼ 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

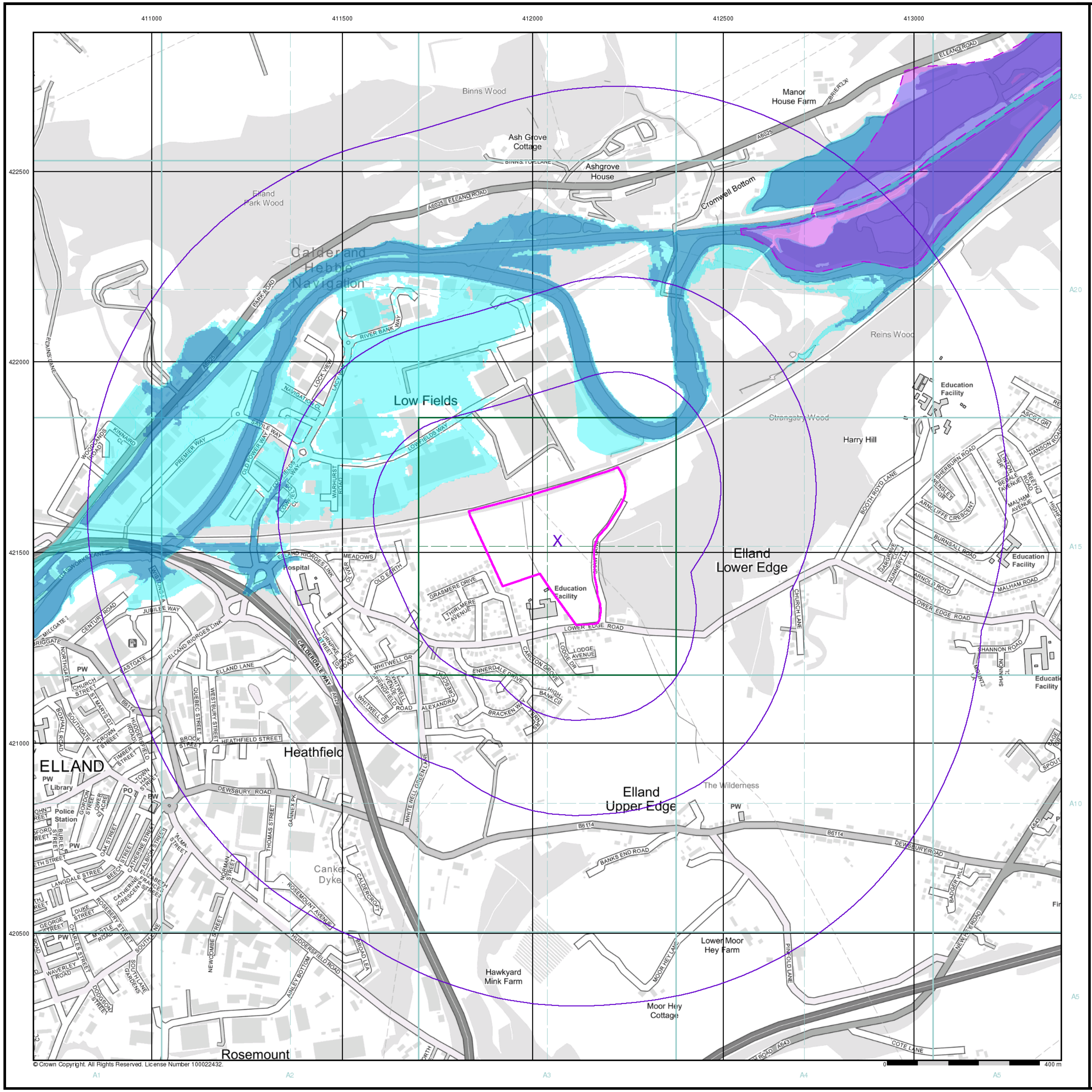
Order Number:	291485538_1_1
Customer Ref:	PO18803/JW/4246
National Grid Reference:	412070, 421530
Slice:	A
Site Area (Ha):	8.96
Search Buffer (m):	1000

Site Details

Lower Edge Road, Elland, HX5 9PL

Landmark INFORMATION GROUP

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



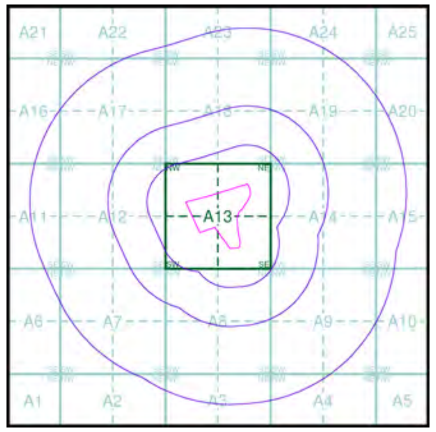
General

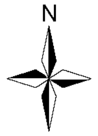
⬠ Specified Site
⬠ Specified Buffer(s)
X Bearing Reference Point

Agency and Hydrological (Flood)

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

Flood Map - Slice A





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Slice:	A
Site Area (Ha):	8.96
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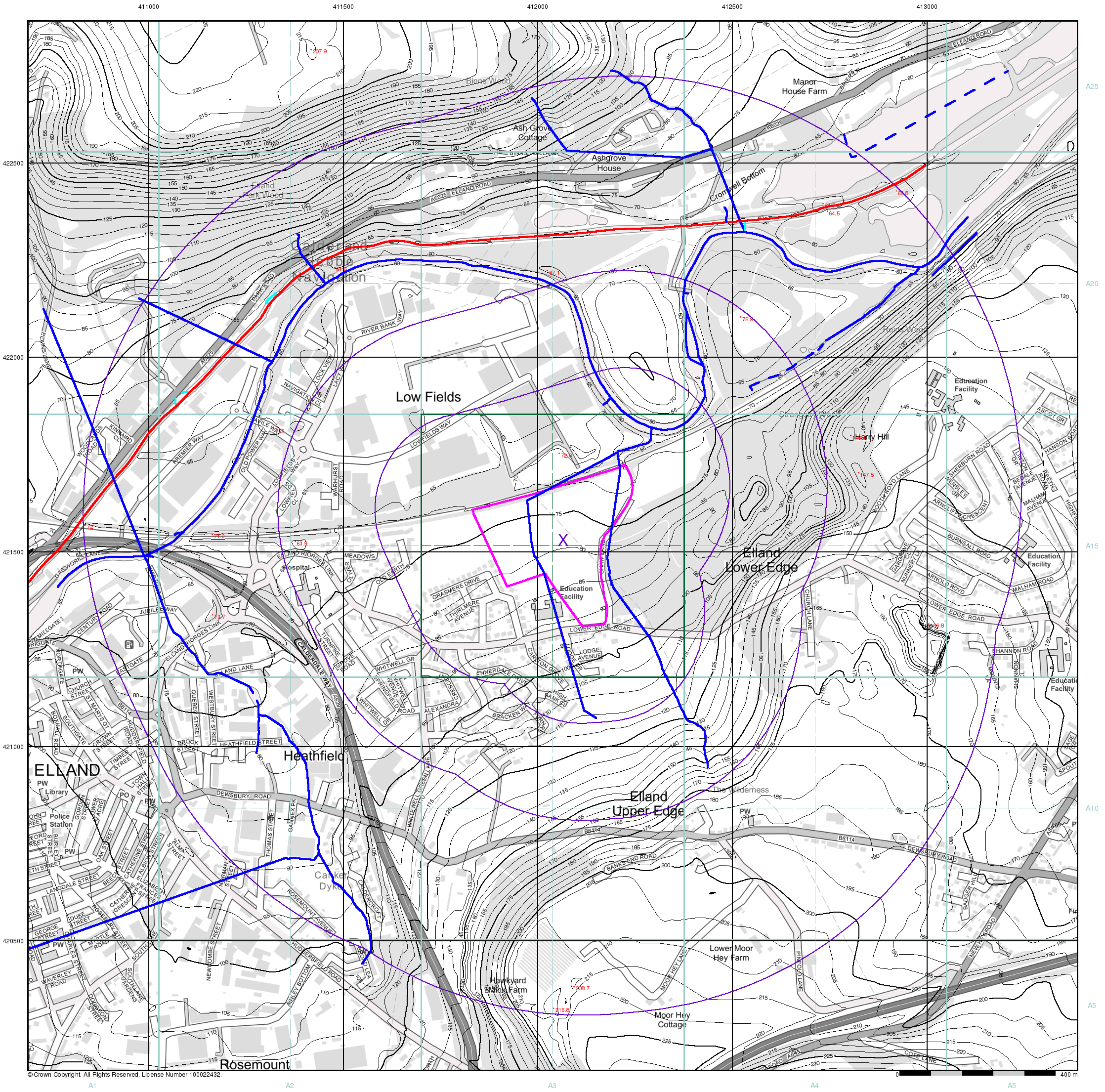
Site Details

Lower Edge Road, Elland, HX5 9PL



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LITHOS CONSULTING

General

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

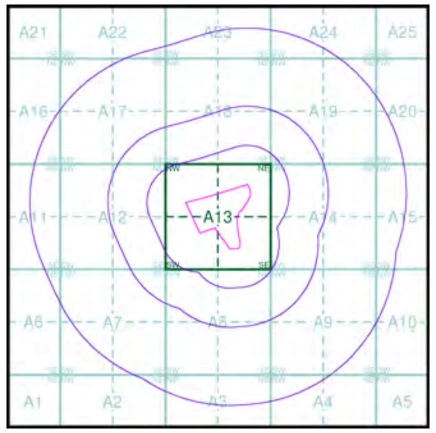
OS Water Network Data

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

Contours (height in meters)

Standard Contour	MLW Mean Low Water
Master Contour	MHW Mean High Water
Spot Height 167.3	

OS Water Network Map - Slice A



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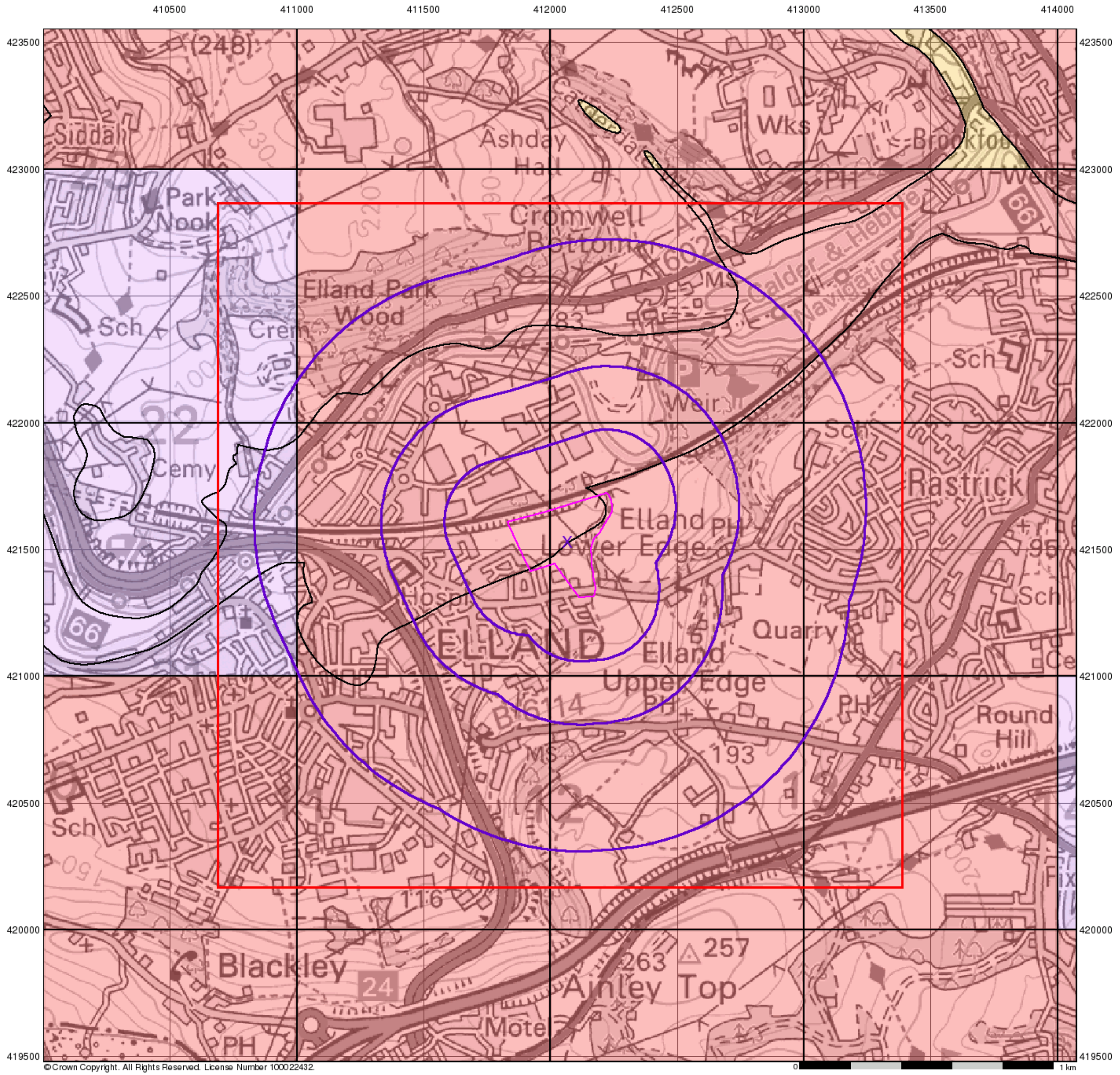


LITHOS CONSULTING

Groundwater Vulnerability

General

⬠	Specified Site	⬠	Specified Buffer(s)	X	Bearing Reference Point
☐	Slice	8	Map ID		

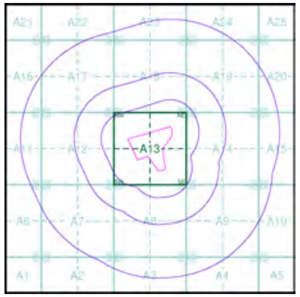
Agency and Hydrological

Bedrock Aquifers	Superficial Aquifers
🟥 High Vulnerability, Principal Aquifer	🟧 High Vulnerability, Principal Aquifer
🟥 High Vulnerability, Secondary Aquifer	🟨 High Vulnerability, Secondary Aquifer
🟪 Medium Vulnerability, Principal Aquifer	🟪 Medium Vulnerability, Principal Aquifer
🟪 Medium Vulnerability, Secondary Aquifer	🟪 Medium Vulnerability, Secondary Aquifer
🟦 Low Vulnerability, Principal Aquifer	🟦 Low Vulnerability, Principal Aquifer
🟦 Low Vulnerability, Secondary Aquifer	🟦 Low Vulnerability, Secondary Aquifer

⬜ Unproductive Aquifer

⁝ Soluble Rock

Site Sensitivity Context Map - Slice A



N

Order Details

Order Number:	291485538_1_1
Customer Ref:	PO18803/JW/4246
National Grid Reference:	412070, 421530
Slice:	A
Site Area (Ha):	8.96
Search Buffer (m):	1000

Site Details

Lower Edge Road, Elland, HX5 9PL

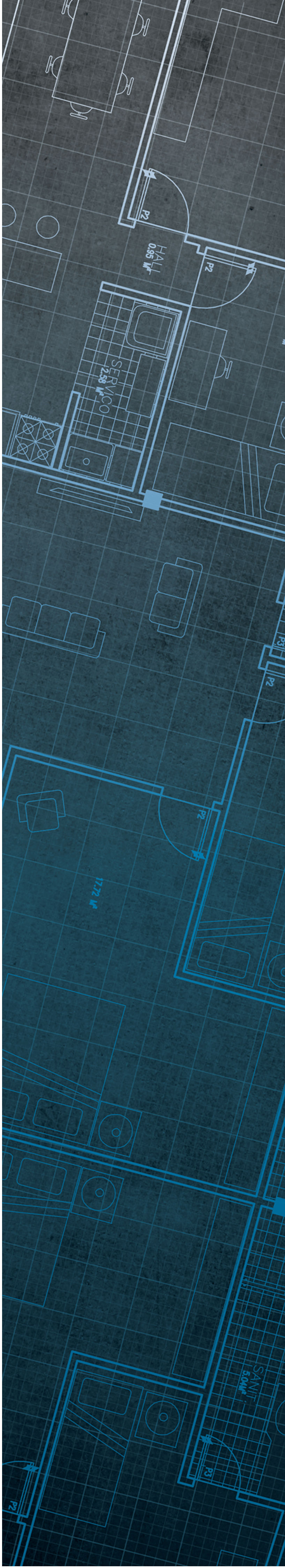
The Coal Authority

Consultants

Coal Mining Report

Lower Edge Road
Elland
HX5 9PL

Date of enquiry:	**21 February 2022**
Date enquiry received:	**21 February 2022**
Issue date:	**21 February 2022**
Our reference:	**51002947191001**
Your reference:	**PO18804/JW/4246**



Consultants

Coal Mining Report

This report is based on and limited to the records held by the Coal Authority at the time the report was produced.

Client name

LITHOS CONSULTING LTD

Enquiry address

Lower Edge Road
Elland
HX5 9PL

Approximate position of property

How to contact us

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

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Mansfield
Nottinghamshire
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/company/the-coal-authority
/thecoalauthority
/thecoalauthority

Section 1 – Mining activity and geology

Past underground mining

Colliery	Seam	Mineral	Coal Authority reference	Depth (m)	Direction to working	Dipping rate of seam worked (degrees)	Dipped direction of seam worked	Extraction thickness (cm)	Year last mined
unnamed	HALIFAX HARD	Coal	6G7G	4	Beneath Property	5.1	North-East	168	1940
unnamed	HALIFAX HARD	Coal	6ZFI	5	Beneath Property	4.1	East	76	1905
unnamed	HALIFAX HARD	Coal	6G7I	9	Beneath Property	5.0	North-East	76	1905
unnamed	HALIFAX HARD	Coal	6ZFJ	11	North	4.1	East	168	1940
unnamed	HALIFAX HARD	Coal	6G7J	12	Beneath Property	5.1	North-East	76	1905
unnamed	HALIFAX SOFT	Coal	6G7M	43	Beneath Property	3.2	North-East	46	1897
unnamed	HALIFAX SOFT	Coal	6G7L	44	Beneath Property	3.2	North-East	46	1903

Probable unrecorded shallow workings

Yes.

Spine roadways at shallow depth

No spine roadway recorded at shallow depth.

Mine entries

Entry type	Reference	Grid reference	Treatment description	Mineral	Conveyancing details
Shaft	411421-008	411945 421461		Coal	
Shaft	412421-006	412243 421586		Coal	
Shaft	412421-007	412239 421603		Coal	
Shaft	412421-012	412066 421532		Coal	
Adit	412421-024	412099 421741		Coal	
Adit	412421-025	412010 421720		Coal	
Adit	412421-026	412023 421700		Coal	
Adit	412421-027	412032 421702		Coal	
Adit	412421-028	412035 421707		Coal	
Adit	412421-029	412031 421718		Coal	
Shaft	412421-035	412160 421733		Coal	
Shaft	412421-036	412230 421714		Coal	
Shaft	412421-037	412088 421601		Coal	
Shaft	412421-038	412032 421280		Coal	
Shaft	412421-039	412047 421280		Coal	
Adit	412421-042	412003 421730		Coal	

Abandoned mine plan catalogue numbers

The following abandoned mine plan catalogue numbers intersect with some, or all, of the enquiry boundary:

OM4879	7489	FGB784
GCR99	GCR98	14141
OM15197	5764	FGB1006

Our records show we have more plans than those shown above which could affect the enquiry boundary.

Please contact us on 0345 762 6848 to determine the exact abandoned mine plans you require based on your needs.

Outcrops

Seam name	Mineral	Seam workable	Distance to outcrop (m)	Direction to outcrop	Bearing of outcrop
HALIFAX HARD	Coal	Yes	Within	N/A	189
HALIFAX HARD	Coal	Yes	20.9	North	198

Geological faults, fissures and breaklines

No faults, fissures or breaklines recorded.

Opencast mines

Please refer to the “Summary of findings” map (on separate sheet) for details of any opencast areas within 500 metres of the enquiry boundary.

Coal Authority managed tips

None recorded within 500 metres of the enquiry boundary.

Section 2 – Investigative or remedial activity

Please refer to the 'Summary of findings' map (on separate sheet) for details of any activity within the area of the site boundary.

Site investigations

Distance to site investigation (m)	Direction
35.9	East
2.3	South-West

See Section 4 for further information.

Remediated sites

None recorded within 50 metres of the enquiry boundary.

Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, 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.

Mine gas

None recorded within 500 metres of the enquiry boundary.

Mine water treatment schemes

None recorded within 500 metres of the enquiry boundary.

Section 3 – Licensing and future mining activity

Future underground mining

None recorded.

Coal mining licensing

None recorded within 200 metres of the enquiry boundary.

Court orders

None recorded.

Section 46 notices

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

Withdrawal of support notices

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.

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.

Section 4 – Further information

The following potential risks have been identified and as part of your risk assessment should be investigated further.

Development advice

The site is within an area of historical coal mining activity. Should you require advice and/or support on understanding the mining legacy, its risks to your development or what next steps you need to take, please contact us.

Site investigations

The site is within an area of previous interest. It is close to where the Coal Authority has received information relating to past site investigations.

The site requires further investigation and may influence how you approach your risk assessment.

For further information on specific site or ground investigations in relation to any issues raised in Section 4, please call us on 0345 762 6848 or email us at groundstability@coal.gov.uk.

Section 5 – Data definitions

The datasets used in this report have limitations and assumptions within their results. For more guidance on the data and the results specific to the enquiry boundary, please **call us on 0345 762 6848** or **email us at groundstability@coal.gov.uk.**

Past underground coal mining

Details of all recorded underground mining relative to the enquiry boundary. Only past underground workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination, will be included.

Probable unrecorded shallow workings

Areas where the Coal Authority believes there to be unrecorded coal workings that exist at or close to the surface (less than 30 metres deep).

Spine roadways at shallow depth

Connecting roadways either, working to working, or, surface to working, both in-seam and cross measures that exist at or close to the surface (less than 30 metres deep), either within or within 10 metres of the enquiry boundary.

Mine entries

Details of any shaft or adit either within, or within 100 metres of the enquiry boundary including approximate location, brief treatment details where known, the mineral worked from the mine entry and conveyance details where the mine entry has previously been sold by the Authority or its predecessors British Coal or the National Coal Board.

Abandoned mine plan catalogue numbers

Plan numbers extracted from the abandoned mines catalogue containing details of coal and other mineral abandonment plans deposited via the Mines Inspectorate in accordance with the Coal Mines Regulation Act and Metalliferous Mines Regulation Act 1872. A maximum of 9 plan extents that intersect with the enquiry boundary will be included. This does not infer that the workings and/or mine entries shown on the abandonment plan will be relevant to the site/property boundary.

Outcrops

Details of seam outcrops will be included where the enquiry boundary intersects with a conjectured or actual seam outcrop location (derived by either the British Geological Survey or the Coal Authority) or intersects with a defined 50 metres buffer on the coal (dip) side of the outcrop. An indication of whether the Coal Authority believes the seam to be of sufficient thickness and/or quality to have been worked will also be included.

Geological faults, fissures and breaklines

Geological disturbances or fractures in the bedrock. Surface fault lines (British Geological Survey derived data) and fissures and breaklines (Coal Authority derived data) intersecting with the enquiry boundary will be included. In some circumstances faults, fissures or breaklines have been known to contribute to surface subsidence damage as a consequence of underground coal mining.

Opencast mines

Opencast coal sites from which coal has been removed in the past by opencast (surface) methods and where the enquiry boundary is within 500 metres of either the licence area, site boundary, excavation area (high wall) or coaling area.

Coal Authority managed tips

Locations of disused colliery tip sites owned and managed by the Coal Authority, located within 500 metres of the enquiry boundary.

Site investigations

Details of site investigations within 50 metres of the enquiry boundary where the Coal Authority has received information relating to coal mining risk investigation and/or remediation by third parties.

Remediated sites

Sites where the Coal Authority has undertaken remedial works either within or within 50 metres of the enquiry boundary following report of a hazard relating to coal mining under the Coal Authority's Emergency Surface Hazard Call Out procedures.

Coal mining subsidence

Details of alleged coal mining subsidence claims made since 31 October 1994 either within or within 50 metres of the enquiry boundary. Where the claim relates to the enquiry boundary confirmation of whether the claim was accepted, rejected or whether liability is still being determined will be given. Where the claim has been discharged, whether this was by repair, payment of compensation or a combination of both, the value of the claim, where known, will also be given.

Details of any current 'Stop Notice' deferring remedial works or repairs affecting the property/site, and if so the date of the notice.

Details of any request made to execute preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991. If yes, whether any person withheld consent or failed to comply with any request to execute preventative works.

Mine gas

Reports of alleged mine gas emissions received by the Coal Authority, either within or within 500 metres of the enquiry boundary that subsequently required investigation and action by the Coal Authority to mitigate the effects of the mine gas emission.

Mine water treatment schemes

Locations where the Coal Authority has constructed or operates assets that remove pollutants from mine water prior to the treated mine water being discharged into the receiving water body.

These schemes are part of the UK's strategy to meet the requirements of the Water Framework Directive. Schemes fall into 2 basic categories: Remedial – mitigating the impact of existing pollution or Preventative – preventing a future pollution incident.

Mine water treatment schemes generally consist of one or more primary settlement lagoons and one or more reed beds for secondary treatment. A small number are more specialised process treatment plants.

Future underground mining

Details of all planned underground mining relative to the enquiry boundary. Only those future workings where the enquiry boundary is within 0.7 times the depth of the workings (zone of likely physical influence) allowing for seam inclination will be included.

Coal mining licensing

Details of all licenses issued by the Coal Authority either within or within 200 metres of the enquiry boundary in relation to the under taking of surface coal mining, underground coal mining or underground coal gasification.

Court orders

Orders in respect of the working of coal under the Mines (Working Facilities and Support) Acts of 1923 and 1966 or any statutory modification or amendment thereof.

Section 46 notices

Notice of proposals relating to underground coal mining operations that have been given under section 46 of the Coal Mining Subsidence Act 1991.

Withdrawal of support notices

Published notices of entitlement to withdraw support and the date of the notice. Details of any revocation notice withdrawing the entitlement to withdraw support given under Section 41 of the Coal Industry Act 1994.

Payment to owners of former copyhold land

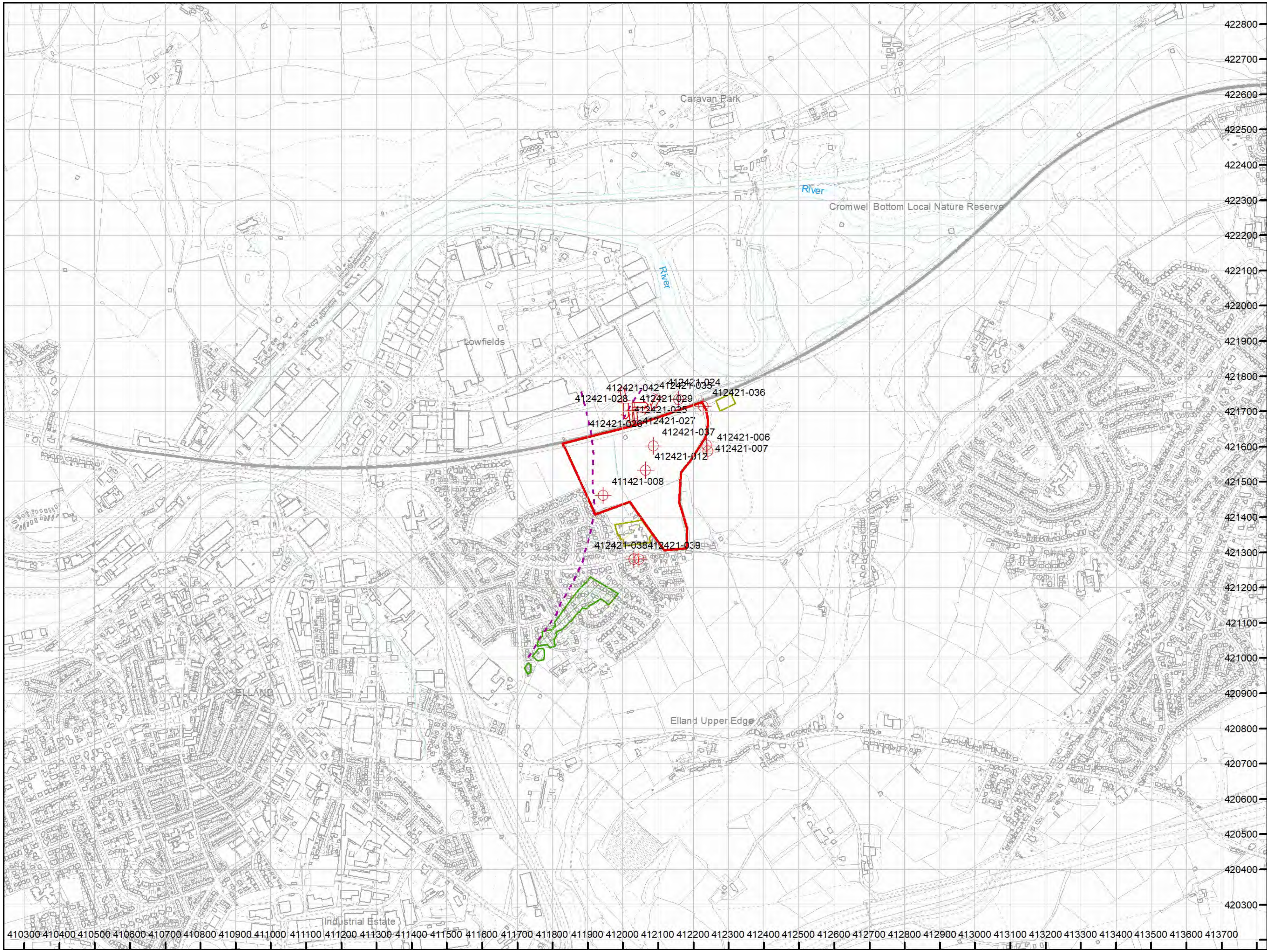
Relevant notices which may affect the property and any subsequent notice of retained interests in coal and coal mines, acceptance or rejection notices and whether any compensation has been paid to a claimant.

Summary of findings

The map highlights any specific surface or subsurface features within or near to the boundary of the site.

Key

Approximate position of the enquiry boundary shown	□
Disused mine shaft	⊕
Disused adit	⇧
Outcrop (Conjectured)	⁄
Unlicensed opencast site	▨
Site investigations	⧄



How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)
www.groundstability.com

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Section of Shaw Laithe Pit Shaft, Elland. C

(Drawn up by W. T. Knowles. M.I.M.E.)

Through the courtesy of Mr. Ramsden.

	Thickness.	Depth.
Black shale	10.06 33. 0	10.06 33. 0
Band coal	0.15 0 . 6	10.21 33. 6
Fireclay ("Termer" Blue Clay". Best quality for firebricks).	1.37 4 . 6	11.58 38. 0
Hard Bed Band Coal	0.30 1 . 0	11.88 39. 0
'Seggar Fireclay' Second quality for bricks	0.91 3 . 0	12.80 42. 0
Strong grey band	2.74 9 . 0	15.54 51 . 0
Black shale	3.66 12.0	19.20 63 . 0
'Mussel Bed' Bind	1.83 6 . 0	21.03 69 . 0
Black shale	21.03 69 . 0	138 . 0 42.06
Grey shale	0.91 3 . 0	141 . 0 42.98
Fine strong black shale. Goniatites &c	0.30 1 . 0	142 . 0 43.28
Hard Bed Coal	0.71 2.4	144 . 4 43.99
Ganister rock	0.20 0.8	145 . 0 44.20
Fireclay	0.71 2.4	147 - 4 44.91
Grey bind (Bastard fireclay)	2.13 7.0	154 . 4 47.04
Middle Band Coal	0.30 1.0	155 . 4 47.34
Fine black shale	7.92 26. 0	181 . 4 55.27
Seat stone	0.76 2 . 6	183 . 10 56.03
Strong grey bind	0.61 2 . 0	185 . 10 56.64
Strong black shale with ironstone balls	0.61 2.0	187 . 10 57.25
Shale (Sandy)	2.74 9.0	196 . 10 59.74
Sandy Shale with ironstone balls	0.30 1.0	197 . 10 60.30
Sandy shale	0.61 2.0	199 . 10 60.91
Hard stone bind. Hagstone	0.69 2.3	202 . 1 61.59
Shale	1.83 6.0	208 . 1 63.42
Hard stone bind	0.76 2.6	210 - 7 64.18
Dark bind	0.69 2.3	212 - 10 64.87
Black shale	1.22 4.0	216 - 10 66.09
Grey shale	0.30 1.0	217 . 10 66.39
SOFT BED COAL	0.46 1.6	219 . 4 66.85
Seat Earth	0.91 3.0	221 . 4 67.77
Blue Bind	1.83 6.0	228 . 4 69.59
Sandy shale	0.61 2.0	230 . 4 70.20

3

92 77 SE12SW/35 (4.)

99

		Thickness.	Depth. ft. ins.
Carried forward		—	230.4 70.20
Stone and rag	2.44	8.0	238.4 72.64
Strong sandy shale	2.74	9.0	247.4 75.31
Stone	2.36	7.9	255.1 77.75
[Sump.]	10.97	36.0	291.1 88.72.

Total depth
88.72 291 ft 1ins or
(97 yards 1 inch).

Appendix F

Trial Pit Logs

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP01
Sheet 1 of 1

Project Name: Shaw Lane
Project No. 4246
Co-ords: 412136.66 - 421364.67
Level: 88.85
Date 28/10/2021

Location: Elland
Dimensions (m): 3 × 0.6
Depth 2.30
Scale 1:25

Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged GLM

Water Strike	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
						▨	Dark brownish grey sandy CLAY. Occasional rootlets. (TOPSOIL)
				0.30	88.55	☰	Firm light brown mottled grey slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. Low subangular sandstone cobble content. (COHESIVE GLACIOFLUVIAL DEPOSITS)
				1.30	87.55	⁘	Firm dark brown gravelly CLAY. Gravel is angular tabular of mudstone. (COHESIVE RESIDUAL SOIL)
				1.90	86.95	⁘	Dark greyish brown slightly clayey angular tabular fine to medium GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				2.30	86.55		End of pit at 2.30 m

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

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

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP02
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412113.78 - 421527.17 Level: 78.45	Date 28/10/2021
Location: Elland		Dimensions (m): 3 × 0.6 Depth 1.90	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged GLM

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
							MADE GROUND: Dark greyish brown sandy CLAY. Rare subangular cobble of sandstone and brick. (MADE GROUND TOPSOIL)
				0.25	78.20		Stiff brown mottled grey slightly gravelly CLAY. Gravel is subangular medium to coarse of sandstone. Rare subangular cobbles of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
				0.70	77.75		Firm brown sandy gravelly CLAY. Gravel is angular tabular medium to coarse of sandstone lithorelicts. (COHESIVE RESIDUAL SOIL)
				1.50	76.95		Greyish brown angular tabular fine GRAVEL of mudstone. Degrades to silty clay with effort when handled. (GRANULAR RESIDUAL SOIL)
				1.90	76.55		End of pit at 1.90 m

1
2
3
4
5

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

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

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP03
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412132.38 - 421646.64 Level: 71.35	Date 28/10/2021
Location: Elland		Dimensions (m): 3 × 0.6 Depth 2.50	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged GLM

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
						▨	Dark greyish brown sandy SILT. Frequent rootlets. (TOPSOIL)
				0.30	71.05	▤	Stiff light brown mottled grey slightly gravelly CLAY. Gravel is subangular medium of sandstone and siltstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
				1.20	70.15	▦	Firm brown mottled grey gravelly CLAY. Gravel is angular tabular medium to coarse of sandstone. Low subangular sandstone cobble content. (COHESIVE RESIDUAL SOIL)
				2.20	69.15	▩	Brown clayey sandy angular tabular fine GRAVEL of mudstone and siltstone. (GRANULAR RESIDUAL SOIL)
				2.50	68.85		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 not encountered. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

AGS

Trial Pit Log

Trialpit No **TP04**

Sheet 1 of 1

Project Name: Shaw Lane

Project No. 4246

Co-ords: 411909.80 - 421575.87

Level: 75.25

Date 28/10/2021

Location: Elland

Dimensions (m): 3 × 0.6

Depth 2.20

Scale 1:25

Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth

Logged GLM

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
							Dark brown sandy silty CLAY. Frequent rootlets. (TOPSOIL)
				0.30	74.95		Firm light brown mottled grey gravelly CLAY. Gravel is subangular medium of sandstone. In parts comprises sandy clay. (COHESIVE GLACIOFLUVIAL DEPOSITS)
				1.20	74.05		Brown mottled grey gravelly slightly sandy CLAY. Gravel is angular tabular of siltstone and siltstone lithorelicts. (COHESIVE RESIDUAL SOIL)
				2.00	73.25		Weak grey thickly laminated MUDSTONE. Recovered as angular tabular medium gravel. (COAL MEASURES)
				2.20	73.05		End of pit at 2.20 m

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

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

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP05
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411970.33 - 421457.70 Level: 79.90	Date 28/10/2021
Location: Elland		Dimensions (m): 3 × 0.6 Depth 2.70	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged GLM

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30	79.60	▨	MADE GROUND: Dark brown sandy silty CLAY. Frequent rootlets. (MADE GROUND TOPSOIL)
				1.90	78.00	▩	MADE GROUND: Dark brownish grey clayey angular tabular fine to medium GRAVEL of mudstone and carbonaceous mudstone. (GRANULAR MADE GROUND) *From 0.4m to 2.4m; spalling of trial pit walls.* *From 1.1m; low angular tabular mudstone cobble content.*
				2.40	77.50	▩	MADE GROUND: Reddish brown ash SAND and subrounded to angular fine to medium GRAVEL of mudstone burnt shale clinker and rare pottery and shells. (ASH & CLINKER)
				2.70	77.20	▤	Stiff light brown mottled grey gravelly CLAY. Gravel is subangular medium of mudstone. (COHESIVE RESIDUAL SOIL)
							End of pit at 2.70 m

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

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

AGS

Trial Pit Log

Trialpit No
TP06
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411998.71 - 421540.93 Level: 77.75	Date 28/10/2021
Location: Elland		Dimensions (m): 3 × 0.6 Depth 1.90	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged GLM

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.25	77.50	▨	Dark greyish brown silty slightly sandy CLAY. Some rootlets. (TOPSOIL)
				0.80	76.95	▤	Firm light brown sandy CLAY. Rare subangular sandstone cobbles. (COHESIVE GLACIOFLUVIAL DEPOSITS)
				1.70	76.05	▦	Stiff brown mottled grey gravelly CLAY. Gravel is angular tabular fine to coarse of siltstone. (COHESIVE RESIDUAL SOIL)
				1.90	75.85	✕	Weak grey thickly laminated SILTSTONE. Recovered as clayey angular fine gravel. (COAL MEASURES)

End of pit at 1.90 m

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

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

Trial Pit Log

Trialpit No **TP07**

Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412067.34 - 421502.46 Level: 79.90	Date 28/10/2021
Location: Elland		Dimensions (m): 3 × 0.6 Depth 2.30	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged GLM

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
						▨	Dark greyish brown sandy CLAY. Occasional rootlets. (TOPSOIL)
				0.30	79.60	▤	Firm light brown mottled grey gravelly CLAY. Gravel is subangular fine to coarse of sandstone. Low subangular sandstone cobble content. (COHESIVE GLACIOFLUVIAL DEPOSITS)
				0.90	79.00	▤	Stiff brown mottled grey gravelly CLAY. Gravel is subangular medium to coarse of sandstone and siltstone. Low subangular sandstone cobble content. (COHESIVE RESIDUAL SOIL)
				2.30	77.60		End of pit at 2.30 m

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

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

Trial Pit Log

Trialpit No
TP101
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412112.72 - 421328.91 Level: 90.10	Date 21/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.70	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T					Dark brown slightly sandy CLAY with frequent rootlets. (TOPSOIL)
				0.20	89.90		Firm orange mottled grey CLAY. (COHESIVE RESIDUAL SOIL)
			HVP=58				
	1.00	D					
			HVP=70				
				1.50	88.60		Stiff dark grey gravelly CLAY. Gravel is angular tabular fine to medium of mudstone lithorelicts. (COHESIVE RESIDUAL SOIL)
			HVP=94				
	1.80	D					
				2.20	87.90		Dark grey mottled orange slightly clayey angular tabular fine to medium GRAVEL of mudstone lithorelicts. (GRANULAR RESIDUAL SOIL)
	2.50	T					
				2.70	87.40		End of pit at 2.70 m

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

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

Trial Pit Log

Trialpit No
TP102
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412141.84 - 421336.36 Level: 90.50	Date 21/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.60	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	B		0.30	90.20		Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of mudstone and coal. (TOPSOIL)
	0.80	D	HVP=78	1.00	89.50		Firm orange mottled grey slightly sandy CLAY. (COHESIVE RESIDUAL SOIL)
	1.40	T	HVP=92	1.70	88.80		Brown slightly clayey sandy angular tabular fine to medium GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL) *At 1.1m, sandstone boulder in East of pit.*
	2.00	D	HVP=138	2.30	88.20		Stiff dark grey slightly gravelly CLAY. Gravel is angular tabular fine to medium of mudstone lithorelicts. (GRANULAR RESIDUAL SOIL)
				2.60	87.90		Dark grey mottled brown slightly clayey angular tabular fine to medium GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)

End of pit at 2.60 m

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

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

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP103
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412130.58 - 421395.73 Level: 86.80	Date 21/03/2022
Location: Elland		Dimensions (m): 3 × 0.9	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Depth 3.20	Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T					Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine of mudstone and coal. (TOPSOIL)
				0.30	86.50		Firm orange mottled grey slightly gravelly CLAY. Gravel is angular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL) *At 0.5m, angular sandstone cobble.*
	0.50	D	HVP=60				
				1.00	85.80		Stiff dark brown mottled grey gravelly CLAY. Gravel is subangular fine to medium of mudstone and sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=111				
	1.60	D	HVP=128				
				1.80	85.00		Grey mottled brown slightly clayey angular tabular fine to medium GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
	2.50	T					
				3.20	83.60		End of pit at 3.20 m

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

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

AGS

Trial Pit Log

Trialpit No
TP104
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412091.71 - 421369.59 Level: 87.35	Date 21/03/2022
Location: Elland		Dimensions (m): 3 0.9	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Depth 2.60	Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
						▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular tabular fine to medium of sandstone, mudstone and rare coal. (TOPSOIL)
				0.30	87.05	▤	Firm orange mottled grey slightly sandy CLAY with rare angular coarse gravel of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=61				
	0.60	D					
				0.90	86.45	▤	Stiff brown mottled grey gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=112				
	1.50	D					*At 1.5m, angular sandstone cobble.*
			HVP=118				*At 1.6m to 1.7m, 0.4m pocket of angular sandstone gravel and cobbles.*
				1.90	85.45	▤	Dark brown mottled grey clayey angular tabular fine to medium GRAVEL of mudstone lithorelicts. (GRANULAR RESIDUAL SOIL)
				2.40	84.95	▤	Dark grey mottled brown slightly clayey angular tabular fine to medium GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				2.60	84.75		End of pit at 2.60 m

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

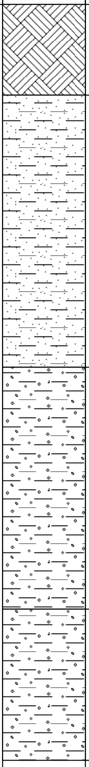
Stability: 1. The sides of the trial pit remained stable during excavation.

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP105
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412061.80 - 421403.25 Level: 84.45	Date 21/03/2022
Location: Elland		Dimensions (m): 3 × 0.9	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Depth 2.50	Logged AP



Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Stratum Description
	Depth	Type	Results			
	0.10	J&T				Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine of sandstone and occasional coal. (TOPSOIL)
	0.20	B				
				0.30	84.15	Firm becoming stiff orange mottled grey slightly gravelly slightly sandy CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=70			
	0.60	D				
			HVP=108			
				1.20	83.25	Stiff brown mottled grey gravelly CLAY. Gravel is angular tabular fine to medium of sandstone with occasional angular sandstone cobbles. (COHESIVE RESIDUAL SOIL)
			HVP=116			
			HVP=132			
				2.00	82.45	Stiff brown mottled grey very gravelly CLAY. Gravel is subangular tabular fine to medium of coal, sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	2.20	D				
				2.50	81.95	End of pit at 2.50 m

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

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

AGS

Trial Pit Log

Trialpit No
TP106
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412099.07 - 421417.07 Level: 85.00	Date 21/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.40	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	84.80	▨	Dark brown slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone and coal. (TOPSOIL)
			HVP=68				
				0.70	84.30	▤	Firm orange mottled grey gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=145				
	1.20	D					
				1.30	83.70	▤	Stiff brown mottled grey gravelly CLAY. Gravel is subangular tabular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	1.80	T					
							At 2.0m, angular tabular sandstone cobbles.
				2.40	82.60	▥	Grey and brown slightly sandy very clayey angular tabular fine to coarse GRAVEL of sandstone, mudstone and coal. (GRANULAR RESIDUAL SOIL)
							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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

Trial Pit Log

Trialpit No	**TP107**
	Sheet 1 of 1
Project Name:	Shaw Lane
Project No.	4246
Co-ords:	412132.62 - 421429.90
Level:	84.70
Date	21/03/2022
Location:	Elland
Dimensions (m):	3 × 0.9
Depth	2.50
Scale	1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged	AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	84.40	▨	Dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone and coal. (TOPSOIL)
	0.70	D	HVP=65 HVP=77	1.10	83.60	▨	Firm becoming stiff orange mottled grey slightly sandy gravelly CLAY. Gravel is subangular tabular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
	1.60	D	HVP=140 HVP=138	2.00	82.70	▨	Stiff brown mottled grey gravelly CLAY. Gravel is subangular tabular fine to coarse of predominantly sandstone. (COHESIVE RESIDUAL SOIL)
				2.50	82.20	▨	Dark grey mottled brown clayey angular tabular fine to medium GRAVEL of mudstone lithorelicts. (GRANULAR RESIDUAL SOIL)

End of pit at 2.50 m

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

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

AGS

Trial Pit Log

Trialpit No **TP108**

Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412120.00 - 421470.96 Level: 81.35	Date 21/03/2022
Location: Elland		Dimensions (m): 3 0.9 Depth 2.50	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	B					Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone, mudstone and occasional coal. (TOPSOIL)
				0.30	81.05		Stiff orange mottled grey slightly sandy gravelly CLAY. Gravel is angular tabular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=70				*At 0.7m, terracotta field drain, no flow.*
	0.80	D					
			HVP=119				
				1.30	80.05		Stiff greyish brown mottled grey gravelly CLAY. Gravel is angular tabular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				1.80	79.55		Brown gravelly very clayey fine to coarse SAND. Gravel is subangular tabular fine to medium of sandstone and coal. (GRANULAR RESIDUAL SOIL)
	2.00	T					
				2.30	79.05		Brown slightly gravelly slightly clayey fine to coarse SAND. Gravel is subangular fine to medium of sandstone and coal. (GRANULAR RESIDUAL SOIL)
				2.50	78.85		End of pit at 2.50 m

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

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

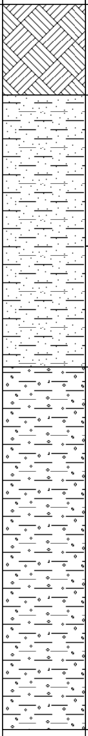
Trial Pit Log

Trialpit No
TP109
Sheet 1 of 1

Project Name: Shaw Lane
Project No. 4246
Co-ords: 412078.14 - 421469.45
Level: 82.05
Date 21/03/2022

Location: Elland
Dimensions (m): 3 × 0.9
Depth 2.40
Scale 1:25

Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged AP



Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T					Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of predominantly sandstone. (TOPSOIL)
				0.30	81.75		Stiff orangish brown sandy slightly gravelly CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=90				
							At 0.8m, terracotta field drain, no flow.
	0.90	D					
			HVP=105				
				1.20	80.85		Stiff dark brown mottled grey gravelly CLAY. Gravel is subangular tabular fine to coarse of sandstone and coal. (COHESIVE RESIDUAL SOIL)
	1.50	D					
			HVP=120				
			HVP=123				
				2.40	79.65		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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

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Trial Pit Log

Trialpit No
TP110
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412040.69 - 421445.78 Level: 82.00	Date 21/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.80	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30	81.70	▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone and coal. (TOPSOIL)
			HVP=108	0.60	81.40	▨	Stiff orange mottled grey sandy CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	0.80	D	HVP=115			▨	Stiff brown mottled grey gravelly CLAY. Gravel is subangular fine to medium of sandstone and coal. (COHESIVE RESIDUAL SOIL)
	1.50	D					
			HVP=118				
			HVP=120				
	2.70	D		2.80	79.20		
							End of pit at 2.80 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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

AGS

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Trial Pit Log

Trialpit No **TP111**
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411989.05 - 421442.08 Level: 80.75	Date 21/03/2022
Location: Elland		Dimensions (m): 3 0.9 Depth 2.70	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T		0.20	80.55	▨	MADE GROUND: Dark brown sandy slightly gravelly CLAY with frequent rootlets. Gravel is angular fine to medium of glass and ceramic tile with fragments of metal. (MADE GROUND TOPSOIL)
	0.25	J,K&T		0.30	80.45	▨	MADE GROUND: Reddish brown mottled black ashy angular fine to medium GRAVEL of clinker, brick and sandstone. (ASH & CLINKER)
	0.60	J&T		2.10	78.65	▨	MADE GROUND: Firm brown mottled black slightly gravelly CLAY. Gravel is angular fine to coarse of coal, mudstone and sandstone. (REWORKED NATURAL)
	2.30	T		2.70	78.05	⁘	Dark grey mottled orange clayey angular tabular fine to coarse GRAVEL of mudstone lithorelicts and coal. (GRANULAR RESIDUAL SOIL)
							End of pit at 2.70 m

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

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

AGS

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Trial Pit Log

Trialpit No
TP112
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411919.04 - 421431.17 Level: 80.40	Date 21/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.50	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
							MADE GROUND: Dark brown slightly sandy gravelly CLAY with frequent rootlets and a low cobble content. Gravel is angular fine to coarse of brick, sandstone, coal and tile. Cobbles are of sandstone, brick and masonry blocks. (MADE GROUND TOPSOIL)
	0.30	J&T					
				0.50	79.90		Firm orangish brown slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=70				
	0.90	D					
			HVP=75				
			HVP=68				
				1.50	78.90		Stiff brown mottled grey gravelly CLAY. Gravel is angular tabular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=85				
	2.10	D					
				2.20	78.20		Stiff grey CLAY. (COHESIVE RESIDUAL SOIL) *From 2.2m, difficult to excavate.*
			HVP=140				
	2.40	D					
				2.50	77.90		End of pit at 2.50 m

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

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

AGS

Trial Pit Log

Trialpit No
TP113
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411925.94 - 421480.98 Level: 78.50	Date 21/03/2022
Location: Elland		Dimensions (m): 3 × 0.9	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Depth 2.00	Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	B		0.30	78.20	▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone and coal. (TOPSOIL)
			HVP=69	0.60	77.90	▤	Firm orange mottled grey slightly sandy CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS) *At 0.4m, sandstone cobble culvert, dry.*
			HVP=103				
	0.80	D					
			HVP=150	1.70	76.80	▤	Stiff brown mottled grey gravelly CLAY. Gravel is subangular fine to coarse of sandstone and coal. (COHESIVE RESIDUAL SOIL)
	1.80	D					
			HVP=148	2.00	76.50	▤	Stiff grey slightly gravelly CLAY. Gravel is angular tabular fine to medium of sandstone and coal. (COHESIVE RESIDUAL SOIL) *At 2.0m, sandstone boulder. Unable to excavate further.*

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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

AGS

Trial Pit Log

Trialpit No
TP114
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411945.13 - 421457.41 Level: 79.90	Date 21/03/2022
Location: Elland		Dimensions (m): 3 × 0.9	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Depth 2.40	Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	79.60	▨	MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of coal and mudstone. (MADE GROUND TOPSOIL)
	0.50	J&T		0.60	79.30	▨	MADE GROUND: Light grey clayey angular tabular fine to medium GRAVEL of mudstone. (COLLIERY SPOIL)
	1.20	D	HVP=65 HVP=68 HVP=111	1.60	78.30	▤	Firm orange mottled grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
				1.80	78.10	■	Black COAL. Recovered as clayey angular fine to medium gravel. (HALIFAX HARD BED COAL)
	2.00	D	HVP=120	2.40	77.50	▤	Stiff light grey slightly gravelly CLAY. Gravel is angular fine to medium of coal and mudstone. (COHESIVE RESIDUAL SOIL)
							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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

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Trial Pit Log

Trialpit No	**TP115**
	Sheet 1 of 1
Project Name:	Shaw Lane
Project No.	4246
Co-ords:	411971.98 - 421473.92
Level:	79.65
Date	21/03/2022
Location:	Elland
Dimensions (m):	3 × 0.9
Depth	2.60
Scale	1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged	AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30	79.35	▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone, mudstone and coal. (TOPSOIL)
	0.60	D	HVP=68	1.20	78.45		Firm orange mottled grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS) *At 0.8m, terracotta field drain, no flow.*
	1.40	D	HVP=100	1.50	78.15		Stiff brown mottled grey gravelly CLAY. Gravel is subangular tabular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=111	2.10	77.55		Stiff dark grey CLAY. (COHESIVE RESIDUAL SOIL)
				2.60	77.05	■	Black COAL. (HALIFAX HARD BED COAL) *At 2.6m, maximum reach of excavator.*

End of pit at 2.60 m

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

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

AGS

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Trial Pit Log

Trialpit No	**TP116**
Sheet 1 of 1	
Project Name:	Shaw Lane
Project No.	4246
Co-ords:	411984.75 - 421493.81
Level:	79.00
Date	22/03/2022
Location:	Elland
Dimensions (m):	3 × 0.9
Depth	2.30
Scale	1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged	AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	78.70	▨	Dark brown slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of coal and sandstone. (TOPSOIL)
			HVP=60				
	0.60	D					
			HVP=68	1.20	77.80	▤	Firm orange mottled grey slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=150				
	1.60	D					
			HVP=150	1.80	77.20	▤	Stiff dark brown mottled grey gravelly CLAY. Gravel is subangular fine to medium of sandstone and coal. (COHESIVE RESIDUAL SOIL)
	2.20	D		2.30	76.70	▤	Stiff brown slightly sandy very gravelly CLAY. Gravel is angular fine to coarse of sandstone and coal. (COHESIVE RESIDUAL SOIL) *From 1.8m, too gravelly for vanes.*
							End of pit at 2.30 m

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

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

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP117
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412028.93 - 421481.23 Level: 80.50	Date 23/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.50	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T					
	0.20	B					
				0.30	80.20	▨	Dark brown slightly gravelly slightly sandy CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone, mudstone and rare coal. (TOPSOIL)
			HVP=52				
				0.90	79.60	▤	Firm orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone and mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=140				
	1.30	D					
			HVP=150				
			HVP=147				
	2.40	D					
				2.50	78.00	▤	Stiff brown mottled grey gravelly CLAY. Gravel is fine to coarse of sandstone, mudstone and occasional coal. (COHESIVE RESIDUAL SOIL)
							End of pit at 2.50 m

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

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

AGS

Trial Pit Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412081.54 - 421502.81 Level: 80.25	Trialpit No **TP118** Sheet 1 of 1 Date 23/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.60	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	79.95	▨	Dark brown slightly gravelly slightly sandy CLAY with frequent rootlets. Gravel is subangular to subrounded fine to medium of sandstone, mudstone and occasional coal. (TOPSOIL)
			HVP=63	0.70	79.55	░	Firm orange mottled grey slightly sandy CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.70	D	HVP=101 HVP=103	1.90	78.35	░	Stiff brown mottled grey gravelly CLAY. Gravel is subrounded to angular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	2.30	D	HVP=108	2.60	77.65	░	Stiff dark grey mottled brown very gravelly CLAY. Gravel is angular tabular fine to medium of mudstone lithorelicts. (COHESIVE RESIDUAL SOIL)
							End of pit at 2.60 m

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

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

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP119
Sheet 1 of 1

Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412132.07 - 421520.46 Level: 77.95	Date 23/03/2022
Location:	Elland		Dimensions (m): 3 × 0.9 Depth 2.50	Scale 1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J,K&T		0.30	77.65		MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY with roots, rootlets and a low angular tabular sandstone cobble content. Gravel is subrounded to subangular fine to medium of sandstone and coal. (MADE GROUND TOPSOIL) *At 0.2m, sandstone cobbles.*
	0.50	J,K&T		0.70	77.25		MADE GROUND: Brown sandy CLAY with roots and rootlets. (COHESIVE MADE GROUND)
			HVP=68				
	1.10	D					
			HVP=65	1.60	76.35		Firm orange mottled grey sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=78	2.00	75.95		Stiff brown mottled grey slightly sandy gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	2.20	T		2.50	75.45		Brown clayey fine to coarse SAND and subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)

End of pit at 2.50 m

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

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

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP120
Sheet 1 of 1

Project Name: Shaw Lane
Project No. 4246
Co-ords: 412138.10 - 421540.37
Level: 76.30
Date 23/03/2022
Location: Elland
Dimensions (m): 3 0.9
Depth 2.40
Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged AP

Water Strike	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J,K&T		0.40	75.90		MADE GROUND: Dark brown sandy gravelly CLAY with rootlets and a low cobble content. Gravel is subangular fine to coarse of sandstone and brick. Cobbles of angular tabular sandstone with fragments of tile and plastic, plastic bag, ash, clinker and shale. (MADE GROUND TOPSOIL)
	0.70	D	HVP=60 HVP=68	1.60	74.70		Firm orange mottled grey gravelly CLAY. Gravel is subangular fine to medium of sandstone and occasional coal. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.90	T		2.40	73.90		Brown clayey fine to coarse SAND and angular tabular fine to coarse GRAVEL of sandstone, coal and mudstone. (GRANULAR RESIDUAL SOIL)
							End of pit at 2.40 m

1
2
3
4
5

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

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

AGS

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Trial Pit Log

Trialpit No **TP121**
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412127.85 - 421547.11 Level: 76.55	Date 23/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.60	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing		
	Depth	Type	Results
	0.20	J,K&T	
	0.50	J,K&T	
			HVP=82
	1.00	D	
			HVP=68
			HVP=65
	1.80	T	

Depth (m)	Level (m)	Stratum Description
0.30	76.25	MADE GROUND: Dark brown sandy gravelly CLAY with roots and rootlets and a low cobble content. Gravel is angular to subangular fine to coarse of sandstone, brick, coal and tile with fragments of plastic and glass and angular sandstone cobbles and bricks. (MADE GROUND TOPSOIL) *At 0.2m, overbreak in made ground with spalling.*
0.60	75.95	MADE GROUND: Black ashy fine to medium GRAVEL of clinker, shale and brick. (ASH & CLINKER) *At 0.3m, occasional sandstone tabular cobbles, 1m x 1m x 0.3m thick.*
1.10	75.45	Stiff orange mottled grey gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
1.50	75.05	Firm dark grey gravelly CLAY. Gravel is subangular tabular fine to medium of mudstone lithorelicts. (COHESIVE RESIDUAL SOIL)
2.60	73.95	Dark grey mottled brown clayey angular tabular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)

End of pit at 2.60 m

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

Stability: 1. Spalling of the sides of the trial pit at 0.2m depth during excavation with some overbreak in the made ground.

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No **TP122**
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412125.25 - 421566.82 Level: 75.55	Date 23/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.70	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Samples and In Situ Testing

Water Strike	Depth	Type	Results
	0.20	J,K&T	
	0.50	J,K&T	
			HVP=70
			HVP=65
	1.50	D	
			HVP=68

Depth (m)	Level (m)	Legend	Stratum Description
0.05	75.50	▨	MADE GROUND: Dark brown sandy gravelly CLAY with rootlets. Gravel is subangular fine to medium of clinker, ash, mudstone and occasional coal. (MADE GROUND TOPSOIL)
0.30	75.25	▨	MADE GROUND: Black and reddish brown ashy fine to coarse GRAVEL of clinker, sandstone and coal. (ASH & CLINKER) *At 0.2m, ?lead water pipe, no flow.*
0.80	74.75	▨	MADE GROUND: Greyish brown slightly gravelly slightly sandy CLAY. Gravel is subangular fine to medium of mudstone, sandstone and coal. (COHESIVE MADE GROUND) *At 0.6m, vitrified clay pipe 150mm diameter - dry.*
1.20	74.35	▒	Firm orange mottled grey gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
2.50	73.05	▒	Firm brown mottled grey gravelly CLAY. Gravel is angular tabular fine to medium of mudstone lithorelicts. (COHESIVE RESIDUAL SOIL)
2.70	72.85	▒	Dark grey mottled brown clayey angular tabular fine to coarse GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)

End of pit at 2.70 m

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

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

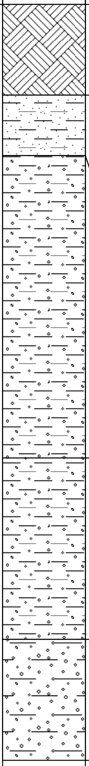
AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP123
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412100.40 - 421544.98 Level: 77.70	Date 23/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.50	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
							Dark brown slightly sandy slightly gravelly CLAY with roots and rootlets. Gravel is subangular fine to medium of sandstone, mudstone and occasional coal. (TOPSOIL)
	0.20	J,K&T					
				0.30	77.40		Firm orange mottled grey slightly gravelly slightly sandy CLAY. Gravel is subrounded to subangular fine to medium of sandstone and coal. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=70				
				0.50	77.20		Stiff brown mottled grey gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone, mudstone and occasional coal. (COHESIVE RESIDUAL SOIL)
	0.80	D					
			HVP=108				
				1.50	76.20		Firm dark grey gravelly CLAY. Gravel is angular tabular fine to medium of mudstone lithorelicts. (COHESIVE RESIDUAL SOIL)
	1.80	D					
			HVP=58				
			HVP=63				
				2.10	75.60		Dark grey clayey angular tabular fine to medium GRAVEL of mudstone. (GRANULAR RESIDUAL SOIL)
				2.50	75.20		End of pit at 2.50 m

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

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

AGS

Trial Pit Log

Trialpit No **TP124**

Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412065.33 - 421527.59 Level: 78.90	Date 23/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.50	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30	78.60		Dark brown slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone, mudstone and occasional coal. (TOPSOIL)
	0.50	D					Firm orangish brown mottled grey slightly sandy CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=65				
				0.70	78.20		Stiff brown mottled grey gravelly CLAY. Gravel is angular tabular fine to coarse of sandstone and occasional mudstone and coal. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.20	D					
			HVP=80				
			HVP=98				
				1.70	77.20		Stiff dark grey gravelly CLAY. Gravel is angular tabular fine to medium of mudstone lithorelicts. (COHESIVE RESIDUAL SOIL)
	1.90	D					
			HVP=110				
				2.10	76.80		Dark grey clayey angular tabular fine to medium GRAVEL of mudstone lithorelicts. (GRANULAR RESIDUAL SOIL)
				2.50	76.40		End of pit at 2.50 m

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

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

Trial Pit Log

Trialpit No
TP125
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412029.80 - 421529.25 Level: 78.50	Date 22/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.30	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	78.20	▨	MADE GROUND: Dark brown slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone, coal and mudstone. (TOPSOIL)
	0.40	J,K&T		0.60	77.90	▨	MADE GROUND: Brown, black and orange mottled gravelly CLAY. Gravel is angular fine to medium of mudstone, coal and sandstone. (REWORKED NATURAL)
			HVP=65	1.50	77.00	▤	Firm orangish brown mottled grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone and mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	2.00	D		2.30	76.20	▤	Stiff brown mottled grey very gravelly CLAY. Gravel is subangular to angular fine to coarse of sandstone and mudstone. (COHESIVE RESIDUAL SOIL) *At 1.5m, too gravelly for vanes.*
							End of pit at 2.30 m

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

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

Trial Pit Log

Trialpit No
TP126
Sheet 1 of 1

Project Name: Shaw Lane
Project No. 4246
Co-ords: 411960.46 - 421519.79
Level: 77.90
Date 22/03/2022
Location: Elland
Dimensions (m): 3 × 0.9
Depth 2.30
Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	B				▨	Dark brown slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone and occasional coal. (TOPSOIL)
	0.20	J&T		0.30	77.60		
			HVP=60			▤	Firm orange mottled grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=68				
			HVP=111	1.00	76.90		
	1.30	D				▤	Stiff brown mottled grey gravelly CLAY. Gravel is subangular fine to coarse of sandstone, mudstone and coal. (COHESIVE RESIDUAL SOIL) *At 1.0m, terracotta field drain, no flow.*
			HVP=120	1.70	76.20		
	2.00	D	HVP=131			▤	Stiff dark grey gravelly CLAY. Gravel is subangular to angular fine to coarse of mudstone and sandstone. (COHESIVE RESIDUAL SOIL)
				2.30	75.60		End of pit at 2.30 m

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

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

Trial Pit Log

Trialpit No
TP127
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411900.85 - 421513.54 Level: 77.10	Date 22/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.10	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	76.80	▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular to subrounded fine to medium of sandstone and coal. (TOPSOIL)
	1.20	D	HVP=85	1.40	75.70	▤	Firm orange mottled grey slightly sandy CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=150	2.10	75.00	▤	Stiff brown mottled grey gravelly CLAY. Gravel is angular fine to coarse of sandstone and coal. (COHESIVE RESIDUAL SOIL)
							End of pit at 2.10 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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

AGS

Trial Pit Log

Trialpit No
TP128
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411907.09 - 421552.04 Level: 76.10	Date 22/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.50	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	B		0.30	75.80		Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of mudstone and coal. (TOPSOIL)
			HVP=92				
	0.60	D					
				1.20	74.90		Firm orange mottled grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS) *At 1.0m, terracotta field drain, no flow.*
			HVP=100				
	1.50	D		1.80	74.30		Stiff brown mottled grey gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	2.00	D					
			HVP=138	2.50	73.60		Stiff dark grey slightly gravelly CLAY. Gravel is subrounded to subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
							End of pit at 2.50 m

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

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

Trial Pit Log

Trialpit No **TP129**
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411969.89 - 421550.64 Level: 76.95	Date 22/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.40	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T		0.30	76.65	▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone and coal. (TOPSOIL)
			HVP=58 HVP=62	1.20	75.75	▤	Firm orange mottled grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS) *At 1.0m, terracotta field drain, no flow.*
	1.60	D	HVP=83	1.90	75.05	▤	Stiff brown mottled grey gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
				2.40	74.55	▤	Grey mottled brown very clayey angular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
							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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

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Trial Pit Log

Trialpit No
TP130
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412030.64 - 421569.40 Level: 76.65	Date 22/03/2022
Location: Elland		Dimensions (m): 3 0.9 Depth 2.30	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	B		0.30	76.35	▨	Dark brown slightly gravelly slightly sandy CLAY with frequent rootlets. Gravel is subangular to subrounded fine to medium of mudstone and coal. (TOPSOIL)
				0.60	76.05	▤	Firm orange mottled grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone and coal. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=68	2.30	74.35	▤	Stiff brown mottled grey gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
	1.30	D					
			HVP=82				
			HVP=91				
							End of pit at 2.30 m

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

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

AGS

Trial Pit Log

Trialpit No
TP131
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412090.42 - 421574.23 Level: 75.95	Date 23/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.60	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T				▨	MADE GROUND: Dark brown ashy, sandy slightly gravelly CLAY with frequent rootlets. Gravel is angular fine to coarse of clinker, tile, pottery and glass. (MADE GROUND TOPSOIL)
	0.20	B					
				0.40	75.55	▤	Firm orangish brown sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=101				
	1.00	D					
			HVP=113				
				2.00	73.95	▤	Stiff black gravelly CLAY. Gravel is angular tabular fine to medium of mudstone and coal. (COHESIVE RESIDUAL SOIL)
	2.20	D					
			HVP=121				
				2.60	73.35		End of pit at 2.60 m

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

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

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Trial Pit Log

Trialpit No
TP132
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412161.71 - 421587.39 Level: 73.60	Date 24/03/2022
Location: Elland		Dimensions (m): 3 0.9	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Depth 2.30	Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.40	73.20	▩	MADE GROUND: Dark brown sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and mudstone. (MADE GROUND TOPSOIL)
	0.50 0.80	D&B J&T		1.50	72.10	▩	MADE GROUND: Light orangish brown sandy angular tabular fine to coarse GRAVEL of sandstone with a high cobble content. Cobbles are angular of sandstone. (GRANULAR MADE GROUND)
▼			HVP=55	2.30	71.30	▤	Firm light orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS) *At 1.5m, slight water seepage in north face of pit.*
							End of pit at 2.30 m

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Slight groundwater seepage was encountered at 1.5m during excavation. 3. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

AGS

Trial Pit Log

Trialpit No
TP133
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412177.83 - 421604.30 Level: 72.70	Date 24/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.20	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	72.50	▨	Dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and mudstone. (TOPSOIL)
	0.60	D		1.00	71.70	▤	Firm light orangish brown very sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS) *Between 0.2m and 1.0m, unable to get reliable vane readings due to high sand content.*
				1.90	70.80	░	Light greyish brown sandy angular to subangular tabular fine to coarse GRAVEL of sandstone and sandstone lithorelicts. (GRANULAR RESIDUAL SOIL)
				2.20	70.50	░	Dark grey MUDSTONE. Recovered as sandy angular tabular fine to coarse gravel. (COAL MEASURES)
							End of pit at 2.20 m

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

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

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Trial Pit Log

Trialpit No
TP134
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412148.90 - 421610.00 Level: 72.90	Date 24/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.50	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.40	72.50		Dark brown sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone. (TOPSOIL)
	0.70	D&B	HVP=51	1.00	71.90		Firm light brown very sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of sandstone and mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
				1.50	71.40		Firm light orange and grey mottled gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse sandstone and mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS) *Between 1.0m and 1.5m, unable to get reliable vane readings due to high gravel content.*
				2.50	70.40		Light grey clayey slightly sandy angular to subangular fine to coarse fine to coarse GRAVEL of sandstone and sandstone lithorelicts. (GRANULAR RESIDUAL SOIL)
							End of pit at 2.50 m

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

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

Trial Pit Log

Trialpit No
TP135 (N)
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412086.16 - 421598.99 Level: 74.65	Date 23/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.60	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30	74.35	▨	(TOPSOIL)
				1.20	73.45	▨	NORTH PIT: MADE GROUND: Black gravelly CLAY. Gravel is angular fine to coarse of coal and mudstone. (MADE GROUND TOPSOIL)
				2.60	72.05	▨	MADE GROUND: Brown and black gravelly CLAY. Gravel is angular tabular fine to coarse of coal and mudstone. (COHESIVE MADE GROUND) *At 2.6m, maximum reach of excavator.*
							End of pit at 2.60 m

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

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

Trial Pit Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412086.16 - 421598.99 Level: 74.65	Trialpit No **TP135 (S)** Sheet 1 of 1
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.60	Date 23/03/2022
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Scale 1:25 Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	B		0.30	74.35	▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subrounded to subangular fine to medium of sandstone, mudstone and coal. (TOPSOIL)
	0.80	D	HVP=92	1.20	73.45	▤	Stiff orange mottled grey slightly sandy slightly gravelly CLAY. Gravel is subrounded to subangular fine to medium of sandstone and coal. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.50	J,K&T	HVP=93	2.60	72.05	▤	Stiff dark brown mottled grey gravelly CLAY. Gravel is angular tabular fine to coarse of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)

End of pit at 2.60 m

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

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

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Trial Pit Log

Trialpit No **TP136**

Sheet 1 of 1

Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412050.51 - 421607.68 Level: 75.05	Date 23/03/2022
Location:	Elland		Dimensions (m): 3 × 0.9 Depth 2.30	Scale 1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	74.75	▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subrounded to subangular fine to medium of sandstone and mudstone. (TOPSOIL)
			HVP=68	0.90	74.15	▨	Firm orange mottled grey sandy CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.40	D	HVP=81 HVP=100	1.90	73.15	▨	Stiff reddish brown mottled grey gravelly CLAY. Gravel is subangular fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
	2.20	D		2.30	72.75	▨	Stiff dark grey gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and coal. (COHESIVE RESIDUAL SOIL)

End of pit at 2.30 m

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

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

AGS

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Trial Pit Log

Trialpit No
TP137
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411994.91 - 421580.47 Level: 75.95	Date 22/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.40	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	75.65		Dark brown slightly gravelly slightly sandy CLAY with frequent rootlets. Gravel is subrounded to subangular fine to medium of sandstone, mudstone and coal. (TOPSOIL)
	0.60	D		1.00	74.95		Firm orange and grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=106	1.80	74.15		Stiff brown mottled grey slightly sandy gravelly CLAY. Gravel is subangular to angular fine to coarse of mudstone and sandstone. (COHESIVE RESIDUAL SOIL)
	2.30	D	HVP=110	2.40	73.55		Stiff dark grey gravelly CLAY. Gravel is angular tabular fine to coarse of sandstone, mudstone and coal. (COHESIVE RESIDUAL SOIL)

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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

AGS

Trial Pit Log

Trialpit No **TP138**
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411933.92 - 421587.93 Level: 75.05	Date 22/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.50	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10 0.20	B J&T		0.30	74.75	▨	Dark brown slightly gravelly slightly sandy CLAY with frequent rootlets. Gravel is subangular to subrounded fine to medium of mudstone, coal and sandstone. (TOPSOIL)
			HVP=60	1.30	73.75	▤	Firm orange mottled grey slightly gravelly CLAY. Gravel is subrounded to subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.70 2.40	D D	HVP=83 HVP=150	2.50	72.55	▤	Stiff brown mottled grey gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
							End of pit at 2.50 m

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

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

LITHOS CONSULTING

Trial Pit Log

Trialpit No	**TP139**	Sheet 1 of 1	
Project Name: Shaw Lane	Project No. 4246	Co-ords: 411861.79 - 421577.53 Level: 74.45	Date 22/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 1.70	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10 0.20	B J&T		0.30	74.15	▨	Dark brown slightly gravelly slightly sandy CLAY with frequent rootlets. Gravel is subrounded to subangular fine to medium of sandstone, mudstone and coal. (TOPSOIL)
	0.60	D		0.80	73.65	▤	Firm orange mottled grey slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.60	D	HVP=108 HVP=103 HVP=113	1.70	72.75	▤	Stiff brown mottled grey gravelly CLAY. Gravel is angular fine to coarse of sandstone and coal. (COHESIVE RESIDUAL SOIL) *From 1.3m to 1.7m, sandstone boulder in pit. Unable to excavate further.*

End of pit at 1.70 m

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

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

AGS

Trial Pit Log

Trialpit No **TP140**
Sheet 1 of 1

Project Name: Shaw Lane
Project No. 4246
Co-ords: 411966.52 - 421602.51
Level: 74.80
Date 22/03/2022
Location: Elland
Dimensions (m): 3 × 0.9
Depth 2.40
Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged AP

Water Strike	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
							Dark brown slightly sandy CLAY with frequent rootlets. (TOPSOIL)
				0.30	74.50		Firm orange mottled grey slightly gravelly CLAY. Gravel is subrounded to subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=50				
	0.80	D					
				1.10	73.70		Stiff brown mottled grey gravelly CLAY. Gravel is angular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
			HVP=75				
	1.70	D					
			HVP=150				
				2.40	72.40		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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP141
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412031.65 - 421636.69 Level: 73.45	Date 23/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.30	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	B		0.30	73.15	▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subrounded to subangular fine to medium of sandstone, mudstone and occasional coal. (TOPSOIL)
	0.70	D	HVP=120	1.00	72.45	▤	Firm orange mottled grey sandy slightly gravelly CLAY. Gravel is subangular fine to medium of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.40	D	HVP=140 HVP=141	2.30	71.15	▤	Stiff brown mottled grey gravelly CLAY. Gravel is subangular fine to coarse of sandstone, mudstone and coal. (COHESIVE RESIDUAL SOIL)
							End of pit at 2.30 m

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

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

AGS

Trial Pit Log

Trialpit No	**TP142**
	Sheet 1 of 1
Project Name:	Shaw Lane
Project No.	4246
Co-ords:	412070.89 - 421628.66
Level:	74.05
Date	23/03/2022
Location:	Elland
Dimensions (m):	3 × 0.9
Depth	2.40
Scale	1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged	AP

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	73.75	▨	Dark brown slightly sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to medium of sandstone, mudstone and coal. (TOPSOIL)
				0.70	73.35	▨	Firm orange mottled grey sandy slightly gravelly CLAY. Gravel is subrounded to subangular fine to coarse of sandstone and occasional coal. (COHESIVE GLACIOFLUVIAL DEPOSITS)
			HVP=136			▨	Stiff brown mottled grey slightly sandy gravelly CLAY. Gravel is subrounded to angular fine to coarse of sandstone and occasional coal. (COHESIVE RESIDUAL SOIL)
	1.20	D					
			HVP=95				
			HVP=132				*At 2.1m, becomes sandy.*
	2.30	D		2.40	71.65		
							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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

Trial Pit Log

Trialpit No **TP143**
Sheet 1 of 1

Project Name: Shaw Lane
Project No. 4246
Co-ords: 412093.36 - 421643.86
Level: 72.70
Date 24/03/2022

Location: Elland
Dimensions (m): 3 × 0.9
Depth 2.40
Scale 1:25

Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.30	J,K&T		0.40	72.30	▨	Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to medium of mixed lithology including sandstone and mudstone. (TOPSOIL)
	0.70	D	HVP=55 HVP=48	1.40	71.30	▤	Firm light brown orange and grey mottled slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.60	D		2.40	70.30	▤	Stiff dark brown mottled grey sandy slightly gravelly CLAY with low cobble content. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and mudstone. Cobbles are rounded of sandstone. (COHESIVE RESIDUAL SOIL) *Between 1.4m and 2.4m, unable to get reliable hand vane reading due to high sand and gravel content.*

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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

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Trial Pit Log

Trialpit No	**TP144**
Sheet 1 of 1	

Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412109.76 - 421625.47 Level: 73.10	Date 24/03/2022
Location:	Elland		Dimensions (m): 3 × 0.9 Depth 2.20	Scale 1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	72.90		Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and mudstone. (TOPSOIL)
			HVP=55	1.40	71.70		Firm light orange and grey mottled slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse sandstone and mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
	1.60	D	HVP=85	2.00	71.10		Stiff dark brown gleyed grey slightly gravelly CLAY. Gravel is subrounded to rounded fine to coarse of predominantly sandstone. (COHESIVE RESIDUAL SOIL)
				2.20	70.90		Dark grey MUDSTONE. Recovered as angular tabular fine to coarse gravel. (COAL MEASURES)

End of pit at 2.20 m

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

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

AGS

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Trial Pit Log

Trialpit No
TP145
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412181.91 - 421636.65 Level: 70.90	Date 24/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.40	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20	J&T		0.30	70.60	▨	Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and mudstone. (TOPSOIL)
	0.70	D&B		0.90	70.00	▤	Light brown slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
				2.40	68.50	░	Light brown sandy slightly clayey angular tabular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
							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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

AGS

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Trial Pit Log

Trialpit No **TP146**

Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412148.09 - 421663.91 Level: 70.40	Date 24/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.40	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged CC

Water Strike	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.20 0.20	B J&T		0.30	70.10	▨	Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and mudstone. (TOPSOIL)
	0.70	D	HVP=52	1.30	69.10	▤	Firm light orangish brown sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS) *From 1.2m, rounded cobbles of sandstone.*
			HVP=92	2.40	68.00	▤	Stiff dark brown gleyed grey gravelly slightly sandy CLAY with a low cobble content. Gravel is subrounded to rounded fine to coarse of predominantly sandstone. Cobbles are rounded of sandstone. (COHESIVE RESIDUAL SOIL)
							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. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

AGS

LITHOS CONSULTING

Trial Pit Log

Trialpit No
TP147
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412186.02 - 421681.36 Level: 68.55	Date 24/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 2.20	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged CC

Water Strike	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20	68.35		Dark brown slightly sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone. (TOPSOIL)
	0.60	D		0.90	67.65		Light brown gravelly slightly clayey SAND. Gravel is angular to subrounded fine to coarse of sandstone. (GRANULAR GLACIOFLUVIAL DEPOSITS)
				2.20	66.35		Light brown sandy angular to subangular tabular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
							End of pit at 2.20 m

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

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

AGS

Trial Pit Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412165.11 - 421600.49 Level: 73.10	Trialpit No **TP148** Sheet 1 of 1 Date 24/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 0.90	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged CC

Water Strike	Samples and In Situ Testing Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.20	J&T				▩	MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and mudstone. (MADE GROUND TOPSOIL)
	0.50	J&T		0.30	72.80	▩	MADE GROUND: Dark brown clayey angular to subangular fine to coarse GRAVEL of mixed lithologies including coal, brick, mudstone and sandstone. (GRANULAR MADE GROUND)
			HVP=65	0.70	72.40		Firm light orangish brown mottled grey gravelly slightly sandy CLAY. Gravel is angular to subangular tabular fine to coarse of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
				0.90	72.20		End of pit at 0.90 m

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

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

Trial Pit Log

Trialpit No
TP149
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412178.30 - 421591.50 Level: 73.30	Date 24/03/2022
Location: Elland		Dimensions (m): 3 × 0.9 Depth 0.90	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth			Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.40	J&T		0.60	72.70	▨	MADE GROUND: Dark brown sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone, brick and coal. (MADE GROUND TOPSOIL)
				0.90	72.40	▤	Firm light brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
							End of pit at 0.90 m

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

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

Trial Pit Log

Trialpit No
TP150
Sheet 1 of 1

Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412158.40 - 421575.67 Level: 74.30	Date 24/03/2022
Location:	Elland		Dimensions (m): 3 × 0.9	Scale 1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Depth 0.80	Logged CC

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.40	J&T		0.60	73.70	▩	MADE GROUND: Dark grey sandy slightly clayey angular to subangular fine to coarse GRAVEL of mixed lithologies including sandstone, brick, clinker, mudstone and coal with a high cobble content. Cobbles are angular of sandstone. (MADE GROUND TOPSOIL)
				0.80	73.50	⁙	Light brown gravelly slightly clayey SAND. Gravel is angular to subangular fine to coarse of sandstone. (GRANULAR GLACIOFLUVIAL DEPOSITS)

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. Backfilled with materials arising upon completion. 4. Co-ordinates from hand held GPS, hole not surveyed in.

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

Appendix G

Window Sample

Borehole Logs

Borehole Log

Borehole No.
WS101
Sheet 1 of 1

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412148.71 - 421364.45	Hole Type WS
Location:	Elland		Level:	89.10	Scale 1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	23/03/2022 - 23/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	88.90		Dark brown slightly sandy CLAY with frequent rootlets. (TOPSOIL)
					0.70	88.40		Stiff orange and brown mottled slightly gravelly CLAY. Gravel subrounded fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)
					0.75	88.35		Brown slightly clayey SAND and subangular fine to medium sandstone. (GRANULAR RESIDUAL SOIL)
					1.20	87.90		Stiff brownish grey CLAY. (COHESIVE RESIDUAL SOIL)
					1.55	87.55		Firm grey gravelly CLAY. Gravel is subangular fine to medium of mudstone. (COHESIVE RESIDUAL SOIL)
					1.95	87.15		Very weak brownish grey MUDSTONE. Recovered as very clayey subangular fine to medium gravel. (COAL MEASURES)
					2.40	86.70		Very weak black MUDSTONE with orange brown iron staining. Recovered as angular tabular gravel. (COAL MEASURES)
					3.00	86.10		Weak black MUDSTONE with orange brown iron staining. Recovered as angular tabular gravel. (COAL MEASURES)
								End of borehole at 3.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

Borehole Log

				Borehole No. **WS102** Sheet 1 of 1
Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412081.87 - 421365.52	Hole Type WS
Location:	Elland		Level: 87.25	Scale 1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 23/03/2022 - 23/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.25	87.00		Dark brown silty CLAY with frequent rootlets. (TOPSOIL)
					0.70	86.55		Firm orange and light brown mottled very sandy CLAY (COHESIVE RESIDUAL SOIL)
					1.30	85.95		Stiff orange and brown mottled sandy slightly gravelly CLAY. Gravel subrounded fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)
					1.70	85.55		Stiff dark brown mottled grey gravelly CLAY. Gravel is subangular medium of sandstone. (COHESIVE RESIDUAL SOIL)
					2.00	85.25		Very weak thinly laminated grey MUDSTONE. Recovered as clayey subangular fine to medium gravel. (COAL MEASURES)
					3.00	84.25		Very weak thinly laminated orange brown MUDSTONE. Recovered as subangular fine to medium gravel. (COAL MEASURES)
								End of borehole at 3.00 m

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2
3
4
5

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

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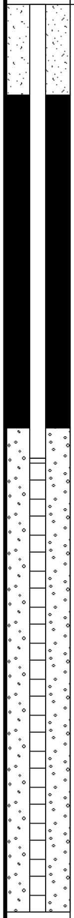
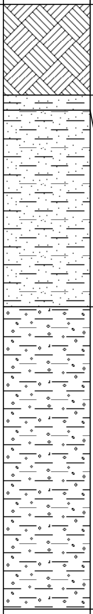
Borehole Log

Borehole No.	**WS103**
Sheet 1 of 1	

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412103.28 - 421451.01	Hole Type WS
Location:	Elland		Level:	83.00	Scale 1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	23/03/2022 - 23/03/2022	Logged By ET



Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown slightly silty slightly sandy CLAY. (TOPSOIL)
					0.30	82.70		Firm orange sandy slightly gravelly CLAY. Gravel is subangular fine of coal. (COHESIVE RESIDUAL SOIL)
					0.35	82.65		Firm orange and light brown mottled sandy CLAY. (COHESIVE RESIDUAL SOIL)
					1.00	82.00		Stiff dark brown gravelly CLAY. Gravel is subangular fine to coarse of sandstone, mudstone and coal. (COHESIVE RESIDUAL SOIL)
					2.00	81.00		No recovery.
					3.00	80.00		End of borehole at 3.00 m



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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Borehole Log

Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412027.69 - 421442.63	Borehole No. **WS104** Sheet 1 of 1
Location:	Elland		Level: 81.70	Hole Type WS
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 23/03/2022 - 23/03/2022	Scale 1:25
				Logged By ET

Well	Water Strikes	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30	81.40		Dark brown sandy CLAY with frequent rootlets. (TOPSOIL)
					0.40	81.30		Stiff orange very sandy CLAY. (COHESIVE RESIDUAL SOIL)
					1.00	80.70		Stiff orange and light brown mottled sandy CLAY. Rare subangular fine to medium gravel of sandstone. (COHESIVE RESIDUAL SOIL)
					1.80	79.90		Stiff dark brown mottled light grey slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone, mudstone and coal. (COHESIVE RESIDUAL SOIL)
					2.00	79.70		Light brown slightly clayey GRAVEL. Gravel is angular to subangular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
					3.00	78.70		Stiff dark brown slightly gravelly CLAY. Gravel is subangular fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)
								End of borehole at 3.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

Borehole Log

Borehole No.	**WS105**
Sheet 1 of 1	
Project Name:	Shaw Lane
Project No.	4246
Co-ords:	412140.04 - 421507.97
Hole Type	WS
Location:	Elland
Level:	78.30
Scale	1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Dates:	23/03/2022 - 23/03/2022
Logged By	ET

Well	Water Strikes	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30	78.00		Dark brown slightly clayey gravelly SAND. Gravel is subangular fine to coarse of mudstone and sandstone. (TOPSOIL)
					0.50	77.80		Firm dark brown slightly gravelly sandy CLAY. Gravel is subangular fine to coarse of mudstone and sandstone. (COHESIVE RESIDUAL SOIL)
					1.00	77.30		Firm orange slightly gravelly very sandy CLAY. Gravel is subangular fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)
					1.10	77.20		Brown gravelly SAND. Gravel is subangular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
					2.00	76.30		Firm brown sandy gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
					3.00	75.30		Very weak brownish grey MUDSTONE. Recovered as very clayey subangular fine to medium gravel. (COAL MEASURES)
								End of borehole at 3.00 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

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Borehole Log

Borehole No.	**WS106**	Sheet 1 of 1			
Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412100.91 - 421550.73	Hole Type WS
Location:	Elland		Level:	77.40	Scale 1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	23/03/2022 - 23/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30	77.10		Dark brown slightly clayey gravelly SAND. Gravel is subangular fine to coarse of mudstone and sandstone. (TOPSOIL)
					1.00	76.40		Firm orange sandy slightly gravelly CLAY. Gravel is subangular fine to coarse sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					1.30	76.10		No recovery.
					1.50	75.90		Stiff orange mottled purplish grey gravelly CLAY. Gravel is subangular fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)
					1.80	75.60		Very stiff purplish grey gravelly CLAY. Gravel is subangular fine to coarse mudstone and rare sandstone. (COHESIVE RESIDUAL SOIL)
					3.00	74.40		Very weak grey MUDSTONE with orange brown iron staining. Recovered as angular tabular gravel. (COAL MEASURES)
								End of borehole at 3.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412019.68 - 421522.59	Borehole No. **WS107** Sheet 1 of 1 Hole Type WS
Location: Elland		Level: 78.70	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 23/03/2022 - 23/03/2022	Logged By ET

Well	Water Strikes	**Samples and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30	78.40	▨	Dark brown clayey SAND with frequent rootlets. (TOPSOIL)
■					0.50	78.20	▤	Stiff orange very sandy CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					0.80	77.90	▤	Stiff reddish brown mottled light grey sandy slightly gravelly CLAY. Gravel is subangular fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)
					3.00	75.70	▒	Very stiff dark brown slightly clayey gravelly SAND. Gravel is subangular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
								End of borehole at 3.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

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Borehole Log

Borehole No.
WS108
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412062.15 - 421585.13	Hole Type WS
Location: Elland		Level: 75.90	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 23/03/2022 - 23/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	75.70		Dark brown silty CLAY with frequent rootlets. (TOPSOIL)
					0.90	75.00		Firm orange and grey mottled sandy CLAY. Rare subrounded fine to coarse of gravel sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					1.20	74.70		Dark brown and grey mottled slightly clayey SAND and subangular fine to coarse GRAVEL of mudstone. (COHESIVE RESIDUAL SOIL)
					1.90	74.00		Dark brown slightly gravelly CLAY. Gravel is subangular fine to coarse mudstone and rare sandstone. (COHESIVE RESIDUAL SOIL)
					2.10	73.80		Very weak dark grey MUDSTONE with orange brown iron staining. Recovered as clayey gravel. (COAL MEASURES)
					3.00	72.90		Very weak black MUDSTONE with orange brown iron staining. Recovered as angular tabular gravel. (COAL MEASURES) *Between 2.85m and 2.9m, completely penetrative orange brown iron staining.* End of borehole at 3.00 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

Borehole Log

Borehole No.
WS109
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412167.67 - 421588.50	Hole Type WS
Location: Elland		Level: 73.35	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 23/03/2022 - 23/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Dark brown very silty SAND. (MADE GROUND TOPSOIL)
					0.30	73.05		MADE GROUND: brown slightly gravelly slightly clayey SAND. Gravel is subangular fine to coarse mudstone and sandstone. (GRANULAR MADE GROUND)
					0.50	72.85		Brown sandy SILT. (GRANULAR GLACIOFLUVIAL DEPOSITS)
					0.80	72.55		Light brown COBBLE of sandstone. (GRANULAR RESIDUAL SOIL)
					0.90	72.45		Dark brown to reddish brown gravelly slightly clayey SAND. Gravel is subangular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
					1.30	72.05		Orange sandy slightly clayey subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)
					1.60	71.75		Stiff grey gravelly CLAY. Gravel is subangular fine mudstone. (COHESIVE RESIDUAL SOIL)
					1.90	71.45		Very weak black MUDSTONE with orange brown iron staining. Recovered as clayey angular gravel. (COAL MEASURES)
					2.20	71.15		Weak dark grey MUDSTONE with orange brown iron staining. Recovered as angular gravel. (COAL MEASURES)
					3.00	70.35		End of borehole at 3.00 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

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Borehole Log

Borehole No.
WS110
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412194.96 - 421656.70	Hole Type WS
Location: Elland		Level: 70.15	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 23/03/2022 - 23/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	69.95		Dark brown slightly clayey SAND. (TOPSOIL)
					0.60	69.55		Firm brown sandy SILT with rare subangular fine gravel of mudstone. (GRANULAR GLACIOFLUVIAL DEPOSITS)
					1.90	68.25		Dark brown gravelly slightly silty SAND. Gravel is subangular fine to coarse of mudstone and sandstone. (GRANULAR RESIDUAL SOIL)
					3.00	67.15		Dark brown gravelly CLAY with occassional cobbles of sandstone. Gravel is subangular fine to coarse mudstone. (WEATHERED COAL MEASURES)

End of borehole at 3.00 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Borehole Log

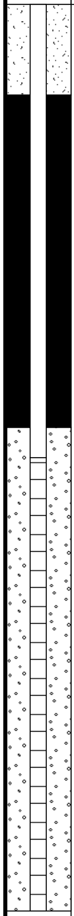
Borehole No.	**WS111**	Sheet 1 of 1	
Project Name: Shaw Lane	Project No. 4246	Co-ords: 412129.49 - 421626.43	Hole Type WS
Location: Elland		Level: 72.45	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 24/03/2022 - 24/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30	72.15		Dark brown slightly sandy CLAY with frequent rootlets. (TOPSOIL)
					0.65	71.80		Firm orange and grey mottled slightly sandy slightly gravelly CLAY. Gravel is subrounded fine to coarse of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					0.85	71.60		Light brown gravelly slightly clayey SAND. Gravel is angular to subangular fine to coarse of sandstone. (GRANULAR RESIDUAL SOIL)
					1.30	71.15		Stiff dark brown mottled grey gravelly CLAY. Gravel is subangular fine to medium of sandstone and mudstone. (COHESIVE RESIDUAL SOIL)
					1.50	70.95		Stiff grey gravelly CLAY. Gravel is subangular fine mudstone. (COHESIVE RESIDUAL SOIL)
					1.55	70.90		Stiff dark brown mottled grey gravelly CLAY. Gravel is subangular medium of sandstone. (COHESIVE RESIDUAL SOIL)
					2.00	70.45		Stiff dark grey slightly gravelly CLAY. Gravel is subrounded to subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
					2.20	70.25		Very weak dark grey MUDSTONE with orange brown iron staining. Recovered as clayey gravel. (COAL MEASURES)
					2.50	69.95		Weak dark grey MUDSTONE with orange brown iron staining. Recovered as gravel. (COAL MEASURES)
					3.00	69.45		Weak black MUDSTONE with orange brown iron staining on surfaces. (COAL MEASURES)
								End of borehole at 3.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

LITHOS CONSULTING	**Borehole Log**		Borehole No. **WS112** Sheet 1 of 1
Project Name: Shaw Lane	Project No. 4246	Co-ords: 412072.26 - 421646.32	Hole Type WS
Location: Elland		Level: 73.30	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 24/03/2022 - 24/03/2022	Logged By ET



Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15	73.15	▨	Dark brown sandy CLAY with frequent rootlets. (TOPSOIL)
					0.50	72.80		Stiff orange and light brown mottled very sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					1.00	72.30		Firm dark brown mottled light grey gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone and coal. (COHESIVE RESIDUAL SOIL)
					1.70	71.60		Stiff orange and light grey mottled sandy slightly gravelly CLAY. Gravel is subangular fine to coarse sandstone and coal. (COHESIVE RESIDUAL SOIL)
					3.00	70.30		Very stiff reddish brown gravelly CLAY. Gravel is subangular coarse of sandstone and fine of mudstone. (COHESIVE RESIDUAL SOIL)
								End of borehole at 3.00 m

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Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Borehole Log

LITHOS CONSULTING				Borehole No. **WS113** Sheet 1 of 1
Project Name: Shaw Lane	Project No. 4246	Co-ords:	411990.67 - 421622.24	Hole Type WS
Location: Elland		Level:	73.90	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	24/03/2022 - 24/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.25	73.65		Dark brown sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to coarse mudstone and sandstone. (TOPSOIL)
					0.90	73.00		Stiff orange slightly silty slightly sandy slightly gravelly CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					1.10	72.80		Very stiff dark brown mottled light grey gravelly slightly sandy CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
					1.20	72.70		Purplish brown slightly clayey coarse SAND of quartz and mudstone. (GRANULAR RESIDUAL SOIL)
					1.35	72.55		Very stiff orange mottled light grey slightly gravelly slightly sandy CLAY. Gravel is subangular fine to coarse sandstone and fine mudstone. (COHESIVE RESIDUAL SOIL)
					3.00	70.90		Firm very sandy slightly gravelly CLAY. Gravel subangular fine to coarse sandstone and fine mudstone. (COHESIVE RESIDUAL SOIL)

End of borehole at 3.00 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

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Borehole Log

Borehole No.	**WS114**	Sheet 1 of 1	
Project Name: Shaw Lane	Project No. 4246	Co-ords: 411938.62 - 421433.18	Hole Type WS
Location: Elland		Level: 80.65	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 24/03/2022 - 24/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	80.45		Dark brown very sandy CLAY with frequent rootlets. Sand is coarse quartz and mudstone. (TOPSOIL)
					0.40	80.25		Firm brownish grey slightly sandy silty CLAY. Rare subangular fine gravel of mudstone and sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					1.20	79.45		Firm brown very gravelly CLAY. Gravel is subangular fine to coarse of mudstone. (COHESIVE RESIDUAL SOIL)
					2.40	78.25		Firm orange mottled light grey sandy CLAY. (COHESIVE RESIDUAL SOIL)
					2.60	78.05		Soft becoming stiff light grey CLAY. (COHESIVE RESIDUAL SOIL)
					3.00	77.65		Very weak light grey SILTSTONE. (COAL MEASURES)

End of borehole at 3.00 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Borehole Log

Borehole No.	**WS115**	Sheet 1 of 1	
Project Name: Shaw Lane	Project No. 4246	Co-ords: 411969.00 - 421488.87	Hole Type WS
Location: Elland		Level: 79.10	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 24/03/2022 - 24/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	78.90		Dark brown silty SAND with frequent rootlets. (TOPSOIL)
					0.30	78.80		Stiff brownish grey gravelly CLAY. Gravel is subangular fine to medium mudstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					2.00	77.10		Firm orange mottled light grey sandy CLAY with occasional coarse sand of coal. (COHESIVE RESIDUAL SOIL)
					2.60	76.50		Very stiff dark brown with grey gleyed sandy gravelly CLAY. Gravel is subangular fine to coarse of sandstone. (COHESIVE RESIDUAL SOIL)
					2.85	76.25		Soft brown very sandy slightly gravelly CLAY. Gravel is subangular fine of mudstone. (COHESIVE RESIDUAL SOIL)
					3.00	76.10		Light brown SANDSTONE. Recovered as slightly clayey coarse gravel. (COAL MEASURES)

End of borehole at 3.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

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Borehole Log

Borehole No.
WS116
Sheet 1 of 1

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	411907.86 - 421505.31	Hole Type WS
Location:	Elland		Level:	77.40	Scale 1:25
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	24/03/2022 - 24/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	77.20		Dark brown slightly clayey silty SAND with frequent rootlets. (TOPSOIL)
					0.40	77.00		Orange and light grey mottled sandy slightly gravelly CLAY with occasional rootlets. Gravel is subangular fine to coarse sandstone. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					1.30	76.10		No recovery.
					3.00	74.40		Very stiff dark brown with light grey gleyed very sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone. Low cobble content of sandstone. (COHESIVE RESIDUAL SOIL) *At 1.3m, refusal on cobble of sandstone hole advanced with smaller core barrel size.*

End of borehole at 3.00 m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Borehole Log

Borehole No.
WS117
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411976.68 - 421566.62	Hole Type WS
Location: Elland		Level: 76.35	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 24/03/2022 - 24/03/2022	Logged By ET

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.25	76.10		Dark brown sandy slightly gravelly CLAY with frequent rootlets. Gravel is subangular fine to coarse mudstone and sandstone. (TOPSOIL)
					0.50	75.85		Firm orange sandy gravelly CLAY. Gravel is subangular fine to coarse sandstone. Occasional coarse sand of coal. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					1.30	75.05		Very stiff dark brown sandy gravelly CLAY. Gravel is subangular fine to coarse sandstone. Occasional coarse sand of coal. (COHESIVE RESIDUAL SOIL)
					1.40	74.95		Very stiff brown very sandy slightly gravelly CLAY. Gravel is subangular fine of mudstone. (COHESIVE RESIDUAL SOIL)
					2.80	73.55		Very stiff dark brown gravelly slightly sandy CLAY. Gravel is subangular fine of mudstone. (COHESIVE RESIDUAL SOIL)
					3.00	73.35		Light brown SANDSTONE. Recovered as clayey subangular fine to coarse gravel. (COAL MEASURES)

End of borehole at 3.00 m

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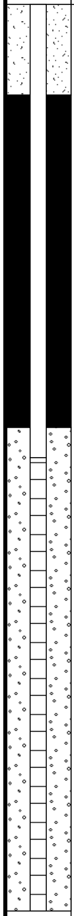
Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Borehole Log

Borehole No.
WS118
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411912.37 - 421599.67	Hole Type WS
Location: Elland		Level: 74.55	Scale 1:25
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 24/03/2022 - 24/03/2022	Logged By ET



Well	Water Strikes	Samples and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.20	74.35		Dark brown slightly clayey silty SAND with frequent rootlets. (TOPSOIL)
					0.45	74.10		Firm orange mottled light brown slightly sandy CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					0.55	74.00		Light brown COBBLE of sandstone. (GRANULAR GLACIOFLUVIAL DEPOSITS)
					1.10	73.45		Soft orange and light brown sandy CLAY. (COHESIVE GLACIOFLUVIAL DEPOSITS)
					2.20	72.35		Very stiff dark brown sandy slightly gravelly CLAY. Gravel if subangular fine to medium of sandstone. (COHESIVE RESIDUAL SOIL)
					2.65	71.90		Very stiff brownish grey gravelly CLAY. Gravel is subangular fine to medium micaceous sandstone. (COHESIVE RESIDUAL SOIL)
					3.00	71.55		Firm orange sandy slightly gravelly CLAY. Gravel is subangular fine to coarse sandstone. (COHESIVE RESIDUAL SOIL)
								End of borehole at 3.00 m

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Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Co-ordinates from hand held GPS, hole not surveyed in.

AGS

Appendix H

Probehole Logs

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Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411924E - 421455N	Borehole No. **PH101** Sheet 1 of 2
Location: Elland		Level: 79.25 m AOD	Hole Type PH
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 04/04/2022	Scale 1:100
			Logged By CR

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
						79.25		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					2.50	76.75		Greyish-brown MUDSTONE. (COAL MEASURES) *At 6.8m, becomes grey.*
					10.80	68.45		Dark grey MUDSTONE. (COAL MEASURES)
					13.50	65.75		Grey and dark grey MUDSTONE. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 23.8m to 25.0m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

					Borehole No. **PH101** Sheet 2 of 2
Project Name:	Shaw Lane	Project No. 4246	Co-ords:	411924E - 421455N	Hole Type PH
Location:	Elland		Level:	79.25 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	04/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
■							▤	Grey and dark grey MUDSTONE. (COAL MEASURES) *Between 23.8m and 25.0m, loss of flush returns, likely due to blockage in casing.*
■					26.40	52.85	▤	Grey MUDSTONE. (COAL MEASURES)
					33.00			End of Borehole at 33.00m

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 23.8m to 25.0m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412017E - 421459N	Borehole No. **PH102** Sheet 1 of 1
Location: Elland		Level: 80.75 m AOD	Hole Type PH
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 04/04/2022	Scale 1:100
			Logged By CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						80.75		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					4.50	76.25		Greyish-brown CLAY with bands of sandstone. (COHESIVE RESIDUAL SOIL)
					6.50	74.25		Orangish-brown SANDSTONE. (COAL MEASURES)
					7.50	73.25		BROKEN GROUND. (HALIFAX HARD BED COAL) *At 7.5m, loss of flush returns.*
					8.40	72.35		SOLID. (COAL MEASURES)
					15.00			End of Borehole at 15.00m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 7.5m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Borehole No.
PH103
Sheet 1 of 2

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412053E - 421438N	Hole Type PH
Location:	Elland		Level:	82.75 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	04/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						82.75		Greyish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					4.00	78.75		Brown and orangish-brown MUDSTONE. (COAL MEASURES)
					5.20	77.55		Grey MUDSTONE. (COAL MEASURES)
					8.00	74.75		Dark grey MUDSTONE. (COAL MEASURES) *Between 10.3m and 11.1m, looked softer drilling but driller noted as solid no loss of flush returns and no coal chippings.*
					11.10	71.65		Grey MUDSTONE. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 21.5m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

LITHOS CONSULTING				Borehole No. **PH103** Sheet 2 of 2
Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412053E - 421438N	Hole Type PH
Location:	Elland		Level: 82.75 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 04/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨							▤	Grey MUDSTONE. (COAL MEASURES) *At 21.5m, loss of flush returns, likely due to blockage in casing.*	21 22 23
					24.00			End of Borehole at 24.00m	24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 21.5m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412078E - 421380N	Borehole No. **PH104** Sheet 1 of 2
Location:	Elland		Level:	86.65 m AOD	Hole Type PH
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	04/04/2022	Scale 1:100
					Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						86.65		Brown CLAY. (COHESIVE RESIDUAL SOIL)
					3.00	83.65		Greyish-brown MUDSTONE. (COAL MEASURES) *At 5.5m, becomes grey.*
					8.30	78.35		Dark grey MUDSTONE. (COAL MEASURES)
					9.50	77.15		Grey MUDSTONE. (COAL MEASURES)
					12.70	73.95		BROKEN GROUND. (HALIFAX HARD BED COAL) *At 12.7m, loss of flush returns.*
					14.40	72.25		SOLID. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 12.7m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

LITHOS CONSULTING			Borehole No. **PH104** Sheet 2 of 2
Project Name: Shaw Lane	Project No. 4246	Co-ords: 412078E - 421380N	Hole Type PH
Location: Elland		Level: 86.65 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 04/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨					21.00		▤	SOLID. (COAL MEASURES)	21
								End of Borehole at 21.00m	
									22
									23
									24
									25
									26
									27
									28
									29
									30
									31
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									39
									40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 12.7m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

Borehole No.	**PH105**	Sheet 1 of 2

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412132E - 421327N		Hole Type PH
Location: Elland		Level: 90.85 m AOD		Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 04/04/2022		Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						90.85		Greyish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					3.50	87.35		Grey and brown MUDSTONE. (COAL MEASURES)
					4.50	86.35		Grey MUDSTONE. (COAL MEASURES)
					6.80	84.05		Dark grey MUDSTONE. (COAL MEASURES)
					8.10	82.75		Grey MUDSTONE. (COAL MEASURES)
					10.40	80.45		Dark grey MUDSTONE. (COAL MEASURES)
					11.30	79.55		Grey and dark grey MUDSTONE. (COAL MEASURES)
					16.20	74.65		Grey MUDSTONE. (COAL MEASURES)
					18.60	72.25		BROKEN GROUND. (HALIFAX HARD BED COAL) *At 18.6m, loss of flush returns.*
					19.60	71.25		SOLID.

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 18.6m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Borehole No.
PH105
Sheet 2 of 2

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412132E - 421327N	Hole Type PH
Location:	Elland		Level:	90.85 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	04/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
▨					27.00		☰	SOLID. (COAL MEASURES)
								End of Borehole at 27.00m

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 18.6m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

LITHOS CONSULTING			Borehole No. **PH105A** Sheet 1 of 1
Project Name: Shaw Lane	Project No. 4246	Co-ords: 412131E - 421328N	Hole Type PH
Location: Elland		Level: 90.70 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 05/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						90.70		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					2.00	88.70		Greyish-brown CLAY with bands of mudstone. (COHESIVE RESIDUAL SOIL)
					3.00	87.70		Dark grey MUDSTONE. (COAL MEASURES)
					6.00			End of Borehole at 6.00m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

Borehole No.	**PH106**
	Sheet 1 of 2
Project Name:	Shaw Lane
Project No.	4246
Co-ords:	412144E - 421386N
Hole Type	PH
Location:	Elland
Level:	87.80 m AOD
Scale	1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Dates:	05/04/2022
Logged By	CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						87.80		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					2.20	85.60		Dark grey MUDSTONE. (COAL MEASURES)
					6.20	81.60		Grey and dark grey MUDSTONE (COAL MEASURES)
					17.00	70.80		BROKEN GROUND. (HALIFAX HARD BED COAL) *At 17.0m, loss of flush returns.*
					18.50	69.30		SOLID. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 17.0m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Borehole No.	**PH106**
	Sheet 2 of 2
Project Name:	Shaw Lane
Project No.	4246
Co-ords:	412144E - 421386N
Hole Type	PH
Location:	Elland
Level:	87.80 m AOD
Scale	1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Dates:	05/04/2022
Logged By	CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨							▤	SOLID. (COAL MEASURES)	21 22 23
					24.00			End of Borehole at 24.00m	24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 17.0m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

Borehole No.	**PH107**	Sheet 1 of 2		
Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412106E - 421410N	Hole Type PH
Location:	Elland		Level: 85.60 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 05/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						85.60	┅	Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					4.50	81.10	▤	Dark grey MUDSTONE. (COAL MEASURES)
					15.00	70.60	▤	Grey MUDSTONE. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 27.7m during drilling.
3. Flush returns were partially lost from 27.7m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412106E - 421410N	Borehole No. **PH107** Sheet 2 of 2
Location: Elland		Level: 85.60 m AOD	Hole Type PH
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 05/04/2022	Scale 1:100
			Logged By CR

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Grey MUDSTONE. (COAL MEASURES)
					22.40	63.20		Grey and dark grey MUDSTONE (COAL MEASURES)
	▼							*At 27.7m, loss of flush returns followed by partial returns of damp arisings, groundwater encountered.*
					33.00			End of Borehole at 33.00m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 27.7m during drilling. 3. Flush returns were partially lost from 27.7m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No. **PH107A**
Sheet 1 of 1

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412105E - 421410N	Hole Type PH
Location:	Elland		Level:	85.65 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	05/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						85.65		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					4.50	81.15		Dark grey MUDSTONE. (COAL MEASURES)
					6.00			End of Borehole at 6.00m

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2
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Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.	**PH108**
	Sheet 1 of 2
Project Name:	Shaw Lane
Project No.	4246
Co-ords:	412122E - 421461N
Hole Type	PH
Location:	Elland
Level:	82.20 m AOD
Scale	1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth
Dates:	05/04/2022
Logged By	CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						82.20		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL) *At 2.0m, becomes grey.*
					4.00	78.20		Dark grey MUDSTONE. (COAL MEASURES)
					12.70	69.50		BROKEN GROUND. (HALIFAX HARD BED COAL) *At 12.7m, loss of flush returns.*
					15.70	66.50		SOLID. (COAL MEASURES)
					17.40	64.80		Grey MUDSTONE. (COAL MEASURES) *At 17.4m, recovery of flush returns.*

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 12.7m to 17.4m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412122E - 421461N	Borehole No. **PH108** Sheet 2 of 2
Location: Elland		Level: 82.20 m AOD	Hole Type PH Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 05/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨					21.00		▤	Grey MUDSTONE. (COAL MEASURES)	21
								End of Borehole at 21.00m	
									22
									23
									24
									25
									26
									27
									28
									29
									30
									31
									32
									33
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									35
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									39
									40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 12.7m to 17.4m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.	**PH109**	Sheet 1 of 1	
Project Name: Shaw Lane	Project No. 4246	Co-ords: 412076E - 421496N	Hole Type PH
Location: Elland		Level: 80.85 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 05/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						80.85		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL) *At 3.5m, becomes grey.*
					4.50	76.35		Dark grey MUDSTONE. (COAL MEASURES)
					9.60	71.25		Soft drilling. (HALIFAX HARD BED COAL) *At 9.6m, partial loss of flush returns.*
					11.80	69.05		SOLID. (COAL MEASURES)
					12.90	67.95		Grey MUDSTONE. (COAL MEASURES) *At 12.9m, recovery of flush returns.*
					13.80	67.05		SOLID. (COAL MEASURES) *At 13.8m, loss of flush returns.*
					14.40	66.45		Grey MUDSTONE. (COAL MEASURES) *At 14.4m, recovery of flush returns.*
					15.00	65.85		SOLID. (COAL MEASURES) *At 15.0m, loss of flush returns.*
					17.00	63.85		Grey MUDSTONE. (COAL MEASURES) *At 17.0m, recovery of flush returns.*
					18.00			End of Borehole at 18.00m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 9.6m with partial recovery below. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

					Borehole No. **PH109A** Sheet 1 of 1
Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412078E - 421495N	Hole Type PH
Location:	Elland		Level:	80.90 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	05/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						80.90		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL) *At 3.5m, becomes grey and brown.*
					4.80	76.10		Dark grey MUDSTONE. (COAL MEASURES)
					6.00			End of Borehole at 6.00m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

Borehole No.	**PH110**	Sheet 1 of 2	
Project Name:	Shaw Lane	Project No. 4246	
Co-ords:	412013E - 421524N	Hole Type	PH
Location:	Elland	Level:	78.55 m AOD
Scale	1:100		
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth	Dates:	05/04/2022
Logged By	CR		

Well	Water Strikes	**Sample and In Situ Testing** Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
						78.55		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					3.20	75.35		Orangish-brown SAND with bands of sandstone. (GRANULAR RESIDUAL SOIL)
					5.70	72.85		Orange SANDSTONE. (COAL MEASURES)
					6.20	72.35		Grey MUDSTONE. (COAL MEASURES)
					11.60	66.95		Dark grey MUDSTONE. (COAL MEASURES)
					17.40	61.15		Black COAL. (MIDDLE BAND COAL)
	▼				17.50	61.05		Dark grey and grey MUDSTONE. (COAL MEASURES) *At 17.6m, partial loss of flush returns and recovery of damp arisings, groundwater encountered.*

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 17.6m during drilling.
3. Flush returns were partially lost from 17.6m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

Borehole No.
PH110
Sheet 2 of 2

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412013E - 421524N	Hole Type PH
Location: Elland		Level: 78.55 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 05/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨					33.00		▤	Dark grey and grey MUDSTONE. (COAL MEASURES)	21 22 23 24 25 26 27 28 29 30 31 32
								End of Borehole at 33.00m	33 34 35 36 37 38 39 40

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 17.6m during drilling.
3. Flush returns were partially lost from 17.6m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412091E - 421564N
Location:	Elland		Level: 78.70 m AOD
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 05/04/2022

Borehole No. **PH111**
Sheet 1 of 1
Hole Type: PH
Scale: 1:100
Logged By: CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						78.70		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					2.70	76.00		Dark grey MUDSTONE. (COAL MEASURES)
					7.80	70.90		VOID. (HALIFAX HARD BED COAL) *At 7.8m, loss of flush returns.*
					8.40	70.30		BROKEN GROUND. (HALIFAX HARD BED COAL)
					10.50	68.20		SOLID. (COAL MEASURES)
					17.00			End of Borehole at 17.00m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 7.8m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411944E - 421528N	Borehole No. **PH112** Sheet 1 of 2
			Hole Type PH
Location: Elland		Level: 77.45 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						77.45		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					4.00	73.45		Orangish-brown CLAY with bands of sandstone. (COHESIVE RESIDUAL SOIL)
					5.50	71.95		Yellowish-brown SANDSTONE. (COAL MEASURES)
					7.80	69.65		Grey MUDSTONE with bands of clay. (COAL MEASURES)
					11.10	66.35		Black COAL. (MIDDLE BAND COAL)
					11.30	66.15		Yellowish-brown SANDSTONE. (COAL MEASURES)
					12.40	65.05		Dark grey MUDSTONE. (COAL MEASURES)
					17.80	59.65		Grey and dark grey MUDSTONE. (COAL MEASURES)
	▼							*Between 19.4m & 19.8m, noted as softer drilling*

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 19.4m during drilling.
3. Flush returns were partially lost from 19.4m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Project Name:	Shaw Lane	Project No. 4246	Co-ords: 411944E - 421528N	Borehole No. **PH112** Sheet 2 of 2
Location:	Elland		Level: 77.45 m AOD	Hole Type PH
				Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨					24.00		▤	Grey and dark grey MUDSTONE. (COAL MEASURES) *Between 19.4m & 19.8m, noted as softer drilling and partial loss of flush returns. Possible groundwater strike as recovery of wet damp arisings noted at 20.8m.*	21 22 23 24
								End of Borehole at 24.00m	25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 19.4m during drilling.
3. Flush returns were partially lost from 19.4m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

Borehole No.	**PH113**	Sheet 1 of 2	
Project Name:	Shaw Lane	Project No. 4246	
Co-ords:	411885E - 421555N	Hole Type	PH
Location:	Elland	Level:	75.70 m AOD
Scale	1:100		
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth	Dates:	06/04/2022
Logged By	CR		

Well	Water Strikes	**Sample and In Situ Testing** Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
						75.70		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					3.20	72.50		Orangish-brown CLAY with bands of sandstone. (COHESIVE RESIDUAL SOIL)
					6.40	69.30		Yellowish-brown SANDSTONE. (COAL MEASURES)
					11.30	64.40		Grey and dark grey MUDSTONE. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 27.0m to 29.0m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.	**PH113**	Sheet 2 of 2		
Project Name:	Shaw Lane	Project No. 4246	Co-ords: 411885E - 421555N	Hole Type PH
Location:	Elland		Level: 75.70 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
▨					22.70	53.00	▤	Grey and dark grey MUDSTONE. (COAL MEASURES)
▨					23.20	52.50	■	Black COAL. (HALIFAX SOFT BED COAL)
▨					33.00		▤	Grey MUDSTONE. (COAL MEASURES) *Between 27.0m & 29.0m, loss of flush returns, likely due to blockage in casing.*
								End of Borehole at 33.00m

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were lost from 27.0m to 29.0m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
PH113A
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411887E - 421553N	Hole Type PH
Location: Elland		Level: 75.85 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						75.85		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					3.40	72.45		Orangish-brown CLAY with bands of sandstone. (COHESIVE RESIDUAL SOIL)
					6.00			End of Borehole at 6.00m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

				Borehole No. **PH114** Sheet 1 of 2
Project Name:	Shaw Lane	Project No. 4246	Co-ords: 411948E - 421565N	Hole Type PH
Location:	Elland		Level: 76.10 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						76.10		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					1.70	74.40		Orangish-brown CLAY with bands of sandstone. (COHESIVE RESIDUAL SOIL)
					4.60	71.50		Yellowish-brown SANDSTONE. (COAL MEASURES) *At 10.6m, partial loss of flush returns, still solid drilling, likely blockage in casing.*
					14.30	61.80		Dark grey MUDSTONE. (COAL MEASURES) *At 14.3m, recovery of flush returns.*
					14.80	61.30		Grey MUDSTONE. (COAL MEASURES)
					16.90	59.20		Dark grey MUDSTONE. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were partially lost from 10.6m to 14.3m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 411948E - 421565N	Borehole No. **PH114** Sheet 2 of 2
Location: Elland		Level: 76.10 m AOD	Hole Type PH
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Scale 1:100
			Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨					24.00		▤	Dark grey MUDSTONE. (COAL MEASURES)	21 22 23 24
								End of Borehole at 24.00m	25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were partially lost from 10.6m to 14.3m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.	**PH115**	Sheet 1 of 2	
Project Name: Shaw Lane	Project No. 4246	Co-ords: 412003E - 421574N	Hole Type PH
Location: Elland		Level: 76.30 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						76.30		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					2.00	74.30		Yellowish-brown SAND with bands of sandstone. (GRANULAR RESIDUAL SOIL)
					4.50	71.80		Yellowish-brown SANDSTONE. (COAL MEASURES)
					9.60	66.70		Grey MUDSTONE. (COAL MEASURES)
					12.70	63.60		Dark grey MUDSTONE. (COAL MEASURES)
					17.00	59.30		Black COAL. (MIDDLE BAND COAL)
	▼				17.30	59.00		Dark grey and grey MUDSTONE. (COAL MEASURES) *Between 17.7m & 19.4m, partial loss of flush returns followed by recovery of damp arisings, groundwater encountered.*

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 17.7m during drilling. 3. Flush returns were partially lost from 17.7m to 19.4m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING

Borehole Log

Borehole No.
PH115
Sheet 2 of 2

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412003E - 421574N	Hole Type PH
Location: Elland		Level: 76.30 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Logged By CR

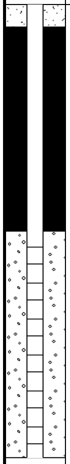
Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
▨					24.00		☰	Dark grey and grey MUDSTONE. (COAL MEASURES)
								End of Borehole at 24.00m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 17.7m during drilling. 3. Flush returns were partially lost from 17.7m to 19.4m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

LITHOS CONSULTING	# Borehole Log	Borehole No. **PH115A** Sheet 1 of 1

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412003E - 421573N		Hole Type PH
Location:	Elland		Level:	76.40 m AOD		Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	06/04/2022		Logged By CR



Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						76.40	▤	Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					2.00	74.40	░	Yellowish-brown SAND with bands of sandstone. (GRANULAR RESIDUAL SOIL)
					4.50	71.90	⁘	Yellowish-brown SANDSTONE. (COAL MEASURES)
					6.00			End of Borehole at 6.00m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412072E - 421605N	Borehole No. **PH116** Sheet 1 of 2
Location: Elland		Level: 74.90 m AOD	Hole Type PH Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
						74.90		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					2.30	72.60		Dark grey MUDSTONE. (COAL MEASURES)
					7.20	67.70		Grey MUDSTONE. (COAL MEASURES)
					7.80	67.10		Black COAL. (HALIFAX HARD BED COAL)
					8.50	66.40		Grey MUDSTONE. (COAL MEASURES) *At 9.6m, 0.1m band of yellowish-brown sandstone.*
					16.30	58.60		Dark grey MUDSTONE. (COAL MEASURES)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 20.9m during drilling.
3. Flush returns were partially lost from 20.9m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH116
Sheet 2 of 2

Project Name:	Shaw Lane	Project No. 4246	Co-ords: 412072E - 421605N	Hole Type PH
Location:	Elland		Level: 74.90 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 06/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨	▼				27.00		▤	Dark grey MUDSTONE. (COAL MEASURES) *At 20.9m, partial loss of flush returns followed by recovery of wet arisings.* *At 24.0m, loss of flush returns, likely due to groundwater.*	21 22 23 24 25 26 27
								End of Borehole at 27.00m	28 29 30 31 32 33 34 35 36 37 38 39 40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 20.9m during drilling.
3. Flush returns were partially lost from 20.9m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412108E - 421617N	Borehole No. **PH117** Sheet 1 of 2
Location:	Elland		Level:	73.55 m AOD	Hole Type PH
					Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	06/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
						73.55		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					3.10	70.45		Dark grey MUDSTONE. (COAL MEASURES)
					9.00	64.55		Black COAL. (HALIFAX HARD BED COAL) *Between 9.1m & 10.4m, partial loss of flush returns.*
					9.70	63.85		SOLID. (COAL MEASURES)
					10.40	63.15		Grey MUDSTONE. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were partially lost from 9.1m to 10.4m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Borehole No.
PH117
Sheet 2 of 2

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412108E - 421617N	Hole Type PH
Location:	Elland		Level:	73.55 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	06/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
▨					21.00		▤	Grey MUDSTONE. (COAL MEASURES)
								End of Borehole at 21.00m

21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Flush returns were partially lost from 9.1m to 10.4m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

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Borehole Log

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412158E - 421602N	Borehole No. **PH118** Sheet 1 of 2
Location:	Elland		Level:	73.20 m AOD	Hole Type PH
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	07/04/2022	Scale 1:100
					Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
■						73.20	┅	Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
▨					4.40	68.80	▤	Dark grey MUDSTONE. (COAL MEASURES)
▨					10.80	62.40	■	Black COAL. (HALIFAX HARD BED COAL)
▨					11.80	61.40	▤	Grey MUDSTONE. (COAL MEASURES)
▨					16.70	56.50	▤	Dark grey and grey MUDSTONE. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412158E - 421602N	Borehole No. **PH118** Sheet 2 of 2
Location: Elland		Level: 73.20 m AOD	Hole Type PH Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 07/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
▨					21.00		▤	Dark grey and grey MUDSTONE. (COAL MEASURES)
								End of Borehole at 21.00m

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Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Borehole No.
PH119
Sheet 1 of 2

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412099E - 421451N	Hole Type PH
Location:	Elland		Level:	83.05 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	07/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						83.05		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					3.00	80.05		Dark grey MUDSTONE. (COAL MEASURES)
					14.90	68.15		Grey MUDSTONE. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412099E - 421451N	Borehole No. **PH119** Sheet 2 of 2
Location: Elland		Level: 83.05 m AOD	Hole Type PH Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 07/04/2022	Logged By CR

Well	Water Strikes	**Sample and In Situ Testing**			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨					21.00		▤	Grey MUDSTONE. (COAL MEASURES)	
								End of Borehole at 21.00m	21
									22
									23
									24
									25
									26
									27
									28
									29
									30
									31
									32
									33
									34
									35
									36
									37
									38
									39
									40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412133E - 421553N
Location: Elland		Level: 75.80 m AOD
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 07/04/2022

Borehole No.
PH120
Sheet 1 of 2

Hole Type
PH

Scale
1:100

Logged By
CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						75.80		Grey CLAY. (COHESIVE RESIDUAL SOIL)
					3.00	72.80		Dark grey MUDSTONE. (COAL MEASURES)
					9.60	66.20		Black COAL. (HALIFAX HARD BED COAL)
					10.50	65.30		Grey MUDSTONE. (COAL MEASURES)
					16.90	58.90		Dark grey MUDSTONE. (COAL MEASURES)

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Continued on Next Sheet

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Project Name: Shaw Lane	Project No. 4246	Co-ords: 412133E - 421553N	Hole Type PH
Location: Elland		Level: 75.80 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates: 07/04/2022	Logged By CR

Borehole No.
PH120
Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨					21.00		▤	Dark grey MUDSTONE. (COAL MEASURES)	21
								End of Borehole at 21.00m	
									22
									23
									24
									25
									26
									27
									28
									29
									30
									31
									32
									33
									34
									35
									36
									37
									38
									39
									40

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

Borehole No.
PH120A
Sheet 1 of 1

Project Name: Shaw Lane	Project No. 4246	Co-ords:	412134E - 421553N	Hole Type PH
Location: Elland		Level:	75.80 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	07/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						75.80		Orangish-brown and grey CLAY. (COHESIVE RESIDUAL SOIL)
					3.00	72.80		Dark grey MUDSTONE. (COAL MEASURES)
					6.00			End of Borehole at 6.00m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

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Borehole Log

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412188E - 421633N	Hole Type PH
Location:	Elland		Level:	71.05 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	07/04/2022	Logged By CR

Borehole No.
PH121
Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						71.05		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					4.30	66.75		Dark grey MUDSTONE. (COAL MEASURES)
	▼				10.70	60.35		Soft drilling. (HALIFAX HARD BED COAL) *At 10.7m, loss of flush followed by partial recovery of wet arisings. Driller noted as soft and likely workings.*
					11.90	59.15		SOLID. (COAL MEASURES)

Continued on Next Sheet

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 10.7m during drilling.
3. Flush returns were lost from 10.7m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Borehole Log

Borehole No.
PH121
Sheet 2 of 2

Project Name: Shaw Lane	Project No. 4246	Co-ords:	412188E - 421633N	Hole Type PH
Location: Elland		Level:	71.05 m AOD	Scale 1:100
Client: Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	07/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
▨					21.00		☰	SOLID. (COAL MEASURES)	21
								End of Borehole at 21.00m	
									22
									23
									24
									25
									26
									27
									28
									29
									30
									31
									32
									33
									34
									35
									36
									37
									38
									39
									40

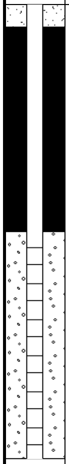
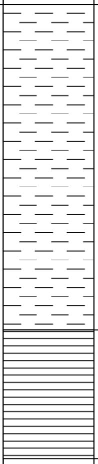
Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater encountered at 10.7m during drilling.
3. Flush returns were lost from 10.7m. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

LITHOS CONSULTING

Borehole Log

Borehole No.
PH121A
Sheet 1 of 1

Project Name:	Shaw Lane	Project No. 4246	Co-ords:	412187E - 421631N	Hole Type PH
Location:	Elland		Level:	71.15 m AOD	Scale 1:100
Client:	Messrs Stephen & Gary Boyle, and Mrs Susan Illingworth		Dates:	07/04/2022	Logged By CR

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
						71.15		Orangish-brown CLAY. (COHESIVE RESIDUAL SOIL)
					4.30	66.85		Dark grey MUDSTONE. (COAL MEASURES)
					6.00			End of Borehole at 6.00m

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Exploratory hole surveyed in (level and co-ordinates) on completion.

AGS

Appendix I

Chemical Results

Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

For the attention of Alex Petts

Report No: B28810-2
Issue No 01

LABORATORY TEST REPORT

Project Name	**SHAW LANE, ELLAND**		
Project Number	**B28810-2**	Date samples received	29/03/2022
Your Ref		Date written instructions received	31/03/2022
Purchase Order	PO18958/4246/ET	Date testing commenced	31/03/2022

Please find enclosed the results as summarised below

Figure / Table	Test Quantity	Description	ISO 17025 Accredited
1 - 5	30	Client Specified Suites - Soil	See report

Remarks :

Issued by : Stephen Langman

Date of Issue : 21/04/2022

Key to symbols used in this report
S/C : Testing was sub-contracted

Approved Signatories :
S. Langman
21/04/2022

S Langman (Laboratory Coordinator), D Bowen (Production Manager)

Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.

Samples tested for asbestos are retained for 6 months from the date of analysis.
The results reported relate to samples received in the laboratory only.
All results contained in this report are provisional unless signed by an approved signatory
This report should not be reproduced except in full without the written approval of the laboratory.
Under multisite accreditation the testing contained in this report may have been performed at another Terra Tek laboratory.
The enclosed results remain the property of Terra Tek Limited and we reserve the right to withdraw
our report if we have not received cleared funds in accordance with our standard terms and conditions
Only those results indicated in this report are UKAS accredited and any opinions or interpretations expressed are outside the scope of UKAS accreditation.
Feedback on the this report may be left via our website www.terratek.co.uk/contact-us

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification																				
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Lead mg/kg	Mercury mg/kg	Selenium mg/kg	Copper mg/kg	Nickel mg/kg	Zinc mg/kg	Vanadium mg/kg	Boron (water soluble) mg/kg	Hexavalent Chromium mg/kg	Trivalent Chromium mg/kg	Total organic carbon %	pH	Calorific value MJ/kg
TP101	0.10		J	817103	34.9	1.08	49	116	0.39	1.6	59	36	170	71	1.7	<0.3	49	8.4	6.5	~
TP105	0.10		J	817118	24.8	0.99	51	78	<0.1	2.1	43	31	118	59	0.9	<0.3	51	6.2	6.2	~
TP107	0.20		J	817125	29.3	0.90	61	99	0.23	1.6	93	29	153	58	1.1	<0.3	61	6.2	6.2	~
TP109	0.10		J	817131	31.9	0.71	64	104	0.37	1.6	60	23	102	56	0.8	<0.3	64	6.3	5.6	~
TP111	0.10		J	817138	71.0	1.45	534	216	0.88	2.2	160	36	276	69	1.2	<0.3	534	9.9	5.6	~
TP111	0.25		J	817140	92.2	1.43	99	49	0.23	1.7	140	75	164	102	0.6	<0.3	99	21.8	5.9	3.8
TP112	0.30		J	817146	41.7	1.03	157	150	0.63	1.4	89	30	188	55	1.5	<0.3	157	8.6	6.5	~
TP114	0.20		J	817153	19.1	1.07	48	73	<0.1	1.3	48	30	126	43	0.7	<0.3	48	4.7	5.5	~
TP114	0.50		J	817155	6.4	1.06	38	31	<0.1	<0.5	43	47	90	35	0.4	<0.3	38	3.7	5.7	<1.0
TP116	0.20		J	817162	33.8	1.18	51	134	0.20	1.3	80	38	166	60	1.5	<0.3	51	12.4	6.3	~
Limits of Detection					0.5	0.10	1	1	0.10	0.5	1	1	0.5	1	0.2	0.3	1	0.1	~	1
Terra Tek Analysis Method					TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP032	TP184	~	TP189	TP019	S/C
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M	M	U	M	M	M	M	U	N	N	N	M	N

Originator	Checked & Approved
DAB	S. Langman 21/04/2022

RESULTS OF CHEMICAL CONTAMINATION TESTS - SOIL

KEY

* - deviating result (refer to Appendix S2 for details)

^ - result expressed on as-received basis

TTk

Figure 1

Sheet 1 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification																				
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Lead mg/kg	Mercury mg/kg	Selenium mg/kg	Copper mg/kg	Nickel mg/kg	Zinc mg/kg	Vanadium mg/kg	Boron (water soluble) mg/kg	Hexavalent Chromium mg/kg	Trivalent Chromium mg/kg	Total organic carbon %	pH	Calorific value MJ/kg
TP119	0.20		J	817175	29.5	0.78	38	123	0.29	1.6	53	23	136	49	1.0	<0.3	38	7.2	6.9	~
TP119	0.50		J	817178	6.9	0.56	32	23	<0.1	1.2	23	20	86	42	0.3	<0.3	32	1.7	6.2	~
TP120	0.20		J	817183	15.7	0.73	36	133	0.34	<0.5	60	34	113	48	0.8	<0.3	36	5.9	7.8	~
TP121	0.20		J	817188	22.9	0.81	32	243	0.26	0.9	83	35	219	43	1.5	<0.3	32	8.9	7.6	~
TP121	0.50		J	817191	13.5	0.40	16	54	<0.1	<0.5	53	41	48	36	0.6	<0.3	16	23.4	7.9	5.0
TP122	0.20		J	817196	36.2	1.17	42	195	<0.1	0.8	330	93	189	68	0.7	<0.3	42	16.0	6.5	3.2
TP122	0.50		J	817199	11.2	0.51	27	55	<0.1	1.0	38	27	79	41	0.7	<0.3	27	4.8	6.0	~
TP123	0.20		J	817203	31.4	0.49	38	129	0.38	1.8	57	19	72	46	0.7	<0.3	38	10.9	4.7	~
TP125	0.40		J	817213	11.6	0.90	37	34	<0.1	1.4	54	37	88	43	0.4	<0.3	37	1.5	5.2	~
TP127	0.20		J	817221	21.7	0.86	51	91	0.14	1.7	56	27	114	52	0.8	<0.3	51	6.3	5.8	~
Limits of Detection					0.5	0.10	1	1	0.10	0.5	1	1	0.5	1	0.2	0.3	1	0.1	~	1
Terra Tek Analysis Method					TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP032	TP184	~	TP189	TP019	S/C
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M	M	U	M	M	M	M	U	N	N	N	M	N

Originator	Checked & Approved
DAB	S. Langman 21/04/2022

RESULTS OF CHEMICAL CONTAMINATION TESTS - SOIL

KEY

* - deviating result (refer to Appendix S2 for details)

^ - result expressed on as-received basis

TTk

Figure 1

Sheet 2 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No B28810-2

Sample Identification																								
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Arsenic mg/kg	Cadmium mg/kg	Chromium mg/kg	Lead mg/kg	Mercury mg/kg	Selenium mg/kg	Copper mg/kg	Nickel mg/kg	Zinc mg/kg	Vanadium mg/kg	Boron (water soluble) mg/kg	Hexavalent Chromium mg/kg	Trivalent Chromium mg/kg	Total organic carbon %	pH	Calorific value MJ/kg				
TP131	0.10		T	817228	34.3	1.00	192	162	0.90	1.2	102	30	190	62	1.1	<0.3	192	7.6	5.7	~				
TP132	0.20		T	817232	44.2	1.58	57	269	0.43	2.2	139	42	809	70	1.3	<0.3	57	10.2	6.8	~				
TP136	0.20		T	817236	34.2	0.91	53	177	0.29	1.1	83	37	197	49	1.1	<0.3	53	8.7	6.4	~				
TP139	0.20		T	817247	23.0	1.07	61	100	0.23	1.1	65	29	130	51	1.1	<0.3	61	6.2	5.7	~				
TP143	0.30		T	817259	34.7	1.19	122	129	0.62	1.6	97	31	203	58	1.0	<0.3	122	7.7	5.3	~				
TP145	0.20		T	817271	31.9	1.03	78	183	0.22	1.4	95	27	174	48	1.6	<0.3	78	7.7	5.7	~				
TP148	0.20		T	817276	21.2	0.68	63	69	0.21	1.3	55	33	122	51	0.9	<0.3	63	5.0	5.0	~				
TP148	0.50		T	817282	43.8	0.77	140	143	0.72	1.4	89	27	161	38	1.0	<0.3	140	7.6	5.5	~				
TP149	0.40		T	817284	32.9	0.85	37	37	0.21	4.6	33	19	45	54	0.6	<0.3	37	6.0	4.6	~				
TP149	0.40		J	817286	28.4	0.88	37	125	0.17	2.4	91	42	125	63	1.0	<0.3	37	8.8	6.1	~				
Limits of Detection					0.5	0.10	1	1	0.10	0.5	1	1	0.5	1	0.2	0.3	1	0.1	~	1				
Terra Tek Analysis Method					TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP137	TP032	TP184	~	TP189	TP019	S/C				
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M	M	U	M	M	M	M	U	N	N	N	M	N				

Originator	Checked & Approved
DAB	S. Langman 21/04/2022

RESULTS OF CHEMICAL CONTAMINATION TESTS - SOIL

KEY

* - deviating result (refer to Appendix S2 for details)

^ - result expressed on as-received basis

TTk

Figure 1

Sheet 3 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification										
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Sulphate (soluble in 2:1 water extract) as SO4 g/l	Sulphate (acid soluble as SO4) %	Total Sulphur %	Chloride (water soluble in 2:1 water extract) mg/l	Magnesium (water soluble in 2:1 extract) mg/l	Nitrate (in 2:1 water extract) as NO3 mg/l
TP111	0.25		J	817140	0.07	~	0.16	5.7	4	17
TP114	0.50		J	817155	<0.01	0.04	0.03	3.8	2	21
TP119	0.50		J	817178	0.01	~	0.04	6.1	2	12
TP121	0.50		J	817191	0.01	~	0.07	3.8	5	12
TP122	0.20		J	817196	0.06	~	0.12	3.5	3	8
TP122	0.50		J	817199	<0.01	~	0.05	6.7	3	4
TP135	1.50		T	817243	~	0.91	0.36	~	~	~
TP148	0.50		J	817284	0.06	~	0.54	5.9	1	5
Limits of Detection					0.01	0.01	0.01	0.1	1	1
Terra Tek Analysis Method					TP169	TP171	TP129	TP134	TP136	TP136
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M	N	N

Originator	Checked & Approved
DAB	21/04/2022

BRE SUITE

Figure 2

Sheet 1 of 1

2141 - BRE Suite Soil - B28810-2 01.xls

Version 011 - 26/07/2012

Lab Project No B28810-2 : 21/04/2022 17:02:33

Moor Lane, Witton, Birmingham, B6 7HG

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification																								
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Naphthalene mg/kg	Acenaphthylene mg/kg	Acenaphthene mg/kg	Fluorene mg/kg	Phenanthrene mg/kg	Anthracene mg/kg	Fluoranthene mg/kg	Pyrene mg/kg	Benzo (a) anthracene mg/kg	Chrysene mg/kg	Benzo (b) fluoranthene mg/kg	Benzo (k) fluoranthene mg/kg	Benzo (a) pyrene mg/kg	Indeno (1,2,3 - cd) pyrene mg/kg	Dibenzo (ah) anthracene mg/kg	Benzo (ghi) perylene mg/kg	Total PAHs (USEPA 16) mg/kg			
TP101	0.10		J	817103	0.11	<0.05	0.14	0.12	1.73	0.47	3.64	3.27	1.34	1.93	2.08	1.49	1.64	0.90	0.17	1.19	20.2			
TP105	0.10		J	817118	0.07	<0.05	<0.10	<0.05	0.55	0.18	0.55	0.48	0.21	0.34	0.23	0.18	0.17	0.11	<0.10	0.15	3.2			
TP107	0.20		J	817125	0.11	<0.05	<0.10	0.06	0.79	0.23	0.67	0.64	0.22	0.49	0.24	0.29	0.29	0.19	<0.10	0.26	4.5			
TP109	0.10		J	817131	0.71	<0.05	0.44	0.38	3.62	0.92	3.06	3.05	1.33	1.85	1.42	1.13	1.11	0.64	0.19	0.81	20.7			
TP111	0.10		J	817138	0.51	<0.05	0.17	0.15	3.01	0.71	4.40	3.15	1.48	2.44	1.78	1.62	2.02	1.10	0.21	1.41	24.2			
TP111	0.25		J	817140	2.28	<0.05	<0.10	0.07	1.28	0.56	0.51	0.57	0.25	0.53	0.26	0.18	0.19	<0.10	<0.10	0.18	6.9			
TP112	0.30		J	817146	0.29	<0.05	0.23	0.22	2.37	0.70	2.69	2.35	0.83	1.26	0.93	0.71	0.98	0.58	0.13	0.92	15.2			
TP114	0.20		J	817153	0.09	<0.05	<0.10	<0.05	0.76	0.25	1.19	1.10	0.41	0.65	0.37	0.46	0.48	0.29	<0.10	0.35	6.4			
TP114	0.50		J	817155	<0.05	<0.05	<0.10	<0.05	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	<0.05	<0.05	<0.05	<0.10	<0.10	<0.10	<1.3			
TP116	0.20		J	817162	0.17	<0.05	<0.10	0.11	1.76	0.44	1.74	1.70	0.59	1.04	0.80	0.68	0.77	0.43	<0.10	0.58	10.8			
Limits of Detection					0.05	0.05	0.10	0.05	0.10	0.10	0.10	0.10	0.10	0.10	0.05	0.05	0.05	0.10	0.10	0.10	1.3			
Terra Tek Analysis Method					TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045			
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			

Originator	Checked & Approved
DAB	S. Langman 21/04/2022

POLYAROMATIC HYDROCARBONS (USEPA 16) - SOIL

KEY

* - deviating result (refer to Appendix S2 for details)

^ - result expressed on as-received basis

TTk

Figure 3

Sheet 1 of 3

2150 - PAHs SOIL - B28810-2 01.xls
Version 008 - 19/06/2007

Lab Project No B28810-2 : 21/04/2022 17:02:37
Moor Lane, Witton, Birmingham, B6 7HG

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification																					
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Naphthalene mg/kg	Acenaphthylene mg/kg	Acenaphthene mg/kg	Fluorene mg/kg	Phenanthrene mg/kg	Anthracene mg/kg	Fluoranthene mg/kg	Pyrene mg/kg	Benzo (a) anthracene mg/kg	Chrysene mg/kg	Benzo (b) fluoranthene mg/kg	Benzo (k) fluoranthene mg/kg	Benzo (a) pyrene mg/kg	Indeno (1,2,3 - cd) pyrene mg/kg	Dibenzo (ah) anthracene mg/kg	Benzo (ghi) perylene mg/kg	Total PAHs (USEPA 16) mg/kg
TP119	0.20		J	817175	0.47	0.27	1.65	1.72	4.46	1.40	2.72	2.18	0.77	0.90	0.91	0.61	0.69	0.35	<0.10	0.48	19.6
TP119	0.50		J	817178	<0.05	<0.05	<0.10	<0.05	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.05	<0.05	<0.05	<0.10	<0.10	<0.10	<1.3
TP120	0.20		J	817183	0.55	<0.05	0.16	0.25	2.01	0.79	2.39	2.15	0.85	1.22	1.13	0.94	0.90	0.51	0.11	0.72	14.7
TP121	0.20		J	817188	0.67	<0.05	0.26	0.25	3.32	0.98	3.94	3.58	1.51	1.99	1.76	1.20	1.64	0.79	0.18	1.15	23.2
TP121	0.50		J	817191	0.34	<0.05	0.12	0.20	2.15	0.45	0.57	0.48	0.26	0.79	0.21	0.16	0.18	<0.10	<0.10	0.17	6.1
TP122	0.20		J	817196	0.53	<0.05	<0.10	0.14	1.80	0.55	1.69	1.60	0.55	1.04	0.72	0.52	0.54	0.23	<0.10	0.34	10.2
TP122	0.50		J	817199	<0.05	<0.05	<0.10	<0.05	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.05	<0.05	<0.05	<0.10	<0.10	<0.10	<1.3
TP123	0.20		J	817203	0.19	<0.05	<0.10	0.14	1.41	0.37	1.97	1.89	0.60	1.27	0.90	0.66	0.67	0.45	<0.10	0.53	11.1
TP125	0.40		J	817213	<0.05	<0.05	<0.10	<0.05	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.05	<0.05	<0.05	<0.10	<0.10	<0.10	<1.3
TP127	0.20		J	817221	0.41	<0.05	0.75	0.36	5.06	1.06	4.86	5.74	2.29	2.41	3.58	2.49	3.22	2.10	0.26	2.71	37.3
Limits of Detection					0.05	0.05	0.10	0.05	0.10	0.10	0.10	0.10	0.10	0.10	0.05	0.05	0.05	0.10	0.10	0.10	1.3
Terra Tek Analysis Method					TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

Originator	Checked & Approved
DAB	S. Langman 21/04/2022

POLYAROMATIC HYDROCARBONS (USEPA 16) - SOIL

KEY

* - deviating result (refer to Appendix S2 for details)

^ - result expressed on as-received basis

Figure 3

Sheet 2 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No B28810-2

Sample Identification																					
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Naphthalene mg/kg	Acenaphthylene mg/kg	Acenaphthene mg/kg	Fluorene mg/kg	Phenanthrene mg/kg	Anthracene mg/kg	Fluoranthene mg/kg	Pyrene mg/kg	Benzo (a) anthracene mg/kg	Chrysene mg/kg	Benzo (b) fluoranthene mg/kg	Benzo (k) fluoranthene mg/kg	Benzo (a) pyrene mg/kg	Indeno (1,2,3 - cd) pyrene mg/kg	Dibenzo (ah) anthracene mg/kg	Benzo (ghi) perylene mg/kg	Total PAHs (USEPA 16) mg/kg
TP129	0.10		J	817228	0.37	<0.05	0.12	0.11	1.09	0.42	1.19	1.04	0.43	0.80	0.54	0.54	0.53	0.33	<0.10	0.49	8.0
TP131	0.10		J	817232	1.28	<0.05	0.11	0.15	2.04	0.64	2.93	2.72	1.19	1.43	1.21	0.99	1.04	0.56	0.12	0.73	17.1
TP132	0.20		J	817236	0.31	<0.05	0.15	0.19	2.71	0.55	2.86	2.55	1.25	1.62	1.71	1.03	1.80	0.73	0.16	0.95	18.0
TP136	0.20		J	817247	0.22	<0.05	<0.10	0.08	0.84	0.38	1.07	0.99	0.30	0.65	0.63	0.45	0.38	0.23	<0.10	0.31	6.5
TP139	0.20		J	817259	0.77	0.19	0.11	0.44	2.83	0.57	1.72	1.68	0.66	1.12	0.71	0.65	0.67	0.36	<0.10	0.60	13.1
TP143	0.30		J	817271	0.39	<0.05	0.12	0.14	1.82	0.44	2.31	2.06	0.99	1.36	1.28	1.03	1.00	0.54	0.15	0.74	14.4
TP145	0.20		J	817276	0.13	<0.05	<0.10	<0.05	0.45	0.13	0.34	0.31	0.15	0.31	0.17	0.16	0.15	0.15	<0.10	0.18	2.6
TP148	0.20		J	817282	0.23	<0.05	<0.10	0.07	0.97	0.26	1.53	1.38	0.40	0.82	0.38	0.80	0.58	0.37	0.10	0.55	8.4
TP148	0.50		J	817284	0.06	<0.05	<0.10	<0.05	0.98	0.10	0.16	0.18	<0.10	0.30	0.06	0.08	<0.05	<0.10	<0.10	<0.10	1.9
TP149	0.40		J	817286	1.56	<0.05	0.39	0.33	4.06	1.42	7.38	6.46	2.44	4.15	3.61	2.90	3.17	1.61	0.33	1.99	41.8
Limits of Detection					0.05	0.05	0.10	0.05	0.10	0.10	0.10	0.10	0.10	0.10	0.05	0.05	0.05	0.10	0.10	0.10	1.3
Terra Tek Analysis Method					TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045	TP045
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

Originator	Checked & Approved
DAB	S. Langman 21/04/2022

POLYAROMATIC HYDROCARBONS (USEPA 16) - SOIL

KEY

* - deviating result (refer to Appendix S2 for details)

^ - result expressed on as-received basis

TTk

Figure 3

Sheet 3 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No B28810-2

Sample Identification				Lab Sample ID	TPH >C6-C10	TPH >C10-C12	TPH>C12-C16	TPH >C16-C21	TPH >C21-C35	TPH >C35-C40	Sample received in appropriate container
Hole	Depth m	Sample Ref	Sample Type		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
TP111	0.25		V	817141	<1	<1	3	4	16	1	Yes
TP119	0.20		V	817176	<1	<1	<1	4	14	1	Yes
TP119	0.50		V	817179	<1	<1	<1	<1	9	4	Yes
TP120	0.20		V	817184	<1	<1	<1	<1	6	<1	Yes
TP121	0.20		V	817189	<1	<1	4	12	22	1	Yes
TP121	0.50		V	817192	<1	<1	3	3	5	<1	Yes
TP122	0.20		V	817197	<1	<1	6	18	60	1	Yes
TP122	0.50		V	817200	<1	<1	<1	<1	3	<1	Yes
TP125	0.40		V	817214	<1	<1	1	4	14	1	Yes
Limits of Detection					1	1	1	1	1	1	
Terra Tek Analysis Method					TP067	TP067	TP067	TP067	TP067	TP067	
Accreditation M=Mcerts U=UKAS N=No accreditation					N	N	N	N	N	N	

Originator	Checked & Approved
DAB	21/04/2022

TOTAL PETROLEUM HYDROCARBONS (BANDING) - SOIL

KEY

* - deviating result (refer to Appendix S2 for details)

^ - result expressed on as-received basis

TTk

Figure 4

Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification															
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Asbestos	Chrysotile (white asbestos)	Amosite (brown asbestos)	Crocidolite (blue asbestos)	Anthophyllite asbestos	Tremolite asbestos	Actinolite asbestos	Quantity of soil/material provided g	Comments	Quantification Result (dry mass) %	Analyst
TP101	0.10		T	817102	ND	~	~	~	~	~	~	1,072	~	~	MN
TP105	0.10		T	817117	ND	~	~	~	~	~	~	1,078	~	~	MN
TP107	0.20		T	817123	ND	~	~	~	~	~	~	1,219	~	~	MN
TP109	0.10		T	817130	ND	~	~	~	~	~	~	978	~	~	MN
TP111	0.10		T	817137	ND	~	~	~	~	~	~	821	~	~	MN
TP111	0.25		T	817139	ND	~	~	~	~	~	~	678	~	~	MN
TP112	0.30		T	817145	ND	~	~	~	~	~	~	841	~	~	MN
TP114	0.20		T	817152	ND	~	~	~	~	~	~	990	~	~	MN
TP114	0.50		T	817154	ND	~	~	~	~	~	~	1,244	~	~	MN
TP116	0.20		T	817161	ND	~	~	~	~	~	~	863	~	~	MN
Limits of Detection												~		0.001	
Terra Tek Analysis Method												TP181		TP183	
Accreditation M=Mcerts U=UKAS N=No accreditation												U		U	

Originator	Checked & Approved
MN	21/04/2022

ASBESTOS IDENTIFICATION

Refer to Appendix S4 notes when interpreting asbestos results

KEY

ND - no asbestos detected

D - asbestos detected

Figure 5

Sheet 1 of 3

2700 - Asbestos SOIL TTK - B28810-2 01.xls

Version 010 - 29/01/2009

Lab Project No B28810-2 : 21/04/2022 16:58:08

Moor Lane, Witton, Birmingham, B6 7HG

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND
Client
Engineer

Contract No **B28810-2**

Sample Identification															
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Asbestos	Chrysotile (white asbestos)	Amosite (brown asbestos)	Crocidolite (blue asbestos)	Anthophyllite asbestos	Tremolite asbestos	Actinolite asbestos	Quantity of soil/material provided g	Comments	Quantification Result (dry mass) %	Analyst
TP119	0.20		T	817174	ND	~	~	~	~	~	~	941	~	~	MN
TP119	0.50		T	817177	ND	~	~	~	~	~	~	945	~	~	MN
TP120	0.20		T	817182	ND	~	~	~	~	~	~	1,080	~	~	MN
TP121	0.20		T	817187	ND	~	~	~	~	~	~	952	~	~	MN
TP121	0.50		T	817190	ND	~	~	~	~	~	~	876	~	~	MN
TP122	0.20		T	817195	ND	~	~	~	~	~	~	1,094	~	~	MN
TP122	0.50		T	817198	ND	~	~	~	~	~	~	1,155	~	~	MN
TP123	0.20		T	817202	ND	~	~	~	~	~	~	1,021	~	~	MN
TP125	0.40		T	817212	ND	~	~	~	~	~	~	1,052	~	~	MN
TP127	0.20		T	817220	ND	~	~	~	~	~	~	1,111	~	~	MN
Limits of Detection												~		0.001	
Terra Tek Analysis Method												TP181		TP183	
Accreditation M=Mcerts U=UKAS N=No accreditation												U		U	

Originator	Checked & Approved
MN	S. Langman 21/04/2022

ASBESTOS IDENTIFICATION

Refer to Appendix S4 notes when interpreting asbestos results

KEY
ND - no asbestos detected
D - asbestos detected

Figure 5

Sheet 2 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification															
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Asbestos	Chrysotile (white asbestos)	Amosite (brown asbestos)	Crocidolite (blue asbestos)	Anthophyllite asbestos	Tremolite asbestos	Actinolite asbestos	Quantity of soil/material provided g	Comments	Quantification Result (dry mass) %	Analyst
TP129	0.10		T	817227	ND	~	~	~	~	~	~	894	~	~	MN
TP131	0.10		T	817231	ND	~	~	~	~	~	~	1,146	~	~	MN
TP132	0.20		T	817235	ND	~	~	~	~	~	~	757	~	~	MN
TP136	0.20		T	817246	ND	~	~	~	~	~	~	902	~	~	MN
TP139	0.20		T	817258	ND	~	~	~	~	~	~	822	~	~	MN
TP143	0.30		T	817270	ND	~	~	~	~	~	~	893	~	~	MN
TP145	0.20		T	817275	ND	~	~	~	~	~	~	1,116	~	~	MN
TP148	0.20		T	817281	ND	~	~	~	~	~	~	720	~	~	MN
TP148	0.50		T	817283	ND	~	~	~	~	~	~	918	~	~	MN
TP149	0.40		T	817285	ND	~	~	~	~	~	~	838	~	~	MN
Limits of Detection												~		0.001	
Terra Tek Analysis Method												TP181		TP183	
Accreditation M=Mcerts U=UKAS N=No accreditation												U		U	

Originator	Checked & Approved
MN	S. Langman 21/04/2022

ASBESTOS IDENTIFICATION

Refer to Appendix S4 notes when interpreting asbestos results

KEY

ND - no asbestos detected

D - asbestos detected

TTK

Figure 5

Sheet 3 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification				Lab Sample ID	Date Sampled	Temperature on receipt °C	PRIMARY MATRIX	Secondary Matrix	Additional matrix	% Loss at 30C	% Retained 2mm
Exploratory Hole	Depth m	Sample Ref	Sample Type								
TP101	0.10		J	817103	21/03/22	15.8	Clayey SAND	Fine Gravel		35.2	21.2
TP105	0.10		J	817118	21/03/22	15.8	Clayey SAND	Fine Gravel		25.5	18.2
TP107	0.20		J	817125	21/03/22	15.8	Clayey SAND	Fine Gravel		29.5	18.3
TP109	0.10		J	817131	21/03/22	15.8	Clayey SAND	Fine Gravel		25.3	17
TP111	0.10		J	817138	21/03/22	15.8	Clayey SAND	Fine Gravel		32.6	16.2
TP111	0.25		J	817140	21/03/22	15.8	Clayey SAND	Fine Gravel		27	23
TP112	0.30		J	817146	21/03/22	15.8	Clayey SAND	Fine Gravel		26.5	28.4
TP114	0.20		J	817153	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		22.2	28.7
TP114	0.50		J	817155	21/03/22	15.8	Clayey SAND	Fine Gravel		12.3	33.9
TP116	0.20		J	817162	21/03/22	15.8	Clayey SAND	Fine Gravel		28.8	15.6
TP119	0.20		J	817175	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		26	18.9
TP119	0.50		J	817178	21/03/22	15.8	Clayey SAND	Fine Gravel		22.4	20.1
TP120	0.20		J	817183	21/03/22	15.8	Clayey SAND	Fine Gravel		18.4	44.6
TP121	0.20		J	817188	21/03/22	15.8	Clayey SAND	Fine Gravel		17.7	44.3
TP121	0.50		J	817191	21/03/22	15.8	Clayey SAND	Fine to Medium Gravel		20.7	35.8

Notes

Terra Tek are accredited for clay, sand and loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials such as gravel, are not accredited where they comprise the major component of the sample.

Results are expressed on a dry-weight basis (samples dried at <30^{o}C) except where stated. Samples for asbestos testing are dried at 85^{o}C.

With the exception of samples analysed for asbestos, the laboratory removes any material > 2mm prior to analysis. The quantity and nature of the material is shown as the secondary and additional matrix types in the above table.

Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors List, which is subject to performance assessment, will be selected.

Originator	Checked & Approved
DAB	21/04/2022

SAMPLE DESCRIPTIONS

Appendix S1

Sheet 1 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No** **B28810-2**
Client		
Engineer		

Sample Identification											
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Date Sampled	Temperature on receipt °C	PRIMARY MATRIX	Secondary Matrix	Additional matrix	% Loss at 30C	% Retained 2mm
TP122	0.20		J	817196	21/03/22	15.8	Clayey SAND	Fine Gravel		20.1	38.3
TP122	0.50		J	817199	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		24.2	22
TP123	0.20		J	817203	21/03/22	15.8	Clayey SAND	Fine Gravel		25.9	30.6
TP125	0.40		J	817213	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		14.4	43.6
TP127	0.20		J	817221	21/03/22	15.8	Clayey SAND	Fine Gravel		23.5	27.6
TP129	0.10		J	817228	21/03/22	15.8	Clayey SAND	Fine Gravel		29.2	29
TP131	0.10		J	817232	21/03/22	15.8	Clayey SAND	Fine Gravel		22	23
TP132	0.20		J	817236	21/03/22	15.8	Clayey SAND	Fine to Medium Gravel		23.5	153.6
TP135	1.50		T	817243	21/03/22	15.8	CLAY	Fine Gravel		20.6	29.8
TP136	0.20		J	817247	21/03/22	15.8	Clayey SAND	Fine Gravel		19.9	25.4
TP139	0.20		J	817259	21/03/22	15.8	Sandy CLAY	Fine Gravel		24	20.2
TP143	0.30		J	817271	21/03/22	15.8	Clayey SAND	Fine to Medium Gravel		25	30.8
TP145	0.20		J	817276	21/03/22	15.8	Sandy CLAY	Fine Gravel		23.1	36
TP148	0.20		J	817282	21/03/22	15.8	Clayey SAND	Fine Gravel		23.9	19.8
TP148	0.50		J	817284	21/03/22	15.8	Clayey SAND	Fine to Medium Gravel		18.3	39.3

Notes

Terra Tek are accredited for clay, sand and loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials such as gravel, are not accredited where they comprise the major component of the sample.

Results are expressed on a dry-weight basis (samples dried at <30^{o}C) except where stated. Samples for asbestos testing are dried at 85^{o}C.

With the exception of samples analysed for asbestos, the laboratory removes any material > 2mm prior to analysis. The quantity and nature of the material is shown as the secondary and additional matrix types in the above table.

Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors List, which is subject to performance assessment, will be selected.

Originator	Checked & Approved		
DAB	S. Langman 21/04/2022	**SAMPLE DESCRIPTIONS**	**Appendix S1** Sheet 2 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND
Client	
Engineer	
Contract No	**B28810-2**

Sample Identification				Lab Sample ID	Date Sampled	Temperature on receipt °C	PRIMARY MATRIX	Secondary Matrix	Additional matrix	% Loss at 30C	% Retained 2mm
Exploratory Hole	Depth m	Sample Ref	Sample Type								
TP149	0.40		J	817286	21/03/22	15.8	Clayey SAND	Fine to Medium Gravel		18.6	44.7

Notes

Terra Tek are accredited for clay, sand and loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials such as gravel, are not accredited where they comprise the major component of the sample.

Results are expressed on a dry-weight basis (samples dried at <30^{o}C) except where stated. Samples for asbestos testing are dried at 85^{o}C.

With the exception of samples analysed for asbestos, the laboratory removes any material > 2mm prior to analysis. The quantity and nature of the material is shown as the secondary and additional matrix types in the above table.

Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors List, which is subject to performance assessment, will be selected.

Originator	Checked & Approved
DAB	S. Longman 21/04/2022

SAMPLE DESCRIPTIONS

Appendix S1

Sheet 3 of 3

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification				Lab Sample ID	Date Sampled	Deviating conditions						Preservatives used
Exploratory Hole	Depth m	Sample Ref	Sample Type			Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		
TP101	0.10		T	817102	21/03/22							
TP101	0.10		J	817103	21/03/22							
TP105	0.10		T	817117	21/03/22							
TP105	0.10		J	817118	21/03/22							
TP107	0.20		T	817123	21/03/22							
TP107	0.20		J	817125	21/03/22							
TP109	0.10		T	817130	21/03/22							
TP109	0.10		J	817131	21/03/22							
TP111	0.10		T	817137	21/03/22							
TP111	0.10		J	817138	21/03/22							
TP111	0.25		T	817139	21/03/22							
TP111	0.25		J	817140	21/03/22							
TP111	0.25		V	817141	21/03/22							
TP112	0.30		T	817145	21/03/22							
TP112	0.30		J	817146	21/03/22							

NOTES
1 Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2 The absence of "X" or "Yes" in the table above indicates no reported deviations.
3 Deviations due to use of incorrect sample container are shown on result tables.
4 Deviating results are indicated within result tables.

Originator	Checked & Approved
DAB	21/04/2022

DEVIATING SAMPLES - SOIL

Appendix S2

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification				Lab Sample ID	Date Sampled	Deviating conditions						
Exploratory Hole	Depth m	Sample Ref	Sample Type			Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		Preservatives used
TP114	0.20		T	817152	21/03/22							
TP114	0.20		J	817153	21/03/22							
TP114	0.50		T	817154	21/03/22							
TP114	0.50		J	817155	21/03/22							
TP116	0.20		T	817161	21/03/22							
TP116	0.20		J	817162	21/03/22							
TP119	0.20		T	817174	21/03/22							
TP119	0.20		J	817175	21/03/22							
TP119	0.20		V	817176	21/03/22							
TP119	0.50		T	817177	21/03/22							
TP119	0.50		J	817178	21/03/22							
TP119	0.50		V	817179	21/03/22							
TP120	0.20		T	817182	21/03/22							
TP120	0.20		J	817183	21/03/22							
TP120	0.20		V	817184	21/03/22							

NOTES

1 Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2 The absence of "X" or "Yes" in the table above indicates no reported deviations.
3 Deviations due to use of incorrect sample container are shown on result tables.
4 Deviating results are indicated within result tables.

Originator	Checked & Approved
DAB	21/04/2022

DEVIATING SAMPLES - SOIL

Appendix S2

Version 017 - 22/01/2015

8051 - App S2 - Deviating samples - SOLID - B28810-2 01.xls

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification				Lab Sample ID	Date Sampled	Deviating conditions						Preservatives used
Exploratory Hole	Depth m	Sample Ref	Sample Type			Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		
TP121	0.20		T	817187	21/03/22							
TP121	0.20		J	817188	21/03/22							
TP121	0.20		V	817189	21/03/22							
TP121	0.50		T	817190	21/03/22							
TP121	0.50		J	817191	21/03/22							
TP121	0.50		V	817192	21/03/22							
TP122	0.20		T	817195	21/03/22							
TP122	0.20		J	817196	21/03/22							
TP122	0.20		V	817197	21/03/22							
TP122	0.50		T	817198	21/03/22							
TP122	0.50		J	817199	21/03/22							
TP122	0.50		V	817200	21/03/22							
TP123	0.20		T	817202	21/03/22							
TP123	0.20		J	817203	21/03/22							
TP125	0.40		T	817212	21/03/22							

NOTES
1 Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2 The absence of "X" or "Yes" in the table above indicates no reported deviations.
3 Deviations due to use of incorrect sample container are shown on result tables.
4 Deviating results are indicated within result tables.

Originator	Checked & Approved
DAB	S. Langman 21/04/2022

DEVIATING SAMPLES - SOIL

Appendix S2

Sheet 3 of 5

Moor Lane, Witton, Birmingham, B6 7HG

Lab Project No B28810-2 : 21/04/2022 16:58:25

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification				Lab Sample ID	Date Sampled	Deviating conditions						Preservatives used
Exploratory Hole	Depth m	Sample Ref	Sample Type			Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		
TP125	0.40		J	817213	21/03/22							
TP125	0.40		V	817214	21/03/22							
TP127	0.20		T	817220	21/03/22							
TP127	0.20		J	817221	21/03/22							
TP129	0.10		T	817227	21/03/22							
TP129	0.10		J	817228	21/03/22							
TP131	0.10		T	817231	21/03/22							
TP131	0.10		J	817232	21/03/22							
TP132	0.20		T	817235	21/03/22							
TP132	0.20		J	817236	21/03/22							
TP136	0.20		T	817246	21/03/22							
TP136	0.20		J	817247	21/03/22							
TP139	0.20		T	817258	21/03/22							
TP139	0.20		J	817259	21/03/22							
TP143	0.30		T	817270	21/03/22							

NOTES
1 Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2 The absence of "X" or "Yes" in the table above indicates no reported deviations.
3 Deviations due to use of incorrect sample container are shown on result tables.
4 Deviating results are indicated within result tables.

Originator	Checked & Approved
DAB	21/04/2022

DEVIATING SAMPLES - SOIL

Appendix S2

Version 017 - 22/01/2015
8051 - App S2 - Deviating samples - SOLID - B28810-2 01.xls
Moor Lane, Witton, Birmingham, B6 7HG
Lab Project No B28810-2 : 21/04/2022 16:58:27

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810-2**

Sample Identification						Deviating conditions						
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Date Sampled	Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		Preservatives used
TP143	0.30		J	817271	21/03/22							
TP145	0.20		T	817275	21/03/22							
TP145	0.20		J	817276	21/03/22							
TP148	0.20		T	817281	21/03/22							
TP148	0.20		J	817282	21/03/22							
TP148	0.50		T	817283	21/03/22							
TP148	0.50		J	817284	21/03/22							
TP149	0.40		T	817285	21/03/22							
TP149	0.40		J	817286	21/03/22							
TP135	1.50		T	817243	21/03/22							

NOTES
1 Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2 The absence of "X" or "Yes" in the table above indicates no reported deviations.
3 Deviations due to use of incorrect sample container are shown on result tables.
4 Deviating results are indicated within result tables.

Originator	Checked & Approved
DAB	21/04/2022

DEVIATING SAMPLES - SOIL

TTK

Appendix S2

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No B28810-2

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
GP001	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Preparation of soil samples for chemical analysis	Yes	Yes	N/A
GP012	BS EN 12457-3: Characterisation of Waste - Compliance test for leaching of granular waste materials and sludges (two-stage batch test)	Preparation of soil samples for two-stage leachate test			Dry
TP019	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of pH in 2.5:1 water/soil extract using pH meter.	Yes	Yes	Dry
TP032	MAFF Book 427: The Analysis of Agricultural Materials: Method 8	Determination of water soluble boron by ICP-OES	Yes		Dry
TP040	APHA/AWWA, 19th edition: Method 3500Cr-D	Determination of hexavalent chromium by colorimetry.	Yes		Dry
TP041	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of organic matter by titrimetry.	Yes		Dry
TP042	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of loss on ignition at 50-440°C by gravimetry	Yes	Yes	Dry
TP045	GACHAMJA A.M. Chromatography and Analysis: 1992 9-11 (modified)	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS	Yes	Yes	Dry
TP046	MEWAM method: Phenols in water and Effluents: 4-aminoantipyrine method	Determination of monohydric phenols by steam distillation/colorimetry	Yes	Yes	Dry
TP047	MEWAM method: Cyanide in Waters etc	Determination of free cyanide by steam distillation/colorimetry	Yes		Dry
TP048	MEWAM method: Cyanide in Waters etc	Determination of total cyanide by steam distillation/colorimetry.	Yes	Yes	Dry
TP049	MEWAM method: Cyanide in Waters etc	Determination of complex cyanide by calculation	Yes		Dry
TP050	MEWAM method: Determination of Thiocyanate ,1985	Determination of thiocyanate by colorimetry	Yes	Yes	Dry
TP051	USEPA Method 9030B	Determination of acid soluble sulphides by steam distillation/colorimetry.	Yes	Yes	Dry
TP067	TNRCC Method 1005: 2001 (modified)	Determination of pentane/acetone extractable petroleum hydrocarbons (C8 - C40) by GC/FID	Yes	Yes	Wet
TP072	In-house documented method	Determination of ammoniacal nitrogen by colorimetry			Dry
TP074	In-house documented method	Determination of water soluble fluoride by ion selective electrode			Dry
TP098	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of acid soluble chloride by titrimetry			Dry
TP099	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry
TP100	Wisconsin DNR Modified GRO method, Method for Determining Gasoline Range Organics	Determination of Volatile Petroleum Hydrocarbons/GRO.	Yes	Yes	Wet

Notes

1. Terra Tek (Birmingham) are MCERTS accredited for clay, sand & loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials, ie gravel, are not accredited where they comprise the major component of the sample.
2. Results are expressed on a dry-weight basis (samples dried at <30°C) except where stated. Samples tested for asbestos are dried at <90°C.
3. With the exception of samples analysed for asbestos, the laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. The test results pertain only to the samples provided and is not guaranteed to be representative of the parent material in whole or part from which the sample was taken. Sample location, site address, taken by and client reference are included where provided by the client, Terra Tek accepts no responsibility for the validity or accuracy of this information.

Originator	Checked & Approved
N/A	N/A

SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)

TTk

Appendix S3

Sheet 1 of 2

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No**	**B28810-2**
Client			
Engineer			

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
TP110	USEPA Methods 8082A & 3665A	Determination of Total & Speciated 7 PCB Congeners by GC/MS SIM	Yes	Yes	Wet
TP114	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of carbonate in soil (rapid titration method)			Dry
TP126	TNRCC Method 1006 (modified)	Extracted petroleum hydrocarbons from TP067 split into aromatic and aliphatic fractions. Analysed by GC/FID.	Yes		Wet
TP129	In-house documented method	Determination of total sulphur by ICP-OES spectroscopy	Yes	Yes	Dry
TP134	In-house documented method	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry
TP135	USEPA Methods 8100 & 8270D. In-house method TP045	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS (with concentration stage)			Dry
TP137	BS7755: Section 3.9: 1995/ISO 11466:1995	Determination of acid extractable metals in soil by ICP-OES	Selected	Selected	Dry
TP145	USEPA Methods 3550C & 8270D	Determination of Semi-Volatile Organic Compounds by GC/MS	Yes	Yes	Wet
TP147	USEPA Methods 8082A & 3665A	Determination of total & speciated WHO 12 PCB Congeners by GC/MS SIM.			Wet
TP150	USEPA Methods 8081B & 8141B	Determination of pesticides and herbicides in soil by GC/MS SIM			Dry
TP152	USEPA Method 556	Determination of carbonyls by GC/MS.			Wet
TP154	USEPA Method 5021. Wisconsin DNR modified GRO method	Determination of volatiles in by GC/MS headspace	Yes	Selected	Wet
TP158	USEPA Method 1671	Determination of glycols by GC/FID DI			Wet
TP169	In-house documented method	Determination of water soluble sulphate in 2:1 water/soil extract by ICP-OES spectroscopy	Yes	Yes	Dry
TP171	In-house documented method	Determination of acid soluble sulphate by ICP-OES spectroscopy	Yes	Yes	Dry
TP174	In-house documented method	Determination of Total Organic Carbon in soils by high temperature combustion & NDIR detection	Yes		Dry
TP178	In-house documented method	Determination of water soluble nitrate by ion selective electrode			Dry
TP181	HSG 248 Asbestos: The Analysts Guide (Appendix 2), Edition 2 (May 2021)	Asbestos Identification in bulk materials	Yes	No	Dry
TP183	HSG 248 Asbestos: The Analysts Guide (Appendix 2), Edition 2 (May 2021) & Standing Committee of Analysts: The Quantification of Asbestos in Soil (2017, withdrawn Oct 2020)	Asbestos Identification & Quantification in soils	Yes	No	Dry
TP185	In-house documented method	Determination of loss on ignition at 150-440°C by gravimetry	No	No	Dry

Notes

1. Terra Tek (Birmingham) are MCERTS accredited for clay, sand & loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials, ie gravel, are not accredited where they comprise the major component of the sample.
2. Results are expressed on a dry-weight basis (samples dried at <30°C) except where stated. Samples tested for asbestos are dried at <90°C.
3. With the exception of samples analysed for asbestos, the laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. The test results pertain only to the samples provided and is not guaranteed to be representative of the parent material in whole or part from which the sample was taken. Sample location, site address, taken by and client reference are included where provided by the client, Terra Tek accepts no responsibility for the validity or accuracy of this information.

Originator	Checked & Approved
N/A	N/A

SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)

Appendix S3

Sheet 2 of 2

Site	SHAW LANE, ELLAND	**Contract No** **B28810-2**
Client		
Engineer		

NOTES - ASBESTOS TESTING

The Limit of Detection of the method is 0.001% dry mass of asbestos fibre of the dry weight of soil provided. Where the result of analysis is ND (Not Detected), this indicates that presence of asbestos is below this level.

The Limit of Quantitation of the test is 0.001% dry mass of asbestos fibre of dry weight of soil/material provided based on method validation where the size of sample provided is in excess of 600g.

Asbestos analysis is only undertaken at the Birmingham Laboratory only.

The uncertainty of measurement for the quantification of asbestos fibre in soil can be provided on request.

The identification of product type or the Asbestos Containing Material (ACM) within a soil sample is based on the opinion of the analyst based on the visual assessment and may not be accurate and is not covered by the scope of UKAS accreditation.

The analysis result pertains only to the sample provided and is not guaranteed to be representative in whole or part from where it was taken.

Information relating to the sampling site, ie hole depth and location, is provided by the client and Terra Tek do not accept any responsibilty for the accuracy of validity of this information.

Originator	Checked & Approved	NOTES - ASBESTOS TESTING	**Appendix S4**
MN	N/A		Sheet 1 of 1

Appendix J

Contaminated land assessment for selection of water supply pipes

YorkshireWater

Contaminated Land Assessment Form

Introduction

In January 2011, UK Water Industry Research (UKWIR) published “Guidance for the selection of Water Supply Pipes to be used in Brownfield Sites” (UKWIR 2010 Ref 10/WM/03/21). The aim of this publication is to ensure that the correct materials are selected for Water Pipes to be used below ground in Brownfield Sites. It supersedes the Water Regulations Advisory Scheme (WRAS) Information and Guidance Note 9-04-03 “Laying Pipes in Contaminated Land” which has now been withdrawn.

The UKWIR guidance is for use by Water Companies, Self Lay Organisations, Developers and Consultants during the planning, designing and construction of water mains and/or services in Brownfield Sites. The guidance defines a Brownfield Site as “Land or premises that have not previously been used or developed. They may also be vacant or derelict. However, they are not necessarily contaminated.” UKWIR state the guidance does not apply to Greenfield Sites, however YW reserve the right to apply relevant sections of the publication to Greenfield Sites that may potentially be contaminated.

Contamination Risk Assessment

Please complete the form below to allow us to assess the risk of contamination of the drinking water supply from chemicals within the soil. Yorkshire Water now lays all its water mains and service pipes in plastic. Many organic compounds (i.e. Phenols, Fuels and other hydrocarbons) can either permeate through the walls of plastic pipes into the water supply or dissolve and weaken the pipe causing water leaks.

As a minimum a desk top study (Preliminary Risk Assessment) shall be provided to YW that sets out whether the land through which the Water Pipes are to be laid may be affected by contamination. For those sites where land contamination may be present, appropriate testing shall be undertaken on existing ground materials and remediated materials. The testing requirements are as described below:

Testing Requirements

The tests that are required on all sites where the potential for contamination has been established through the desk top study and where water pipes are proposed to be laid must be undertaken by bodies with accreditation from UKAS (United Kingdom Accreditation Service) and where possible MCERTS (Environment Agency’s Monitoring Certification Service).

The tests on soil/water samples shall be those to detect and report on the levels of the following contaminant groups and chemical characteristics: **VOC’s, SVOC’s, Mineral Oil compounds C10-C40, Conductivity, pH** and **Redox potential** (as stipulated in the UKWIR guidance Appendix G).
If the previous function of the site involved the use, storage, manufacture or disposal of any of the following elements, appropriate testing for these substances will be required:

Ethers, Nitrobenzene, Ketones, Aldehydes and Amines. Please note UKWIR guidance states the presence of Amines on any site precludes the use of Polyethylene pipework.

Sufficiency of Testing

Samples taken must be representative of the soil conditions in which the Water Pipes are proposed to be laid (normally Water Pipes are laid at a depth between 0.7m and 1.3m below finished ground level). As a result samples must be taken at least 500mm below the base of the proposed pipe where the proposed location is known. If the proposed location is unknown then samples must be taken at intervals between the surface level and 1.5m from below finished ground level as a minimum. Where appropriate groundwater sampling and groundwater monitoring will also be necessary (see UKWIR guidance).

Further guidance on representative sampling is contained within BS10175:2011 “Code of practice for the Investigation of Potentially Contaminated Sites”.

The table in section 3 lists the contaminants and their respective levels which can permeate or damage plastic water pipes with consequent risk to the water supply. Where soil analysis results indicate levels of these contaminants above the maximum allowable concentration shown, then Yorkshire Water will determine that all mains and service pipes are laid in suitable materials resistant to the risks posed by those contaminants. Where sites have been used for any of the activities listed in Section 2 all mains and services shall be laid in suitable permeation resistant pipe systems due to the high risk of these contaminants being present.

Health & Safety Assessment

The UKWIR guidance does not cover Health & Safety considerations as part of any operational activities undertaken on Brownfield Sites. In order to maintain the safety of our staff, service partners and customers YW will also assess the site based on the EA CLEA (Contaminated Land Exposure Assessment) guidelines.

In order to comply with Yorkshire Water’s Health & safety requirements please review the following information relating to trigger values for Health & Safety considerations when laying Water Pipes in contaminated Land.

	Contaminant	Mg/Kg		Contaminant	Mg/Kg
Inorganic	Arsenic	32	Organic	Benzene	0.33
	Nickel	130		Toulene	610
	Mercury	170		Ethylbenzene	350
	Selenium	35		Xylene	230
	Cadmium	10		Phenol	420

Contaminants highlighted green tested for with results below the Trigger Values above. Contaminants highlighted red tested for with results above the Trigger Values above. Arsenic between 42mg/kg and 92mg/kg, average 59mg/kg.

Contaminants in black not tested for as no potential source identified on the Conceptual Site Model.

1. Your Details

Company Name	Contact Name
Lithos Consulting	A. Petts

Site Address	Contact Number
Shaw Lane, Elland	01937 545 330

2. The Previous Use of the Site

Please indicate below the previous uses of the site being developed

Predominantly Greenfield site with an infilled clay pit (west), former farm (east), and tramline (crossing the centre). Overhead high voltage power lines crossing north south. Electricity cables (above and below ground) crossing site east to west.

Beyond these areas the site has remained as undeveloped farmland.

Please indicate if the site (or part of it) has previously been used for any of the following activities:

No	Chemicals Manufacture	No	Paint or Ink Manufacture
No	Explosives / Ordnance Manufacture	No	Railway Land / Railway Engineering
No	Fuel Filling Stations / Storage	No	Scrap metals
No	Metal Finishing / Treating	No	Shipbuilding & Repair
No	Mechanical Engineering Works	No	Vehicle Repair Garages
No	Oil & Gas Refineries / Storage	No	Vehicle Manufacturing

3. Contaminants

Please complete the table below with the highest concentrations in mg/kg of each or any of the contaminants listed. The information should be extracted from your soil reports already undertaken, if any of the contaminants were not tested for, this should be declared on the form along with the reasons for this. If you have any difficulty interpreting the results of your soil sample analyses and transposing them into the table, then you should consult the body who undertook the sampling and reporting. If there are more than 3 sample locations with associated test results please copy the table for each location and label each with the sample reference and its location on a site plan.

Laboratory Name:		Date	Concentration	
Group No.	Parameter group	Unit	Depth (m)	Detection Limit
1	Extended VOC suite (with TIC)	mg/kg	Not tested	0.5
1a	BTEX & MTBE	mg/kg	Not tested	0.1
2	Extended SVOC suite (with TIC)	mg/kg	Not tested	2
2e	Phenols	mg/kg	Not tested	2
2f	Cresols and chlorinated phenols	mg/kg	Not tested	2
3	Mineral Oils C_{11}-C_{20}	mg/kg	Not tested	10
4	Mineral Oils C_{21}-C_{40}	mg/kg	Not tested	500
5	Corrosive (Conductivity, Redox & pH)		Not tested	
	Conductivity	µS/cm	Not tested	
	Redox	Volt	Not tested	
	pH	pH	4.7 to 7.8	
2a	Ethers	mg/kg	Not tested	0.5
2b	Nitrobenzene	mg/kg	Not tested	0.5
2c	Ketones	mg/kg	Not tested	0.5
2d	Aldehydes	mg/kg	Not tested	0.5
6	Amines	mg/kg	Not tested	Any presence

No sources of the above potential contaminants identified on the Conceptual Site Model, therefore no testing undertaken.

At the time of investigation, the proposed route(s), and total length, of pipeline were unknown. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance was not undertaken. Sampling within 15m of proposed water supply pipes could be undertaken, once infrastructure design has been completed. However, given the site's history and the relatively consistent ground conditions reported, the use of 'standard' polyethylene water supply pipes should be acceptable.

DO NOT include a copy of your soil report with your application, if you do not complete the table above your application will be returned to you.

Please include a site plan highlighting the locations of the above sample points.
Drawing 4246/6 shows the locations of exploratory holes.

4. Remediation of the site

Please indicate below any remediation work that will be undertaken on the site to remove / mitigate the effect of any contaminants identified in the soil report. Please include the nature and depth of any remediation work.

Excavation of ash and clinker (with elevated arsenic) in TP111 with isolation beneath hardstand or concrete oversite or disposal off site. Where Ash & Clinker remains below garden or landscaped areas it should be isolated beneath a minimum 600mm clean cover.

5. Can I use plastic pipe if I undertake remediation works?

Yes, as long as the remediation work either removes the contaminated soil or reduces the level of contaminants below trigger levels. Moving contaminated material so that it is under roads and footpaths is not acceptable as this is the likely location of the water mains.

As water mains are lad to a depth of 0.9m to the top of the pipe, any contaminated soil to a depth of 1.3m must be removed. We will require post remediation sampling results confirming contamination has fallen below the trigger levels prior to releasing any works to our Service Partners.

If contamination is found all water mains and services on the site must be laid in a suitable barrier pipe. Yorkshire Water will not change the agreed mains material after the agreement has been signed by all parties. So please ensure your remediation proposals are made clear at this stage.

6. Declaration

I hereby confirm that the information provided in this form is true and I understand that should the site conditions change from those indicated in this report that I may incur additional costs.

Your Signature	Date
AP	06/05/2022
Your Name & Title (PLEASE PRINT	**Role in organisation**
A Petts	Engineer

Please return this completed form with your application to Developer Services,
Yorkshire Water Services Ltd, PO Box 52, Bradford BD3 7YD

References

BS10175:2011 “Investigation of Potentially Contaminated Sites Code of Practice

UK Water Industry Research (UKWIR) “ Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites” (Ref 10/WM/03/21)

Appendix K

Geotechnical Test Results

Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

For the attention of Alex Petts

Report No: B28810
Issue No 02

LABORATORY TEST REPORT

Project Name	**SHAW LANE, ELLAND**		
Project Number	**B28810**	Date samples received	29/03/2022
Your Ref		Date written instructions received	29/03/2022
Purchase Order	PO18959/4246/ET	Date testing commenced	29/03/2022

Please find enclosed the results as summarised below

Figure / Table	Test Quantity	Description	ISO 17025 Accredited
1	30	Summary of Geotechnical Tests	See report
2 - 31	30	Atterberg Limit	Yes
32 - 40	9	Particle Size Distribution	Yes

Remarks :

Issued by : Stephen Langman Date of Issue : 22/04/2022

Key to symbols used in this report
S/C : Testing was sub-contracted

Approved Signatories : S Langman
22/04/2022

S Langman (Laboratory Coordinator), D Bowen (Production Manager)

Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.
Samples tested for asbestos are retained for 6 months from the date of analysis.
The results reported relate to samples received in the laboratory only.
All results contained in this report are provisional unless signed by an approved signatory
This report should not be reproduced except in full without the written approval of the laboratory.
Under multisite accreditation the testing contained in this report may have been performed at another Terra Tek laboratory.
The enclosed results remain the property of Terra Tek Limited and we reserve the right to withdraw our report if we have not received cleared funds in accordance with our standard terms and conditions
Only those results indicated in this report are UKAS accredited and any opinions or interpretations expressed are outside the scope of UKAS accreditation.
Feedback on the this report may be left via our website www.terratek.co.uk/contact-us

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810**

Sample Identification							Atterberg limits						Density		Total Stress					
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Water Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength (Hand Vane) kPa	Shear Strength (Triaxial) kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Thermal Conductivity W/m°C	Electrical Resistivity Ohm.cm
TP101	1.00		T	817104	Brown silty, slightly sandy CLAY.	44.6	83	32	51	0	CV									
TP101	1.80		T	817105	Brown/ grey silty CLAY with occasional gravel. Gravel is fine to medium.	34.4	70	30	40	2	CH									
TP102	2.00		T	817109	Dark brown sandy, silty CLAY.	22.8	39	22	17	0	CI									
TP107	0.70		T	817126	Brown/ grey slightly sandy CLAY.	25.5	55	21	34	0	CH									
TP107	1.60		T	817127	Brown silty, sandy CLAY with some gravel. Gravel is fine to medium.	23.6	46	23	23	11	CI									
Notes	Opinions and interpretations are outside the scope of UKAS accreditation					Test details are given on the 'Notes on Laboratory Procedures' sheet														
					UKAS Accredited Test Y/N	Y	Y	Y	Y	Y	-	Y	Y	Y	N	Y	-	-	N	N

Originator	Checked & Approved
CR	22/04/2022

SUMMARY OF GEOTECHNICAL TESTS

TTk

Figure 1

Sheet 1 of 6

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No B28810

Sample Identification							Atterberg limits						Density		Total Stress					
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Water Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength (Hand Vane) kPa	Shear Strength (Triaxial) kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Thermal Conductivity W/m°C	Electrical Resistivity Ohm.cm
TP110	0.80		T	817134	Brown sandy, silty CLAY with some gravel. Gravel is fine to medium.	17.2	40	22	18	18	CI									
TP112	0.90		T	817147	Grey/ brown sandy CLAY.	21.5	39	18	21	0	CI									
TP112	2.10		T	817148	Brown sandy CLAY with some gravel. Gravel is fine to medium.	15.4	39	17	22	17	CI									
TP112	2.40		T	817149	Grey sandy, slightly silty CLAY.	14.7	41	15	26	0	CI									
TP114	2.00		T	817158	Grey/ brown sandy, slightly silty CLAY with occasional gravel. Gravel is fine to medium.	15.3	38	13	25	2	CI									
Notes	Opinions and interpretations are outside the scope of UKAS accreditation				UKAS Accredited Test Y/N	Y	Y	Y	Y	Y	-	Y	Y	Y	N	Y	-	-	N	N

Test details are given on the 'Notes on Laboratory Procedures' sheet

Originator	Checked & Approved
CR	22/04/2022

SUMMARY OF GEOTECHNICAL TESTS

TTk

Figure 1

Sheet 2 of 6

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND
Client	
Engineer	
Contract No	**B28810**

Sample Identification							Atterberg limits						Density		Total Stress					
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Water Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength (Hand Vane) kPa	Shear Strength (Triaxial) kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Thermal Conductivity W/m°C	Electrical Resistivity Ohm.cm
TP116	0.60		T	817163	Light brown very sandy CLAY with some gravel. Gravel is fine to medium.	23.9	32	14	18	8	CL									
TP116	1.60		T	817164	Dark brown sandy, slightly silty CLAY with some gravel. Gravel is fine to medium.	17.1	43	18	25	14	CI									
TP116	2.20		T	817165	Brown/ grey sandy CLAY with much gravel. Gravel is fine to coarse.	9.5	36	16	20	28	CI									
TP120	0.70		T	817185	Brown sandy, slightly silty CLAY.	26.8	49	20	29	0	CI									
TP123	1.80		T	817206	Brown silty CLAY.	33.3	58	28	30	0	CH									
Notes	Opinions and interpretations are outside the scope of UKAS accreditation				UKAS Accredited Test Y/N	Y	Y	Y	Y	Y	-	Y	Y	Y	N	Y	-	-	N	N

Test details are given on the 'Notes on Laboratory Procedures' sheet

Originator	Checked & Approved
CR	22/04/2022

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

Sheet 3 of 6

Classification Summary - B28810 01.xls
Version 009 - 14/11/2007

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND
Client	
Engineer	
Contract No	**B28810**

Sample Identification							Atterberg limits						Density		Total Stress					
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Water Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength (Hand Vane) kPa	Shear Strength (Triaxial) kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Thermal Conductivity W/m°C	Electrical Resistivity Ohm.cm
TP124	1.20		T	817208	Brown very sandy CLAY with some gravel. Gravel is fine to coarse.	14.6	33	17	16	23	CL									
TP124	1.90		T	817209	Dark brown silty, sandy CLAY.	21.3	51	19	32	0	CH									
TP128	0.60		T	817224	Brown/ grey silty, sandy CLAY with some gravel. Gravel is fine to coarse.	23.7	43	22	21	6	CI									
TP128	1.50		T	817225	Dark brown sandy CLAY with some gravel. Gravel is fine to medium.	20.9	43	21	22	15	CI									
TP131	2.20		T	817234	Dark brown silty, sandy CLAY.	23.4	50	21	29	0	CI									
Notes	Opinions and interpretations are outside the scope of UKAS accreditation					Test details are given on the 'Notes on Laboratory Procedures' sheet														
					UKAS Accredited Test Y/N	Y	Y	Y	Y	Y	-	Y	Y	Y	N	Y	-	-	N	N

Originator	Checked & Approved
CR	22/04/2022

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

Sheet 4 of 6

Lab Project No B28810 : 22/04/2022 13:43:33
Moor Lane, Witton, Birmingham, B6 7HG

Classification Summary - B28810 01.xls
Version 009 - 14/11/2007

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND
Client	
Engineer	
Contract No	**B28810**

Sample Identification							Atterberg limits						Density		Total Stress					
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Water Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength (Hand Vane) kPa	Shear Strength (Triaxial) kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Thermal Conductivity W/m°C	Electrical Resistivity Ohm.cm
TP133	0.60		T	817239	Brown very sandy, silty CLAY with some gravel. Gravel is fine to coarse.	24.6	35	17	18	9	CL									
TP134	0.70		B	817298	Brown very sandy CLAY/ SILT with some organic matter and occasional gravel. Gravel is fine to coarse.	31.6	49	21	28	11	CI									
TP136	1.40		T	817248	Brown very sandy CLAY with occasional gravel. Gravel is fine to medium.	18.7	35	14	21	3	CL									
TP136	2.20		T	817249	Dark brown CLAY with some gravel. Gravel is fine to medium.	15.4	39	18	21	13	CI									
TP137	0.60		T	817252	Brown sandy CLAY with some gravel. Gravel is fine to medium.	18.7	37	17	20	24	CI									
Notes	Opinions and interpretations are outside the scope of UKAS accreditation				UKAS Accredited Test Y/N	Y	Y	Y	Y	Y	-	Y	Y	Y	N	Y	-	-	N	N

Test details are given on the 'Notes on Laboratory Procedures' sheet

Originator	Checked & Approved
CR	22/04/2022

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

Sheet 5 of 6

Lab Project No B28810 : 22/04/2022 13:43:35
Moor Lane, Witton, Birmingham, B6 7HG

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810**

Sample Identification							Atterberg limits						Density		Total Stress					
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Water Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength (Hand Vane) kPa	Shear Strength (Triaxial) kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Thermal Conductivity W/m°C	Electrical Resistivity Ohm.cm
TP139	0.60		T	817260	Brown mottled grey silty, sandy CLAY with some gravel. Gravel is fine to medium.	30.4	46	17	29	9	CI									
TP139	1.60		T	817261	Brown very sandy CLAY with some gravel. Gravel is fine to coarse.	12.5	34	15	19	21	CL									
TP143	0.70		T	817272	Brown fine to coarse GRAVEL with much clayey silt.	17.8	39	27	12	53	MI									
TP143	1.60		T	817273	Brown very sandy CLAY with some gravel. Gravel is fine to medium.	16.3	33	13	20	22	CL									
TP146	0.70		T	817279	Light brown sandy CLAY.	22.2	62	20	42	0	CH									
Notes	Opinions and interpretations are outside the scope of UKAS accreditation				UKAS Accredited Test Y/N	Y	Y	Y	Y	Y	-	Y	Y	Y	N	Y	-	-	N	N

Test details are given on the 'Notes on Laboratory Procedures' sheet

Originator	Checked & Approved
CR	22/04/2022

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

Sheet 6 of 6

Classification Summary - B28810 01.xls
Version 009 - 14/11/2007

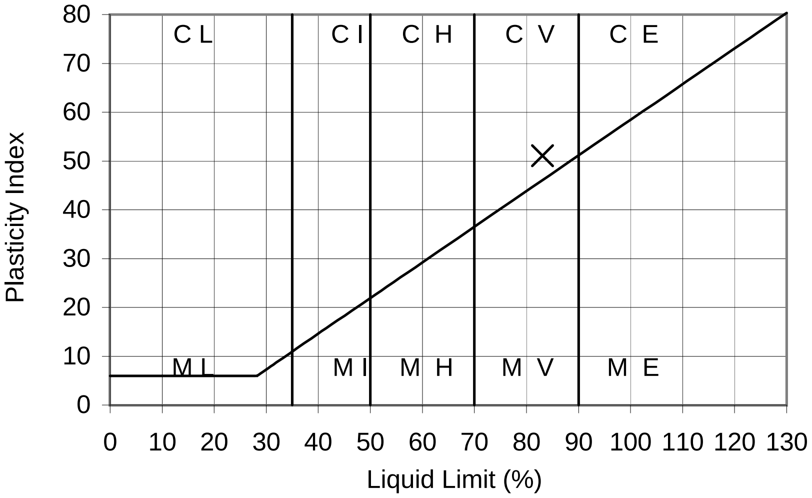
Lab Project No B28810 : 22/04/2022 13:43:36
Moor Lane, Witton, Birmingham, B6 7HG

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP101
Engineer		Sample Ref	
		Depth (m)	1.00
		Sample Type	T

Non Engineering Description : Brown silty, slightly sandy CLAY.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	18.7	Water content 1 (%)	80.0
Penetration 2 (mm)	19.2	Water content 2 (%)	80.4
Correllation Factor Used			1.036

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	44.6 %
Percentage retained on 425µm sieve :	0 %
Liquid Limit :	83 %
Plastic Limit :	32 %
Plasticity Index :	51
Equivalent water content of material passing 425µm sieve :	44.6 %
Liquidity Index :	0.25

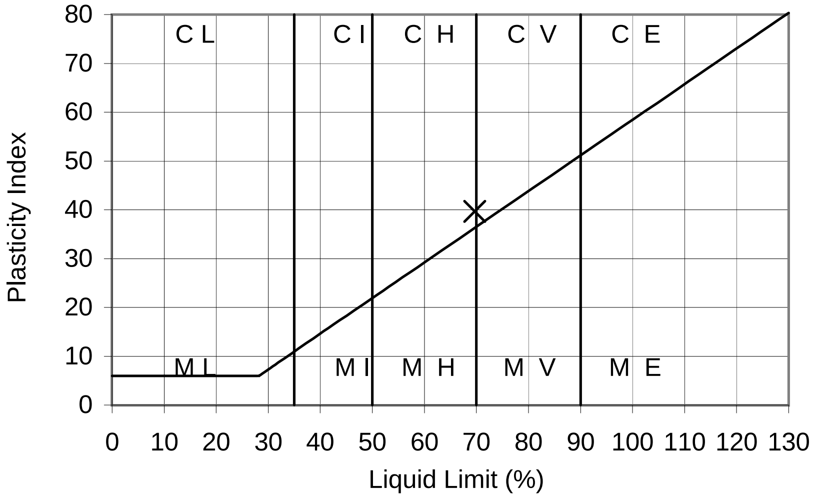
Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS EN ISO 17892-12:2018 Clause 5.3.14 BS EN ISO 17892-12:2018 Clause 5.5	**Figure 2** Sheet 1 of 1
TJH	S. Langman 22/04/2022		

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP101
Engineer		Sample Ref	
		Depth (m)	1.80
		Sample Type	T

Non Engineering Description : Brown/ grey silty CLAY with occasional gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	17.4	Water content 1 (%)	66.0
Penetration 2 (mm)	17.4	Water content 2 (%)	66.1
Correllation Factor Used			1.055

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	34.4	%
Percentage retained on 425µm sieve :	2	%
Liquid Limit :	70	%
Plastic Limit :	30	%
Plasticity Index :	40	
Equivalent water content of material passing 425µm sieve :	35.2	%
Liquidity Index :	0.13	

Originator	Checked & Approved
TJH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

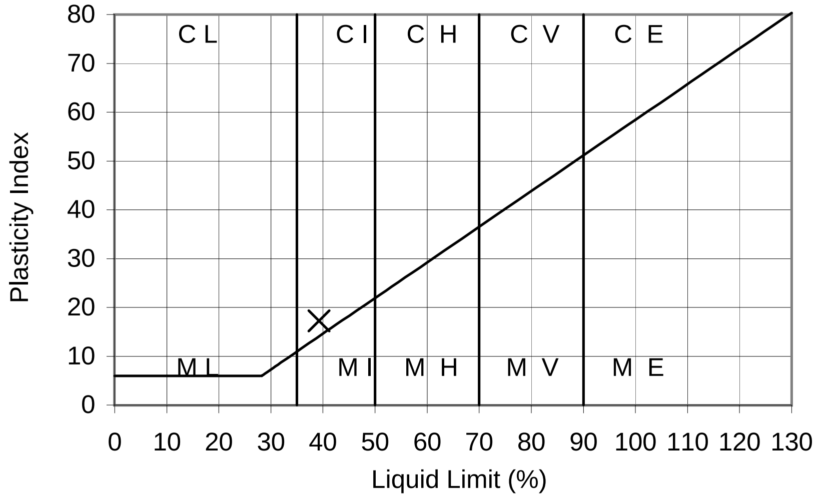
TTK **Figure 3**

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP102
Engineer		Sample Ref	
		Depth (m)	2.00
		Sample Type	T

Non Engineering Description : Dark brown sandy, silty CLAY.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	19.3	Water content 1 (%)	38.5
Penetration 2 (mm)	19.0	Water content 2 (%)	38.5
Correllation Factor Used			1.02

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	22.8 %
Percentage retained on 425µm sieve :	0 %
Liquid Limit :	39 %
Plastic Limit :	22 %
Plasticity Index :	17
Equivalent water content of material passing 425µm sieve :	22.8 %
Liquidity Index :	0.05

Originator	Checked & Approved
TJH	22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

Figure 4

Sheet 1 of 1

Version 056 - 19/05/2021

1220 - LLPL TP107 00.70 T - B28810-817126.xls : Sample ID 817126

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

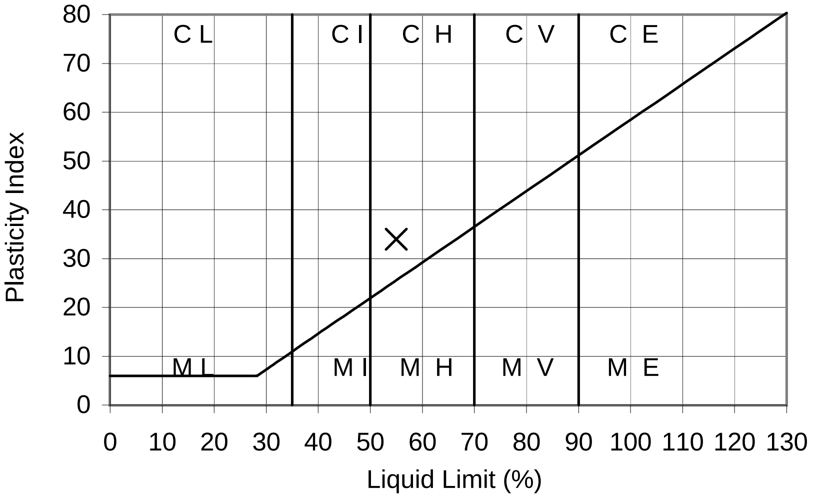
Engineer

Contract No. B28810

Hole ID	TP107
Sample Ref	
Depth (m)	0.70
Sample Type	T

Non Engineering Description : Brown/ grey slightly sandy CLAY.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	22.0	Water content 1 (%)	56.7
Penetration 2 (mm)	22.2	Water content 2 (%)	57.0
Correllation Factor Used			0.967

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	25.5 %
Percentage retained on 425µm sieve :	0 %
Liquid Limit :	55 %
Plastic Limit :	21 %
Plasticity Index :	34
Equivalent water content of material passing 425µm sieve :	25.5 %
Liquidity Index :	0.13

Originator	Checked & Approved
TJH	22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

Figure 5

Sheet 1 of 1

Moor Lane, Witton, Birmingham, B6 7HG

Lab Project No B28810 : 22/04/2022 13:43:52

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

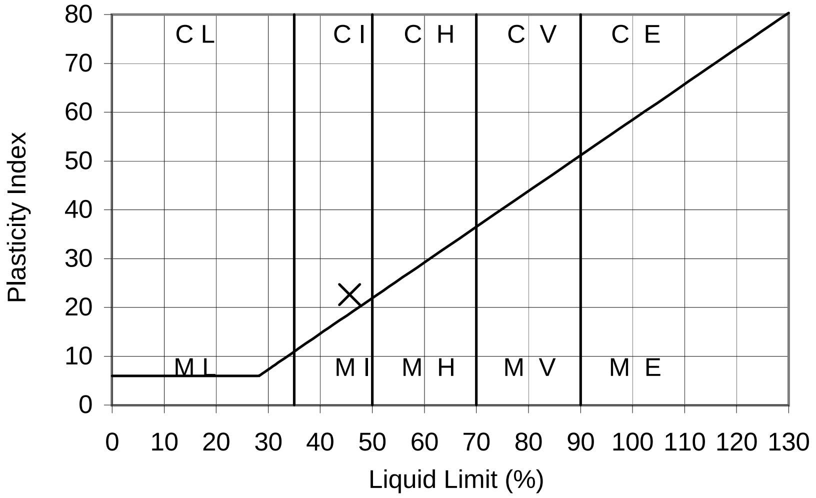
Engineer

Contract No. B28810

Hole ID	TP107
Sample Ref	
Depth (m)	1.60
Sample Type	T

Non Engineering Description : Brown silty, sandy CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	22.5	Water content 1 (%)	47.0
Penetration 2 (mm)	23.0	Water content 2 (%)	47.2
Correllation Factor Used			0.968

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	23.6	%
Percentage retained on 425µm sieve :	11	%
Liquid Limit :	46	%
Plastic Limit :	23	%
Plasticity Index :	23	
Equivalent water content of material passing 425µm sieve :	26.5	%
Liquidity Index :	0.15	

Originator	Checked & Approved
SH	22/04/2022

Liquid Limit (One Point Cone Penetrometer Method) Plastic Limit, Plasticity Index & Liquidity Index

BS EN ISO 17892-12:2018 Clause 5.3.14

BS EN ISO 17892-12:2018 Clause 5.5

Figure 6

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

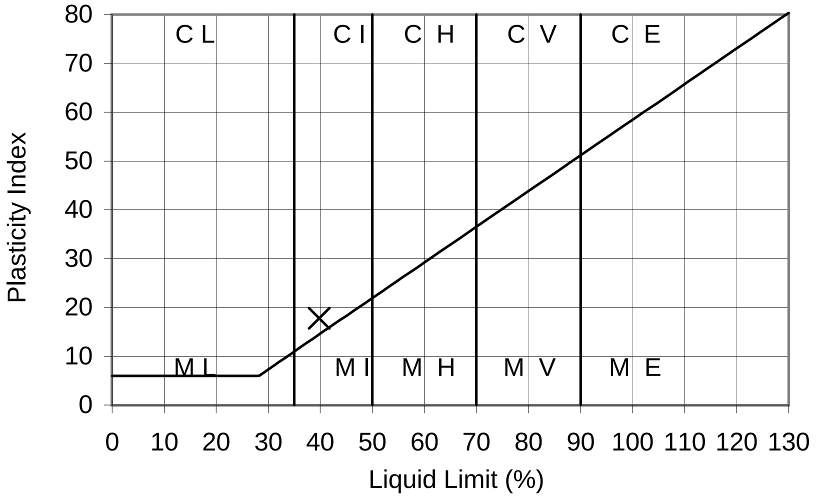
Site SHAW LANE, ELLAND
Client
Engineer

Contract No. B28810

Hole ID	TP110
Sample Ref	
Depth (m)	0.80
Sample Type	T

Non Engineering Description : Brown sandy, silty CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	19.5	Water content 1 (%)	39.0
Penetration 2 (mm)	19.7	Water content 2 (%)	39.0
Correllation Factor Used			1.02

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	17.2 %
Percentage retained on 425µm sieve :	18 %
Liquid Limit :	40 %
Plastic Limit :	22 %
Plasticity Index :	18
Equivalent water content of material passing 425µm sieve :	20.9 %
Liquidity Index :	-0.06

Originator	Checked & Approved
TJH	22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTk

Figure 7

Site SHAW LANE, ELLAND

Client

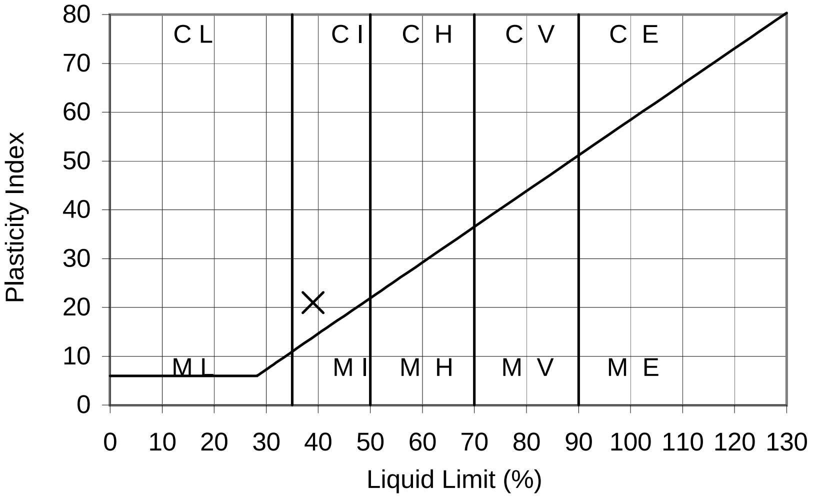
Engineer

Contract No. B28810

Hole ID TP112
Sample Ref
Depth (m) 0.90
Sample Type T

Non Engineering Description : Grey/ brown sandy CLAY.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	20.0	Water content 1 (%)	38.2
Penetration 2 (mm)	19.5	Water content 2 (%)	38.3
Correllation Factor Used			1.02

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	21.5 %
Percentage retained on 425µm sieve :	0 %
Liquid Limit :	39 %
Plastic Limit :	18 %
Plasticity Index :	21
Equivalent water content of material passing 425µm sieve :	21.5 %
Liquidity Index :	0.17

Originator	Checked & Approved
TJH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index

BS EN ISO 17892-12:2018 Clause 5.3.14

BS EN ISO 17892-12:2018 Clause 5.5

TTK

Figure 8

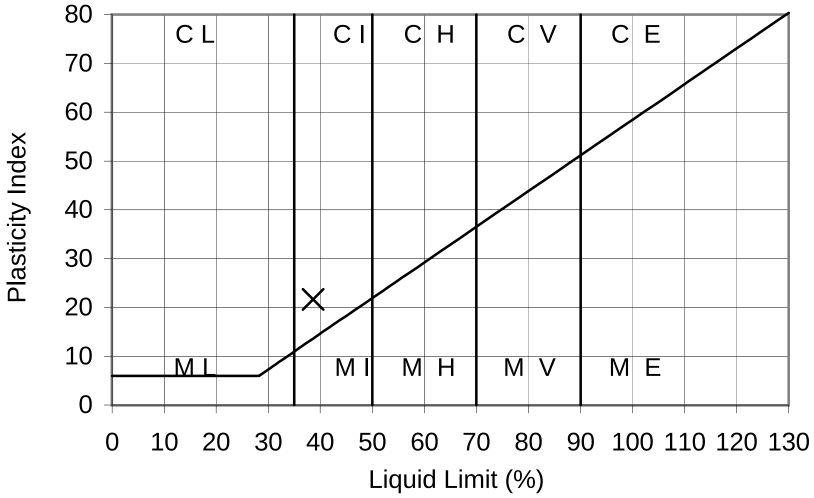
Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP112
Engineer		Sample Ref	
		Depth (m)	2.10
		Sample Type	T

Non Engineering Description : Brown sandy CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	17.9	Water content 1 (%)	37.3
Penetration 2 (mm)	18.1	Water content 2 (%)	37.1
Correllation Factor Used			1.039

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	15.4 %
Percentage retained on 425µm sieve :	17 %
Liquid Limit :	39 %
Plastic Limit :	17 %
Plasticity Index :	22
Equivalent water content of material passing 425µm sieve :	18.5 %
Liquidity Index :	0.07

Originator	Checked & Approved
TJH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

Figure 9

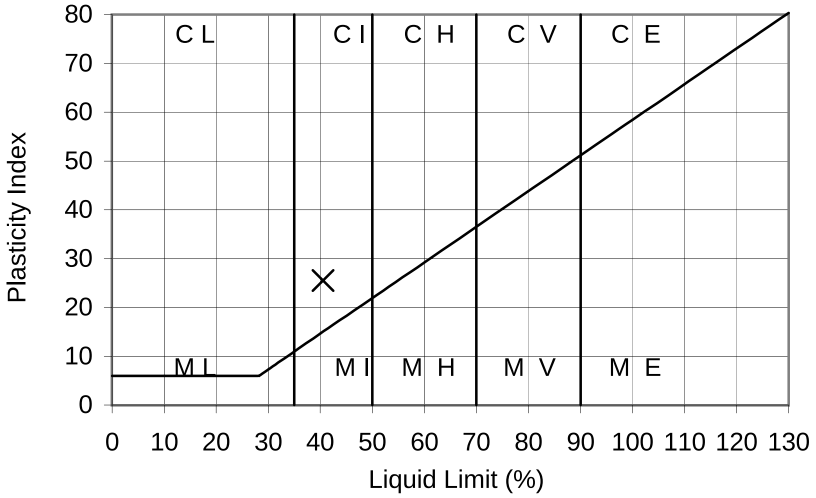
Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
		Hole ID	TP112
Client		Sample Ref	
		Depth (m)	2.40
Engineer		Sample Type	T

Non Engineering Description : Grey sandy, slightly silty CLAY.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	20.7	Water content 1 (%)	40.4
Penetration 2 (mm)	20.2	Water content 2 (%)	40.7
Correllation Factor Used			1

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	14.7	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	41	%
Plastic Limit :	15	%
Plasticity Index :	26	
Equivalent water content of material passing 425µm sieve :	14.7	%
Liquidity Index :	-0.01	

Originator	Checked & Approved
AH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

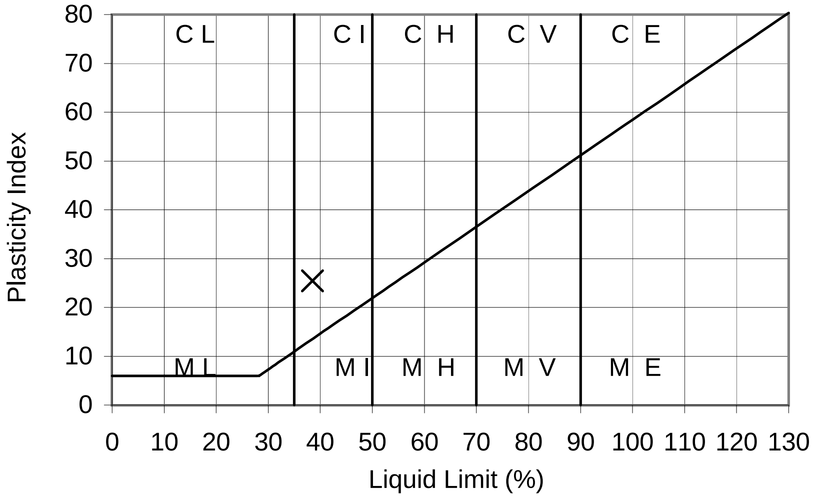
Figure 10

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP114
Engineer		Sample Ref	
		Depth (m)	2.00
		Sample Type	T

Non Engineering Description : Grey/ brown sandy, slightly silty CLAY with occasional gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	19.9	Water content 1 (%)	37.7
Penetration 2 (mm)	20.0	Water content 2 (%)	37.7
Correllation Factor Used			1.02

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	15.3	%
Percentage retained on 425µm sieve :	2	%
Liquid Limit :	38	%
Plastic Limit :	13	%
Plasticity Index :	25	
Equivalent water content of material passing 425µm sieve :	15.6	%
Liquidity Index :	0.10	

Originator	Checked & Approved
AH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index

BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTk

Figure 11

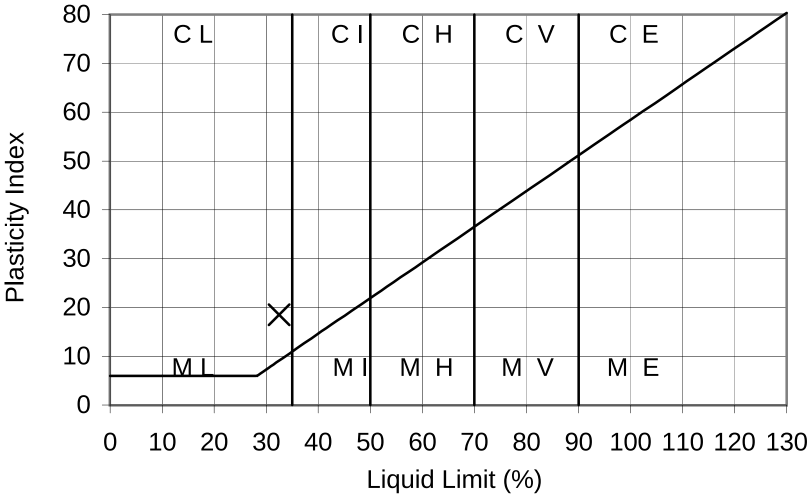
Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP116
Engineer		Sample Ref	
		Depth (m)	0.60
		Sample Type	T

Non Engineering Description : Light brown very sandy CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	21.1	Water content 1 (%)	33.0
Penetration 2 (mm)	20.9	Water content 2 (%)	33.1
Correllation Factor Used			0.984

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	23.9	%
Percentage retained on 425µm sieve :	8	%
Liquid Limit :	32	%
Plastic Limit :	14	%
Plasticity Index :	18	
Equivalent water content of material passing 425µm sieve :	26.0	%
Liquidity Index :	0.67	

Originator	Checked & Approved
TJH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index

BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

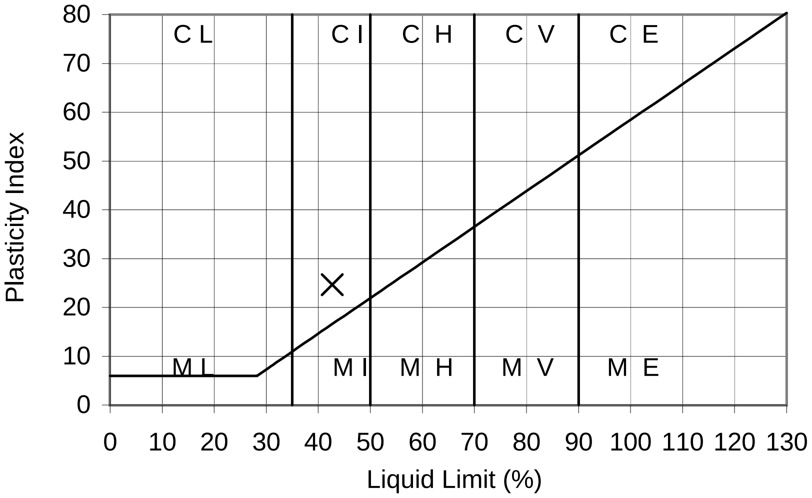
Figure 12

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP116
Engineer		Sample Ref	
		Depth (m)	1.60
		Sample Type	T

Non Engineering Description : Dark brown sandy, slightly silty CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	21.3	Water content 1 (%)	43.4
Penetration 2 (mm)	21.5	Water content 2 (%)	43.3
Correllation Factor Used			0.984

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	17.1	%
Percentage retained on 425µm sieve :	14	%
Liquid Limit :	43	%
Plastic Limit :	18	%
Plasticity Index :	25	
Equivalent water content of material passing 425µm sieve :	19.9	%
Liquidity Index :	0.08	

Originator	Checked & Approved
SH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index

BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

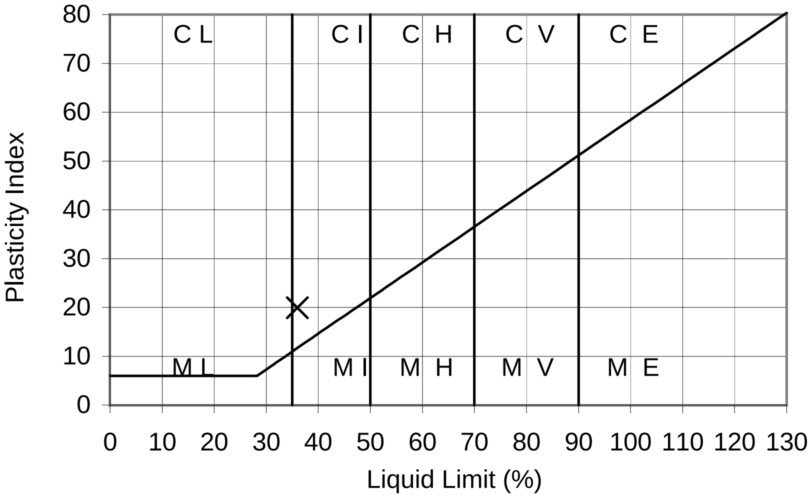
Figure 13

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP116
Engineer		Sample Ref	
		Depth (m)	2.20
		Sample Type	T

Non Engineering Description : Brown/ grey sandy CLAY with much gravel. Gravel is fine to coarse.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	18.7	Water content 1 (%)	34.8
Penetration 2 (mm)	18.4	Water content 2 (%)	35.1
Correllation Factor Used			1.03

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	9.5	%
Percentage retained on 425µm sieve :	28	%
Liquid Limit :	36	%
Plastic Limit :	16	%
Plasticity Index :	20	
Equivalent water content of material passing 425µm sieve :	13.2	%
Liquidity Index :	-0.14	

Originator	Checked & Approved
AH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index

BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTk **Figure 14**

Sheet 1 of 1

Version 056 - 19/05/2021
1220 - LLPL TP120 00.70 T - B28810-817185.xls : Sample ID 817185

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

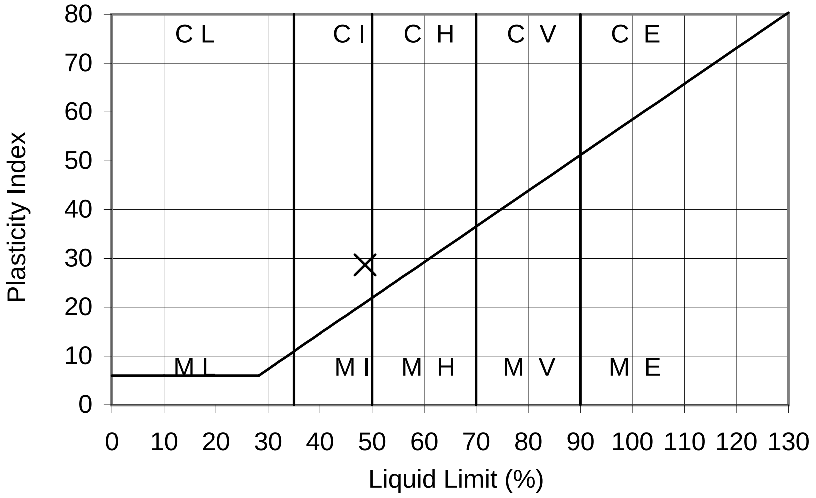
Engineer

Contract No. B28810

Hole ID	TP120
Sample Ref	
Depth (m)	0.70
Sample Type	T

Non Engineering Description : Brown sandy, slightly silty CLAY.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	20.4	Water content 1 (%)	48.5
Penetration 2 (mm)	19.9	Water content 2 (%)	48.8
Correllation Factor Used			1

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	26.8 %
Percentage retained on 425µm sieve :	0 %
Liquid Limit :	49 %
Plastic Limit :	20 %
Plasticity Index :	29
Equivalent water content of material passing 425µm sieve :	26.8 %
Liquidity Index :	0.23

Originator	Checked & Approved
AH	22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTk

Figure 15

Sheet 1 of 1

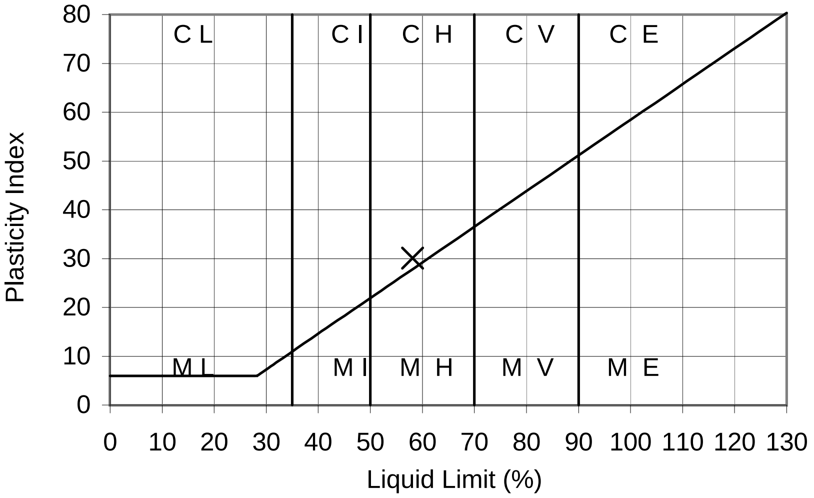
Moor Lane, Witton, Birmingham, B6 7HG
Lab Project No B28810 : 22/04/2022 13:44:25

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP123
Engineer		Sample Ref	
		Depth (m)	1.80
		Sample Type	T

Non Engineering Description : Brown silty CLAY.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	21.3	Water content 1 (%)	59.1
Penetration 2 (mm)	21.1	Water content 2 (%)	59.1
Correllation Factor Used			0.984

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	33.3	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	58	%
Plastic Limit :	28	%
Plasticity Index :	30	
Equivalent water content of material passing 425µm sieve :	33.3	%
Liquidity Index :	0.18	

Originator	Checked & Approved
TJH	22/04/2022

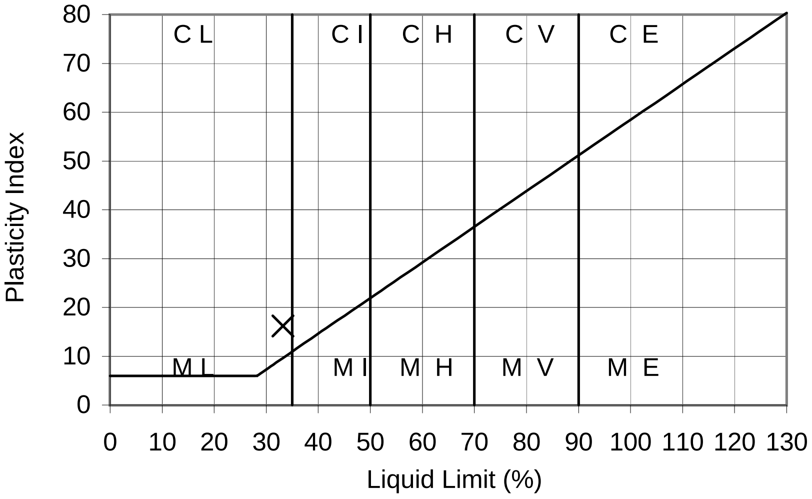
Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

Figure 16

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site SHAW LANE, ELLAND	**Contract No. B28810**
	Client Engineer	Hole ID TP124 Sample Ref Depth (m) 1.20 Sample Type T

Non Engineering Description : Brown very sandy CLAY with some gravel. Gravel is fine to coarse.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	19.6	Water content 1 (%)	32.6
Penetration 2 (mm)	20.0	Water content 2 (%)	32.8
Correllation Factor Used			1.015

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	14.6 %
Percentage retained on 425µm sieve :	23 %
Liquid Limit :	33 %
Plastic Limit :	17 %
Plasticity Index :	16
Equivalent water content of material passing 425µm sieve :	18.9 %
Liquidity Index :	0.12

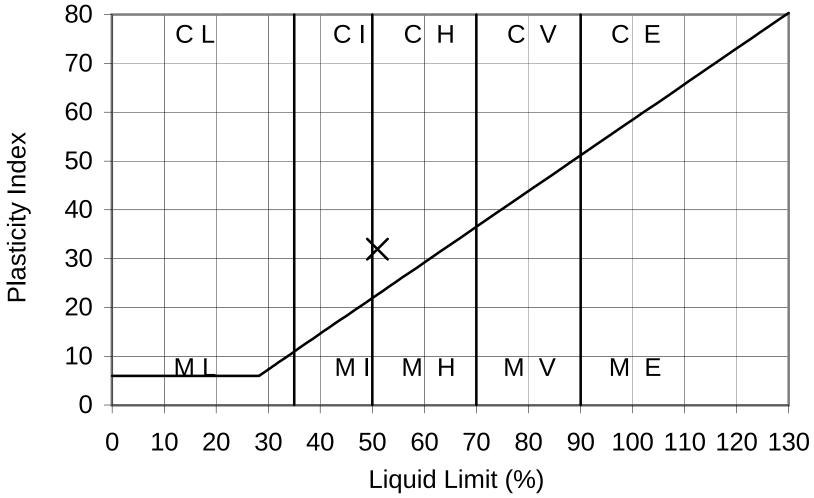
Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS EN ISO 17892-12:2018 Clause 5.3.14 BS EN ISO 17892-12:2018 Clause 5.5	TTK	**Figure 17**
AH	22/04/2022			Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP124
		Sample Ref	
		Depth (m)	1.90
Engineer		Sample Type	T

Non Engineering Description : Dark brown silty, sandy CLAY.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	19.7	Water content 1 (%)	50.0
Penetration 2 (mm)	19.6	Water content 2 (%)	49.9
Correllation Factor Used			1.02

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	21.3 %
Percentage retained on 425µm sieve :	0 %
Liquid Limit :	51 %
Plastic Limit :	19 %
Plasticity Index :	32
Equivalent water content of material passing 425µm sieve :	21.3 %
Liquidity Index :	0.07

Originator	Checked & Approved
SH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

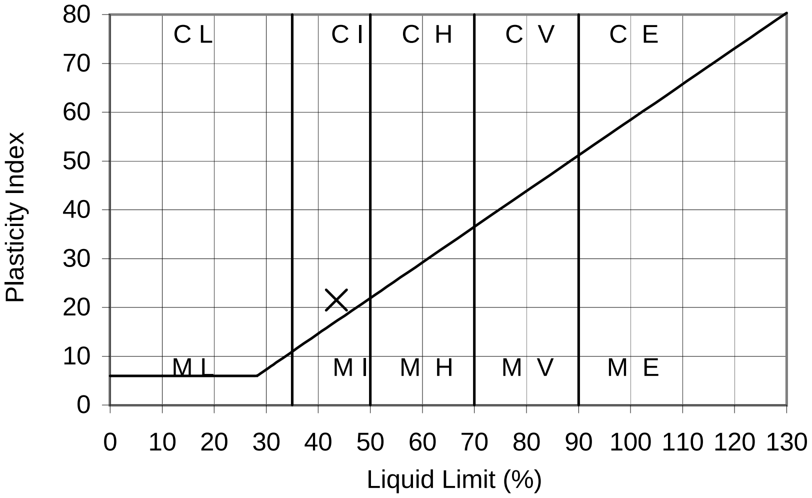
Figure 18

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP128
Engineer		Sample Ref	
		Depth (m)	0.60
		Sample Type	T

Non Engineering Description : Brown/ grey silty, sandy CLAY with some gravel. Gravel is fine to coarse.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	19.6	Water content 1 (%)	42.5
Penetration 2 (mm)	19.5	Water content 2 (%)	42.8
Correllation Factor Used			1.02

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	23.7	%
Percentage retained on 425µm sieve :	6	%
Liquid Limit :	43	%
Plastic Limit :	22	%
Plasticity Index :	21	
Equivalent water content of material passing 425µm sieve :	25.2	%
Liquidity Index :	0.15	

Originator	Checked & Approved
AH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

Figure 19

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

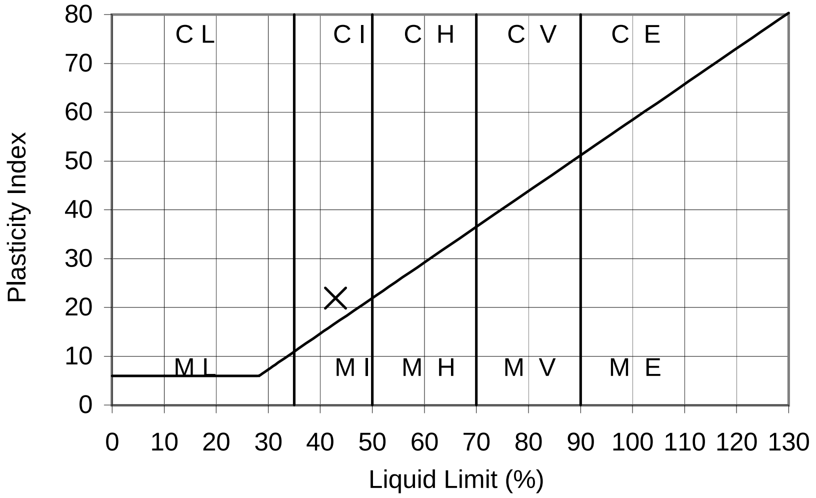
Engineer

Contract No. B28810

Hole ID TP128
Sample Ref
Depth (m) 1.50
Sample Type T

Non Engineering Description : Dark brown sandy CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	20.5	Water content 1 (%)	42.7
Penetration 2 (mm)	20.0	Water content 2 (%)	43.2
Correllation Factor Used			1

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	20.9 %
Percentage retained on 425µm sieve :	15 %
Liquid Limit :	43 %
Plastic Limit :	21 %
Plasticity Index :	22
Equivalent water content of material passing 425µm sieve :	24.6 %
Liquidity Index :	0.16

Originator	Checked & Approved
SH	22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

Figure 20

Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

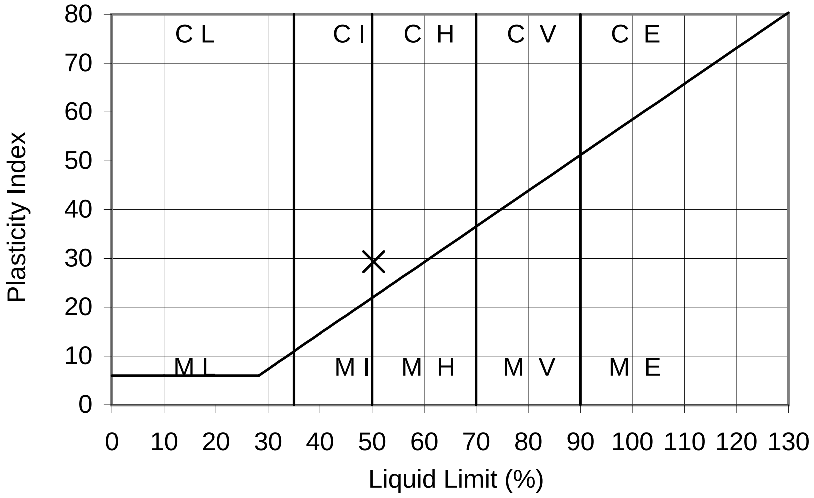
Engineer

Contract No. B28810

Hole ID TP131
Sample Ref
Depth (m) 2.20
Sample Type T

Non Engineering Description : Dark brown silty, sandy CLAY.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	18.5	Water content 1 (%)	48.5
Penetration 2 (mm)	18.7	Water content 2 (%)	48.3
Correllation Factor Used			1.039

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	23.4	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	50	%
Plastic Limit :	21	%
Plasticity Index :	29	
Equivalent water content of material passing 425µm sieve :	23.4	%
Liquidity Index :	0.08	

Originator	Checked & Approved
TJH	S. Langmen 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

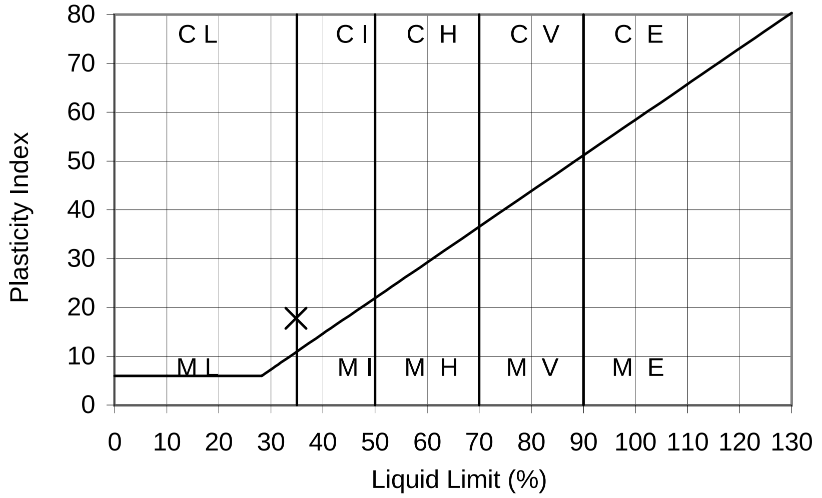
Figure 21

Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site SHAW LANE, ELLAND	**Contract No. B28810**
	Client Engineer	Hole ID TP133 Sample Ref Depth (m) 0.60 Sample Type T

Non Engineering Description : Brown very sandy, silty CLAY with some gravel. Gravel is fine to coarse.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	21.0	Water content 1 (%)	35.3
Penetration 2 (mm)	21.2	Water content 2 (%)	35.4
Correllation Factor Used			0.984

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	24.6 %
Percentage retained on 425µm sieve :	9 %
Liquid Limit :	35 %
Plastic Limit :	17 %
Plasticity Index :	18
Equivalent water content of material passing 425µm sieve :	27.0 %
Liquidity Index :	0.56

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS EN ISO 17892-12:2018 Clause 5.3.14 BS EN ISO 17892-12:2018 Clause 5.5	TTK **Figure 22** Sheet 1 of 1
SH	S. Langman 22/04/2022		

Version 056 - 19/05/2021

1220 - LLPL TP134 00.70 B - B28810-817298.xls : Sample ID 817298

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

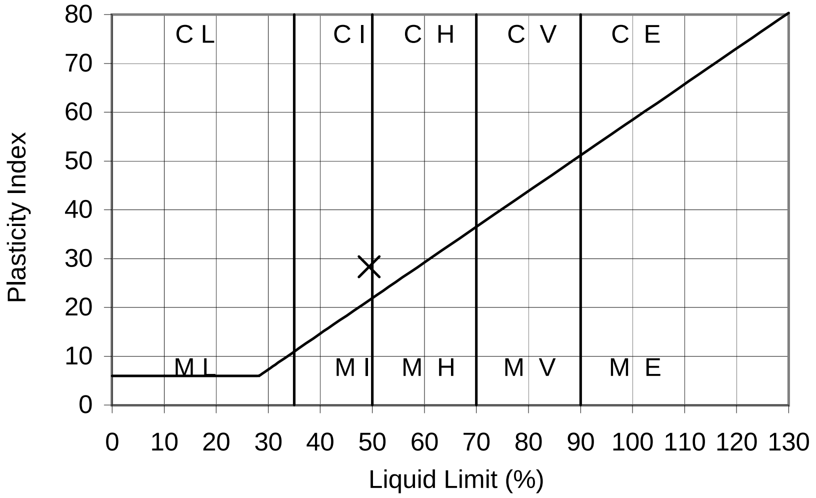
Engineer

Contract No. B28810

Hole ID	TP134
Sample Ref	
Depth (m)	0.70
Sample Type	B

Non Engineering Description : Brown very sandy CLAY/ SILT with some organic matter and occasional gravel. Gravel is fine to coarse.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	22.5	Water content 1 (%)	51.1
Penetration 2 (mm)	22.7	Water content 2 (%)	51.0
Correllation Factor Used			0.967

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	31.6 %
Percentage retained on 425µm sieve :	11 %
Liquid Limit :	49 %
Plastic Limit :	21 %
Plasticity Index :	28
Equivalent water content of material passing 425µm sieve :	35.5 %
Liquidity Index :	0.52

Originator	Checked & Approved
SH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

Figure 23

Sheet 1 of 1

Moor Lane, Witton, Birmingham, B6 7HG

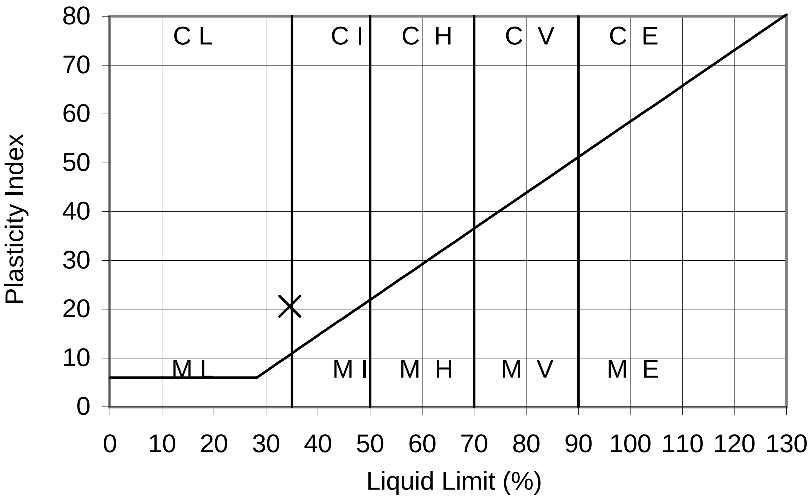
Lab Project No B28810 : 22/04/2022 13:44:50

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP136
		Sample Ref	
		Depth (m)	1.40
Engineer		Sample Type	T

Non Engineering Description : Brown very sandy CLAY with occasional gravel. Gravel is fine to medium.

Preparation : Sample as received, Percentage retained on 425µm sieve estimated by hand picking



Penetration 1 (mm)	19.8	Water content 1 (%)	34.7
Penetration 2 (mm)	20.2	Water content 2 (%)	34.4
Correllation Factor Used			1

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	18.7 %
Percentage retained on 425µm sieve :	3 %
Liquid Limit :	35 %
Plastic Limit :	14 %
Plasticity Index :	21
Equivalent water content of material passing 425µm sieve :	19.2 %
Liquidity Index :	0.25

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS EN ISO 17892-12:2018 Clause 5.3.14 BS EN ISO 17892-12:2018 Clause 5.5	TTK	**Figure 24**
SH	S. Langmea 22/04/2022			Sheet 1 of 1

Version 056 - 19/05/2021

1220 - LLPL TP136 02.20 T - B28810-817249.xls : Sample ID 817249

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

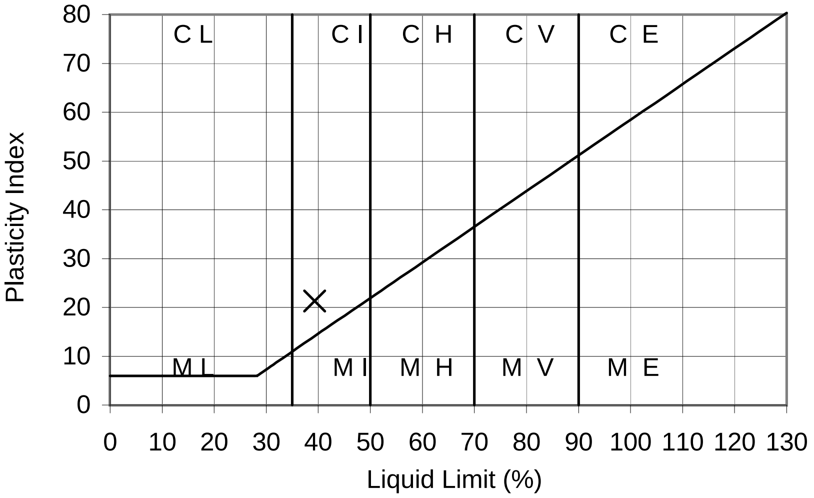
Engineer

Contract No. B28810

Hole ID TP136
Sample Ref
Depth (m) 2.20
Sample Type T

Non Engineering Description : Dark brown CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	19.2	Water content 1 (%)	38.4
Penetration 2 (mm)	18.8	Water content 2 (%)	38.6
Correllation Factor Used			1.02

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	15.4	%
Percentage retained on 425µm sieve :	13	%
Liquid Limit :	39	%
Plastic Limit :	18	%
Plasticity Index :	21	
Equivalent water content of material passing 425µm sieve :	17.6	%
Liquidity Index :	-0.02	

Originator	Checked & Approved
AH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

Figure 25

Sheet 1 of 1

Moor Lane, Witton, Birmingham, B6 7HG

Lab Project No B28810 : 22/04/2022 13:44:56

Version 056 - 19/05/2021

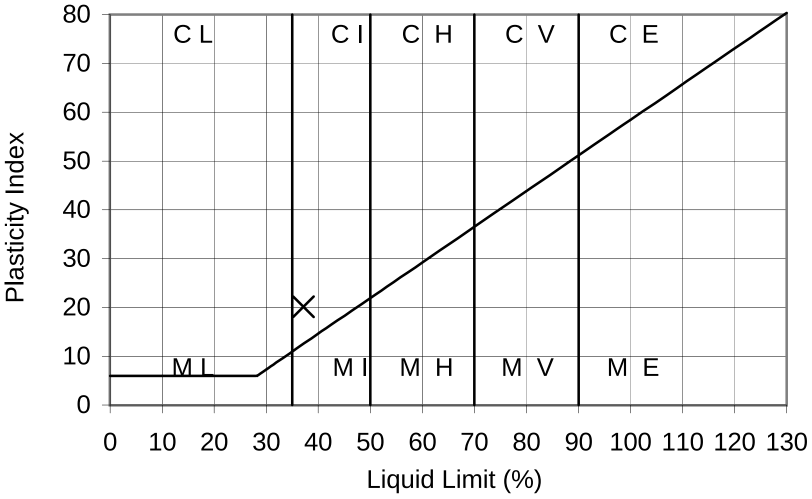
1220 - LLPL TP137 00.60 T - B28810-817252.xls : Sample ID 817252

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP137
		Sample Ref	
		Depth (m)	0.60
Engineer		Sample Type	T

Non Engineering Description : Brown sandy CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	17.4	Water content 1 (%)	34.9
Penetration 2 (mm)	16.9	Water content 2 (%)	35.3
Correllation Factor Used			1.058

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	18.7	%
Percentage retained on 425µm sieve :	24	%
Liquid Limit :	37	%
Plastic Limit :	17	%
Plasticity Index :	20	
Equivalent water content of material passing 425µm sieve :	24.6	%
Liquidity Index :	0.38	

Originator	Checked & Approved
TJH	22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index

BS EN ISO 17892-12:2018 Clause 5.3.14

BS EN ISO 17892-12:2018 Clause 5.5

TTK

Figure 26

Sheet 1 of 1

Moor Lane, Witton, Birmingham, B6 7HG

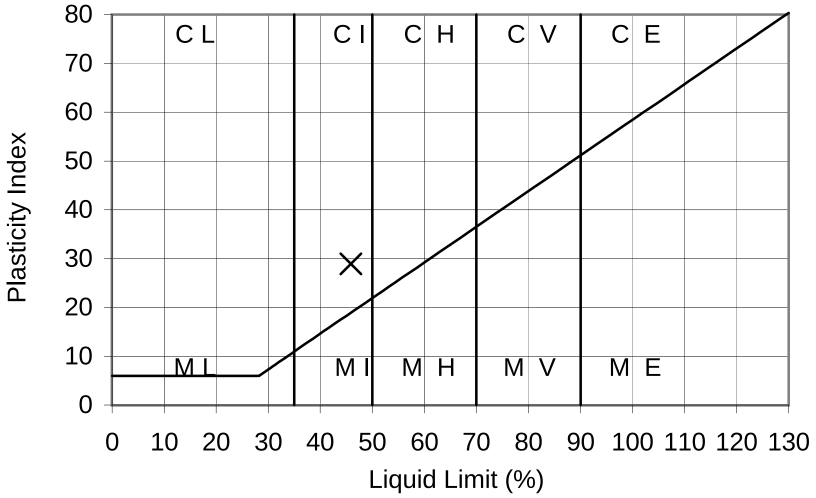
Lab Project No B28810 : 22/04/2022 13:44:59

Version 056 - 19/05/2021
1220 - LLPL TP139 00.60 T - B28810-817260.xls : Sample ID 817260

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site SHAW LANE, ELLAND	**Contract No. B28810**
	Client Engineer	Hole ID TP139 Sample Ref Depth (m) 0.60 Sample Type T

Non Engineering Description : Brown mottled grey silty, sandy CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	19.2	Water content 1 (%)	45.1
Penetration 2 (mm)	18.9	Water content 2 (%)	44.9
Correllation Factor Used			1.02

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	30.4	%
Percentage retained on 425µm sieve :	9	%
Liquid Limit :	46	%
Plastic Limit :	17	%
Plasticity Index :	29	
Equivalent water content of material passing 425µm sieve :	33.4	%
Liquidity Index :	0.57	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS EN ISO 17892-12:2018 Clause 5.3.14 BS EN ISO 17892-12:2018 Clause 5.5	TTk	**Figure 27** Sheet 1 of 1
SH	22/04/2022			

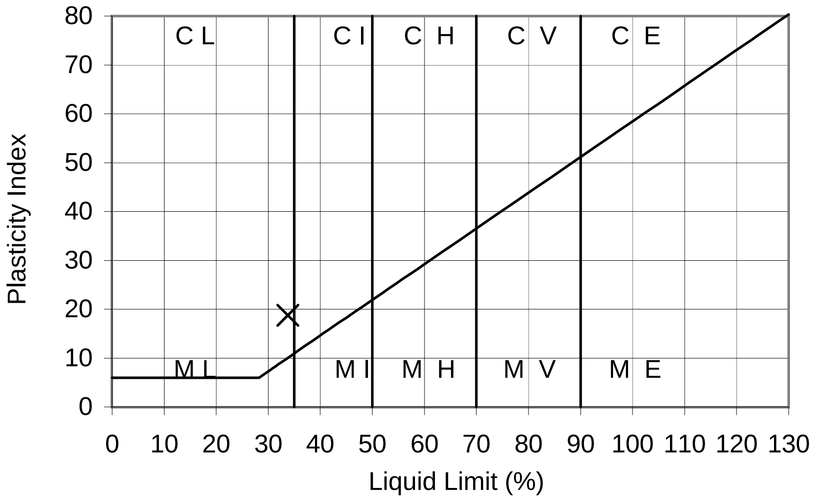
Moor Lane, Witton, Birmingham, B6 7HG
Lab Project No B28810 : 22/04/2022 13:45:02

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP139
Engineer		Sample Ref	
		Depth (m)	1.60
		Sample Type	T

Non Engineering Description : Brown very sandy CLAY with some gravel. Gravel is fine to coarse.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	17.0	Water content 1 (%)	32.5
Penetration 2 (mm)	17.5	Water content 2 (%)	32.4
Correllation Factor Used			1.042

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	12.5	%
Percentage retained on 425µm sieve :	21	%
Liquid Limit :	34	%
Plastic Limit :	15	%
Plasticity Index :	19	
Equivalent water content of material passing 425µm sieve :	15.7	%
Liquidity Index :	0.04	

Originator	Checked & Approved
AH	S. Langman 22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

TTK

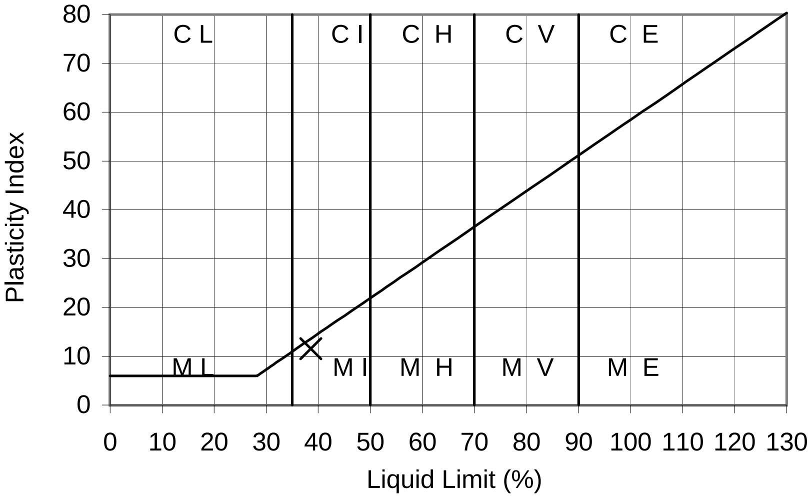
Figure 28

Sheet 1 of 1

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP143
Engineer		Sample Ref	
		Depth (m)	0.70
		Sample Type	T

Non Engineering Description : Brown fine to coarse GRAVEL with much clayey silt.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	19.6	Water content 1 (%)	37.9
Penetration 2 (mm)	19.8	Water content 2 (%)	37.7
Correllation Factor Used			1.02

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	17.8	%
Percentage retained on 425µm sieve :	53	%
Liquid Limit :	39	%
Plastic Limit :	27	%
Plasticity Index :	12	
Equivalent water content of material passing 425µm sieve :	37.6	%
Liquidity Index :	0.88	

Originator	Checked & Approved
SH	22/04/2022

Liquid Limit (One Point Cone Penetrometer Method)
Plastic Limit, Plasticity Index & Liquidity Index
BS EN ISO 17892-12:2018 Clause 5.3.14
BS EN ISO 17892-12:2018 Clause 5.5

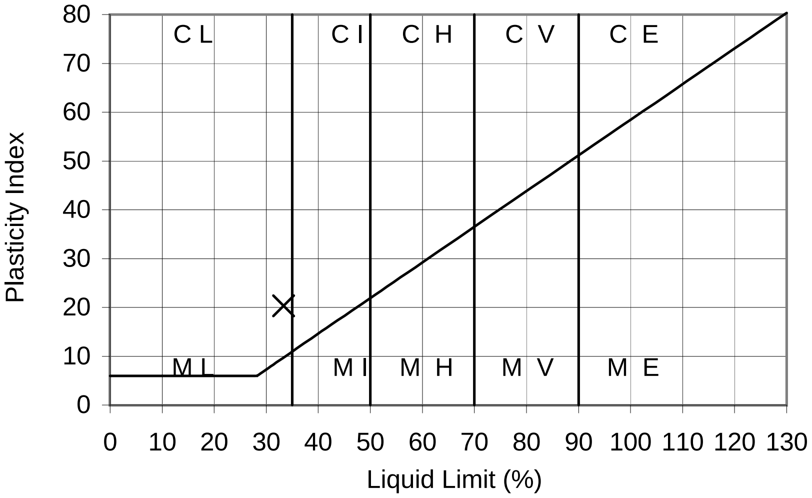
Figure 29

Version 056 - 19/05/2021

1220 - LLPL TP143 01.60 T - B28810-817273.xls : Sample ID 817273

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site SHAW LANE, ELLAND	**Contract No. B28810** Hole ID TP143 Sample Ref Depth (m) 1.60 Sample Type T
	Client Engineer	

Non Engineering Description :	Brown very sandy CLAY with some gravel. Gravel is fine to medium.
Preparation :	Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	20.0	Water content 1 (%)	32.9
Penetration 2 (mm)	19.5	Water content 2 (%)	32.8
Correllation Factor Used			1.015

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	16.3	%
Percentage retained on 425µm sieve :	22	%
Liquid Limit :	33	%
Plastic Limit :	13	%
Plasticity Index :	20	
Equivalent water content of material passing 425µm sieve :	20.9	%
Liquidity Index :	0.40	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS EN ISO 17892-12:2018 Clause 5.3.14 BS EN ISO 17892-12:2018 Clause 5.5	TTk **Figure 30**
SH	22/04/2022		Sheet 1 of 1

Moor Lane, Witton, Birmingham, B6 7HG

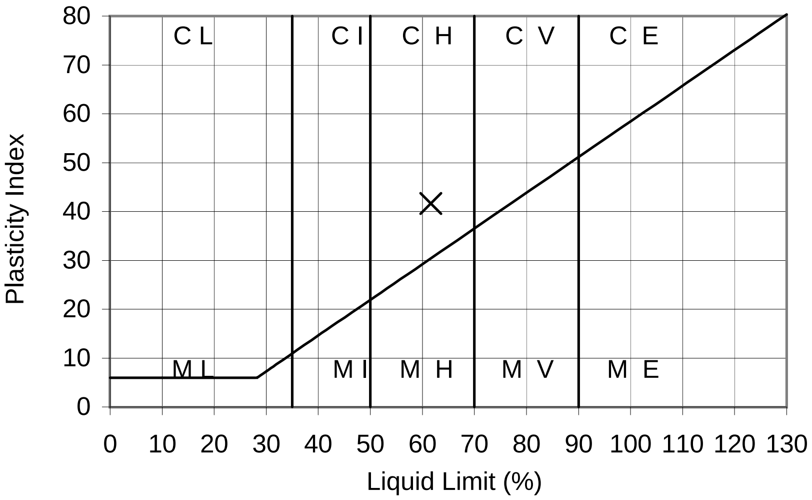
Lab Project No B28810 : 22/04/2022 13:45:10

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No.**	**B28810**
Client		Hole ID	TP146
Engineer		Sample Ref	
		Depth (m)	0.70
		Sample Type	T

Non Engineering Description : Light brown sandy CLAY.

Preparation : Sample washed and air dried, Percentage retained on 425µm sieve measured by wet sieving



Penetration 1 (mm)	18.2	Water content 1 (%)	59.4
Penetration 2 (mm)	18.2	Water content 2 (%)	59.5
Correllation Factor Used			1.036

Liquid Limit was determined by mixing using increasing water content and 30° cone

Results :

As Received Water Content : (BS EN ISO 17892-1:2014)	22.2	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	62	%
Plastic Limit :	20	%
Plasticity Index :	42	
Equivalent water content of material passing 425µm sieve :	22.2	%
Liquidity Index :	0.05	

Originator	Checked & Approved	**Liquid Limit (One Point Cone Penetrometer Method)**	**Figure 31**
RH	S. Langman 22/04/2022	**Plastic Limit, Plasticity Index & Liquidity Index** BS EN ISO 17892-12:2018 Clause 5.3.14 BS EN ISO 17892-12:2018 Clause 5.5	Sheet 1 of 1

Version 058 - 10/06/2013

1263 - PSD - BS EN 17892 TP102 00.20 B - B28810-817289.xls : Sample ID 817289

TERRA TEK

SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No**	**B28810**
Client		Hole	TP102
		Sample Ref	
		Depth (m)	0.20
Engineer		Sample Type	B

Particle Size	% Passing
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	99
10.0 mm	99
6.30 mm	97
5.00 mm	96
3.35 mm	91
2.00 mm	87
1.18 mm	82
630 µm	75
425 µm	70
300 µm	64
200 µm	55
150 µm	51
63 µm	38
20 µm	26
6 µm	19
2 µm	12

Non Engineering Description

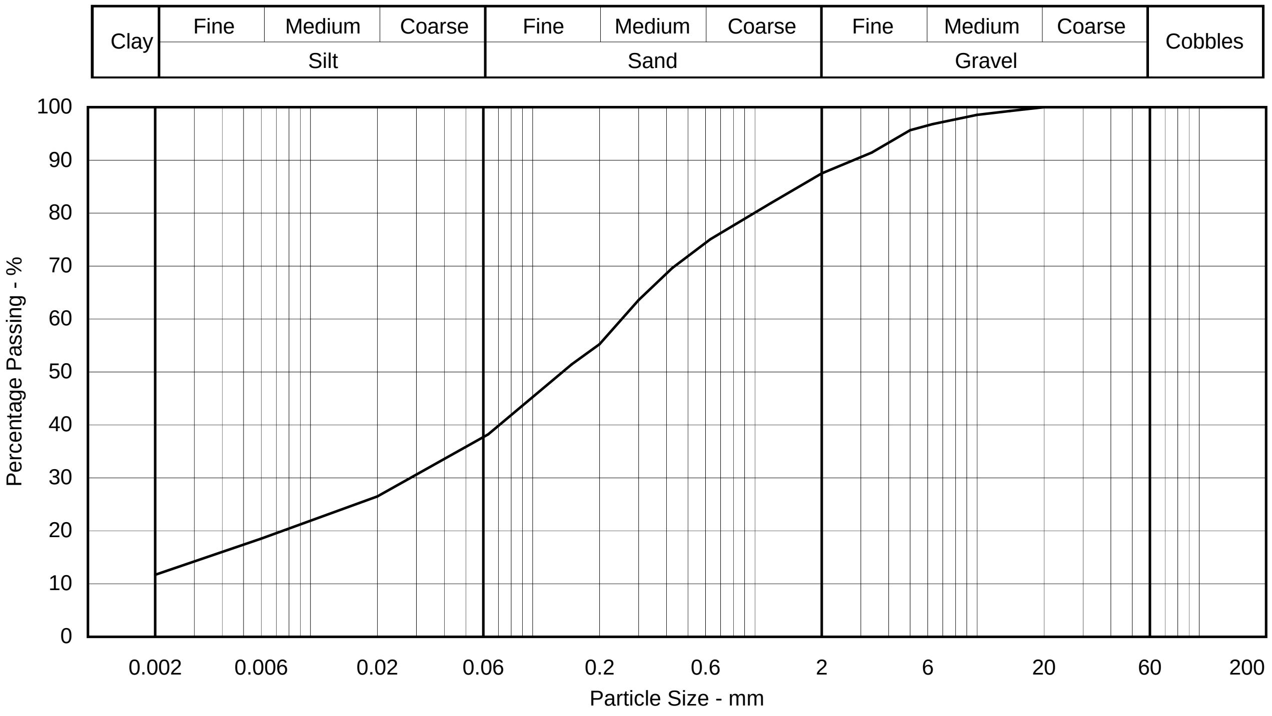
Brown very silty, clayey SAND with some gravel and organic matter.

Sample Proportions - %	
Cobbles	0.0
Gravel	12.5
Sand	50.1
Silt	25.7
Clay	11.6

Particle Diameter - mm	
D100	20
D60	0.25
D10	
Uniformity Coefficient (SHW series 600, Table 6/1, footnote 5)	N/A

Notes

Sedimentation sample not pre-treated



Moor Lane, Witton, Birmingham, B6 7HG

Lab Project No B28810 : 22/04/2022 13:45:16

Originator	Checked & Approved
RH RH/ME	22/04/2022

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4 2016 Clause 5.2 - Sieving Method

BS EN ISO 17892-4 2016 Clause 5.4 - Pipette Method

TTk

Figure 32

Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810**

Hole TP108
Sample Ref
Depth (m) 0.20
Sample Type B

Particle Size	% Passing
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	98
10.0 mm	98
6.30 mm	97
5.00 mm	96
3.35 mm	93
2.00 mm	90
1.18 mm	85
630 µm	76
425 µm	69
300 µm	62
200 µm	54
150 µm	50
63 µm	39
20 µm	29
6 µm	22
2 µm	15

Non Engineering Description

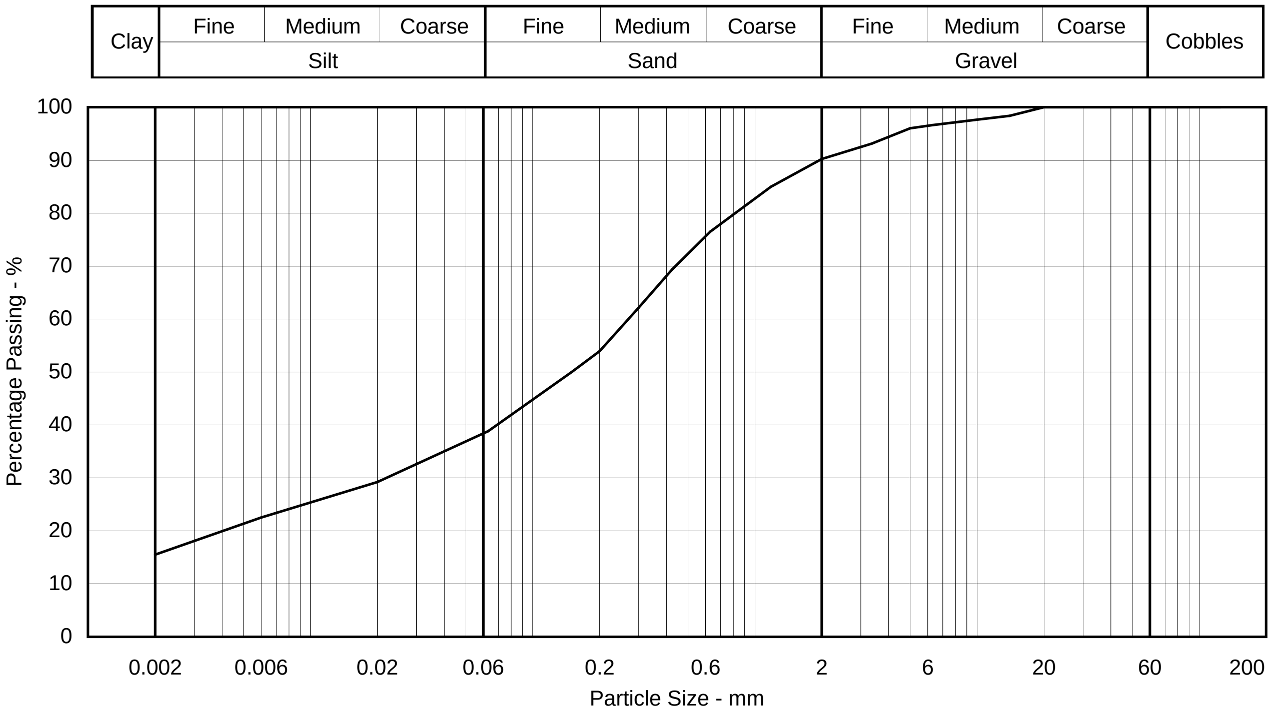
Brown clayey, silty SAND with much organic matter and some gravel. Gravel is fine to medium.

Sample Proportions - %	
Cobbles	0.0
Gravel	9.8
Sand	52.1
Silt	22.6
Clay	15.5

Particle Diameter - mm	
D100	20
D60	0.27
D10	
Uniformity Coefficient (SHW series 600, Table 6/1, footnote 5)	N/A

Notes

Sedimentation sample not pre-treated



Originator	Checked & Approved
RH RH/ME	22/04/2022

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4 2016 Clause 5.2 - Sieving Method
BS EN ISO 17892-4 2016 Clause 5.4 - Pipette Method

Figure 33

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Version 058 - 10/06/2013

1263 - PSD - BS EN 17892 TP113 00.20 B - B28810-817292.xls : Sample ID 817292

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	Contract No	**B28810**
Client		Hole	TP113
		Sample Ref	
Engineer		Depth (m)	0.20
		Sample Type	B

Particle Size	% Passing
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
10.0 mm	99
6.30 mm	97
5.00 mm	97
3.35 mm	94
2.00 mm	91
1.18 mm	86
630 µm	80
425 µm	75
300 µm	69
200 µm	60
150 µm	54
63 µm	41
20 µm	30
6 µm	24
2 µm	16

Non Engineering Description

Brown clayey, silty SAND with some gravel and organic matter. Gravel is fine to medium.

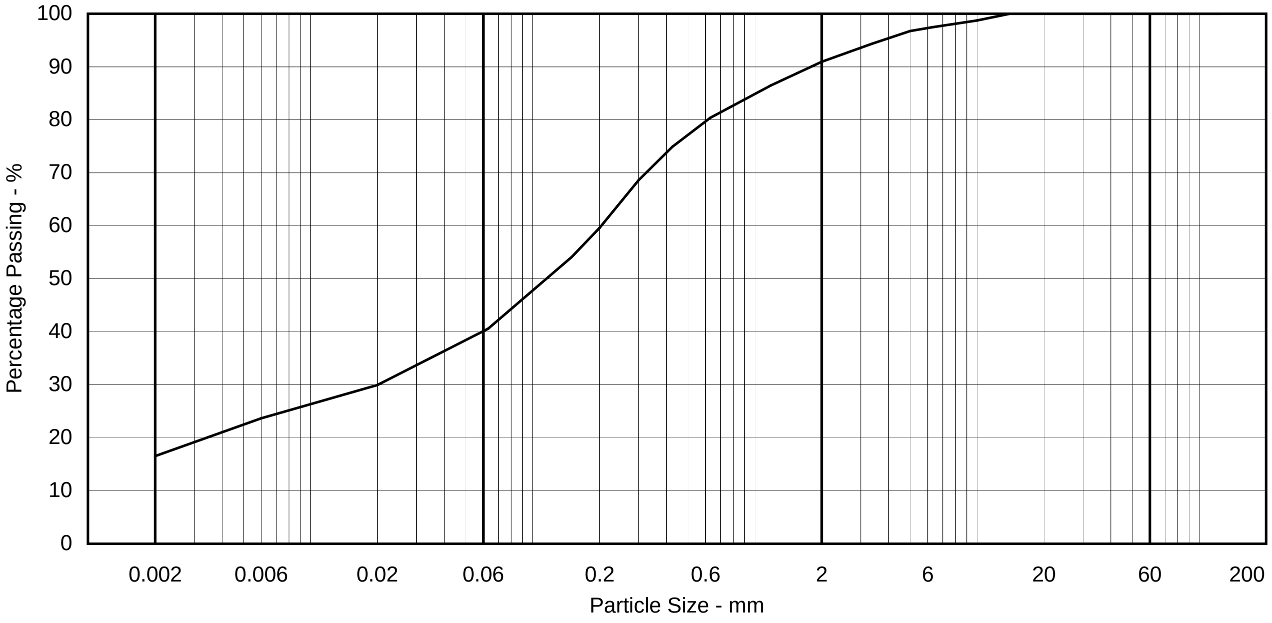
Sample Proportions - %	
Cobbles	0.0
Gravel	9.1
Sand	51.1
Silt	23.3
Clay	16.5

Particle Diameter - mm	
D100	14
D60	0.20
D10	
Uniformity Coefficient (SHW series 600, Table 6/1, footnote 5)	N/A

Notes

Sedimentation sample not pre-treated

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles
	Silt			Sand			Gravel			



Moor Lane, Witton, Birmingham, B6 7HG

Lab Project No B28810 : 22/04/2022 13:45:22

Originator	Checked & Approved
RH ME	22/04/2022

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4 2016 Clause 5.2 - Sieving Method
BS EN ISO 17892-4 2016 Clause 5.4 - Pipette Method

TTK

Figure 34

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1263 - PSD - BS EN 17892 TP117 00.20 B - B28810-817293.xls : Sample ID 817293

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No**	**B28810**
Client		Hole	TP117
		Sample Ref	
		Depth (m)	0.20
Engineer		Sample Type	B

Particle Size	% Passing
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	96
28.0 mm	96
20.0 mm	96
14.0 mm	95
10.0 mm	95
6.30 mm	93
5.00 mm	92
3.35 mm	88
2.00 mm	84
1.18 mm	79
630 µm	73
425 µm	69
300 µm	64
200 µm	56
150 µm	51
63 µm	36
20 µm	28
6 µm	20
2 µm	14

Non Engineering Description

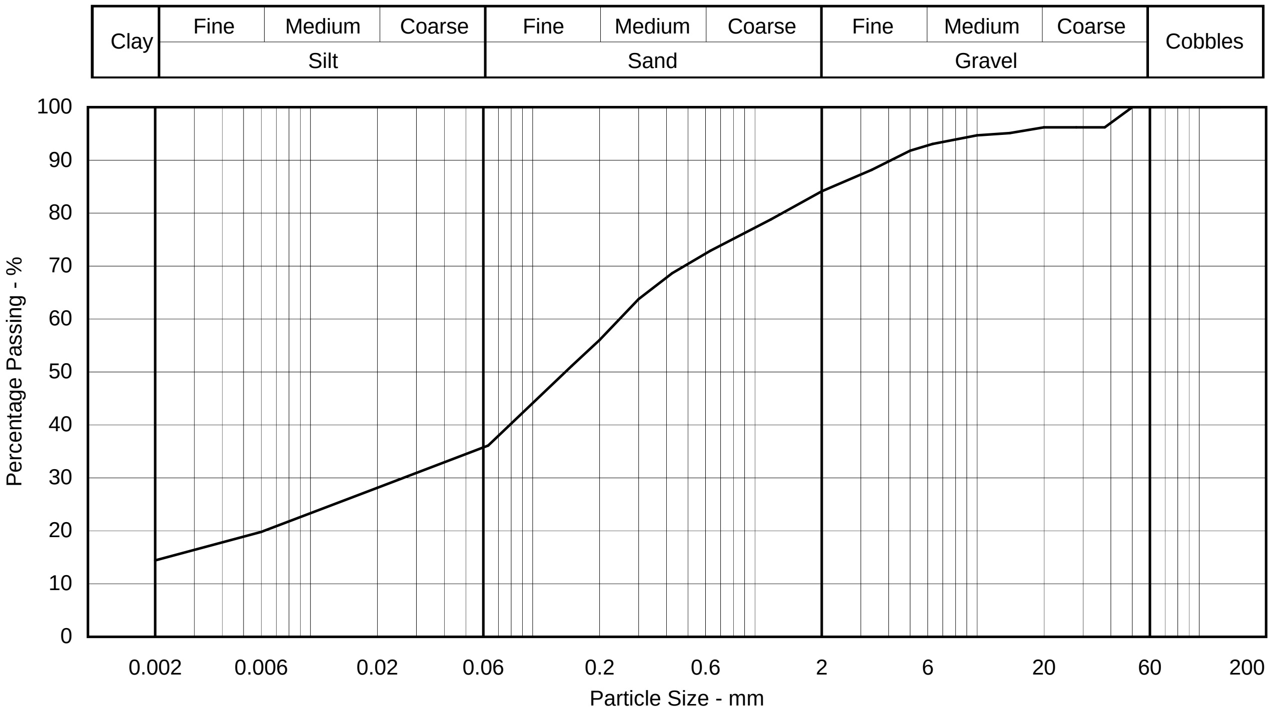
Brown clayey, silty SAND with some gravel and organic matter. Gravel is fine to coarse.

Sample Proportions - %	
Cobbles	0.0
Gravel	15.9
Sand	48.5
Silt	21.1
Clay	14.4

Particle Diameter - mm	
D100	50
D60	0.25
D10	
Uniformity Coefficient (SHW series 600, Table 6/1, footnote 5)	N/A

Notes

Sedimentation sample not pre-treated



Originator	Checked & Approved
RH ME	22/04/2022

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4 2016 Clause 5.2 - Sieving Method
BS EN ISO 17892-4 2016 Clause 5.4 - Pipette Method

Figure 35

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Moor Lane, Witton, Birmingham, B6 7HG

Lab Project No B28810 : 22/04/2022 13:45:24

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No**	**B28810**
Client		Hole	TP130
		Sample Ref	
		Depth (m)	0.20
Engineer		Sample Type	B

Particle Size	% Passing
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	96
20.0 mm	96
14.0 mm	95
10.0 mm	93
6.30 mm	91
5.00 mm	90
3.35 mm	86
2.00 mm	82
1.18 mm	77
630 µm	72
425 µm	68
300 µm	63
200 µm	57
150 µm	52
63 µm	39
20 µm	30
6 µm	21
2 µm	14

Non Engineering Description

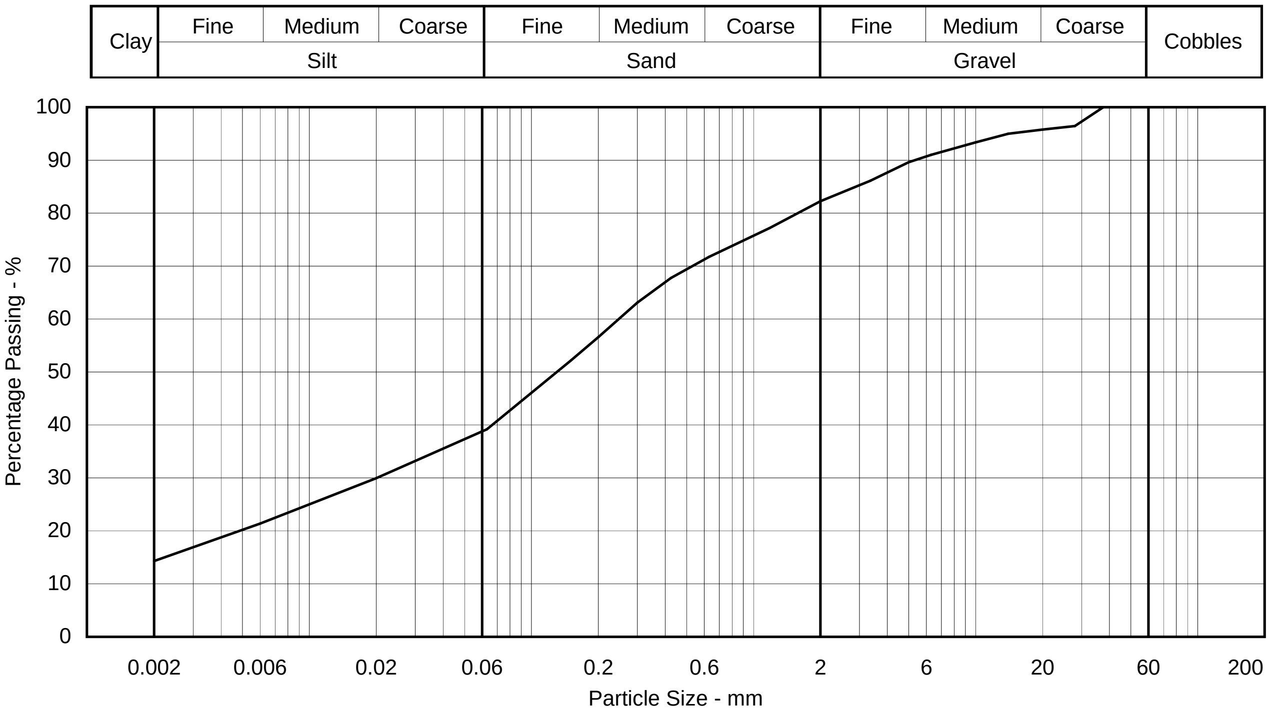
Brown silty, clayey SAND with some gravel and organic matter. Gravel is fine to coarse.

Sample Proportions - %	
Cobbles	0.0
Gravel	17.8
Sand	43.7
Silt	24.3
Clay	14.2

Particle Diameter - mm	
D100	38
D60	0.25
D10	
Uniformity Coefficient (SHW series 600, Table 6/1, footnote 5)	N/A

Notes

Sedimentation sample not pre-treated



Originator	Checked & Approved
RH ME	S. Langmein 22/04/2022

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4 2016 Clause 5.2 - Sieving Method
BS EN ISO 17892-4 2016 Clause 5.4 - Pipette Method

Figure 36

Version 058 - 10/06/2013

1263 - PSD - BS EN 17892 TP134 00.70 B - B28810-817298.xls : Sample ID 817298

TERRA TEK

SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No**	**B28810**
Client		Hole	TP134
		Sample Ref	
		Depth (m)	0.70
Engineer		Sample Type	B

Particle Size	% Passing
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	98
20.0 mm	98
14.0 mm	98
10.0 mm	97
6.30 mm	97
5.00 mm	96
3.35 mm	96
2.00 mm	95
1.18 mm	94
630 µm	91
425 µm	89
300 µm	86
200 µm	81
150 µm	75
63 µm	59

Non Engineering Description

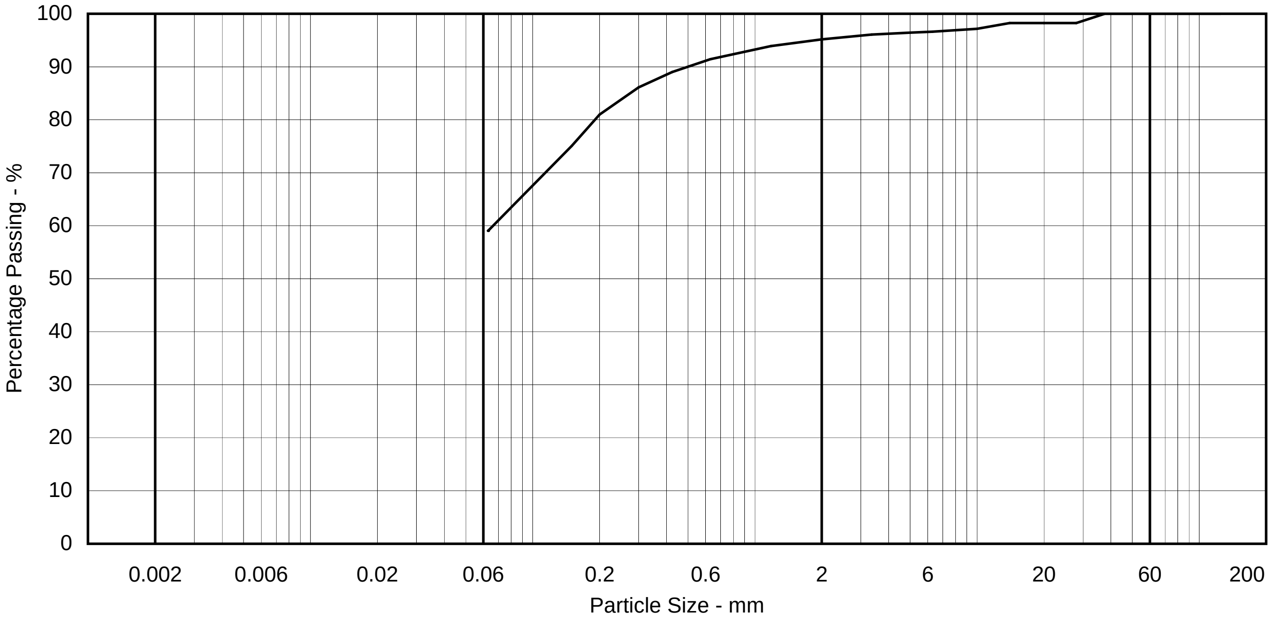
Brown very sandy CLAY/ SILT with some organic matter and occasional gravel. Gravel is fine to coarse.

Sample Proportions - %	
Cobbles	0.0
Gravel	4.8
Sand	36.2
Silt & Clay	59.0

Particle Diameter - mm	
D100	38
D60	0.066
D10	
Uniformity Coefficient (SHW series 600, Table 6/1, footnote 5)	N/A

Notes

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles
	Silt			Sand			Gravel			



Originator	Checked & Approved
RH	22/04/2022

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4 2016 Clause 5.2 - Sieving Method

Figure 37

Sheet 1 of 1

Moor Lane, Witton, Birmingham, B6 7HG

Lab Project No B28810 : 22/04/2022 13:45:30

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND
Client	
Engineer	

Contract No	**B28810**
Hole	TP139
Sample Ref	
Depth (m)	0.10
Sample Type	B

Particle Size	% Passing
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	99
10.0 mm	98
6.30 mm	96
5.00 mm	96
3.35 mm	93
2.00 mm	91
1.18 mm	87
630 µm	82
425 µm	76
300 µm	69
200 µm	61
150 µm	55
63 µm	40
20 µm	29
6 µm	21
2 µm	14

Non Engineering Description

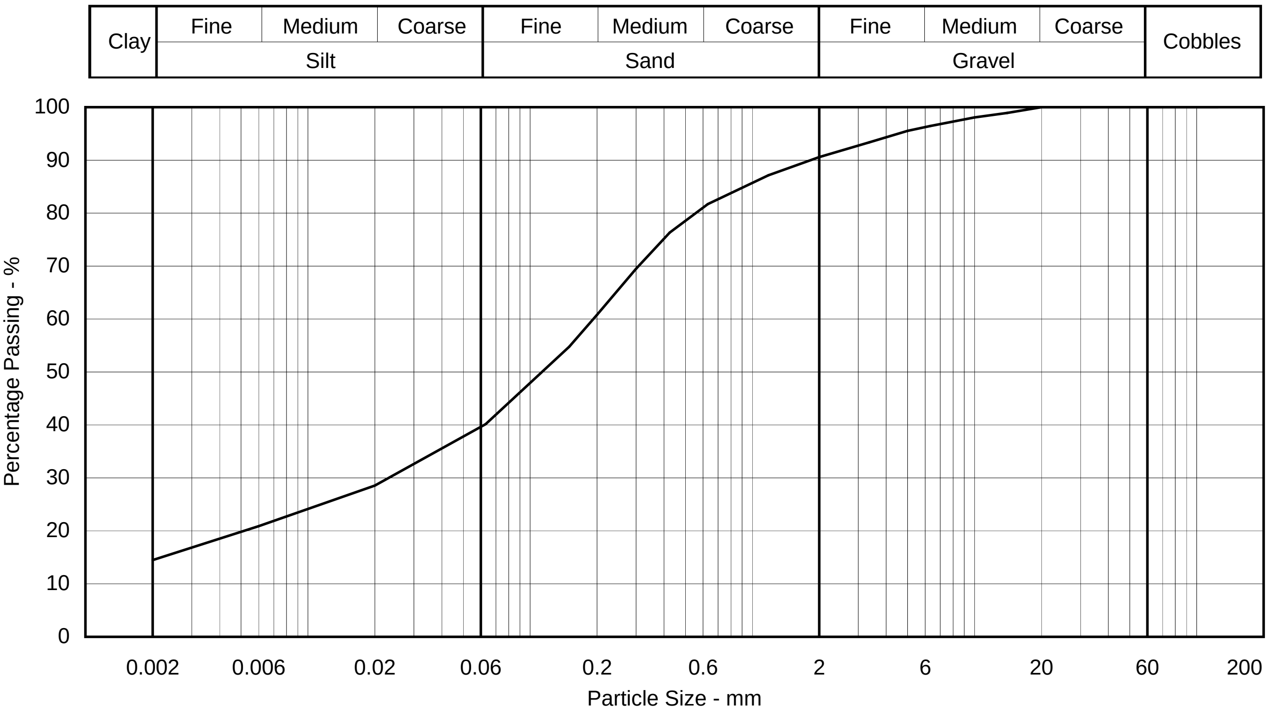
Dark brown silty, clayey SAND with some gravel and organic matter. Gravel is fine to medium.

Sample Proportions - %	
Cobbles	0.0
Gravel	9.4
Sand	51.3
Silt	24.8
Clay	14.5

Particle Diameter - mm	
D100	20
D60	0.19
D10	
Uniformity Coefficient (SHW series 600, Table 6/1, footnote 5)	N/A

Notes

Sedimentation sample not pre-treated



Originator	Checked & Approved
RH ME	22/04/2022

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4 2016 Clause 5.2 - Sieving Method
BS EN ISO 17892-4 2016 Clause 5.4 - Pipette Method

Figure 38

Sheet 1 of 1

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No**	**B28810**
Client		Hole	TP145
Engineer		Sample Ref	
		Depth (m)	0.70
		Sample Type	B

Particle Size	% Passing
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	97
50.0 mm	97
37.5 mm	95
28.0 mm	92
20.0 mm	88
14.0 mm	87
10.0 mm	84
6.30 mm	80
5.00 mm	78
3.35 mm	72
2.00 mm	67
1.18 mm	61
630 µm	56
425 µm	53
300 µm	50
200 µm	46
150 µm	44
63 µm	37

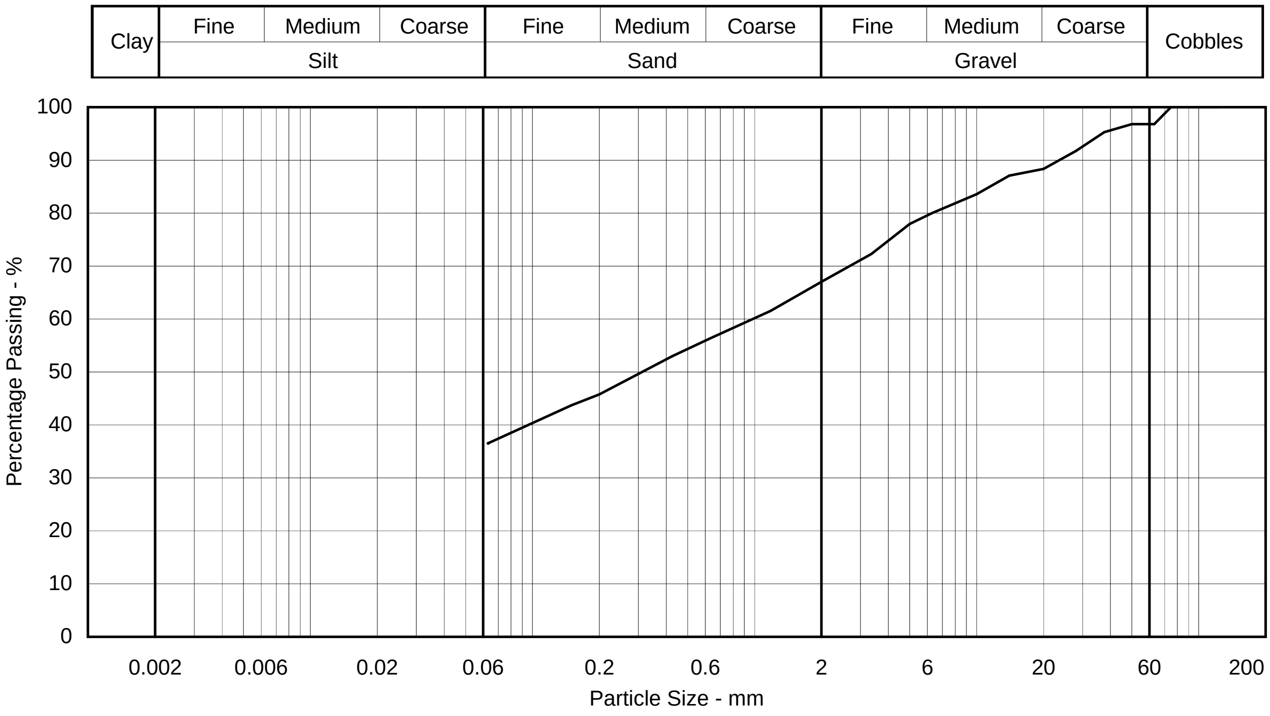
Non Engineering Description

Brown very sandy CLAY with much gravel. Gravel is fine to cobble size.

Sample Proportions - %	
Cobbles	3.2
Gravel	29.8
Sand	30.5
Silt & Clay	36.5

Particle Diameter - mm	
D100	75
D60	0.99
D10	
Uniformity Coefficient (SHW series 600, Table 6/1, footnote 5)	N/A

Notes



Originator	Checked & Approved
RH	22/04/2022

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4 2016 Clause 5.2 - Sieving Method

Figure 39

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Version 058 - 10/06/2013

1263 - PSD - BS EN 17892 TP145 00.70 B - B28810-817304.xls : Sample ID 817304

Moor Lane, Witton, Birmingham, B6 7HG

Lab Project No B28810 : 22/04/2022 13:45:36

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND	**Contract No**	**B28810**
Client		Hole	TP146
Engineer		Sample Ref	
		Depth (m)	0.20
		Sample Type	B

Particle Size	% Passing
125.0 mm	100
90.0 mm	100
75.0 mm	100
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	96
20.0 mm	94
14.0 mm	91
10.0 mm	89
6.30 mm	87
5.00 mm	86
3.35 mm	82
2.00 mm	79
1.18 mm	74
630 µm	68
425 µm	64
300 µm	59
200 µm	52
150 µm	48
63 µm	38
20 µm	28
6 µm	21
2 µm	14

Non Engineering Description

Grey silty, clayey SAND with some gravel and organic matter. Gravel is fine to coarse.

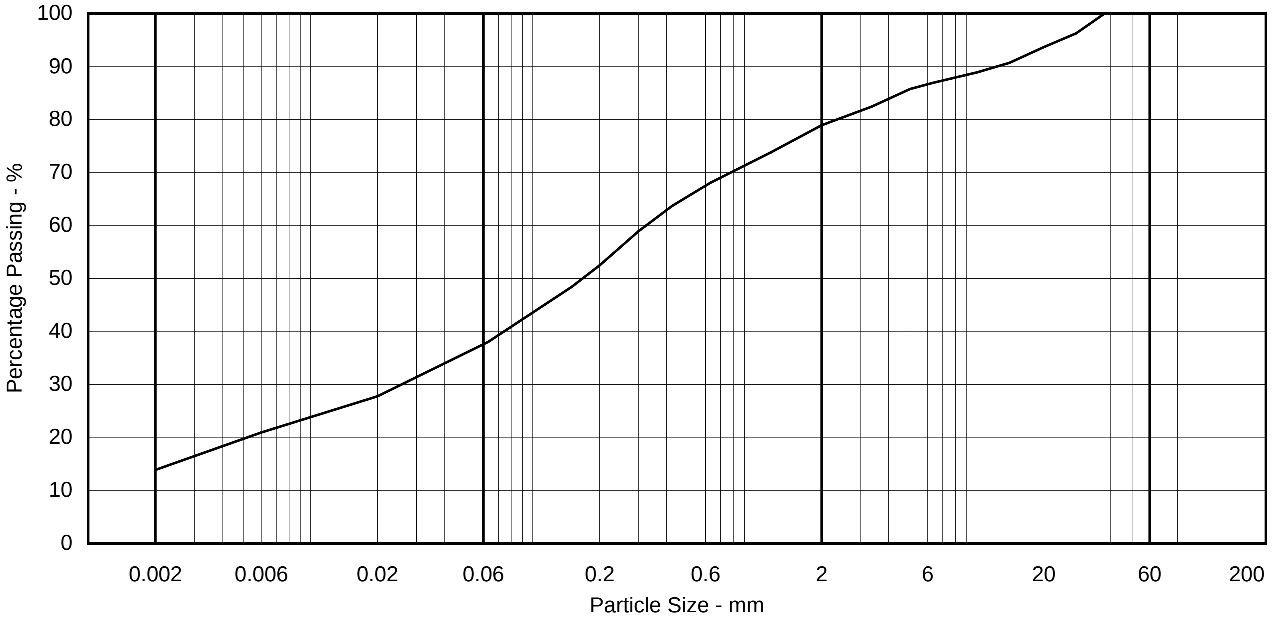
Sample Proportions - %	
Cobbles	0.0
Gravel	21.1
Sand	41.6
Silt	23.5
Clay	13.8

Particle Diameter - mm	
D100	38
D60	0.32
D10	
Uniformity Coefficient (SHW series 600, Table 6/1, footnote 5)	N/A

Notes

Sedimentation sample not pre-treated

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles
	Silt			Sand			Gravel			



Originator	Checked & Approved
RH ME	22/04/2022

PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4 2016 Clause 5.2 - Sieving Method
BS EN ISO 17892-4 2016 Clause 5.4 - Pipette Method

Figure 40

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Version 058 - 10/06/2013
1263 - PSD - BS EN 17892 TP146 00.20 B - B28810-817305.xls : Sample ID 817305
Moor Lane, Witton, Birmingham, B6 7HG
Lab Project No B28810 : 22/04/2022 13:45:38

Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

For the attention of Alex Petts

Report No: B28810
Issue No 01

LABORATORY TEST REPORT

Project Name	**SHAW LANE, ELLAND**		
Project Number	**B28810**	Date samples received	29/03/2022
Your Ref		Date written instructions received	29/03/2022
Purchase Order	PO18959/4246/ET	Date testing commenced	29/03/2022

Please find enclosed the results as summarised below

Figure / Table	Test Quantity	Description	ISO 17025 Accredited
1	29	Client Specified Suites - Soil	Yes

Remarks :

Issued by : Stephen Langman
Date of Issue : 22/04/2022

Key to symbols used in this report
S/C : Testing was sub-contracted

Approved Signatories :
S. Langman
22/04/2022
S Langman (Laboratory Coordinator), D Bowen (Production Manager)

Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.

Samples tested for asbestos are retained for 6 months from the date of analysis.
The results reported relate to samples received in the laboratory only.
All results contained in this report are provisional unless signed by an approved signatory
This report should not be reproduced except in full without the written approval of the laboratory.
Under multisite accreditation the testing contained in this report may have been performed at another Terra Tek laboratory.
The enclosed results remain the property of Terra Tek Limited and we reserve the right to withdraw
our report if we have not received cleared funds in accordance with our standard terms and conditions
Only those results indicated in this report are UKAS accredited and any opinions or interpretations expressed are outside the scope of UKAS accreditation.
Feedback on the this report may be left via our website www.terratek.co.uk/contact-us

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810**

Sample Identification								
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	pH	Sulphate (soluble in 2:1 water extract) as SO4 g/l	Sulphate (acid soluble as SO4) %	Total Sulphur %
TP101	2.50		T	817106	7.4	0.05	0.04	0.02
TP102	1.40		T	817108	7.7	0.03	0.05	0.02
TP102	2.00		T	817109	6.4	0.04	0.04	0.01
TP103	2.50		T	817114	5.9	0.03	0.03	<0.01
TP106	1.80		T	817122	5.7	0.03	0.03	0.02
TP107	0.70		T	817126	6.7	<0.01	0.02	<0.01
TP108	2.00		T	817129	6.4	0.03	0.05	0.02
TP110	0.80		T	817134	5.3	0.02	0.04	0.02
TP112	0.90		T	817147	7.4	0.01	0.02	0.01
TP112	2.40		T	817149	5.3	0.01	0.07	0.03
Limits of Detection					~	0.01	0.01	0.01
Terra Tek Analysis Method					TP019	TP169	TP171	TP129
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M

Originator	Checked & Approved
DAB	22/04/2022

BRE SUITE

TTk

Figure 1

Sheet 1 of 3

1140 - BRE Suite Soil - B28810 01.xls

Version 011 - 26/07/2012

Lab Project No B28810 : 22/04/2022 14:04:20

Moor Lane, Witton, Birmingham, B6 7HG

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND
Client	
Engineer	
Contract No	**B28810**

Sample Identification				Lab Sample ID	pH	Sulphate (soluble in 2:1 water extract) as SO4 g/l	Sulphate (acid soluble as SO4) %	Total Sulphur %
Hole	Depth m	Sample Ref	Sample Type					
TP114	2.00		T	817158	5.5	0.01	0.04	0.03
TP116	0.60		T	817163	7.0	<0.01	~	~
TP116	1.60		T	817164	5.8	0.03	0.04	0.02
TP119	2.20		T	817181	5.3	0.04	0.05	0.02
TP120	0.70		T	817185	6.4	0.26	~	~
TP120	1.90		T	817186	4.7	0.06	0.07	0.03
TP123	1.80		T	817206	5.5	0.04	0.04	0.01
TP124	1.20		T	817208	7.7	<0.01	~	~
TP124	1.90		T	817209	5.3	0.03	0.13	0.06
TP128	0.60		T	817224	7.0	0.01	~	~
Limits of Detection					~	0.01	0.01	0.01
Terra Tek Analysis Method					TP019	TP169	TP171	TP129
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M

Originator	Checked & Approved
DAB	S. Langman 22/04/2022

BRE SUITE

TTk

Figure 1

Sheet 2 of 3

1140 - BRE Suite Soil - B28810 01.xls
Version 011 - 26/07/2012

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site	SHAW LANE, ELLAND
Client	
Engineer	
Contract No	**B28810**

Sample Identification								
Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	pH	Sulphate (soluble in 2:1 water extract) as SO4 g/l	Sulphate (acid soluble as SO4) %	Total Sulphur %
TP128	1.50		T	817225	5.1	0.03	0.05	0.02
TP131	2.20		T	817234	5.1	0.02	0.36	0.14
TP134	0.70		B	817298	5.5	0.02	~	~
TP136	1.40		T	817248	7.5	0.02	0.03	0.02
TP136	2.20		T	817249	7.0	0.02	0.03	0.01
TP137	0.60		T	817252	7.3	0.01	~	~
TP139	0.60		T	817260	7.0	<0.01	~	~
TP139	1.60		T	817261	5.3	0.02	0.04	0.02
TP143	1.60		T	817273	5.6	0.04	0.04	0.02
Limits of Detection					~	0.01	0.01	0.01
Terra Tek Analysis Method					TP019	TP169	TP171	TP129
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M

Originator	Checked & Approved
DAB	22/04/2022

BRE SUITE

TTk

Figure 1

Sheet 3 of 3

Lab Project No B28810 : 22/04/2022 14:04:22
Moor Lane, Witton, Birmingham, B6 7HG

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site SHAW LANE, ELLAND	**Contract No** **B28810**
	Client Engineer	

Sample Identification				Lab Sample ID	Date Sampled	Temperature on receipt °C	PRIMARY MATRIX	Secondary Matrix	Additional matrix	% Loss at 30C	% Retained 2mm
Exploratory Hole	Depth m	Sample Ref	Sample Type								
TP101	2.50		T	817106	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		13.2	18
TP102	1.40		T	817108	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		14.3	40.9
TP102	2.00		T	817109	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		19	19.1
TP103	2.50		T	817114	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		16.3	15.7
TP106	1.80		T	817122	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		13	50.5
TP107	0.70		T	817126	21/03/22	15.8	CLAY	Fine Gravel		21	24.7
TP108	2.00		T	817129	21/03/22	15.8	Clayey SAND	Fine to Medium Gravel		12	24.6
TP110	0.80		T	817134	21/03/22	15.8	Sandy CLAY	Fine Gravel		15.3	45.6
TP112	0.90		T	817147	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		18.5	30.1
TP112	2.40		T	817149	21/03/22	15.8	CLAY	Fine Gravel		12.4	30.2
TP114	2.00		T	817158	21/03/22	15.8	CLAY	Fine Gravel		13.2	28.2
TP116	0.60		T	817163	21/03/22	15.8	Sandy CLAY	Fine Gravel		19.1	34.6
TP116	1.60		T	817164	21/03/22	15.8	Sandy CLAY	Fine Gravel		12.9	35.7
TP119	2.20		T	817181	21/03/22	15.8	Clayey SAND	Fine to Medium Gravel		12.2	33.2
TP120	0.70		T	817185	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		23.7	18.3

Notes

Terra Tek are accredited for clay, sand and loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials such as gravel, are not accredited where they comprise the major component of the sample.

Results are expressed on a dry-weight basis (samples dried at <30^{o}C) except where stated. Samples for asbestos testing are dried at 85^{o}C.

With the exception of samples analysed for asbestos, the laboratory removes any material > 2mm prior to analysis. The quantity and nature of the material is shown as the secondary and additional matrix types in the above table.

Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors List, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	**SAMPLE DESCRIPTIONS**	**Appendix S1**
DAB	22/04/2022		Sheet 1 of 2

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site SHAW LANE, ELLAND Client Engineer	**Contract No** **B28810**

Sample Identification				Lab Sample ID	Date Sampled	Temperature on receipt °C	PRIMARY MATRIX	Secondary Matrix	Additional matrix	% Loss at 30C	% Retained 2mm
Exploratory Hole	Depth m	Sample Ref	Sample Type								
TP120	1.90		T	817186	21/03/22	15.8	Clayey SAND	Fine to Medium Gravel		11.8	30.4
TP123	1.80		T	817206	21/03/22	15.8	Sandy CLAY	Fine Gravel		23.6	25.1
TP124	1.20		T	817208	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		11.3	27.1
TP124	1.90		T	817209	21/03/22	15.8	CLAY	Fine Gravel		15.2	47.9
TP128	0.60		T	817224	21/03/22	15.8	CLAY	Fine Gravel		19.1	30.9
TP128	1.50		T	817225	21/03/22	15.8	Sandy CLAY	Fine Gravel		13.3	28.6
TP131	2.20		T	817234	21/03/22	15.8	Sandy CLAY	Fine to Medium Gravel		18	27.7
TP136	1.40		T	817248	21/03/22	15.8	Sandy CLAY	Fine Gravel		14.7	25.5
TP136	2.20		T	817249	21/03/22	15.8	Sandy CLAY	Fine Gravel		11.5	29.8
TP137	0.60		T	817252	21/03/22	15.8	Sandy CLAY	Fine Gravel		18.5	31.7
TP139	0.60		T	817260	21/03/22	15.8	Sandy CLAY	Fine Gravel		20.2	17.4
TP139	1.60		T	817261	21/03/22	15.8	Sandy CLAY	Fine Gravel		10.3	34.5
TP143	1.60		T	817273	21/03/22	15.8	Sandy CLAY	Fine Gravel		14.5	19.9
TP134	0.70		B	817298	21/03/22	15.8	Clayey SAND	Fine Gravel		25.8	19.5

Notes

Terra Tek are accredited for clay, sand and loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials such as gravel, are not accredited where they comprise the major component of the sample.

Results are expressed on a dry-weight basis (samples dried at <30°C) except where stated. Samples for asbestos testing are dried at 85°C.

With the exception of samples analysed for asbestos, the laboratory removes any material > 2mm prior to analysis. The quantity and nature of the material is shown as the secondary and additional matrix types in the above table.

Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors List, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	**SAMPLE DESCRIPTIONS**	**Appendix S1**
DAB	22/04/2022		Sheet 2 of 2

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810**

Sample Identification				Lab Sample ID	Date Sampled	Deviating conditions						
Exploratory Hole	Depth m	Sample Ref	Sample Type			Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		Preservatives used
TP101	2.50		T	817106	21/03/22							
TP102	1.40		T	817108	21/03/22							
TP102	2.00		T	817109	21/03/22							
TP103	2.50		T	817114	21/03/22							
TP106	1.80		T	817122	21/03/22							
TP107	0.70		T	817126	21/03/22							
TP108	2.00		T	817129	21/03/22							
TP110	0.80		T	817134	21/03/22							
TP112	0.90		T	817147	21/03/22							
TP112	2.40		T	817149	21/03/22							
TP114	2.00		T	817158	21/03/22							
TP116	0.60		T	817163	21/03/22							
TP116	1.60		T	817164	21/03/22							
TP119	2.20		T	817181	21/03/22							
TP120	0.70		T	817185	21/03/22							

NOTES
1 Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2 The absence of "X" or "Yes" in the table above indicates no reported deviations.
3 Deviations due to use of incorrect sample container are shown on result tables.
4 Deviating results are indicated within result tables.

Originator	Checked & Approved
DAB	S. Langman 22/04/2022

DEVIATING SAMPLES - SOIL

TTk **Appendix S2**

Sheet 1 of 2

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810**

Sample Identification				Lab Sample ID	Date Sampled	Deviating conditions						Preservatives used
Exploratory Hole	Depth m	Sample Ref	Sample Type			Sampling date has not been provided	Exceeded maximium holding time for selected test(s)	Presence of headspace in sample vial	Poorly fitting cap or lid	Damaged container		
TP120	1.90		T	817186	21/03/22							
TP123	1.80		T	817206	21/03/22							
TP124	1.20		T	817208	21/03/22							
TP124	1.90		T	817209	21/03/22							
TP128	0.60		T	817224	21/03/22							
TP128	1.50		T	817225	21/03/22							
TP131	2.20		T	817234	21/03/22							
TP134	0.70		B	817298	21/03/22							
TP136	1.40		T	817248	21/03/22							
TP136	2.20		T	817249	21/03/22							
TP137	0.60		T	817252	21/03/22							
TP139	0.60		T	817260	21/03/22							
TP139	1.60		T	817261	21/03/22							
TP143	1.60		T	817273	21/03/22							

NOTES
1. Results reported for samples classified as deviating may be compromised. Deviation types are shown as "X" or "Yes" in the table above.
2. The absence of "X" or "Yes" in the table above indicates no reported deviations.
3. Deviations due to use of incorrect sample container are shown on result tables.
4. Deviating results are indicated within result tables.

Originator	Checked & Approved
DAB	22/04/2022

DEVIATING SAMPLES - SOIL

Appendix S2

Sheet 2 of 2

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810**

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
GP001	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Preparation of soil samples for chemical analysis	Yes	Yes	N/A
GP012	BS EN 12457-3: Characterisation of Waste - Compliance test for leaching of granular waste materials and sludges (two-stage batch test)	Preparation of soil samples for two-stage leachate test			Dry
TP019	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of pH in 2.5:1 water/soil extract using pH meter.	Yes	Yes	Dry
TP032	MAFF Book 427: The Analysis of Agricultural Materials: Method 8	Determination of water soluble boron by ICP-OES	Yes		Dry
TP040	APHA/AWWA, 19th edition: Method 3500Cr-D	Determination of hexavalent chromium by colorimetry.	Yes		Dry
TP041	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of organic matter by titrimetry.	Yes		Dry
TP042	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of loss on ignition at 50-440°C by gravimetry	Yes	Yes	Dry
TP045	GACHAMJA A.M. Chromatography and Analysis: 1992 9-11 (modified)	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS	Yes	Yes	Dry
TP046	MEWAM method: Phenols in water and Effluents: 4-aminoantipyrine method	Determination of monohydric phenols by steam distillation/colorimetry	Yes	Yes	Dry
TP047	MEWAM method: Cyanide in Waters etc	Determination of free cyanide by steam distillation/colorimetry	Yes		Dry
TP048	MEWAM method: Cyanide in Waters etc	Determination of total cyanide by steam distillation/colorimetry.	Yes	Yes	Dry
TP049	MEWAM method: Cyanide in Waters etc	Determination of complex cyanide by calculation	Yes		Dry
TP050	MEWAM method: Determination of Thiocyanate ,1985	Determination of thiocyanate by colorimetry	Yes	Yes	Dry
TP051	USEPA Method 9030B	Determination of acid soluble sulphides by steam distillation/colorimetry.	Yes	Yes	Dry
TP067	TNRCC Method 1005: 2001 (modified)	Determination of pentane/acetone extractable petroleum hydrocarbons (C8 - C40) by GC/FID	Yes	Yes	Wet
TP072	In-house documented method	Determination of ammoniacal nitrogen by colorimetry			Dry
TP074	In-house documented method	Determination of water soluble fluoride by ion selective electrode			Dry
TP098	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of acid soluble chloride by titrimetry			Dry
TP099	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry
TP100	Wisconsin DNR Modified GRO method, Method for Determining Gasoline Range Organics	Determination of Volatile Petroleum Hydrocarbons/GRO.	Yes	Yes	Wet

Notes

1. Terra Tek (Birmingham) are MCERTS accredited for clay, sand & loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials, ie gravel, are not accredited where they comprise the major component of the sample.
2. Results are expressed on a dry-weight basis (samples dried at <30°C) except where stated. Samples tested for asbestos are dried at <90°C.
3. With the exception of samples analysed for asbestos, the laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. The test results pertain only to the samples provided and is not guaranteed to be representative of the parent material in whole or part from which the sample was taken. Sample location, site address, taken by and client reference are included where provided by the client, Terra Tek accepts no responsibility for the validity or accuracy of this information.

Originator	Checked & Approved
N/A	N/A

SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)

TTK

Appendix S3

Sheet 1 of 2

TERRA TEK
SITE INVESTIGATION AND LABORATORY SERVICES

Site SHAW LANE, ELLAND

Client

Engineer

Contract No **B28810**

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
TP110	USEPA Methods 8082A & 3665A	Determination of Total & Speciated 7 PCB Congeners by GC/MS SIM	Yes	Yes	Wet
TP114	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of carbonate in soil (rapid titration method)			Dry
TP126	TNRCC Method 1006 (modified)	Extracted petroleum hydrocarbons from TP067 split into aromatic and aliphatic fractions. Analysed by GC/FID.	Yes		Wet
TP129	In-house documented method	Determination of total sulphur by ICP-OES spectroscopy	Yes	Yes	Dry
TP134	In-house documented method	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry
TP135	USEPA Methods 8100 & 8270D. In-house method TP045	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS (with concentration stage)			Dry
TP137	BS7755: Section 3.9: 1995/ISO 11466:1995	Determination of acid extractable metals in soil by ICP-OES	Selected	Selected	Dry
TP145	USEPA Methods 3550C & 8270D	Determination of Semi-Volatile Organic Compounds by GC/MS	Yes	Yes	Wet
TP147	USEPA Methods 8082A & 3665A	Determination of total & speciated WHO 12 PCB Congeners by GC/MS SIM.			Wet
TP150	USEPA Methods 8081B & 8141B	Determination of pesticides and herbicides in soil by GC/MS SIM			Dry
TP152	USEPA Method 556	Determination of carbonyls by GC/MS.			Wet
TP154	USEPA Method 5021. Wisconsin DNR modified GRO method	Determination of volatiles in by GC/MS headspace	Yes	Selected	Wet
TP158	USEPA Method 1671	Determination of glycols by GC/FID DI			Wet
TP169	In-house documented method	Determination of water soluble sulphate in 2:1 water/soil extract by ICP-OES spectroscopy	Yes	Yes	Dry
TP171	In-house documented method	Determination of acid soluble sulphate by ICP-OES spectroscopy	Yes	Yes	Dry
TP174	In-house documented method	Determination of Total Organic Carbon in soils by high temperature combustion & NDIR detection	Yes		Dry
TP178	In-house documented method	Determination of water soluble nitrate by ion selective electrode			Dry
TP181	HSG 248 Asbestos: The Analysts Guide (Appendix 2), Edition 2 (May 2021)	Asbestos Identification in bulk materials	Yes	No	Dry
TP183	HSG 248 Asbestos: The Analysts Guide (Appendix 2), Edition 2 (May 2021) & Standing Committee of Analysts: The Quantification of Asbestos in Soil (2017, withdrawn Oct 2020)	Asbestos Identification & Quantification in soils	Yes	No	Dry
TP185	In-house documented method	Determination of loss on ignition at 150-440°C by gravimetry	No	No	Dry

Notes

1. Terra Tek (Birmingham) are MCERTS accredited for clay, sand & loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials, ie gravel, are not accredited where they comprise the major component of the sample.
2. Results are expressed on a dry-weight basis (samples dried at <30°C) except where stated. Samples tested for asbestos are dried at <90°C.
3. With the exception of samples analysed for asbestos, the laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. The test results pertain only to the samples provided and is not guaranteed to be representative of the parent material in whole or part from which the sample was taken. Sample location, site address, taken by and client reference are included where provided by the client, Terra Tek accepts no responsibility for the validity or accuracy of this information.

Originator	Checked & Approved
N/A	N/A

SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)

Appendix S3

Sheet 2 of 2

Appendix L
Gas Monitoring Results

Visit 1

Job Title:			Job No:
Shaw Lane, Elland			4246
Client:			Sheet :
Titchmarsh & Bagley			1 of 2
Date:	Arrival Time:	Depart Time:	Operator:
27/04/2022	08:00	14:30	Cameron Daniel

Gas Monitoring Results:

Ambient Concentration (% Volume):	CH_4:	ND	CO_2:	ND	O_2:	20.6

Monitoring Point	Groundwater level	Concentrations					Gas Flow Rates			Bottom of well	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH_4	CO_2	CH_4	CO_2	O_2					
	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	m	
WS101	1.35	ND	1.5	ND	1.5	19.8	ND	ND	ND	3.02	Bailed 09:20 - 09:22 to 2.99 m (5 L). Remonitored 13:35.
WS102	ND	ND	0.2	ND	0.2	20.6	ND	ND	ND	3.07	Valve open on arrival - closed before monitoring.
WS103	ND	ND	1.3	ND	1.3	20.0	ND	ND	ND	2.96	
WS104	ND	ND	ND	ND	ND	20.7	ND	ND	ND	2.98	
WS105	ND	ND	1.8	ND	1.8	18.5	ND	ND	ND	3.05	
WS106	ND	ND	0.3	ND	0.3	20.7	ND	ND	ND	3.04	
WS107	ND	ND	0.1	ND	0.1	20.7	ND	ND	ND	3.05	
WS108	ND	ND	1.9	ND	1.9	19.9	ND	ND	ND	3.06	
WS109	2.62	ND	2.5	ND	2.5	18.4	ND	ND	ND	3.01	
WS110	ND	ND	1.6	ND	1.6	19.2	ND	ND	ND	2.99	
WS111	ND	ND	ND	ND	ND	20.7	ND	ND	ND	2.95	Valve open on arrival - closed before monitoring.
WS112	ND	ND	0.5	ND	0.5	20.3	ND	ND	ND	2.99	
WS113	2.99	ND	1.7	ND	1.7	19.7	ND	ND	ND	3.02	
WS114	1.55	ND	0.8	ND	0.8	20.4	ND	ND	ND	2.92	Bailed 10:48 - 10:50 to 2.91 m (4 L). Remonitored 13:25.
WS115	2.40	ND	0.4	ND	0.4	20.5	ND	ND	ND	2.95	
WS116	2.75	ND	0.6	ND	0.6	20.2	ND	ND	ND	2.77	
WS117	3.07	ND	1.5	ND	1.5	19.4	ND	ND	ND	3.08	
WS118	ND	ND	1.6	ND	1.6	19.7	ND	ND	ND	3.03	
PH101	ND	ND	2.6	ND	2.6	14.9	ND	ND	ND	3.79	
PH105A	5.60	ND	ND	ND	ND	20.7	-3.5	ND	15.0	5.63	Bung blocked - briefly removed before monitoring.
PH107A	ND	ND	2.4	ND	2.4	16.9	ND	ND	ND	5.83	
PH109A	ND	ND	0.4	ND	0.4	19.9	ND	ND	ND	5.76	
PH113A	5.59	ND	2.3	ND	2.3	18.5	ND	ND	ND	5.72	
PH115A	ND	ND	0.8	ND	0.8	20.0	-1.5	ND	45.0	5.60	
PH120A	ND	ND	ND	ND	ND	20.6	ND	ND	ND	5.82	
PH121A	ND	ND	2.8	ND	2.8	16.3	ND	ND	ND	5.66	Bung blocked - briefly removed before monitoring.

Equipment Used:	Next Calibration Date
Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	08/03/2023

Key

ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

	CH_4	CO_2	O_2
Trigger level 1	1.0	5.0	16.0
Trigger level 2	5.0	10.0	10.0

	Site Data:			Weather Station Data (Sefton live Station)					
	Temp (°C):	10 to 14		Barometric Pressure Trend:			Rising		
Time:	09:01	13:08	14:17	01:01	06:00	08:58	13:08	14:17	16:00
Pressure (mb):	1019	1022	1019	1038	1039	1040	1041	1041	1040

Weather Conditions:	Overcast / Gentle breeze
Surface Ground Conditions:	Damp

Remarks:

Job Title:			Job No:
Shaw Lane, Elland			4246
Client:			Sheet :
Titchmarsh & Bagley			3 of 4
Date:	Arrival Time:	Depart Time:	Operator:
10/05/2022	10:00	14:40	Cameron Daniel

Gas Monitoring Results:

Ambient Concentration (% Volume):	CH_4:	ND	CO_2:	ND	O_2:	20.8

Monitoring Point	Groundwater level	Concentrations					Gas Flow Rates			Bottom of well	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum	Steady	Time to fall from highest to steady		
		CH_4	CO_2	CH_4	CO_2	O_2					
	(m) bgl	% v/v	(%)	% v/v	(%)	(%)	litre/hr	litre/hr	secs	m	
WS101	1.40	ND	1.5	ND	1.5	20.0	ND	ND	ND	2.96	Bailed 10:32 - 10:34 to 2.91 m (5 L). Remonitored 14:13.
WS102	ND	ND	2.5	ND	2.5	12.6	ND	ND	ND	3.08	
WS103	ND	ND	0.8	ND	0.8	20.4	0.3	ND	5.0	2.95	
WS104	ND	ND	3.6	ND	3.6	6.9	2.7	0.9	480.0	2.99	Flow fluctuating 0.7 to 0.9.
WS105	ND	ND	1.9	ND	1.9	18.3	ND	ND	ND	3.06	
WS106	ND	ND	0.4	ND	0.4	20.8	ND	ND	ND	3.04	
WS107	ND	ND	2.4	ND	2.4	17.8	ND	ND	ND	3.03	
WS108	ND	ND	1.8	ND	1.8	20.1	ND	ND	ND	3.04	
WS109	ND	ND	2.8	ND	2.8	18.6	ND	ND	ND	3.02	
WS110	ND	ND	2.4	ND	2.4	17.9	ND	ND	ND	2.98	
WS111	ND	ND	0.9	ND	0.9	19.4	ND	ND	ND	2.96	
WS112	ND	ND	1.4	ND	1.4	19.4	ND	ND	ND	3.01	
WS113	ND	ND	2.2	ND	2.2	19.3	49.5	ND	30.0	3.05	
WS114	1.62	ND	0.7	ND	0.7	20.2	-0.1	ND	5.0	2.94	Bailed 11:26 - 11:27 to 2.88 (3 L). Remonitored 14:06.
WS115	2.39	ND	0.4	ND	0.4	20.4	ND	ND	ND	2.96	
WS116	ND	ND	0.6	ND	0.6	20.4	ND	ND	ND	2.77	
WS117	2.75	ND	2.0	ND	2.0	19.1	49.5	ND	30.0	3.07	
WS118	ND	ND	2.1	ND	2.1	18.8	ND	ND	ND	3.00	
PH101	ND	ND	3.1	ND	3.1	12.0	0.8	ND	10.0	3.81	
PH105A	ND	ND	5.4	ND	5.4	5.2	2.2	1.3	540.0	5.63	Flow fluctuating 0.6 to 1.3.
PH107A	ND	ND	2.3	ND	2.3	16.8	ND	ND	ND	5.80	
PH109A	ND	ND	2.8	ND	2.8	14.2	3.0	1.5	300.0	5.70	Flow fluctuating 0.9 to 1.5.
PH113A	5.70	ND	1.6	ND	1.6	19.6	-0.1	ND	15.0	5.72	
PH115A	ND	ND	0.4	ND	0.4	20.6	2.5	1.5	300.0	5.65	Flow fluctuating 1.0 to 1.5.
PH120A	ND	ND	2.2	ND	2.2	17.3	ND	ND	ND	5.78	
PH121A	ND	ND	2.3	ND	2.3	14.4	ND	ND	ND	5.65	

Equipment Used:	Next Calibration Date
Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter	08/03/2023

Key

ND	None Detected
NR	Not Recorded
1.0	Recorded value does not breach trigger levels
5.0	Recorded value breaches trigger level 1
10.0	Recorded value breaches trigger level 2

	Site Data:			Weather Station Data (Sefton live Station)					
	Temp (°C):	13 to 17		Barometric Pressure Trend:			Gradually falling		
Time:	10:20	12:20	14:23	01:05	08:02	10:21	12:18	14:23	17:01
Pressure (mb):	1000	1000	998	1023	1022	1022	1022	1022	1021

	CH_4	CO_2	O_2
Trigger level 1	1.0	5.0	16.0
Trigger level 2	5.0	10.0	10.0

Weather Conditions:	Moderate breeze/ Light cloud and light rain showers.
Surface Ground Conditions:	Damp

Remarks: