

A photograph showing a cross-section of a stream bed. The water is clear, revealing a rocky and silty bottom. The banks are covered in green grass and some small plants.

Geoenvironmental Appraisal

Land at Crosland Hill, Huddersfield For Redrow Homes

Report no: 3649/2A

Date: March 2021



SUMMARY OF GEOENVIRONMENTAL ISSUES

Job No.	3649	Site area/ha	3.3 ha
Client:	Redrow Homes	NGR:	SE 116 146
Site:	Crosland Hill, Huddersfield	Nearest postcode:	HD4 5NE

The site is located north of Blackmoorfoot Road, between Standard Drive and Crosland Hill Road, approximately 3km southwest of Huddersfield, and is currently occupied by Lowdhams, a retailer of caravans and motorhomes.

The site was formerly occupied by two sandstone quarries, associated roads and buildings. The quarries were filled by 1982, with possible landfill occurring c. 1960. The site has been annotated as a depot since 1982.

Lithos were commissioned by Redrow to provide a geoenvironmental appraisal of the site which it is understood is to be redeveloped with two storey domestic dwellings; a proposed layout has been provided.

Lithos' investigation included a review of 3rd party reports, the site's history and environmental setting, and a ground investigation comprising 35 trial pits, 28 rotary open probeholes and 10 'groups' of stitched probeholes.

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

Issue	Remarks
Mining	The site is located beyond the CA's defined coalfields and no shallow coal is anticipated. No evidence of underground sandstone mining has been found.
Quarrying	The site was occupied by sandstone quarries (Spinkwell, Waterhouse & Manor House Quarries) from c. 1890 to 1960. Quarries have been subsequently backfilled. Backfilled quarries occupy about 75% of the total site area and reach depths of between c. 11m and 23m; average 17m. Highwalls have been found at 6 locations and are very steep/vertical. Two 'ramps' have been found close to the quarry floors. The extent of quarrying proven by drilling to date correlates well with that shown on old OS maps. There are areas of un-quarried ground in the north-west and south-east, and a "ridge" in the centre. The quarries targeted Rough Rock Sandstone which was used as a construction material.
Made ground	Typically comprises the following succession: - Veneer of macadam/gravel Hardstand & sandstone/limestone Sub-Base over; - Quarry Infill – made ground placed during tipping over; - Quarry Arisings – site won materials left over from quarrying operations. This material includes large boulders which increase in frequency with depth. Made Ground reaches depths of between c. 11m and 23m within the footprints of former sandstone quarries. Made Ground reaches between c. 1.6m and 2.3m beyond the former quarries, typically comprising Sub-Base over Quarry Infill. Whilst a significant proportion of degradable materials has not been encountered to date, given reference on old OS maps to "refuse tipping", it cannot be discounted that the Quarry Infill does not include 'undesirable' materials within its make-up.
Natural ground	Natural Ground comprises Residual Soils (predominantly sandy gravel of sandstone, occasionally firm brown clay) over Sandstone bedrock. Residual Soils were only encountered outside of the former quarries.
Issues relating to deep backfill	Deep quarry backfill is prone to both ongoing creep, associated with self-weight, and settlement caused by any new loading. It is considered that the presence of deep backfill will have implications for foundations, drainage, new utilities and highways.
Preparatory & remediation works	Turnover of uppermost 3m to 4m of made ground. Isolation of made ground beneath clean cover comprising 150mm of Topsoil & 450mm of Subsoil over a 150mm hard dig layer. It would be prudent to allow for excavation & screening/treatment/removal of some grossly contaminated soils. Site regrade to create level development terraces is anticipated.

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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Issue	Remarks
Foundations	Plots beyond quarries are expected to be founded on strip/trench footings seated in Residual Soils or bedrock. Plots within former quarries are expected to be founded on piles seated in bedrock. Given the presence of boulders, piles are expected to require pre-boring.
Highways	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 be 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. If any new highway spans a quarry 'high-wall' two layers of Tensar Triax TX160 (or equivalent) geogrid sandwiched within at least 300mm of suitable aggregate should be placed beneath the full width of the highway at least 1.0m below the deepest sewer invert. A specification will need to be agreed with the adopting authority.
Contamination	All made ground types have been found to contain relatively minor concentrations of inorganic contaminants as well as free fibres of asbestos and ACM. Given reference on old OS maps to "refuse tipping", it is possible that more onerous contamination than that encountered to date is present.
Hazardous gas	Known areas of landfill and historical quarries are located within, and within 250m of, the site's boundary and deep made ground is present across about 75% of the site's area. Wells have been installed in 14 boreholes and monitoring is ongoing. A gas risk assessment will be issued on completion of the gas monitoring in August 2021.
Groundwater & excavations	Excavations through made ground are likely to be unstable and encounter overbreak where oversize materials (cobbles & boulders) are encountered. Significant groundwater ingress is not expected. However, localised groundwater inflows may be encountered in deep excavations through the made ground.
Flooding & drainage	The site is located in a Flood Zone 1 where the risk of flooding from rivers and the sea is classified as low. Given the significant thickness of made ground present across about 75% of the site soakaways will not provide a suitable means of surface water disposal and alternative means of drainage will be required.

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

- Demolition of existing buildings/foundations and grubbing up of hardstand.
- Ground improvement – turnover of the made ground, in order to deal with contamination, remove buried obstructions.
- Piled foundations within former quarries; piles are likely to require pre-boring.
- Highwalls may have an impact on the proposed layout.
- Site topography will result in the need for some levels regrade with possible underbuild, retaining structures etc.

Some further work is required, most notably:

- Supplementary post demolition ground investigation (trial pits beneath existing buildings & areas with restricted access & probeholes to delineate highwalls & determine the profile of quarry floors).
- Piling contractors may require rotary cored boreholes to inform pile design.
- Preparation of a remediation strategy and materials management plan.
- Completion of the hazardous gas risk assessment (monitoring ongoing).

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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
3649/1	-	Site location plan
3649/3	-	Site features
3649/3a	-	Site features – quarry locations
3649/3b	-	Site features – spoil heap & refuse tip locations
3649/4	-	Site photographs
3649/5	-	Preliminary conceptual site model
3649/6	-	3 rd party exploratory hole locations
3649/7	-	Exploratory hole locations
3649/8	-	Revised conceptual site model
3649/10	-	Cross Sections

Appendix C - Commission

Appendix D - Historical OS plans

Appendix E - Search responses

From	Date	Content
Landmark	09/01/2020	Environmental search data
BGS	1920s	Photographs of Spinkwell Quarry

Appendix F & G - Exploratory records

Appendix F	TPs 01 to 15 & 101 to 120
Appendix G	PHs 01 to 12 & 101 to 116 & STs 01 to 04 & 101 to 106

Appendix H - Chemical test results

Appendix I - Geotechnical test results

Appendix J - Gas monitoring results

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
CROSLAND HILL, HUDDERSFIELD

1 INTRODUCTION

1.1 The commission and brief

- 1.1.1 Lithos Consulting Limited were commissioned by Redrow Homes to carry out a geoenvironmental appraisal of land at Crosland Hill, Huddersfield.
- 1.1.2 Lithos have previously issued a Preliminary Investigation Report (Ref 3649/1, dated January 2020). The information contained in Report 3649/1 has been incorporated within this Report, which now supersedes Report 3649/1.
- 1.1.3 Correspondence regarding Lithos' appointment, including the brief for this investigation, is included in Appendix C. The agreed scope of works included:
- A site walkover and inspection
 - An assessment of the land use history
 - Determination of the site's environmental setting
 - An intrusive ground investigation comprising 35 trial pits, 28 rotary open probeholes and 10 'groups' of stitched probeholes
 - 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
- 1.1.4 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 Redrow to obtain budget costs for: foundations; gas protection measures; and site preparatory and remediation works.

1.2 The proposed development

- 1.2.1 It is understood that consideration is being given to redevelopment of the site with about 100 domestic dwellings, associated gardens, POS and adoptable roads and sewers. A site layout has not been provided to date.

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.

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

2 SITE DESCRIPTION

2.1 General

- 2.1.1 The site's location is shown on Drawing 3649/1 presented in Appendix B to this report. Site details are summarised in the table below:

Detail	Remarks
Location	3 km southwest of Huddersfield city centre, north of Blackmoorfoot Road, between Standard Drive and Crosland Hill Road.
NGR	SE 116 146
Area	3.3 hectares
Known services	Underground drainage, water, electricity & communications.

2.2 Site features

- 2.2.1 Lithos completed a walkover survey of the site on 22nd January 2020.
- 2.2.2 Existing salient features, at the time of the walkover are presented on Drawing 3649/3 in Appendix B to this report, and are summarised in the table below:

Feature	Remarks
Current access	Off Blackmoorfoot Road in the south-west.
Topography	General slope from east to west, use of retaining walls (up to c. 1.5m tall) throughout the site. Steep slopes present in centre-south and south-east. Slope along south-east boundary with dry stone wall at the base. 'Hollow' (former quarry) c. 5m deep in the south-east.
Approximate areas	4,000m ² buildings (including shipping containers and cabins) 11,500m ² tarmac hardstand 900m ² concrete hardstand/brick paving 3,800m ² grass/soft landscaped/overgrown areas 12,800m ² gravel surfacing, locally overgrown with grass/moss
Nature of boundaries	North-west – dry stone wall and palisade fencing North-east – stone wall and blue metal gates South-east – slope with dry stone wall at base South-west – dry stone wall
Surrounding land uses	North – industrial buildings (Black Cat Fireworks) and housing (Mason Court) South – housing off Crosland Hill Road and industrial buildings. West – Standard Drive with grassed areas/woodland beyond.

- 2.2.3 A selection of site photographs are included on Drawing 3649/4.
- 2.2.4 The site is occupied by Lowdhams, a retailer of caravans and motorhomes. The majority of the land is taken up by outdoor caravan and motorhome storage areas with tarmac site roads, an office, a workshop and a miscellany of smaller structures present throughout.
- 2.2.5 The site is accessed via metal gates and a height-restricted security barrier off Blackmoorfoot Road in the south-west. The access point leads north to a macadam-surfaced area of car parking, adjacent to the two main site buildings in the south-west.

- 2.2.6 From the car park, a macadam-surfaced access road leads east, which enables vehicular access to the areas of caravan storage. A metal drainage grate crosses this road in the east.
- 2.2.7 Caravan and motorhome storage areas take up the majority of the site; the north-west, central-north, east and south-east. They are predominantly gravel-surfaced (which is locally overgrown with moss and some grass); a smaller area in the south-east is surfaced with macadam and stone-sets forming an elliptical 'show' area for site stock.
- 2.2.8 In the far east, there is a macadam-surfaced car park which is currently vacant. This area cannot be accessed via Lowdham's site; instead, vehicles must use metal gates off Crosland Hill Road to the east.
- 2.2.9 Two buildings are present in the south-west, close to the site entrance. The larger building is a two-storey metal-clad structure which serves as a shop and offices; the smaller building is a single-storey metal-clad structure used as a workshop for repairing/maintenance of caravans. The two buildings are linked by a roof, creating a sheltered passageway for pedestrians and vehicles.
- 2.2.10 To the south of these buildings are 3 shipping containers and a cabin, used for various storage and maintenance activities. Recycling skips are present here, along with a small area where old fridges are stored (presumably from older caravans).
- 2.2.11 Other buildings/structures on site include:
- Collection of shipping containers in the centre-south, used for storage
 - Pre-fabricated sales cabin, located in the centre-west
 - 'L' shaped portacabin adjacent to the two main site buildings in the south-west, used by site staff
 - Two wooden-clad 'huts' in the east, used as customer-service buildings
 - Portacabins in the centre-west and centre-south, used by site staff
 - Small toilet block in the south-east
 - Substation in the south-east
- 2.2.12 Various materials are stored and used on site including those for caravan washing & cleaning. A small metal cage housing gas bottles is present close to the wooden huts in the east.
- 2.2.13 Site topography slopes from 213.5m AOD in the west, to 197.5m AOD in the east. Various retaining walls, up to 1.5m in height, have been built to create relatively flat platforms.
- 2.2.14 A vegetated steep slope (c. 1 in 2, about 3m in height) runs along the south-east of the site, with a dry-stone retaining wall at its base, running along Blackmoorfoot Road. The topographical survey supplied does not show the level of Blackmoorfoot Road, but it is estimated to be about 3m below site level in the far south-west, and roughly at the same level as the site is the south-east.
- 2.2.15 In the south-east, there is an overgrown area of steep slopes which form a 'hollow' adjacent to Blackmoorfoot Road. The hollow is up to 5m deep, with slopes of c. 1 in 1 gradient. Based on review of historical plans (see Section 3), this looks to be part of a former quarry. Access into this area was not possible.
- 2.2.16 A steep vegetated slope (1 in 2 gradient) is also present between the workshop building in the south-east and the adjacent caravan storage area; concrete steps enable access between the two areas.

3 SITE HISTORY

3.1 In order to investigate the development history and previous land uses at the site and immediate surrounding land, site centred extracts from Ordnance Survey (OS) plans dating back to 1854 have been examined. These plans are presented in Appendix D to this report.

3.2 The table below provides a summary of the salient points relating to the history of the site with respect to the proposed end use. 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 is greenfield comprising fields.	Several quarries surround site including Crosland Hill Quarry and Waterhouse Quarry to the northwest and two un-named sandstone quarries to the south. Village of Crosland Hill to the north.
1892	Spinkwell Quarries with associated access roads shown in the eastern half of site. The western half remains undeveloped.	Expansion of the quarries to the northwest. Black Moor Foot Road shown immediately south..
1906	Spinkwell Quarries expanded to cover most of site and look to be connected to Waterhouse Quarry in the west. Several buildings associated with quarry shown. Multiple cranes shown on site.	Sections of Waterhouse Quarry shown as Old Quarry. Several small quarries now shown to the south and east.
1916	Quarry in east of site shown as Manor House Quarry.	Standard Fireworks factory shown approximately 100m north. Quarries to the south named Wellfield Quarries. Matlock House Quarry shown to the west.
1930-1938	Expansion of Manor House Quarry. Additional building built in the south east.	Standard Fireworks Factory expanded with numerous associated buildings. Buildings shown immediately south opposite site. Housing shown along Black Moor Road northeast of site.
1956	No significant changes.	Expansion of Wellfield Quarry to the south. Further housing built to the northeast.
1960	Spinkwell Quarries and Manor House Quarry in process of being filled, with several areas being labelled as refuse tip. Building in the southeast no longer shown.	Wellfield Quarry and Matlock House Quarry being used as a refuse tip. Two works buildings shown east of site.
1982	Site is mostly filled with only small area in the south shown as refuse tip. Building remains in the southwest. Section in the north labelled as caravan sales depot.	Buildings immediately south opposite no longer shown and replaced with larger buildings.
2000	Whole of site used as caravan sales depot.	Two further buildings shown on Wellfield Quarry site.

3.3 The approximate extent of former quarrying is shown on Drawing 3649/3A, and the approximate extents of former spoil heaps & refuse tips are shown on Drawing 3649/3B. Drawing 3649/3A suggests approximately 2.1 ha (c. 65% of the total site area) has been subject to quarrying.

3.4 Historical photographs have been found on the BGS geoscientific website which show the Spinkwell quarry during operation (c. 1926). Examination of the photographs show that the extracted mineral was a massive fine-grained sandstone which was worked by means of open quarries (cf. underground workings) by hand. Sandstone blocks were raised from the quarry by cranes positioned around the quarry peripheries and then dressed by hand on-site. It appears that cuttings and unusable stone was discarded back into the quarry once an area had been exhausted. The quarry highwalls appear to be vertical and in the region of 20m high.

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 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 SE11SW)	Made Ground – majority of site is infill to unknown depth (associated with former quarries). Drift – none recorded. Solid – Rough Rock Sandstone (part of Millstone Grit Series). BGS borehole SE11SW145 notes interbedded sandstone and shales to 156m underlain by gritstone and shales to 230m. Shallowest coal seam – none. Strata Dip – shallow; 4° southeast. Faults – none mapped beneath site – closest approximately 1.5km northeast.
Mining	Coal Authority	This site is located beyond the Coal Authority's defined coalfields.
Quarrying	Historical OS plans	Spinkwell Quarries and Manor House Quarry located within site boundary; both were sandstone quarries. Numerous other historical sandstone quarries surround the site.
Radon	Public Health England	The site lies in an area where between 1-3% of homes are estimated to be above the action level.
Hydrogeology	Environment Agency	Source Protection Zone? The site does not lie within a groundwater Source Protection Zone. Aquifer: Secondary A Aquifer (Solid). Groundwater abstractions? One on site or within 10m operated by Johnsons Wellfield Quarries Ltd for mineral products to make-up or top up water. Groundwater vulnerability – High vulnerability, secondary aquifer.
Hydrology	Envirocheck Report	Nearest watercourse(s) – River Colne, approximately 1.2km north. Water quality – Moderate (2016). Pollution incidents? Closest is 355m from site of septic tank affluent into Gargrave Aire in 1991 (category 3 – minor incident). Abstractions? None within 900m. Discharge consents? Closest is 905m from site.
Flood risk	Environment Agency Envirocheck Report	The site lies in Flood Zone 1, where the risk of flooding from rivers or the sea is classified as low. In accordance with Chapter 10 of the National Planning Policy Framework, a site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency).

4.2 Landfills

4.2.1 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
Wellfield Quarry Landfill	SE 116 145 (60m south)	Currently accepting inert landfill to unknown depth. License holder is Johnsons Wellfield Quarries Limited, issued June 2006 by EA.	EA OS plans Envirocheck
Blackmoorfoot Road	SE 115 145 (30m southwest)	Active between 1977 and 1988. Accepted inert and commercial waste. License held by Standard Fireworks. No current use, covered by trees and grass.	
Crosland Hill	SE 118 149 (150m northeast)	Input dates, nature of landfill and license holder not supplied. Housing currently occupies this area.	
Crosland Hill	SE 115 150 (280m northwest)	Input dates, nature of landfill and license holder not supplied. Currently occupied by grassland with possible agricultural use.	
Thewlis Lane	SE 118 145 (140m southeast)	Currently accepting non-biodegradable wastes (not construction). License holder is Johnsons Wellfield Quarries Limited, issued February 1978 by EA.	

4.2.2 The site itself was formerly occupied by two sandstone quarries as noted in Section 3. The Envirocheck report describes the majority of site as potentially infilled land. The nature of the fill is unknown, but the historical plan from 1960 suggests that the quarries were used as refuse tips.

5 PREVIOUS INVESTIGATION FINDINGS

5.1 General

5.1.1 Redrow have provided Lithos with copies of the following reports:

- 'Geo-environmental Appraisal of land at Crosland Hill, Huddersfield' (Ref. G1187/1), issued by AIG Consultants Ltd to Persimmon Homes in March 1999.
- 'Phase 2 Environmental Assessment Lowdham Leisureworld Premises (formerly Goodall's Caravans) Crosland Hill Road Huddersfield' (Ref. 2947-01), issued by QDS Environmental Ltd to Royal Bank of Scotland in January 2003.

5.1.2 Both of the above reports include desk study information and data obtained from intrusive ground investigation.

5.1.3 The AIG Report considers land immediately beyond the northern boundary, whilst the QDS Report considers the current area of interest.

5.1.4 In addition, both of the above reports include a brief review of an investigation undertaken by Delta-Simons in 1997. AIG and QDS state that the findings of the Delta-Simons report have been included/considered in their respective assessments and conclusions. To date the Delta-Simons report has not been made available to Lithos.

5.2 Summary of QDS's findings

5.2.1 QDS's ground investigation works comprised:

- Eleven dynamic sample boreholes to between 0.5m and 4.0m depth.
- Monitoring wells were installed in eight of the dynamic sample boreholes with various response zones generally between 0.3m and 3.0m depending on the end depth of the borehole.
- Chemical laboratory tests (including heavy metals, leachable metals, TPH, VOC, PAH, leachable PAH, pH and leachable pH).
- Water analyses were conducted on 2 off-site samples, including one from an abstraction well in the neighbouring quarry (analyses including heavy metals, TPH, VOC, PAH and pH).
- Gas monitoring; 3 visits between December 2002 and January 2003, with atmospheric pressures in range 1004 mb to 999 mb. Flows were recorded between -0.49 ml/min and 0.19ml/min, however consistently elevated flows were not measured.

5.2.2 The locations of QDS's exploratory holes are shown on Drawing 3649/6 and ground conditions are summarised in the Table below:

Hole	Final depth (m)	Depth of made ground (m)	Nature of made ground	Nature of natural ground
PH1	1.2	1.2	Granular with crushed concrete over cohesive. Slight hydrocarbon odour noted.	None encountered.
PH2	0.6	0.6	Granular with sandstone and brick.	
PH5	0.5	0.5	Cohesive with sandstone and brick fragments.	
PH6	4.0	4.0	Tarmac hardstand over clayey sand with occasional ash, sandstone fragments, glass and occasional brick. Compressed clayey layer with red brick between 3.4-3.6m.	
PH7	4.0	4.0		
PH8	2.5	2.5	Tarmac hardstand over clayey gravelly sand with occasional brick and ash.	
PH9	0.7	0.6	Tarmac hardstand over sandy clay with brick, ash and sandstone over black ash.	Refusal on sandstone.
PH10	2.7	0.5	Tarmac hardstand over clayey sand with ash.	Sand with sandstone fragments over sandy clay over sandstone at 2.3m.
PH11	0.8	0.2	Gravel over crushed concrete.	Sand with sandstone fragments. Refusal on sandstone.
PH12	0.9	0.5	Gravel surfacing over granular made ground with brick, sandstone, wood fragments, glass and concrete.	Sand with frequent sandstone fragments. Refusal on sandstone.
PH13	3.0	1.4	Gravel over cohesive made ground with frequent brick, sandstone and ash. Peaty odour noted.	Soft clay over sand with occasional sandstone.

5.3 Lithos comments

AIG Report

- 5.3.1 The AIG report is reasonably detailed in relation to the desk study and ground investigation although in comparison to a 'modern day' ground investigation it would be expected that a greater number of samples were tested for a more comprehensive suite of chemical and geotechnical testing.
- 5.3.2 Given that the AIG report does not cover the current site area the information contained therein has limited relevance although the desk study provides some useful information relating to the site's environmental setting.

QDS Report

- 5.3.3 The QDS report is focussed on evaluation of potential environmental risks in the context of a commercial end use. Consequently, there is little/no consideration of geotechnical issues nor other matters relevant to a much more sensitive residential end use.
- 5.3.4 The historical section of the desk study is very brief and the presence of refuse tips within the site's boundary is not discussed despite being a significant potential source of contamination and hazardous ground gas.
- 5.3.5 Many of the exploratory holes terminated at shallow depth and have not given a representative view of the depth of made ground across the site.
- 5.3.6 The location of quarry highwalls have not been determined; highwalls can pose a potential constraint to the proposed development.
- 5.3.7 Monitoring for hazardous gas has only been carried out on 3 occasions; one occasion on the day the monitoring wells were installed. In accordance with current guidance (CIRIA Report C6651,) at least 9 monitoring visits over 6 months would be expected in order to undertake a gas risk assessment.

¹ CIRIA C665: Assessing risks posed by hazardous ground gases to buildings (2007).

6 GROUND INVESTIGATION DESIGN

6.1 Anticipated ground conditions & potential issues

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

Anticipated condition	Remarks
Made ground	Anticipated across the entire site comprising tipped materials and reworked sandstone cuttings.
Natural soils & bedrock	Likely veneer of residual soils beyond quarry footprints. Sandstone bedrock at c. 20m depth beneath footprints of quarries. Vertical highwalls around quarry peripheries.
Mineworkings	None anticipated.
Groundwater	Anticipated at depth within bedrock. Likely flowing to the north. Further perched groundwater may be present in areas of made ground.

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

Type of issue	Specific issue	Remarks
Potential on-site contamination sources	1. backfilled pits 2. possible landfill 3. vehicles and machinery 4. storage and repair of vehicles	1. former quarries occupied site pre-1982 2. refuse tips noted on historical maps c.1960 3. machinery and vehicles associated with previous and current use
Potential off-site contamination sources	1. landfill	1. several active and former landfills surround the site
Potential geotechnical hazards	1. relict buried obstructions 2. deep MG 3. soft ground 4. steep slopes	1. former buildings noted on historical plans 2. extent and nature of fill associated with quarries is unknown 3. several steep slopes were noted on the walkover
Other potential constraints	1. retaining walls 2. underground and/or overhead utilities	1. several small retaining walls are utilised on site to create a relatively flat topography 2. utilities may be present

6.2 Preliminary conceptual site model

6.2.1 A preliminary conceptual site model, presented as Drawing No 3649/5 in Appendix B, has been prepared after consideration of all the data presented in Sections 2 to 6.1 inclusive of this report.

6.2.2 An assessment of potential contaminants associated with the former uses has been undertaken with reference to CLR8 and the following DETR Industry Profiles: Waste Recycling; treatment and disposal sites: Landfills and other waste treatment/disposal sites. As a consequence of this assessment, anticipated potential contaminants, within soil and/or groundwater include:

- Heavy metals
- Asbestos
- Total Petroleum & Polyaromatic Hydrocarbons (PAH & TPH)
- Volatile & Semi-Volatile Organic Compounds (VOC & sVOC)

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

6.3 Ground investigation design & strategy

6.3.1 The preliminary conceptual site model has been used as a basis for design of an appropriate ground investigation, the scope of which is summarised below:

Exploratory holes	Purpose
About 40 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
About 6 trial trenches	To identify highwalls associated with former quarries and assess the line and profile of high walls (over the first 3m or so).
About 40 Rotary Boreholes	To determine depth to rockhead in former quarries and the line and profile of high walls (crest to toe). To install monitoring wells in bedrock across the site in order to: • to assess groundwater levels and assess flow direction • retrieve representative groundwater samples, to determine water quality
About 6 Cable Percussion Boreholes	To investigate deeper backfill within former quarries. To install shallow monitoring wells in made ground in order to: • monitor for hazardous gas • determine continuity of shallow water and groundwater • retrieve representative groundwater samples, to determine water quality

6.3.2 Proposed exploratory hole locations should be selected to provide a representative view of the strata beneath the site and to target potential areas of interest identified in Section 6.1 above. A nominal 30m grid spacing should be appropriate, with additional exploratory locations scheduled as necessary in light of the ground conditions actually encountered.

6.3.3 Representative soil samples of natural and any man-made ground should be taken during the works. The number of soil samples taken should be reflective of the geological complexity actually encountered, but in general about 3 samples should be taken from most exploratory holes.

7 FIELDWORK

7.1 Objectives

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

7.2 Exploratory hole location constraints

7.2.1 During Lithos' investigation the site remained in use as a caravan sales area with associated parking, equipment storage, buildings etc.

7.2.2 No access was available in or around the existing buildings, most notably in the south, and exploratory holes were positioned away from site access routes.

7.2.3 On completion all exploratory holes had to be reinstated to a condition which was suitable for trafficking by vehicles and caravans and therefore large trial trenches etc (which create significant disturbance at surface) were not practical.

7.3 Scope of works

7.3.1 Fieldwork was undertaken in two phases; the first in February 2020 and the second in January 2021. During the 2020 investigation Lithos' scope of works comprised an exploratory investigation and, in accordance with Lithos' brief, no samples were recovered for chemical or geotechnical testing and no monitoring wells were installed.

Date of work	Technique	Exploratory holes	Final depths	Remarks
February 2020	Machine excavated trial pits	TPs 01 to 15	0.3m to 2.7m	Pits typically remained dry but were unstable.
	Rotary open probeholes	PHs 01 to 12	6.0m to 26.0m	Monitoring wells installed
	Groups of stitch probeholes	STs 01 to 04	6.0m to 8.0m	-
January 2021	Machine excavated trial pits	TPs 101 to 120	0.9m to 3.1m	Pits typically remained dry but were unstable.
	Rotary open probeholes	PHs 101 to 16	6.0m to 24.0m	Monitoring wells installed
	Groups of stitch probeholes	STs 101 to 106	6.0m to 21.5m	-

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

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

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

7.3.4 Exploratory hole locations are shown on Drawing 3649/7 presented in Appendix B; exploratory holes were picked-up by a surveyor and co-ordinates/ground levels are included on the logs.

8 GROUND CONDITIONS

8.1 General

- 8.1.1 A complete record of strata encountered beneath the proposed development site is given on the various exploratory hole records, presented in Appendices F & G.
- 8.1.2 Ground conditions at this site can be divided into materials found beyond and within quarry footprints. The extents of the quarries are discussed further in Section 8.8.
- 8.1.3 Typical ground conditions encountered at the site are described below in Sections 8.2 (made ground) and 8.4 (natural ground), with a summary provided in the table on pages 14 and 15.

8.2 Made ground

- 8.2.1 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. Nonetheless, the bulk of the made ground can be categorised as one of three broad types:
- **Sub-Base:** Encountered in & beyond quarry footprints, in the majority of exploratory holes from surface or the base of Hardstand (see Section 8.3 below) comprising sandy gravel of sandstone and occasionally limestone to a typical depth of 0.3m (max. 0.6m – TP07).
 - **Quarry Infill:** Encountered in & beyond quarry footprints, in 23 of 35 trial pits to between 0.5m and >2.8m comprising clayey sandy gravel, cobbles and boulders of sandstone, brick, concrete, pottery and clinker with fragments of wood, metal and plastic.
 - **Quarry Arisings:** Encountered in quarry footprints, in 24 of 35 trial pits comprising sandy gravel cobbles and boulders of sandstone and occasional concrete and brick. Occasionally recovered as a coarse soil (i.e. predominantly cobbles and boulders).
- 8.2.2 In addition to the above **Ash & Clinker** (ash sand & gravel of clinker, sandstone, brick, pottery and glass) was encountered from 0.5m to 1.0m in TP119.
- 8.2.3 **Relict Topsoil** comprising dark grey sandy silt/clay with gravel of sandstone and rootlets was encountered in TP110 (0.3m to 0.55m) and TP08 (0.7m to 1.4m).
- 8.2.4 The Sub-Base appears to have been placed across the majority of site areas to create a running layer (surfaced with hardstand) for current site usage as a caravan sales area.
- 8.2.5 The Quarry Infill includes a proportion of anthropogenic materials, including ash, clinker and fragments of plastic and metal, which are generally undesirable as near surface materials. Quarry Infill is generally found over Quarry Arisings, suggesting this material was placed at a later date. It is tentatively suggested that the Quarry Infill represents the general soil, spoil and waste which was placed during the refuse tipping shown on historical mapping.
- 8.2.6 Quarry Arisings generally underlie all other made ground types and appear to comprise off-cuts and chippings of sandstone which were discarded back into the quarries once extraction was completed.
- 8.2.7 The thickness of made ground within the quarry footprints varies from 11.0m to 22.5m deep (average 17m), whilst outside of quarry footprints made ground varies from 1.6m (TP12) to 2.3m (TP01) depth.
- 8.2.8 Whilst not encountered during this investigation, the possibility of 'burial pits', and/or asbestos sheeting (used as shuttering), and/or fragments of asbestos sheeting within the hardcore beneath concrete slabs, cannot be entirely discounted.

8.3 Obstructions

- 8.3.1 Hardstand is present across the majority of external areas which comprises either a veneer of multicoloured gravels or moderately weak to medium strong dark grey Macadam which varies in thickness from 50mm to 90mm.
- 8.3.2 About 15% of the site area is occupied by buildings.
- 8.3.3 Drawing 3649/3 shows the approximate areas of buildings and hardstand.
- 8.3.4 Constraints associated with ongoing usage of the site have prevented trenching to determine the nature of building foundations and the nature of any floor slabs. However, the existing buildings will have foundations and below ground structures should be anticipated.
- 8.3.5 The made ground beneath this site, most notably Quarry Arisings, include a proportion of oversized materials (cobbles and boulders up to >1.0m in diameter) of sandstone and occasional concrete and well bonded brick and mortar. The frequency of sandstone boulders appears to increase with depth.

8.4 Natural ground

- 8.4.1 **Natural Residual Soils** were encountered beyond the footprints of the quarries in 4 of the 35 trial pits (TPs 08, 12, 114 & 116) from between 0.5m (TP116) and 2.3m (TP114) depth and typically comprised sandy gravel and cobbles of sandstone, although Residual Soil in TP114 comprised firm brown clay.
- 8.4.2 **Bedrock** was encountered in TPs 12 and 116 from the base of Residual Soils, as well as the majority of the rotary probeholes, and comprised medium strong fine-grained sandstone of the Rough Rock Sandstone unit. Excavations into bedrock terminated after about 0.5m of penetration.

8.5 Visual & olfactory evidence of organic contamination

- 8.5.1 Visual and olfactory evidence of organic contamination was only encountered during excavation of TP12, comprising a faint diesel smell and a pearlescent sheen to the excavation arisings.
- 8.5.2 Trial pit 116 was advanced immediately adjacent to TP12 to recover samples for chemical testing, but no evidence of contamination was found during the excavation of TP116.
- 8.5.3 Selected samples of potentially contaminated materials were scheduled for chemical testing to determine the nature and extent of any contamination.

Summary of Ground Conditions

Within quarry?	Hole ID	Final Depth (mbgl)	Depth to base (mbgl)									Rough Rock Sandstone (rockhead)	Penetration (m)
			Total Made Ground	Hardstand	Sub-Base	Relict Topsoil	Ash & Clinker	Quarry Infill	Quarry Arisings	Cohesive Residual Soil	Granular Residual Soil		
Yes	TP01	3.2	>3.2	0.10	0.3	-	-	1.5	>3.2	-	-	-	-
	TP02	2.7	>2.7	0.10	0.3	-	-	>2.7	0.5	-	-	-	-
	TP03	2.6	>2.6	0.10	0.4	-	-	0.5	2.6	-	-	-	-
	TP04	2.5	>2.5	-	0.4	-	-	>2.5	-	-	-	-	-
	TP05	2.0	>2.0	-	-	-	-	-	>2.0	-	-	-	-
	TP06	0.3	>0.3	-	-	-	-	-	>0.3	-	-	-	-
	TP07	2.2	>2.2	-	0.6	-	-	>2.2	2.0	-	-	-	-
	TP09	2.4	>2.4	-	-	-	-	-	>2.4	-	-	-	-
	TP10	2.3	>2.3	-	0.2	-	-	1.8	>2.3	-	-	-	-
	TP11	2.1	>2.1	-	0.2	-	-	>2.1	-	-	-	-	-
	TP13	2.2	>2.2	-	0.2	-	-	-	>2.2	-	-	-	-
	TP14	2.0	>2.0	-	0.1	-	-	0.8	>2.0	-	-	-	-
	TP15	2.2	>2.2	-	0.3	-	-	>2.2	1.4	-	-	-	-
	TP101	0.9	>0.9	0.10	0.4	-	-	-	>0.9	-	-	-	-
	TP102	1.6	>1.6	0.08	0.3	-	-	0.6	>1.6	-	-	-	-
	TP103	1.9	>1.9	0.08	0.4	-	-	-	>1.9	-	-	-	-
	TP104	1.8	>1.8	0.07	0.4	-	-	-	>1.8	-	-	-	-
	TP105	2.5	>2.5	0.09	0.4	-	-	-	>2.5	-	-	-	-
	TP106	2.8	>2.8	0.10	0.3	-	-	0.9	>2.8	-	-	-	-
	TP107	2.4	>2.4	0.09	0.4	-	-	-	>2.4	-	-	-	-
	TP108	2.5	>2.5	0.05	0.4	-	-	1.5	>2.5	-	-	-	-
	TP109	2.8	>2.8	0.05	0.5	-	-	>2.8	-	-	-	-	-
	TP110	3.0	>3.0	0.05	0.3	0.55	-	-	>3.0	-	-	-	-
	TP111	2.6	>2.6	-	-	-	-	-	>2.6	-	-	-	-

Within quarry?	Hole ID	Final Depth (mbgl)	Depth to base (mbgl)									Rough Rock Sandstone (rockhead)	Penetration (m)
			Total Made Ground	Hardstand	Sub-Base	Relict Topsoil	Ash & Clinker	Quarry Infill	Quarry Arisings	Cohesive Residual Soil	Granular Residual Soil		
Yes	TP112	2.0	>2.0	0.05	0.4	-	-	>2.0	-	-	-	-	-
	TP113	2.1	>2.1	-	0.4	-	-	-	>2.1	-	-	-	-
	TP114	3.1	2.3	0.05	0.15	-	-	2.3	-	3.1	-	-	-
	TP115	2.8	>2.8	-	0.2	-	-	>2.8	-	-	-	-	-
	TP116	1.5	0.5	0.05	0.25	-	-	0.5	-	-	1.0	1.0	0.5
	TP117	3.0	>3.0	-	0.3	-	-	1.2	>3.0	-	-	-	-
	TP118	2.4	>2.4	-	0.3	-	-	1.1	>2.4	-	-	-	-
	TP119	2.7	>2.7	0.08	0.5	-	1.0.	>2.7	-	-	-	-	-
	TP120	2.5	>2.5	-	0.3	-	-	>2.5	-	-	-	-	-
No	TP08	2.3	1.4	-	-	1.4	-	0.7	-	-	2.25	-	-
	TP12	1.6	1.0	-	0.2	-	-	1.0	-	-	1.6	1.6	0.1

8.6 Groundwater

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

8.6.2 Groundwater levels recorded in the monitoring wells are summarised below.

Hole	Response zone (depth range & strata)	Groundwater body	Typical standing water level	
			m bgl	m AoD [#]
PH101	9.0m to 12.0m – Quarry Backfill.	Perched.	11.58	187.12
PH102	3.0m to 6.0m – Quarry Backfill.		N.D.	-
PH104	3.0m to 6.0m – Quarry Backfill.		5.45	194.45
PH105	1.0m to 4.0m – Quarry Backfill.		N.D.	-
PH106	3.0m to 6.0m – Quarry Backfill.		N.D.	-
PH107	8.0m to 11.0m – Quarry Backfill.		N.D.	-
PH108	3.0m to 6.0m – Quarry Backfill.		N.D.	-
PH110	2.5m to 5.5m – Quarry Backfill.		3.53	205.92
PH111	2.5m to 5.5m – Quarry Backfill & Rough Rock Sandstone bedrock.	Bedrock; Secondary A Aquifer.	N.D.	-
PH112	3.0m to 6.0m – Quarry Backfill.	Perched.	4.15	205.3
PH113	3.0m to 6.0m – Quarry Backfill.		N.R.	-
PH114	2.0m to 5.0m – Quarry Backfill.		N.D.	-
PH115	5.0m to 8.0m – Quarry Backfill.		N.D.	-
PH116	3.0m to 6.0m – Rough Rock Sandstone.	Bedrock; Secondary A Aquifer.	4.58	206.77

[#] levelled-in by survey

8.6.3 Dip data suggests that areas of groundwater are present within the Quarry Backfill, but these do not appear to represent a continuous water table across the site. It is likely that the recorded dips represent localised areas of perched waters which are isolated within the backfilled quarries by areas of cohesive ground or large boulders.

8.6.4 Based on the soil descriptions to date, the Quarry Arisings would be expected to be broadly free draining.

8.7 Stability

8.7.1 The stability of excavations through made ground was often poor. The presence of oversize materials (cobbles and boulders) frequently led to overbreak and spalling of trial pit walls.

8.8 Quarrying investigation

- 8.8.1 As outlined in Section 3 much of the site area has been subject to quarrying of sandstone. Historical mapping and available photographs suggest that quarrying comprised open excavations of c. 20m depth with near-vertical highwalls.

Probeholes

- 8.8.2 A total of 28 'deep' rotary probeholes were advanced across the site to determine the depth to, and extents of, the base of former quarries. The findings of the rotary probeholes are presented in the table below:

Within Quarry?	Hole	Final Depth (mbgl)	Total Made Ground (mbgl)	Penetration into rock (m)	Evidence of mineworkings?	Remarks
Yes	PH01	24.0	19.9	4.1	No	-
	PH02	24.0	18.0	6.0		-
	PH03	24.0	19.1	4.9		-
	PH04	26.0	21.0	5.0		-
	PH05	21.0	15.5	5.5		-
	PH06	26.0	21.0	5.0		-
	PH07	24.0	19.5	4.5		-
	PH08	21.0	16.8	4.2		-
	PH09	18.0	14.0	4.0		-
	PH11	18.0	13.5	4.5		-
	PH12	21.0	17.5	3.5		-
	PH101	21.0	16.7	4.3		Monitoring well installed
	PH102	18.0	12.0	6.0		Monitoring well installed
	PH103	21.0	13.7	7.3		-
	PH104	21.0	16.3	4.7		Monitoring well installed
	PH105	18.0	12.8	5.2		
	PH106	16.0	11.0	5.0		
	PH107	24.0	18.9	5.1		
	PH108	22.3	19.3	3.0		
	PH109	21.0	16.1	4.9		
	PH110	27.0	22.5	4.5		
	PH112	25.0	21.8	3.2		
	PH113	24.5	21.5	3.0		
	PH114	18.0	12.7	5.3		
	PH115	6.0	15.0	3.0		-
No	PH116	18.0	-	-		-
	PH10	6.0	2.4	3.6		-
	PH111	12.0	4.5	7.5		Monitoring well installed

- 8.8.3 The probeholes found that quarry depth varies between 11.0m and 22.5m; average 17m. Backfill in the quarries frequently included large (up to c. 2.0m in diameter) boulders which broadly increased in size and frequency with depth.
- 8.8.4 Using the above data cross sections have been drawn which are presented on Drawing 3649/10. It is apparent that the depth of made ground in backfilled quarries is greatest in the general southwest of the site and broadly shallows in the east.
- 8.8.5 In total, quarry backfill appears to be present beneath about 75% of the total site area, with the remaining 25% underlain by bedrock at relatively shallow depths.

Stitch probeholes

- 8.8.6 A total of 10 groups of stitch probeholes were advanced to determine the line and profile of the buried highwalls. The lines of highwalls were initially determined from the historical OS maps and by feature mapping depressions and changes in gradient whilst on-site.
- 8.8.7 The findings of the stitch probeholes are summarised in the table below:

Stitch	No of PHs	Location of highwall	Depth to rockhead within quarry	Depth to rockhead beyond quarry	Remarks
ST01	2 (a & b)	Between a & b	9.5m	2.0m	Highwall appears vertical/near vertical.
ST02	3 (a – c)	Between b & c	14.3m	2.0m	
ST03	3 (a – c)	Between b & c	12.0m	2.5m	
ST04	3 (a – c)	Between b & c	18.0m	1.8m	
ST101	5 (a – e)	Between c & d	13.0m	2.0m	
ST102	5 (a – e)	-	16.3m to 18.0m	-	No highwall encountered – likely none present in the immediate area & quarries historically 'merged'.
ST103	5 (a – e)	Between a & b	15.0m	3.4m	Highwall appears vertical/near vertical.
ST104	5 (a – e)	-	17.8m to 9.0m	-	Ramp encountered, but no highwall.
ST105	5 (a – e)	Between c & d	21.9m	-	Highwall present, but at depth. Possible terrace/shelf. Constraints prevented further drilling.
ST106	5 (a – e)	-	13.5m to 15.0m	-	No highwall encountered – quarry extends further east than shown on mapping.

- 8.8.8 The lines of buried highwalls, areas of shallow made ground, ramps etc (based on the findings of the probeholes, stitch probeholes and examination of the historical mapping) are presented/interpreted on Drawing 3649/11. Lines are shown as solid where proven and dashed where interpreted; see the following paragraphs for details.
- 8.8.9 The extent of quarrying proven by drilling to date correlates well with that shown on old OS maps (see Drawing 3649/3a). There are areas of un-quarried ground in the north-west, south-west, south-east, and a "ridge" in the centre (between ST103 and ST01), although this feature requires further drilling to better delineate (there were some access constraints here).
- 8.8.10 Generally, highwalls appear to be very steep/vertical. This corresponds with the old photographs (see Section 3) which showed near-vertical highwalls in the former Spinkwell Quarry.

- 8.8.11 Highwalls appear to run along the southern boundary and across the north-western and south-western corners; shallow natural ground is present in the south-east, south-west and north-west.
- 8.8.12 A further 'spur' of shallow natural ground appears to run roughly north to south through the centre, with buried highwalls around its edges.
- 8.8.13 There are two buried 'ramps' which appear to comprise less steep highwalls which rise from around 20m depth to 11m depth and are located in the centre and centre-north. At this stage, the exact profile of the ramps is not wholly clear due to constraints on site, but these ramps possibly linked different 'generations' of quarries for ease of access etc.

Underground workings

- 8.8.14 No evidence of underground workings was encountered in any of the probeholes, or stitch probeholes, drilled during Lithos' investigation.

8.9 Revised conceptual ground model (ground conditions)

- 8.9.1 The Preliminary Conceptual Site Model has been revised in light of data obtained during the ground investigation, most notably with respect to:
- The nature and distribution of made ground, including the presence of significant buried obstructions
 - The nature and distribution of the former quarries
 - The strength, nature and depth of underlying natural strata
 - The nature and distribution of contamination (based on visual/olfactory evidence only)
- 8.9.2 Further refinement of the Conceptual Site Model is presented in Sections 10.2, where the results of laboratory testing for contaminants have been considered.

9 CONTAMINATION (ANALYSIS)

9.1 General

- 9.1.1 The site has been formerly used as: a quarry, with subsequent backfilling and refuse tipping and a caravan sales area.
- 9.1.2 Raw materials stored and used on site included: lubrication oils and fuels, as well as a multitude of materials associated with any waste/soil/overburden which has been used to backfill the former quarries.
- 9.1.3 The site's former usage is likely to have given rise to some ground contamination. Furthermore, significant thicknesses of made ground were encountered in many of the exploratory locations during the ground investigation.
- 9.1.4 In the context of risks to human health associated with residential redevelopment, the Tier 1 Soil Screening Values referenced in this report have been derived via the CLEA default conceptual site model (CSM) used for generating SGVs, but amended, where appropriate, to be more specific to redevelopment within the planning process.
- 9.1.5 Where available, Category 4 Screening Levels (C4SL) have also been referenced.
- 9.1.6 Generic Note 04 in Appendix A provides further details with respect to current guidance and the interpretation of analytical data.

9.2 Testing scheduled

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

Type of sample	No. of samples	Determinands
Made ground	30	speciated poly aromatic hydrocarbons (PAH). pH, water soluble boron, and total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc) & Asbestos ID. Total organic carbon (TOC) & banded total petroleum hydrocarbons.
	20	Water soluble sulphate, chloride, nitrate and magnesium.
	8	Leachable metals: arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc.
	1	Calorific value (CV).

9.3 Soil contamination results

- 9.3.1 The soil contamination test results are summarised in the tables on pages 21 to 25.
- 9.3.2 Laboratory test certificates as received from the laboratory are presented in Appendix H to this report.

Calorific value

- 9.3.3 The calorific value of one sample of Ash & Clinker has yielded a CV of 1.8MJ/kg. Materials whose CVs exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn.
- 9.3.4 Consequently, combustibility of the Ash & Clinker is not considered an issue at this site.

Asbestos

- 9.3.5 An asbestos screen was scheduled on 30 samples of made ground. A total of 5 samples returned positive IDs and further quantification was instructed; results are presented in the table below:

Sample ID	Material Type	Asbestos % by weight	Remarks
TP119 – 0.7m	Ash & Clinker	<0.001%	Bundles of chrysotile fibres.
TP104 – 0.6m	Quarry Arisings	0.109%	Fragment of cement sheeting.
TP102 – 0.4m	Quarry Infill	0.004%	Bundles of chrysotile fibres.
TP109 – 0.8m	Quarry Infill	0.004%	
TP110 – 0.5m	Relict Topsoil	0.080%	Fragment of insulation lagging.

- 9.3.6 It is apparent that some (relatively minor) asbestos is present within several made ground types across this site and remediation will be required; see Sections 10.5 and 10.7.9.
- 9.3.7 It is possible, that areas with greater concentrations of asbestos (either comprising fragments of ACM e.g. cement sheet, or free fibres) are present which have not yet been encountered.

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	Zn\$	CV	Asbestos
				37	5	26	3000	200	200	169	127	350	200	2	
TP119	0.7	Ash & Clinker	8.1	25	0.6	1.1	23	100	95	0.1	25	0.5	94	1.8	Chrysotile
TP101	0.6	Quarry Arisings	8.2	3.7	0.4	0.4	16	18	13	0.1	12	0.5	51	-	N.D.
TP102	0.2	Quarry Arisings	8.3	1.3	0.2	0.1	12	8.3	6.2	0.1	9.4	0.5	21	-	N.D.
TP103	0.7	Quarry Arisings	8.2	24	0.2	0.5	15	23	22	0.1	14	0.5	67	-	N.D.
TP104	0.6	Quarry Arisings	7.8	35	0.4	0.1	18	67	390	0.2	15	0.5	54	-	Chrysotile
TP105	0.6	Quarry Arisings	8.2	7.3	0.5	0.3	12	15	56	0.1	9.8	0.5	55	-	N.D.
TP106	1.0	Quarry Arisings	7.6	14	0.4	0.3	17	31	55	0.1	14	0.5	45	-	N.D.
TP107	0.7	Quarry Arisings	8.0	13	0.3	0.3	20	34	42	0.1	16	0.5	46	-	N.D.
TP111	1.5	Quarry Arisings	7.9	3.4	0.3	0.1	12	12	21	0.1	9.3	0.5	32	-	N.D.
TP113	0.5	Quarry Arisings	7.9	13	0.9	0.3	20	47	110	0.3	20	0.5	79	-	N.D.
TP118	1.9	Quarry Arisings	8.2	5.6	0.2	0.3	15	15	15	0.1	15	0.5	50	-	N.D.
TP102	0.4	Quarry Infill	9.8	7.2	1.1	0.8	20	38	170	0.1	12	0.6	59	-	Chrysotile
TP106	0.5	Quarry Infill	8.2	17	0.3	1.0	9.9	42	80	0.1	9.9	0.5	58	-	N.D.
TP109	0.8	Quarry Infill	8.4	160	2.5	0.9	25	160	310	2.0	33	1.0	150	-	Chrysotile
TP111	0.4	Quarry Infill	8.5	9.3	0.8	0.2	15	32	110	0.2	13	0.5	52	-	N.D.
TP112	0.6	Quarry Infill	8.2	19	1.2	0.3	16	41	200	0.3	18	0.5	94	-	N.D.
TP115	0.4	Quarry Infill	8.0	8.1	0.3	0.4	14	34	61	0.2	18	0.5	120	-	N.D.
TP115	1.4	Quarry Infill	7.8	23	1.6	0.3	16	53	85	0.4	15	0.5	56	-	N.D.
TP116	0.4	Quarry Infill	8.0	2.1	0.2	0.6	5.0	8.6	12	0.1	4.1	0.5	35	-	N.D.
TP117	0.5	Quarry Infill	7.7	5.7	0.2	0.2	14	76	56	0.1	24	0.5	42	-	N.D.
TP118	0.7	Quarry Infill	8.1	3.6	0.2	0.3	11	18	20	0.1	10	0.5	42	-	N.D.
TP110	0.5	Relict Topsoil	7.6	6.8	0.4	0.2	14	16	41	0.1	9.9	0.5	34	-	Chrysotile
TP101	0.2	Sub-Base	8.3	1.7	0.2	0.3	7.5	6.8	4.8	0.1	5.9	0.5	27	-	N.D.
TP103	0.3	Sub-Base	8.2	2.3	0.2	0.1	14	16	4.4	0.1	10	0.5	19	-	N.D.
TP104	0.2	Sub-Base	8.3	2.0	0.2	0.2	13	12	16	0.1	11	0.5	61	-	N.D.
TP108	0.2	Sub-Base	8.3	1.3	0.2	0.2	10	7.6	6.9	0.1	8.0	0.5	27	-	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	Zn\$	CV	Asbestos
				37	5	26	3000	200	200	169	127	350	200	2	
TP110	0.2	Sub-Base	8.7	7.7	0.2	4.4	4.3	56	44	0.4	6.0	0.5	230	-	N.D.
TP112	0.2	Sub-Base	8.8	3.3	0.2	0.9	3.2	7.7	8.6	0.1	4.3	0.5	43	-	N.D.
TP114	0.1	Sub-Base	10.8	24	0.4	0.5	38	60	30	0.09	38	0.5	74	-	N.D.
TP119	0.4	Sub-Base	9.0	2.2	0.2	1.0	7.6	11	30	0.1	7.1	0.5	28	-	N.D.

Key		Source of guidance trigger level	
36	Parameter tested for and found to be in excess of Tier 1 value.	*	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.
179	Parameter tested for and found to be > 5 x Tier 1 value.		
12	Parameter tested for but not found to be in excess of Tier 1 value.	∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).
-	Parameter not tested for.	\$	MAFF. Code of Practice for Agricultural Practice for the Protection of Soil, 1998.
♣	Tier 1 Value is pH dependent.	~	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.
x	Assumes Cr is CrIII. If demonstrated Cr is CrVI Tier 1 would be 21mg/kg.		
ND	No fibres detected (asbestos screen)		
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.			

Summary of the leachability testing

Expl Hole	Depth (m)	Material	Concentration in µg/litre unless otherwise Shown. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Tier 1 Screening Concentrations are shown in BLUE.										
			pH	As ~	B *	Cd ~	Cr ~	Cu ~	Pb ~	Hg ~	Ni ~	Se *	Zn ~
				10	1000	5	50	2000	10	1	20	10	10
TP119	0.70	Ash & Clinker	7.0	0.4	12	0.1	0.3	1.0	0.4	0.1	0.5	0.3	1.3
TP101	0.60	Quarry Arisings	7.1	0.2	12	0.1	0.3	1.0	0.1	0.1	0.5	0.3	1.3
TP106	1.00	Quarry Arisings	7.2	0.3	12	0.1	0.3	0.6	0.1	0.1	0.5	0.3	1.3
TP102	0.40	Quarry Infill	7.0	0.3	12	0.1	0.3	0.7	0.2	0.1	0.5	0.3	1.3
TP109	0.80	Quarry Infill	6.9	4.5	12	0.1	0.3	2.0	0.7	0.1	0.5	0.4	2.6
TP115	0.40	Quarry Infill	7.3	0.7	12	0.1	0.3	0.7	0.3	0.1	0.5	0.3	1.3
TP104	0.20	Sub-Base	8.1	0.2	12	0.1	0.3	0.5	0.1	0.1	0.5	0.3	1.3
TP114	0.10	Sub-Base	7.8	0.2	12	0.1	0.3	0.7	0.1	0.1	0.5	0.3	1.3

Key			Source of guidance trigger level	
36	Parameter tested for and found to be in excess of Tier 1 concentration		~	Directive (2000/60/EC) establishing a framework for Community action in the field of water policy (Water Framework Directive)
0.3	Parameter tested for but not found to be in excess of Tier 1 concentration		*	Water Supply (Water Quality) Regulations 1989, as amended in 2000

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. Soil Screening Concentrations are shown in BLUE and assume a residential with gardens and 600mm cover end use					
			% TOC	PAH		TPH - C ₆ to C ₄₀		
				B(a)P ∞	Naphthalene	GRO~ C ₆ to C ₁₀	DRO $\diamond$ C ₁₀ to C ₂₁	LRO C ₂₁ to C ₄₀
				25	9	34*	156*	5000*
TP119	0.7	Ash & Clinker	7.2	2.1	0.3	0.1	522	1590
TP101	0.05	Hardstand	-	0.4	8.4	-	-	-
TP103	0.05	Hardstand	-	0.2	4.8	-	-	-
TP106	0.05	Hardstand	-	0.1	0.1	-	-	-
TP108	0.02	Hardstand	-	0.4	0.1	-	-	-
TP119	0.05	Hardstand	-	0.1	0.1	-	-	-
TP101	0.6	Quarry Arisings	0.6	0.1	0.1	0.1	30	20
TP102	0.2	Quarry Arisings	< 0.5	0.1	0.1	0.1	30	20
TP103	0.7	Quarry Arisings	0.6	0.1	0.1	0.1	36	80
TP104	0.6	Quarry Arisings	3.5	0.7	2.6	0.1	82	130
TP105	0.6	Quarry Arisings	0.7	0.2	1.4	0.1	40	179
TP106	1.0	Quarry Arisings	1.6	0.1	0.1	0.1	33	58
TP107	0.7	Quarry Arisings	2.3	0.2	0.1	0.1	42	84
TP111	1.5	Quarry Arisings	< 0.5	0.1	0.1	0.1	30	20
TP113	0.5	Quarry Arisings	4.9	2.7	0.4	0.1	256	367
TP118	1.9	Quarry Arisings	< 0.5	0.1	0.1	0.1	30	20
TP102	0.4	Quarry Infill	2.8	1.3	0.4	0.1	30	20
TP106	0.5	Quarry Infill	2.7	0.4	0.2	0.1	156	710
TP109	0.8	Quarry Infill	9.5	0.3	0.1	0.1	90	205
TP111	0.4	Quarry Infill	1.8	0.2	0.1	0.1	147	216
TP112	0.6	Quarry Infill	3.0	0.5	0.8	0.1	75	90
TP115	0.4	Quarry Infill	2.8	0.3	0.3	0.1	60	78

Expl Hole	Depth (m)	Material	Concentrations in mg/kg. Results are quoted to 1 decimal place if <10, and whole numbers if >10. Soil Screening Concentrations are shown in BLUE and assume a residential with gardens and 600mm cover end use					
			% TOC	PAH		TPH - C6 to C40		
				B(α)P ∞	Naphthalene	GRO~ C ₆ to C ₁₀	DRO◇ C ₁₀ to C ₂₁	LRO C ₂₁ to C ₄₀
				25	9	34*	156*	5000*
TP115	1.4	Quarry Infill	7.8	0.1	0.4	0.1	35	32
TP116	0.4	Quarry Infill	3.1	0.1	0.1	0.1	30	20
TP117	0.5	Quarry Infill	1.5	0.1	0.1	0.1	30	20
TP118	0.7	Quarry Infill	1.1	0.1	0.1	0.1	45	200
TP110	0.5	Relict Topsoil	1.9	0.0	0.1	0.1	30	20
TP101	0.2	Sub-Base	< 0.5	0.1	0.1	0.1	30	20
TP103	0.3	Sub-Base	< 0.5	0.1	0.1	0.1	33	305
TP104	0.2	Sub-Base	0.6	0.1	0.1	0.1	119	1270
TP108	0.0	Sub-Base	< 0.5	0.1	0.1	0.1	30	20
TP110	0.2	Sub-Base	4.2	0.1	0.1	0.1	30	20
TP112	0.2	Sub-Base	2.8	0.1	0.1	0.1	30	20
TP114	0.1	Sub-Base	5.2	0.1	0.1	0.1	30	20
TP119	0.4	Sub-Base	2.6	1.8	0.1	0.1	328	1031

* Note: Tier 1 screening values revised for several soil types; see Section 9.3.24.

Key		Source of guidance trigger level	
60	Parameter tested for and in excess of Tier 1 concentration.	∞	Category 4 Screening Level – SP1010, December 2013 (CL:AIRE/Defra).
0.3	Parameter tested for but not in excess of Tier 1 concentration.	~	Assumes all GRO is aromatic fraction C7 to C8.
-	Contaminant not tested for.	◇	Assumes all DRO is aliphatic fraction C10 to C12.
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).			

Inorganic determinands

- 9.3.8 Of the 30 samples of made ground analysed for inorganic parameters, 23 can be classified as uncontaminated and 7 could be classified as contaminated.
- 9.3.9 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).
- 9.3.10 To date the degree of inorganic contamination does not appear to be especially onerous, although some exceedances of the relevant Tier 1 Screening Values are present they are relatively infrequent and never by a factor of more than 5x.
- 9.3.11 However, it should be noted that some made ground at this site (most likely the Ash & Clinker and Quarry Infill) has originated from refuse tipping and consequently would be expected to be heterogeneous.
- 9.3.12 The most common contaminants are lead and asbestos.
- 9.3.13 Statistical analysis of 28 results has been carried out in general accordance with the methods outlined in "Guidance on Comparing Soil Contamination Data with a Critical Concentration", CIEH/CL:AIRE (2008) (see comments in Appendix A, Contamination Testing) and the results are summarised below.

Stratum	No. of samples	US ₉₅ values for contaminants that have yielded one or more Tier 1 exceedances for a given made ground type		
		Arsenic (37)	Lead (200)	Zinc (200)
Quarry Arisings	10	n/a	71	n/a
Quarry Infill	10	25.5	136	n/a
Sub-Base	8	n/a	n/a	64

Notes: Values in bold indicate that the US₉₅ value exceeds the relevant Tier 1 value.

n/a = none of the samples retrieved from this made ground type yielded a concentration in excess of the relevant Tier 1 value.

- 9.3.14 Where there is 95% confidence or greater that the true mean concentration of a given contaminant within a particular soil type is less than the Tier 1 value, it can be concluded that the contaminant does not pose a significant risk to human health.
- 9.3.15 The statistical analysis indicates that none of the upper 95th percentile bound values (US₉₅) for the above made ground types are in excess of the relevant Tier 1 Screening Values.
- 9.3.16 Two samples failed the outlier test; arsenic in a sample of Quarry Backfill recovered from TP109 at 0.8m, and zinc in a sample of Sub-Base recovered from TP110 at 0.2m.
- 9.3.17 **Zinc** is a phytotoxic metal; phytotoxicity describes the inhibitive and toxic effect high concentrations of some substances can have on plant growth.
- 9.3.18 Most substances are harmful to human health at lower concentrations than would be detrimental to plant growth. However, there are three notable exceptions - boron, copper and zinc. Plants are the more sensitive receptor to these elements i.e. detrimental effects are seen in plants at concentrations which do not present a risk to human health. Consequently, for zinc, consideration and protection of flora would also be protective of human health.

- 9.3.19 Allowable concentrations of heavy metals in arable soils are set out in Defra's Code of Good Agricultural Practice 2009². The value for zinc is 200mg/kg, and is based on a continued annual application of heavy metal rich fertiliser (sludge); as such it is not representative of activity in a standard UK garden.
- 9.3.20 Lithos have also derived a value for zinc in relation to risks to human health, using the CLEA model, assuming a residential end use with consumption of home grown produce in a sandy loam soil with 6% SOM. The reported value is 2,170mg/kg, ten times greater than the potential phytotoxic concentration.
- 9.3.21 On balance, given the context of a residential development and the relatively low concentrations recorded, zinc is not considered significant and no special remedial measures are considered necessary.

Organic determinands

- 9.3.22 This site is brownfield and underlain by made ground which has yielded occasional elevated concentrations of inorganic compounds. Consequently, for organic compounds, the Tier 1 Soil Screening Values used in this report have been derived with reference to a CSM that assumes a minimum 600mm of clean soil cover will be placed in gardens/landscaped areas (Lithos Scenario B).
- 9.3.23 Lithos have used the CLEA model to derive risk-based screening values for hydrocarbons, in accordance with the methodology detailed by the TPHCWG, and reviewed by a UK workshop of experts with respect to UK adoption of the method.
- 9.3.24 However, these screening values assume a Soil Organic Matter (SOM) of 6% (equivalent to a TOC of 3.5%). Many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with lower screening values may be required.
- 9.3.25 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?
Ash & Clinker	7.2%	No
Quarry Infill	3.5%	No
Quarry Arisings	1.6%	Yes, revised screening values adopted.
Relict Topsoil	1.9%	
Sub-Base	2.0%	

² Defra – Protecting our Water, Soil & Air – A Code of Good Agricultural Practice for farmers, growers and land managers. 2009

Hydrocarbons (TPH & PAH)

- 9.3.26 Given the absence of visual/olfactory evidence of any hydrocarbon contamination, only a simple banded TPH (cf full speciation) was scheduled on 30 samples. A total of 9 samples from a range of made ground types returned values in excess of Lithos' Tier 1 screening values for diesel range organics (DRO).
- 9.3.27 Evidence of hydrocarbon contamination was encountered during excavation of TP12 during Lithos' original investigation (but no testing was undertaken in accordance with Lithos' brief at the time). TP116 was excavated adjacent to TP12 to recover samples however samples recovered from TP116 did not return results for organic contaminants above the laboratory limit of detection.
- 9.3.28 None of the remaining exploratory holes were advanced at/close to a clear source of hydrocarbon contamination (based on the conceptual site model, site operations and site features), although this does not necessarily discount the presence of hydrocarbon spills.
- 9.3.29 TPH can be associated with a variety of sources and elevated TPH concentrations do not automatically infer a petroleum product is present; indeed the absence of petroleum products on this site is reflected in the preliminary conceptual model. TPH analysis will detect most hydrocarbons and is not restricted to those detailed within the TPHCWG reports.
- 9.3.30 Examination of the exploratory hole logs shows that made ground soils frequently included fragments of clinker, coal, macadam and ash; all of which are commonly associated with organic compounds.
- 9.3.31 Whilst not necessarily associated with a petroleum product, the significance of these hydrocarbons, with respect to health, should still be assessed. Providing no other sources are present on site (solvents, degreasers etc), it can be assumed that the most problematic compounds detected within the banded TPH screen are polycyclic aromatic hydrocarbons (PAHs).
- 9.3.32 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 wealth of toxicological data available) and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food.
- 9.3.33 A C4SL toxicity assessment using the surrogate marker approach can be used to estimate the significance of a mixture of PAHs in soil, using toxicity data for indicator compounds within that mixture. Exposure to the indicator (or surrogate marker) is assumed to represent exposure to all PAHs in that matrix.
- 9.3.34 The sample profiles here are sufficiently similar to the toxicity study adopted for the C4SL assessment, and BaP concentrations are below Lithos' Tier 1 Value. Consequently, the hydrocarbons detected are unlikely to pose any unacceptable risk to end users, and no remediation is required.
- 9.3.35 Whilst classed as a PAH, naphthalene is more volatile and mobile in the environment than other PAHs. As such the significance of naphthalene cannot be considered within the surrogate marker approach. Consequently, naphthalene has been considered individually against Lithos' Tier 1 Value.
- 9.3.36 Concentrations of B(a)P and naphthalene are below their respective Tier 1 Values, and therefore the DRO and LRO hydrocarbons detected are unlikely to pose any unacceptable risk to end users, and no remediation is required.

10 CONTAMINATION (QUALITATIVE RISK ASSESSMENT REMEDIATION)

10.1 Summary of significant contamination

- 10.1.1 Made Ground underlies the entire site to depths of up to about 22m.
- 10.1.2 To date, the soils contamination encountered is relatively "mild". However, given reference on old OS maps to "refuse tipping", it is possible that more onerous contamination than that encountered to date is present.
- 10.1.3 Further contamination may be present beneath areas which have been inaccessible for investigation to date (e.g. beneath buildings, at drainage interceptors etc) and around TP12.
- 10.1.4 Asbestos has been encountered in 5 of 30 samples of made ground tested. Quantification shows that the percentage of asbestos free fibres within the soil mass is typically a 'trace' amount (< 0.005%), but a fragment of asbestos-cement sheeting was recorded in TP104 (0.11%) and insulation lagging in TP110 (0.08%).

10.2 Revised conceptual ground model (contamination)

- 10.2.1 A revised Conceptual Site Model is presented as Drawing 3649/8 in Appendix B. The Model includes the contaminants described in Section 10.1 above, and potential contaminant linkages (summarised below in Section 10.3) to receptors.

10.3 Environmental setting & end use

- 10.3.1 It is apparent from Section 10.1 above, that only limited contamination has been identified to date in the soils beneath this site. However, a supplementary post-demolition investigation will be required.
- 10.3.2 In order to assess the significance of this contamination, consideration must be given to the site's environmental setting and the proposed end use.
- 10.3.3 The underlying Rough Rock sandstone is classified as a Secondary A Aquifer. The nearest surface watercourse is the River Colne, about 1.2km to the north. Therefore, the site's environmental setting is considered to be **moderate sensitivity**.
- 10.3.4 With respect to human health, the proposed end use (residential) is considered sensitive.
- 10.3.5 Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures, see Section 14.6.

10.4 Contaminant linkages

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

Contaminants

10.4.2 Contaminants have been summarised in Section 10.1 above and essentially comprise localised areas of inorganic contaminants (arsenic) and limited volumes of asbestos (fibres and cement sheet fragments).

Pathways

10.4.3 Potential contaminant pathways include:

- Ingestion
- Dermal contact
- Inhalation of contaminated particulates

Receptors

10.4.4 Potential contaminant receptors include:

- End users of the site (residents)

10.4.5 It can be concluded that there are plausible pathways between the soil contaminants summarised in Section 10.1 above and potential receptors (i.e. end users). Consequently, some remediation will be required; either treatment/removal of the contaminant, or "breakage" of the pathway.

10.5 Potential remediation options

General

10.5.1 Given the constraints discussed in Section 7.2 (existing buildings across the majority of the site), a simple post-demolition trial pit investigation will be required before definitive recommendations are provided.

10.5.2 At this stage, it is envisaged that remediation will simply comprise the placement of clean cover. However, it would be prudent to allow for some removal/treatment/ of grossly contaminated soils.

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

Asbestos

10.5.4 CL:AIRE has published a Joint Industry Working Group (JIWG) guidance³ document with the support of the Health & Safety Executive which provides an explanation of how legal requirements of the Control of Asbestos Regulations 2012 have been interpreted to be more directly applicable to the risks associated with asbestos contaminated soil and construction & demolition materials.

10.5.5 Asbestos fibres were identified in 5 of 30 samples of made ground screened for asbestos. A further sample contained a fragment of asbestos cement sheet.

³ Control of Asbestos Regulations 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction & Demolition materials: Industry Guidance. CL:AIRE, 2016.

- 10.5.6 Samples of soil and/or construction & demolition material recovered from brownfield sites may exhibit a wide range of concentrations of asbestos contamination. Due consideration should therefore be given to the interpretation of any 'trace' concentrations in the wider context of the site. Guidance prepared by the JIWG asbestos suggests that judgements on the nature, degree and significance of contamination present should not be made on the basis of individual samples alone.
- 10.5.7 Nonetheless, made ground soils with only a trace of asbestos still have the potential to be hazardous to human health. This is because soil with a low asbestos content of say 0.001% may contain thousands, possibly hundreds of thousands, of potentially respirable asbestos fibres per gram of soil. However, asbestos fibres only pose a risk if they are allowed to become airborne, and release from soil to air can only occur if the soil is dry and then agitated (e.g. by vehicle movement, excavation, wind etc).
- 10.5.8 Provided soils are kept damp the risk of airborne fibre release, even during disturbance associated with excavation, should be negligible, and certainly below the control limit (as set by the Control of Asbestos Regulations 2012) of 0.1 f/cm³ airborne fibres averaged over a 4-hour period.
- 10.5.9 In our experience, damp soils do not allow the release of asbestos fibres, even from soils that contain concentrations in excess of the hazardous waste threshold (0.1%).
- 10.5.10 There may be transient risks during the excavation of made ground soils. Exposure to asbestos of personnel involved in these excavation works is considered likely to be sporadic and of low intensity (provided soils are kept damp). Therefore in accordance with Regulation 3(2) of the Control of Asbestos Regulations (2012), exemption from Regulations: 9 (notification of work with asbestos); 18(1)(a) (asbestos areas); and 22 (health records and medical surveillance) should apply, provided it is 'clear from a suitable and sufficient risk assessment that the control limit of 0.1 f/cm³ airborne fibres averaged over a 4-hour period will not be exceeded'.
- 10.5.11 Nonetheless, risks must be mitigated by appropriate measures (principally damping down), working procedures, and PPE. Method Statements and Risk Assessments should be prepared by the Contractor, and then be reviewed by the Client and Lithos.
- 10.5.12 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.
- 10.5.13 It should be noted that ACMs were commonly used as shuttering beneath concrete slabs, and to form ducts, and it is important that this is kept in mind when breaking through concrete slabs.
- 10.5.14 Made ground where asbestos has been positively identified and considered representative of near-surface soils, should ultimately be isolated beneath a minimum 600mm thick surface cover of "clean" soil (garden/landscaped areas) over a minimum 150mm hard-dig layer, or hardstand (parking areas), or floor slabs (buildings) and therefore there will be no risk of release of asbestos fibres from the ground.
- 10.5.15 Consequently, in line with the principles of sustainable development, there should be no need to export any soil from site.
- 10.5.16 New utilities should be laid in trenches reinstated with 'clean' backfill in order to prevent exposure to maintenance workers in the future.
- 10.5.17 See also comments in the 'Waste Classification' Section below.

Inorganic contamination

- 10.5.18 Whilst the made ground has been found to generally be relatively 'clean', further contamination may be present. In addition, the made ground, most notably the Quarry Infill, includes "unsuitable" materials (e.g. brick, pottery, and locally tin, rope, timber and plastic etc) and contains traces of asbestos fibres.
- 10.5.19 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.
- 10.5.20 A minimum 150mm thick "hard dig" layer of 'clean' inert crushed materials (such as demolition arisings/concrete) should be placed immediately beneath the soil cover (600mm thick, comprising 500mm subsoil and 100mm topsoil). Alternatively, a high-visibility contaminated ground warning / marker barrier, such as Lotrak Alarm18, could be placed beneath the soil cover.

Organic contamination

- 10.5.21 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. Given the comments made in Section 7.2 (fieldwork constraints), it would be prudent to allow for the off-site disposal of some grossly contaminated soil. Further advice should be sought from a specialist contractor, with experience of brownfield remediation, regarding an appropriate contingency.

10.6 Summary of potential contaminant linkages & mitigation

- 10.6.1 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	Isolation beneath at least 600mm clean soil & 150mm hard-dig layer in garden and landscaped areas
	Ingestion		
	Dermal contact		
	Inhalation (dust and/or vapours)	Metals & asbestos in the made ground.	
Buildings	Migration & accumulation of explosive gas	Methane	To be assessed on completion of monitoring and gas risk assessment

◇ 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.

10.7 Waste classification

- 10.7.1 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.
- 10.7.2 Following excavation and stockpiling, sampling will be required prior to disposal.
- 10.7.3 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 WM3⁴. 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.
- 10.7.4 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.
- 10.7.5 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.
- 10.7.6 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.
- 10.7.7 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 9 but will often need supplementing with further testing after soils have been stockpiled (see also advice in Section 14.3).
- 10.7.8 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.
- 10.7.9 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%).
- 10.7.10 As discussed in Section 8.3, Macadam hardstand is present which is typically c. 8mm thick.

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

- 10.7.11 This **Macadam** could be recycled and crushed to yield a 6F3 selected granular material, provided the recovered bitumen content is less than 10% (determined in accordance with BS598-1:2011). Crushed tarmac could also be blended with crushed concrete etc to generate 6F2 graded material. 6F2 can contain up to 50% recycled tarmac/asphalt (provided it does not pose a contamination risk to controlled waters and, if the proportion of asphalt is greater than 20%, the recovered bitumen content is less than 2%).
- 10.7.12 However, if off-site disposal is anticipated, tarmac assessment is based on the amount of coal tar present, this will vary depending on the age of the tarmac. The assessment is based on the amount of benzo(a)pyrene and has a concentration limit of 50mg/kg.
- 10.7.13 Speciated PAH analysis has been undertaken on 5 samples of Macadam and BaP concentrations in all 5 were < 50mg/kg. Consequently, tarmac is likely to fall within waste code 17 03 02:
- 17 - Construction and Demolition wastes,
 - 03 – bituminous mixtures, coal tar and tarred products
 - 02 – bituminous mixtures other than those mentioned in 17 03 01
- 10.7.14 17 03 02 is a mirror non-hazardous entry (17 03 01 is the corresponding mirror hazardous entry). This code along with this supporting report, in particular the laboratory results, should be used to complete a paper trail documenting disposal routes for tarmac.
- 10.7.15 Contractors exporting waste from the site should review the site investigation data and make their own assessment. Alternatively, Lithos could undertake this assessment once exported waste streams have been identified.

11 HAZARDOUS GAS

11.1 General

- 11.1.1 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	Low: made ground essentially inert, with little degradable matter
	Buildings	Explosion		
Off-site landfill	Human health	Asphyxiation & explosion	Lateral migration, ingress & accumulation	Moderate: natural strata are generally of moderate permeability
	Buildings	Explosion		

- 11.1.2 Given the above gas monitoring wells have been installed in 14 boreholes across the site. Details of the installations are given on the probehole logs presented in Appendix G to this the report.
- 11.1.3 The generation potential of the gas source was initially considered to be moderate. Consequently, in accordance with CIRIA Report C665⁵, given the proposed residential end use, 12 visits have been scheduled over a 6-month period.

⁵ CIRIA C665: Assessing risks posed by hazardous ground gases to buildings (2007).

11.2 Scope of works

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

11.2.2 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)

11.3 Monitoring results

11.3.1 The results of the monitoring completed to date are summarised below.

Hole	Response zone	Range of methane concentrations (% v/v)	Range of carbon dioxide concentrations (% v/v)	Range of steady flow rates (litre/hour)
PH101	9.0m to 12.0m – Quarry Backfill.	N.D.	1.3	N.D.
PH102	3.0m to 6.0m – Quarry Backfill.	N.D.	0.2	N.D.
PH104	3.0m to 6.0m – Quarry Backfill.	N.D.	1.1	N.D.
PH105	1.0m to 4.0m – Quarry Backfill.	N.D.	ND	N.D.
PH106	3.0m to 6.0m – Quarry Backfill.	N.D.	0.3	N.D.
PH107	8.0m to 11.0m – Quarry Backfill.	N.D.	0.3	N.D.
PH108	3.0m to 6.0m – Quarry Backfill.	N.D.	0.9	N.D.
PH110	2.5m to 5.5m – Quarry Backfill.	N.D.	0.1	N.D.
PH111	2.5m to 5.5m – Quarry Backfill & Rough Rock Sandstone bedrock.	N.D.	N.D.	N.D.
PH112	3.0m to 6.0m – Quarry Backfill.	N.D.	0.5	N.D.
PH113	3.0m to 6.0m – Quarry Backfill.	N.R.	NR	N.R.
PH114	2.0m to 5.0m – Quarry Backfill.	N.D.	0.4	N.D.
PH115	5.0m to 8.0m – Quarry Backfill.	N.D.	0.4	N.D.
PH116	3.0m to 6.0m – Rough Rock Sandstone.	N.D.	0.7	N.D.

11.4 Discussion

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

11.4.2 To date no significant concentrations of hazardous ground gasses, or flow rates, have been detected and, based on the results to date, onerous gas protective measures would not be expected. However further monitoring is required to undertake a thorough risk assessment.

11.4.3 A hazardous gas risk assessment incorporating all of the results will be issued on completion of monitoring in August 2021.

11.5 Radon

- 11.5.1 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.
- 11.5.2 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.
- 11.5.3 The Public Health England UK radon map and the Landmark report indicate that the site is in an area where **between 1% and 3%** of homes are estimated to be above the action level.
- 11.5.4 Consequently, basic radon protection measures are not required. However, in light of Public Health England advice, the Developer might consider providing all new dwellings with basic radon protection measures.

12 GEOTECHNICAL TESTING

12.1 General

- 12.1.1 A total of 11 samples of natural soil were delivered to a suitably accredited laboratory with a schedule of geotechnical testing drawn up by Lithos.
- 12.1.2 The geotechnical laboratory test results are presented in Appendix I to this report.

12.2 Atterberg limits

- 12.2.1 Only one exploratory hole encountered Cohesive Residual Soil at this site (TP114); Residual Soils are predominantly absent due to the historical quarries; beyond the quarries Residual Soils are usually granular.
- 12.2.2 The plasticity index of one sample of Cohesive Residual Soil has been determined; the sample was recovered from TP114 at 2.5m and gave a moisture content of 17% and a modified plasticity index of 17%. This suggests the Cohesive Residual Soil is of **low shrinkability**.
- 12.2.3 PI has been modified 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.

12.3 Soluble sulphate and pH

- 12.3.1 In accordance with BRE Special Digest 1:2005, this site has been classified as brownfield with a mobile groundwater regime.
- 12.3.2 It is envisaged foundations will extend to depths of up to 25m through made ground and natural strata and samples taken from this depth range have been submitted for pH and water-soluble sulphate (2:1 soil/water extract).
- 12.3.3 The concentrations of sulphate in the aqueous natural soil extracts of three samples were determined. In addition, 19 samples of made ground were tested as part of the contamination suite. The pH value of each sample has also been determined.

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

Soil type	No. samples tested	Lowest pH values	Highest soluble sulphate concentration (mg/l)
Sub-Base	5	8.3	83
Ash & Clinker	1	8.1	100
Quarry Infill	7	7.7	190
Quarry Arisings	6	7.6	43
Cohesive Residual Soil	1	8.1	42
Granular Residual Soil	1	8.4	35
Rough Rock Sandstone	1	8.3	13

12.3.5 pH values were all above 5.5, therefore concentrations of chloride and nitrate are considered insignificant.

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

12.4 Particle size distribution

12.4.1 The grading of 10 samples of made ground has been determined by wet sieving and the results are summarised in the table below:

Sample & depth	Field description	% < 37.5mm sieve	% < 20mm sieve	% < 2mm sieve	% fines	Material description (based on grading & plasticity)
TP111 – 0.6m	Quarry Infill; Clayey sandy GRAVEL, high cobble content.	69	62	43	14	Very sandy clayey GRAVEL, medium cobble content.
TP117 – 0.8m	Quarry Infill; Slightly sandy slightly clayey GRAVEL, medium cobble content.	53	39	20	4	Slightly sandy slightly clayey GRAVEL, high cobble content.
TP119 – 1.4m	Quarry Infill; Clayey sandy GRAVEL, low cobble content.	62	53	30	11	Sandy slightly clayey GRAVEL.
TP102 – 0.9m	Quarry Arisings; COARSE SOIL: cobbles with some boulders & much finer material of clayey sand & gravel.	46	39	24	6	COBBLES with much finer material of sandy slightly clayey gravel.
TP104 – 0.8m	Quarry Arisings; Clayey slightly sandy GRAVEL, high cobble content.	51	46	31	10	COBBLES with much finer material of clayey sand & gravel.
TP106 – 1.5m	Quarry Arisings; Slightly clayey slightly sandy GRAVEL, high cobble & low boulder content.	90	76	58	22	Very sandy clayey GRAVEL.
TP113 – 0.6m	Quarry Arisings; Very clayey slightly sandy GRAVEL, medium cobble & low boulder content.	57	50	33	14	Sandy clayey GRAVEL, high cobble content.
TP117 – 1.5m	Quarry Arisings; Sandy GRAVEL, low cobble content.	69	53	35	8	Sandy slightly clayey GRAVEL, high cobble content.
TP107 – 0.3m	Sub Base; Sandy GRAVEL, medium cobble content.	66	47	31	9	Sandy slightly clayey GRAVEL.
TP109 – 0.3m	Sub Base; Sandy GRAVEL, medium cobble content.	100	94	54	11	Very sandy clayey GRAVEL.

12.4.2 The above gradings broadly support the soil descriptions shown on the exploratory hole logs; Quarry Arisings and Quarry Infill are generally made up of coarse (gravel and cobbles) granular materials, with relatively small proportions of finer cohesive materials.

12.4.3 The Sub-Base is also granular, but with less very coarse material (cobbles) and often with a greater proportion of finer materials.

12.5 Compaction tests

12.5.1 Laboratory compaction tests are useful wherever ground improvement is anticipated, for example to provide a satisfactory CBR beneath proposed highways.

12.5.2 In accordance with BS5930:2015 engineered fill is defined as material which is selected, placed and compacted to an appropriate specification so that it will exhibit the required engineering behaviour.

12.5.3 Grading and moisture content control the degree to which materials can be effectively compacted. If the grading or moisture content of an in-situ material is not suitable to facilitate its compaction then screening, wetting, or lime addition may be required.

12.5.4 Laboratory compaction testing was scheduled on 10 samples of made ground (using a 4.5kg rammer) to determine their suitability for re-engineering.

12.5.5 Laboratory compaction tests are only appropriate if:

- At least 90% of the material passes the 37.5mm sieve; and/or
- At least 70% of the material passes the 20mm sieve

12.5.6 It is apparent from the gradings tabulated in Section 12.4, that the samples scheduled for compaction tests are generally too 'coarse' (i.e. the fraction of coarse gravel and cobbles is too great. Boulders are also present within the Quarry Infill and Quarry Arisings, although for the purpose of practicality these are not included within the bulk samples recovered. However, if particle sizes are only slightly in excess of the above limits, compaction tests can be useful in order to indicate target densities, but the results should be treated with caution and used for guidance only.

12.5.7 The material particle density (Gs) is required in order to plot the 0, 5 and 10% air voids lines on the compaction graph for each material type.

12.5.8 The results are summarised in the tables below:

Sample & depth	Material description	Gs (Mg/m ³)	MDD (Mg/m ³)	OMC (%)	Allowable mc range for 95% MDD & <5% air voids	Typical in-situ moisture content (%)
TP107 – 0.3m	Sub-Base	2.62	1.98	11	10.1 – 14.6	9.3
TP109 – 0.3m	Sub-Base	2.65	2.03	10	9.2 – 14.1	12.0
TP111 – 0.6m	Quarry infill	2.61	1.91	12	11.4 – 16.1	12.0
TP117 – 0.8m	Quarry Infill	2.65	2.04	10	9.1 – 13.6	9.7
TP119 – 1.4m	Quarry infill	2.55	1.88	12	11.2 – 15.4	16.0
TP102 – 0.9m	Quarry Arisings	2.62	2.03	9.7	7.6 – 13.5	7.0
TP104 – 0.8m	Quarry Arisings	2.65	1.94	12	11.3 – 16.4	12.0
TP106 – 1.5m	Quarry Arisings	2.60	2.00	10	9.1 – 14.1	16.0
TP113 – 0.6m	Quarry Arisings	2.60	1.95	11	10.2 – 15.5	13.0
TP117 – 1.5m	Quarry Arisings	2.60	2.04	9	8.3 – 12.7	9.1

- 12.5.9 It is apparent that the in-situ moisture content of the above made ground types are generally within the allowable moisture content range to achieve 95% MDD, although three of the 10 samples fell slightly above/below the relevant moisture content ranges. On this basis it is considered that the broadly is suitable for re-engineering.
- 12.5.10 Made Ground is expected to require screening and/or crushing in order to remove any unsuitable and oversize materials and to meet a suitable grading profile for compaction to be achieved.

12.6 Undrained shear strength testing

Hand shear vane testing

- 12.6.1 Hand shear vane testing was undertaken on blocks of Cohesive Residual Soil recovered from TP114.
- 12.6.2 The shear vane tests gave results of between 46kPa and 60kPa. This classifies the residual soil as being of low to medium strength. The low result of 46kPa is likely a result of disturbance of the clay during excavation and/or softening due to waters infiltrating through made ground onto this material; a shear strength of 60kPa is likely more representative of the soils strength.

13 GEOTECHNICAL ISSUES

13.1 Conceptual site model

- 13.1.1 Historical sandstone quarrying has taken place across about 75% of the site's area.
- 13.1.2 Ground conditions at the site can be divided into areas within and beyond of former sandstone quarries.
- 13.1.3 Beyond the quarries ground conditions comprise a veneer of hardstand (Macadam or gravel) over Sub-Base and Quarry Infill to depths of between 0.5m and 2.3m over Granular Residual Soils and Sandstone bedrock.
- 13.1.4 Within the quarries ground conditions comprise a veneer of hardstand and Sub-Base overlie Quarry Infill and Quarry Arisings with the base of the quarries (sandstone bedrock) at between 11.0m and 22.5m depth (average c. 17m). Highwalls have been located at 6 locations and are near vertical/vertical. Two 'ramps' have been identified within the quarry floors.
- 13.1.5 Currently the site slopes down to the north-east with several terraces, ramps, steep slopes and retaining walls. Some ground improvement is anticipated to remove shallow obstructions and enable highways construction. In addition, some site regrade is anticipated to create development 'terraces'.

13.2 Mining & quarrying

- 13.2.1 The site is located beyond the CA's defined coalfields.
- 13.2.2 No evidence of underground working (for coal or sandstone) has been encountered during Lithos' investigation.
- 13.2.3 The site was occupied by sandstone quarries (Spinkwell, Waterhouse & Manor House Quarries) from c. 1890 to 1960. The quarries targeted Rough Rock Sandstone which was used as a construction material. The quarries were backfilled in the 1960s and 1970s.

- 13.2.4 Historical photographs have been found which show the Spinkwell quarry during operation (c. 1926); copies included in Appendix E. The quarry highwalls appear to be vertical and in the region of 20m high.
- 13.2.5 Backfilled quarries occupy about 75% of the total site area and reach depths of between c. 11m and 23m; average 17m. Highwalls have been found at 6 locations and are very steep/vertical. Two 'ramps' have been found on the quarry floors.
- 13.2.6 The extent of quarrying proven by drilling to date correlates well with that shown on old OS maps (see Drawing 3649/3a). There are areas of un-quarried ground in the north-west, south-west, and south-east, and a "ridge" in the centre (between ST103 and ST01), although this feature requires further drilling to better delineate (there were some access constraints here).

13.3 Potential issues associated with deep backfill

- 13.3.1 It is considered likely that the during backfilling of the quarries the Quarry Arisings and Quarry Infill were placed without mechanical compaction in irregular and thick layers and without any screening to remove oversized materials, degradable waste etc. Historical photographs and Lithos' investigation suggests that oversized materials are present in the made ground, including boulders of up to c. 2.0m diameter which increase in size and frequency with depth. Such material poses a risk to any proposed development due to the potential for significant differential settlement and long term 'creep' settlement.
- 13.3.2 Settlement of deep made ground is initially (first 5 years or so) predominantly associated with inundation (caused by changes in the water table depth and/or surface water infiltration).
- 13.3.3 Consolidation settlement is associated with a reduction in volume caused by expulsion of water from soil pores and transfer of load from excess porewater pressure to soil particles. Consolidation of spoil in backfill under self-weight largely occurs during placement.
- 13.3.4 Creep compression occurs as the particles of fill become more closely packed, under conditions of constant effective stress (arising from self-weight of the fill). Although the movements caused by creep are relatively small, often it is these long-term movements that are of most interest to foundation performance. Many coarse fills show a linear relationship between settlement and the logarithm of the time that has elapsed since the fill was placed (i.e. settlement that occurs during the first 10 years is similar to that from years 10 to 100).
- 13.3.5 Where development on deep fill takes place, in addition to any ongoing creep associated with self-weight, settlement is caused by the imposed foundation loads. This leads to some immediate compression and consolidation within stressed zones.
- 13.3.6 The strength/density of the backfill materials is likely to vary over relatively short distances, especially across the line of any buried highwalls, even any at depth within the quarry (such as the 'ramps' which have been encountered), which could lead to significant differential settlements across small areas.
- 13.3.7 At this stage, and subject to the findings of a detailed geotechnical assessment, it is considered likely that the presence of deep backfill will have implications for:
- Foundations – likely piled, but possibly rafts/reinforced strips following ground improvement; see further details in Section 13.5.
 - Drainage – likely need for placement at maximum possible gradients using flexible connections to prevent any backfalls should differential settlement of the fill occur. Potential need for piling of manholes
 - New utilities – should be constructed of flexible materials. Electricity and communications cabling should also be laid with sufficient 'slack' to accommodate a

degree of movement. The use of flexible joints is recommended where possible, particularly where service connections extend across a rigid/flexible structure interface (e.g. from a piled foundation into a garden area)

- Highways - a specification will need to be agreed with the adopting authority, but reinforcement of the road construction will probably be required; see further details in Section 13.10.

13.4 Site regrade and/or ground improvement

General

13.4.1 Made ground currently underlies the majority of the site to depths of between c. 1m and 22m. The made ground is variable in composition, includes frequent oversized materials and is unlikely to have been placed with any formal means of compaction. Consequently, the made ground is not considered a suitable foundation material.

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

13.4.3 The made ground beneath the site is expected to be of variable strength and composition and therefore would not be considered suitable as a founding stratum. Removal or ground improvement will be required.

Turnover of made ground

13.4.4 The extent of turnover required will depend on the likely long-term settlement predictions and therefore the ground improvement technique used. However, at this stage, it is likely that turnover of at least the uppermost 3m to 4m of made ground will be required.

13.4.5 Because turnover enables inspection of the 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.

13.4.6 Wherever possible, Lithos recommend that excavated soils are retained on site. However, if this is not possible the comments in Section 10.7 should apply.

13.4.7 Assessing the suitability of soil/fill materials for use as engineered fill requires consideration of:

- Organic and biodegradable matter content.
- Particle size, shape and grading, for example single size or tabular gravels cannot be properly and effectively compacted.
- Dry density/moisture content relationships

13.4.8 At this stage it appears that all major made ground types at this site, including the Quarry infill, will be appropriate for re-use as engineering fill, following some screening and crushing to meet a suitable material grading profile. However, it is possible that given the Quarry Infill's origin as refuse tipped material it may include a significant proportion of degradable materials which have yet to be encountered. Soils with a portion of degradable materials (e.g. wood, paper, plants, 'black bag waste' etc) will not be geotechnically suitable for use as an engineered fill.

13.4.9 Screened and engineered fill should yield CBR values in excess of 3%, thereby reducing abnormalities 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.

Site regrade

- 13.4.10 Given existing topography (much of the site is terraced with retaining structures and steep slopes), some earthworks regrade is anticipated, with the need for underbuild and retaining walls.
- 13.4.11 Careful consideration will need to be given to earthworks design, and implications for slope stability, retaining walls, foundations, highway gradients and drainage.
- 13.4.12 Any digital terrain modelling undertaken, or commissioned, by Redrow should consider implications for the foundation recommendations outlined below.
- 13.4.13 Wherever possible, Lithos recommend that excavated soils are retained on site. However, if this is not possible the comments in Section 10.7 should apply.
- 13.4.14 About 75% of the site, including areas of cut, are underlain by significant thicknesses of predominantly granular made ground and rockhead is generally at least 11m below existing ground levels. Therefore, there are not expected to be extensive excavations through bedrock. However, excavations through the Quarry infill and Quarry Arisings are likely to result in instability and overbreak of cut faces.
- 13.4.15 Groundwater monitoring to date suggests that significant inflows will not be encountered in excavations, although some localised ingress of perched waters should be expected.

13.5 Foundation recommendations

General

- 13.5.1 Foundation recommendations assume that development will be of 'traditional' two or three storey construction and that line loads will not exceed 90kN/m run. If this is not the case significant alteration to these recommendations will be required.
- 13.5.2 It is anticipated that significant earthworks and regrade of the site will take place prior to the construction phase of the development. Any digital terrain modelling undertaken, or commissioned, by Redrow should consider implications for the foundation recommendations outlined below.
- 13.5.3 Deep quarry backfill and high walls present a potential development constraint. Ideally, buildings would not span any high wall. It would be prudent to consider revision of the layout with some public open space over the most problematic areas.
- 13.5.4 The potential for ongoing settlement of very loose/soft ground has implications for foundations; see Section 13.3. Given the issues associated with deep backfill, early liaison with warranty providers is recommended.
- 13.5.5 Made ground is not considered a suitable foundation material and foundations should therefore be taken through these materials into underlying natural strata of adequate bearing capacity.
- 13.5.6 At this stage, reinforced footings on engineered fill are not anticipated.
- 13.5.7 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-1.
- 13.5.8 Piled foundations are considered to be the most appropriate foundation solution for plots constructed within the footprint of the former quarries, and across areas beyond quarries where made ground is greater than about 2.5m thick following any site regrade.

- 13.5.9 Alternatively, specialist contractors might be able to utilise techniques such as vibro following full or partial treatment of backfill, or potentially controlled modulus columns (CMCs). Further advice from specialist contractors should be sought; early engagement is highly recommended.

Within quarry footprints - Piles

- 13.5.10 The following general comments relating to piling are provided for guidance, and further advice should be sought from a specialist-piling contractor. Piles will be end bearing in bedrock, therefore in accordance with BS 8004:2015 and EC7, piling contractors may require further boreholes extended a minimum 5m into competent bedrock using rotary coring techniques.
- 13.5.11 Given the presence of large sandstone boulders throughout the full thickness of the backfilled quarries pre-boring of piles is likely to be required.
- 13.5.12 The made ground contains significant sandstone boulders (>2m diameter), and the depths to competent bedrock probably vary significantly over relatively short distances. Consequently, in order to ensure that piles are founded within natural bedrock (and not any overlying quarry backfill), it would be prudent to pre-bore to greater depth (to prove at least 3m of bedrock).
- 13.5.13 Given the variable depths to bedrock across the site, care should be taken to ensure that piles are not allowed to deflect off any steep under-ground gradients within the rock. This could be achieved by socketing and may require pre-drilling and casing of piles. An allowance should also be made for changing piling locations and ground beam design to account for any difficulties encountered with steep rock gradients associated with the former quarries.
- 13.5.14 Steep highwalls have been identified where depths to bedrock vary significantly over very short distances. Development of plots which span highwalls will require careful consideration and early liaison with a specialist piling contractor and the warranty provider is strongly recommended.
- 13.5.15 Warranty providers generally require pile lengths to be at least 3m (measured from pile cut off level to pile toe level). Short piles are also likely to become dislodged during pile trimming operations, creating additional costs associated with remedial works.
- 13.5.16 The safe working load that may be supported on a pile is dependent on the pile diameter, its founding depth and the method of installation.
- 13.5.17 There is the potential for settlement of the ground in external areas around piled plots, and mitigation should be considered:
- Extend facing brickwork so that ground settlement does not result in exposing the underground portions of walls and foundations. Two additional courses should be more than adequate.
 - Flexible connections (e.g. rocker pipes) in drainage and service pipes passing through the buildings. and,
 - Ensure drainage is laid with generous falls to account for any settlement.
- 13.5.18 New houses can be built off ring beams designed to span the piles. In order to bond them to the piles, the tops of the piles must be broken out to expose the reinforcement, which can then be tied to that of the beams.

- 13.5.19 Following the proposed turnover and regrade it should not be necessary to allow for provision of a piling mat as long as the earthworks have been completed to a specification which provides an adequate capacity to support the piling rig in accordance with guidance provided in the 2004 BRE document, "BR 470: Working platforms for tracked plant". Further advice should be sought from the appointed specialist-piling contractor regarding the proposed plant loadings and resulting pressures.
- 13.5.20 The design of working platforms for tracked plant is a geotechnical design process and should be carried out by a competent person. The following parties should have input into the design:
- Permanent works designer, to consider additional uses for platform material as part of the overall development
 - Principal contractor, to define any other purposes for which the platform might be used
 - Contractor or subcontractor, to specify requirements for the platform, including gradients, ramps and edges
- 13.5.21 The number of plots affected by piling will depend on layout proposals but is likely to comprise at least 70% of the total number.
- 13.5.22 Piles can provide an enhanced pathway for the vertical migration of mobile contaminants. The Environment Agency may therefore object to the adoption of piles as a foundation solution. However, objection is considered unlikely given the nature of the contamination encountered, and the fact that quarry backfill is currently resting directly on the underlying sandstone bedrock.

Beyond quarry footprints - Strip/trench fill footings

- 13.5.23 It is considered that shallow strip or deepened trench fill footings will be the most suitable foundation solution for plots positioned outside of the former quarries; where the made ground is less than about 2.5m thick, and residual soils or bedrock is the founding material. It should be noted that subject to final levels and site regrade made ground may be deeper than 2.5m outside of former quarries, and if so alternative foundations (cf. piles) will be required.
- 13.5.24 Reinforcement, as a precaution against differential settlement, is recommended only where foundation excavations encounter significant lateral and vertical variations in strata. One layer of B385 mesh placed 75mm above the base of the footing is likely to provide suitable reinforcement, but further advice should be sought from the Structural Engineer.
- 13.5.25 Where existing buildings are to be demolished, all concrete slabs and service ducts will require breaking out prior to re-development. However, relict foundations could probably be left in-situ and an allowance made for local breaking out, or (probably better) chased-out and removed during the necessary site preparatory works.
- 13.5.26 Foundations of plots placed over relict foundations should be taken to greater depth than the relict foundations and into natural ground of adequate bearing capacity.
- 13.5.27 Foundations will be required to be placed below a line drawn up at 45° from the base of any service or similar excavation and from the crest at rockhead of any buried highwalls.
- 13.5.28 Deepened foundations should be stepped in accordance with NHBC Standards, Chapter 4.4.
- 13.5.29 In order to minimise softening and swelling of cohesive soils or loosening of granular soils, it is recommended that footings are cast as soon as formation level is reached (or alternatively formation could be blinded using concrete with as low a water:cement ratio as possible).

- 13.5.30 Whilst strip or trench fill footings generally represent a simple and inexpensive foundation solution, there are a number of potential disadvantages associated with their use on this site:
- The made ground contains asbestos and some inorganic contaminants and a minimum 6000mm thick clean cover (see Section 10.5) has been recommended. Subject to final remediated development levels, this cover is likely to increase footing depth/underbuild.
 - Disposal of arisings will be required.
 - Foundation and drainage excavations may encounter significant obstructions resulting in significant overbreak.
 - Foundation and drainage excavations will almost certainly require shoring in made ground.
- 13.5.31 In addition to the above, Redrow should review proposed plot designs and layouts, since deeper excavations for trench fill are likely to be unstable where the centre-lines of parallel trenches are closer than about 2m (assuming 600mm widths). Redrow should supervise their groundworker to ensure footings are excavated in a controlled and safe manner.
- 13.5.32 Redrow 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.
- 13.5.33 The Granular Residual Soil (sand, gravel and cobbles) is assumed to have a relative density of at least medium dense (in accordance with BS5930:2015).
- 13.5.34 A safe bearing capacity of around 180kPa, allowing a maximum foundation line load of 100kN/m run, can be assumed if the following are true:
- A foundation length of 10m
 - A foundation breadth of 0.6m
 - A foundation thickness of 225mm
 - A foundation depth of 0.6m depth
 - An angle of shearing resistance of $\phi=34^\circ$ for the granular deposits
- 13.5.35 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.
- 13.5.36 In accordance with NHBC Standards, a minimum founding depth of 450mm (due to potential frost susceptibility) is required in granular soils.
- 13.5.37 This depth should be taken from finished ground level to the underside of the footing. If finished ground level is to be above existing ground level then the foundation excavation simply needs to ensure that there is sufficient depth of excavation to allow casting of the footing entirely within natural ground (not made ground or topsoil).
- 13.5.38 However, if the excavation is dug from original ground level in cold conditions when freezing is expected, then foundation depth should be taken from the existing, not finished, ground level.
- 13.5.39 Where ground level is being raised, it would be prudent to proof roll the exposed granular soils after stripping topsoil (to mitigate any near-surface disturbance), and ideally fill should be placed prior to construction (otherwise the Developer will need to consider the potential for movement associated with placement of the fill).

- 13.5.40 It should also be noted that the footing may require deepening or stepping in order to allow plot drainage to exit the plot footprint (either over or under the footing).
- 13.5.41 The sandstone bedrock is generally considered to have a safe bearing capacity of at least 300kPa and minimal settlements would be anticipated.
- 13.5.42 Where rock is encountered at shallow depth foundations should be placed entirely on rock and not partially on rock and partially on soil. This may, depending on surface gradient, necessitate significant deepening of foundations.

13.6 Floor slabs

- 13.6.1 Floors for low rise housing (2-3 storeys) constructed on piled foundations typically utilise reinforced concrete ground beams which rest on pre-cast or in-situ pile caps. A suspended 'Beam and Block' ground floor is then usually constructed using concrete or polystyrene blocks placed between further concrete beams suspended across the ring beams.
- 13.6.2 Suspended floor slabs should be utilised where the depth of made ground or engineered stone exceeds 600mm in accordance with NHBC Standards Chapter 5.1 (to negate potential settlement problems). The made ground on this site is non-shrinkable, therefore the slabs could be cast in-situ.
- 13.6.3 It is estimated that the thickness of made ground is likely to exceed 600mm beneath all plots. However, this will require revaluating on completion of any regrade and earthworks.
- 13.6.4 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 August.

13.7 Designated concrete mixes

- 13.7.1 Designated mixes are considered in BRE Special Digest SD1 and BS 8500 -1:2015+A1:2016. However, in addition to soil chemistry (sulphate class), there are a number of other considerations relating to structural design that need to be taken into account when determining an appropriate concrete mix.
- 13.7.2 Consequently, Redrow should seek advice from their appointed Structural Engineer.

13.8 Excavations

- 13.8.1 Based on the results of the investigation it is considered unlikely that major groundwater flows will be encountered in shallow excavations.
- 13.8.2 Groundwater should be controlled in accordance with CIRIA report 113 "Control of Groundwater for Temporary Works".
- 13.8.3 The stability of even shallow excavations is likely to be poor, most notably in coarse made ground, and therefore allowance should be made for shoring and overbreak of excavation walls.
- 13.8.4 Bedrock was encountered in several exploratory holes, around the periphery of the site, most notably across the north and west. Based on the exploratory hole logs, excavation greater than about 3.0m is likely to prove difficult across about 15% 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.

13.9 Drainage

- 13.9.1 Localised groundwater has been recorded in 5 of 14 monitoring wells in made ground within the quarry footprints from between about 3.5m and 11m depth.
- 13.9.2 Given the significant thicknesses of made ground encountered on-site soakaway construction will be highly problematic. It should be noted that soakaways cannot be allowed to infiltrate into made ground due to the risk of settlement caused by wash out of fine soil particles.
- 13.9.3 Yorkshire Water have published a guide⁶ for developers and designers outlining their design requirements for surface water attenuation assets.
- 13.9.4 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.
- 13.9.5 It is recommended that the developer contact Yorkshire Water Services with respect to capacity in existing foul and surface water sewers in the vicinity of the development area.

13.10 Highways

- 13.10.1 Made ground is present across the site and consultation with the adopting authority, regarding the specification of the highways, is strongly recommended.
- 13.10.2 The made ground present beneath this site is highly variable in terms of both composition, and strength/density. Furthermore, it often contains a significant amount of oversize (boulders etc), which represent potential 'hard-spots'.
- 13.10.3 Consequently, where made ground is present its full thickness (up to a maximum of 2m - from existing ground level or proposed highway formation, whichever is the lower) should be excavated and either:
- replaced with suitable aggregate in accordance with Series 600 (Earthworks) of The Highways Agency (HA) "Specification for Highway Works" 1998; or
 - screened (suitable for Granular Made Ground, Sub-Base & Quarry Spoil), to allow selection of suitable material, before being replaced in engineered layers (in accordance with Series 600). Unsuitable materials include any soft or wet materials, biodegradables including topsoil, wood, scrap metal, frozen material and oversize.
- 13.10.4 If any new highways span a quarry 'high-wall', 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
- 13.10.5 A minimum length of 5m either side of any highwalls associated with the former quarry should be treated to the above specification, although the final specification should be agreed with the adopting authority.

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

- 13.10.6 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. In addition, the chosen method of ground improvement (if any) may enable significant refinement of the above advice.
- 13.10.7 Any residual made ground materials in the base of the excavation should be inspected and (where necessary) any soft spots removed and replaced with suitable engineered fill.
- 13.10.8 Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.
- 13.10.9 Crushing of demolition/hardstand/foundation arisings will generate aggregate, which (subject to confirmatory testing) should be suitable for use as unbound pavement materials within the highways.

13.11 External works

- 13.11.1 Any digital terrain modelling undertaken, or commissioned, by Redrow should be made available to their Engineering Designer prior to issue of an External Works Drawing.
- 13.11.2 Modelling should take account of the presence of highwalls and deep made ground (former quarries) as these may have an impact on the proposed layout and earthworks design.

14 REDEVELOPMENT ISSUES

14.1 General

- 14.1.1 This report has presented options with respect to foundation solutions, treatment of contamination etc that are considered technically feasible and in line with current good practice. Consequently, we would expect to obtain regulatory approval for whichever option is adopted, although this cannot be guaranteed. Copies of this report should be forwarded to the relevant regulatory authorities (Warranty Provider & Local Authority) for their comment/approval.
- 14.1.2 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.
- 14.1.3 If unanticipated ground is encountered during the construction phase, the Contractor should immediately seek further advice from the Engineer.

14.2 Remediation strategy

- 14.2.1 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.
- 14.2.2 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
- 14.2.3 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.
- 14.2.4 The anticipated remediation works are summarised below:
- General site clearance of surface materials and vegetation
 - Demolition of buildings
 - Break-up of slabs and hardstand
 - Post demolition investigation of the ground beneath the former buildings and slabs, which were inaccessible during the earlier investigations
 - Crushing of all suitable artificial hard material (i.e. concrete/brick etc)
 - Turnover (excavation, screening and replacement in engineered layers, with nominal compaction) of the of made ground to enable:
 - o Removal of any localised fuel/oil contamination; with subsequent treatment and/or off-site disposal
 - o Inspection of the made ground
 - o Removal of below ground obstructions
 - o Preparation of the ground for highway construction
 - Backfill of all resultant excavations, with appropriate compaction
 - Re-grade of site to 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 600mm thick cover layer of 'clean' soils over a 150mm hard dig layer in all garden and landscaped areas
- 14.2.5 The remediation contractor should survey reduced levels during the proposed turnover, prior to the placement of any fill.
- 14.2.6 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.

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

14.3 Control of excavation arisings

- 14.3.1 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.
- 14.3.2 It should be ensured that the groundworker understands the need for good materials management. Most notably the importance of not mixing different materials within a given stockpile; i.e. there should be separate stockpiles of: topsoil; grubbed-up concrete hardstand; macadam; Ash & Clinker; fuel-contaminated soil; excess clean, natural soil arisings; general construction waste etc.
- 14.3.3 Further characterisation of stockpiled materials is likely to be required if off-site disposal is proposed. See also comments in Section 10.7 regarding asbestos.
- 14.3.4 Made ground arisings could be:
- Placed in area deliberately left low on completion of the remediation works in order to accommodate construction arisings
 - redistributed beneath concrete oversite, or areas of hardstanding, where they would be satisfactorily isolated from end users;
 - Isolated beneath the 750mm thick cover layer in garden or landscaped areas

14.4 Good practice guidance

- 14.4.1 The construction phase groundworker should follow good environmental practice to minimise the risks of spillage, leakage etc with reference, but not limited, to the following documents:
- CIRIA C502 'Environmental Good Practice on Site'
 - EA Pollution Prevention Guidelines⁷:
 - o PPG6 - Working at construction and demolition sites
 - o PPG2 - Above ground oil storage tank
 - o PPG7 – The safe operation of refuelling facilities.
 - o PPG21 – Incident Response Planning
- 14.4.2 Site preparatory works associated with this project are likely to involve the re-use of both natural and made ground soils on site and the import of natural soils from another development site. Therefore, the Contractor should prepare a Materials Management Plan (MMP) in accordance with the CL:AIRE Code of Practice (v2, March 2011).
- 14.4.3 The MMP will document how all of the materials to be excavated during the proposed site preparatory and remediation earthworks are to be dealt with.

⁷ Whilst this has formally been withdrawn it can still be accessed via the EA archives and provides useful information on managing risks.

14.5 New utilities

- 14.5.1 It is strongly recommended that all statutory service bodies are consulted at an early stage with respect to the ground conditions within which they will lay services in order to enable them to assess at an early stage any potential abnormal costs.
- 14.5.2 It is recommended that trenches for services including site drainage and water supply are cut over size in order to isolate pipe materials from potential contaminants and to enable maintenance to be conducted in "clean" material.
- 14.5.3 Water Companies have a statutory duty to supply wholesome water, which could be compromised by the selection of an inappropriate pipe material. For example, compounds such as petroleum hydrocarbons and solvents can permeate commonly used plastics pipes, and/or corrosive chemicals can reduce the service life of metallic pipes. Guidance has been developed for the selection of pipes in brownfield sites and is contained in a UKWIR Report⁸.
- 14.5.4 This site is brownfield, and therefore consideration of soil contaminant concentrations is required. Samples taken must be representative of the soil conditions in which the water pipes are proposed to be laid; normally water pipes are laid 0.7m to 1.3m below finished ground level.
- 14.5.5 At the time of writing, significant remediation earthworks are anticipated, and ground currently present along proposed pipeline routes will almost certainly be redistributed. Consequently, to date laboratory testing of soil samples in line with UKWIR guidance has not been undertaken.
- 14.5.6 However, given the site's size, history, and ground conditions encountered, Yorkshire Water may require sampling within 15m of proposed water supply pipes, once infrastructure design has been completed. In the meantime, it is considered likely that Yorkshire Water will request the use of Protectaline mains, with plastic coated copper house connections, given that residual organic contaminants will still be present post-remediation, albeit at acceptable concentrations.

14.6 Health & safety issues - construction workers

- 14.6.1 Access into excavations etc. must be controlled and undertaken in accordance with the CDM Regulations 2015, most notably Regulation 22, to mitigate risk of collapse or asphyxiation.
- 14.6.2 Before site operations are started, the necessary COSHH statements and Health & Safety Plan should be drafted in accordance with the CDM regulations.
- 14.6.3 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.
- 14.6.4 Although workers will only be exposed to the contaminated soil for a relatively short time, the contaminants represent a risk, and simple precautionary measures are required, i.e. good personal hygiene and basic personnel protective equipment. See also comments in Section 10.7 regarding asbestos.

⁸ UKWIR Report 10/WM/03/21 – 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'.

- 14.6.5 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".

14.7 Potential development constraints

- 14.7.1 Topography will require significant regrade earthworks.
- 14.7.2 Deep quarry backfill (see Drawing 3649/11) and high walls present a potential development constraint.
- 14.7.3 Steep highwalls have been identified where depths to bedrock vary significantly over very short distances. Development of plots which span highwalls will require careful consideration and early liaison with a specialist piling contractor and the warranty provider is strongly recommended.

15 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

15.1 General

- 15.1.1 The site is located off Crosland Hill Road and Blackmoorfoot Lane about 3km southwest of Huddersfield city centre and occupies an area of 3.3 hectares. The site slopes down to the north-east with several terraces and retaining walls.
- 15.1.2 At the time of writing the site is occupied by Lowdhams who sell caravans and outdoor leisure equipment. External areas are used for car and caravan parking. Internal areas are used for sales offices, showrooms and maintenance works.
- 15.1.3 It is understood that consideration is being given to redevelopment with about 100 domestic dwellings and associated gardens, POS and adoptable roads and sewers. A site layout has not been provided to date.
- 15.1.4 Historically the majority of the site (about 75% of the total area) has been subject to quarrying for Sandstone as a construction material. Former quarries have subsequently been backfilled with spoil generated by the quarries and by refuse tipping.
- 15.1.5 Ground conditions can be divided into those beyond former quarries (a veneer of made ground between c. 1.6m and 3.2m) and within former quarries (Quarry Infill over Quarry Arisings to between c. 11m and 23m depth).
- 15.1.6 Quarry highwalls have been found at 6 locations and are very steep/vertical. In addition, two 'ramps' have been found within the quarry floor.

15.2 Mining & quarrying

- 15.2.1 This site is located beyond the CA's defined coalfields.
- 15.2.2 No evidence of underground workings in the sandstone have been encountered.
- 15.2.3 The site was occupied by sandstone quarries (Spinkwell, Waterhouse & Manor House Quarries) from c. 1890 to 1960. The quarries targeted Rough Rock Sandstone which was used as a construction material. The quarries were backfilled in the 1960s.
- 15.2.4 Historical photographs which show the Spinkwell quarry during operation (c. 1926) are included in Appendix E. The quarry highwalls appear to be vertical and in the region of 20m high.

15.2.5 Backfilled quarries occupy about 75% of the total site area and reach depths of between c. 11m and 23m; average 17m.

15.2.6 The extent of quarrying proven by drilling to date correlates well with that shown on old OS maps. There are areas of un-quarried ground in the north-west, south-west, and south-east, and a "ridge" in the centre.

15.3 Potential issues associated with deep backfill

15.3.1 It is considered likely that the fill here was placed without mechanical compaction in relatively thick layers (likely >1m) and without any screening to remove oversize boulders etc. Such material poses a risk to development due both to the potential for significant differential settlement, and long-term 'creep' settlement.

15.3.2 At this stage, it is considered that the presence of deep backfill will have implications for foundations, drainage, new utilities and highways.

15.4 Foundations

15.4.1 Foundation recommendations will be dependent on the final earthworks/regrade modelling, and the remediation options applied to this site.

15.4.2 However, it is broadly considered that plots beyond the former quarries will be founded on strip/trench footings which will be seated on bedrock or Residual Soils, whilst plots within the former quarries will be founded on pre-bored piles which will be end-bearing within the sandstone bedrock.

15.4.3 Piles should be pre-bored to prove at least 3m of bedrock in order to ensure that they have not been mistakenly seated upon sandstone boulders.

15.5 Drainage

15.5.1 Due to the very deep made ground across the majority of the site soakaways will not provide a suitable means of surface water disposal. Consequently, it will be necessary to consider alternative sustainable drainage systems (SUDS), and there may be a need for surface water balancing.

15.6 Highways

15.6.1 The made ground should be excavated and either replaced with suitable aggregate, or screened, to allow selection of suitable material, before being replaced in engineered layers.

15.6.2 Where the made ground is re-engineered it is considered that a CBR value of at least 3% should be achievable. However, this should be verified by field trials.

15.6.3 If any new highway spans a quarry 'high-wall' two layers of Tensar Triax TX160 (or equivalent) geogrid sandwiched within at least 300mm of suitable aggregate should be placed beneath the full width of the highway at least 1.0m below the deepest sewer invert.

15.6.4 A specification will need to be agreed with the adopting authority.

15.7 Flooding

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

15.8 Contamination & remediation

- 15.8.1 To date, the soils contamination encountered is relatively "mild". However, given reference on old OS maps to "refuse tipping", it is possible that more onerous contamination than that encountered to date is present.
- 15.8.2 Further contamination may be present beneath areas which have been inaccessible for investigation to date (e.g. beneath buildings, at drainage interceptors etc) and around TP12.
- 15.8.3 Asbestos has been encountered in 5 of 30 samples of made ground tested. Quantification shows that the percentage of asbestos free fibres within the soil mass is typically a 'trace' amount ($< 0.005\%$), but a fragment of asbestos-cement sheeting was recorded in TP104 (0.11%) and insulation lagging in TP110 (0.08%).
- 15.8.4 Made Ground should ultimately be isolated beneath a 600mm clean cover comprising at least 150mm of Topsoil and 450mm Subsoil over a 150mm hard-dig layer. The proposed cover should sufficiently isolate end users from the contaminants found to date.
- 15.8.5 It would be prudent to also allow for some excavation and removal/treatment of more grossly contaminated soils during the proposed earthworks.

15.9 Hazardous gas

- 15.9.1 The site is in an area where between 1% and 3% of homes are estimated to be above the radon action level. Radon protection is not required, but the Developer might consider providing new dwellings with basic measures in light of Public Health England advice.
- 15.9.2 There are known areas of landfill and historical quarrying both within and beyond the site's boundary. Consequently, there may be a risk of hazardous ground gas, and monitoring wells have been installed in 14 rotary open probeholes across the site.
- 15.9.3 Monitoring is underway and a Gas Risk Assessment will be issued on completion in August 2021.

15.10 Further works

- 15.10.1 Given the constraints discussed in Section 7.2 (existing buildings across the majority of the site) a simple post-demolition trial pit investigation will be required in order to remove residual uncertainties with respect to ground and provide more definitive recommendations with respect to contamination and foundations.
- 15.10.2 Further rotary probeholes would be prudent to gain more information relating to the profile of the former quarry floors and to locate highwalls in areas previously inaccessible to investigation.
- 15.10.3 In accordance with BS 8004:2015 and EC7, piling contractors may require rotary cored boreholes extended a minimum 5m into competent bedrock using rotary coring techniques.
- 15.10.4 A Hazardous Gas Risk Assessment will be issued on completion of the monitoring in August 2021.
- 15.10.5 Given the ground conditions encountered to date it is likely that the Local Planning Authority will require the submission of a Remediation Strategy and a Materials Management Plan (MMP).

Appendix A
General Notes

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 through 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 BR211¹, 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 2010². 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 2007³. 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.

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.

General

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

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

Exploratory hole locations

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

Investigation techniques

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

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

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

In-situ testing

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

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

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

Sampling

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

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

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

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

At present, neither ISO/IEC 17025 nor MCERTS specify sample pre-treatment with respect to stone removal. Unsurprisingly therefore UKAS accredited testing laboratories do not adopt the same approach to stones¹ – some crush and test the "as received" soil, whilst others sieve out stones and analyse only the residual soil (the sieve size used varies depending on the laboratory).

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

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

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

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

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

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

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

Anticipated testing	Container(s)
Asbestos identification	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.

Key to exploratory hole logs

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

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:

$$I_p = I_p * (\% < 425\mu\text{m} / 100)$$

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 SO₄ 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:

- For stiff soils the effective overburden pressure*
- For firm soils "somewhat less" than the effective overburden pressure
- For soft soils "appreciably less" than the effective overburden pressure, usually 25 kPa or less
- 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 ϕ') 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 ϕ') 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 (SO₄), 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 C₆ to C₁₀). Also referred to as PRO – Petroleum Range Organics
- DRO – Diesel Range Organics (typically C₁₀ to C₂₈)
- LRO – Lubricating Oil Range Organics (typically C₂₈ to C₄₀)
- MRO – Mineral Oil Range Organics (typically C₁₈ to C₄₄)

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 C₅-C₄₀, whereas others define TPH as C₁₀-C₃₀.

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 C₄ to C₅ 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 C₁₀ to C₄₀ (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 C₆ to C₈, aromatic C₁₀ to C₁₂ 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).

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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.

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

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

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

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

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

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

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

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

Inorganic contaminant	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
As	32	37	37	Use (A) in SI Report for initial "screen". If >5 x A, then consider increase of cover to 1,000mm	40	640	37	C4SL adopted
Cd	10	26	26		149	410	26	C4SL adopted
Cr			3,000		3,000	30,000	3,000	Assumes Cr is CrIII
Pb	450	200	200		310	2,330	200	C4SL adopted
Ni	130		127		127	1,700	127	Assessment of health risk only
Se	350		350		595	13,000	434	
Hg	170		169		238	3,640	199	Assumes in an inorganic compound
B			5		5	5	5	
Cu			80-200		80-200	80-200	80-200	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
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 study¹

¹ SP1010 Appendix E, Provisional C4SLs for benzo(a)pyrene as a surrogate marker for PAHs, CL:AIRE 2013

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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

$$HI = \sum_{i=1}^{18} HQ F_i = \frac{\text{Measured concentration } F_i \text{ (mg kg}^{-1}\text{)}}{SGV F_i \text{ (mg kg}^{-1}\text{)}}$$

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 ICRCCL 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

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, 1999ⁱⁱⁱ

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 ² (%v/v)	Gas Screening Value ^{2,4,5} (l/hr)	Typical Maximum Concentration ² (%v/v)	Gas Screening Value ^{2,3,4,5} (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:

- 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.
- 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.
- 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 x 1.50m x 2.50m, with a total room volume of 5.63m³ has been considered.
- 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.
- 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.
- 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



Reproduced from OS Explorer map 1:25,000 scale by permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationary Office. Crown copyright. All rights reserved. Licence number 100049696.



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Tel 01937 545330

CLIENT

REDROW
HOMES

JOB TITLE

CROSLAND HILL
ROAD,
HUDDERSFIELD

DRAWING TITLE

SITE LOCATION
PLAN

DRAWN

CR

DATE

13/01/20

CHECKED

REG

DATE

13/01/20

STATUS

FOR COMMENT ☐

DRAFT ☐

FOR APPROVAL ☐

FINAL ☒

SCALE

1:25,000

SHEET

A4

DRAWING NO.

3649/1

REVISION



NOTES

- GRASS & OVERGROWN AREAS
- BUILDING
- GRAVEL OR HARDCORE SURFACING
- TARMAC HARDSTAND
- CONCRETE PAVING/HARDSTAND/BRICK PAVING
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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Tel 01937 545330

CLIENT

REDROW HOMES

JOB TITLE

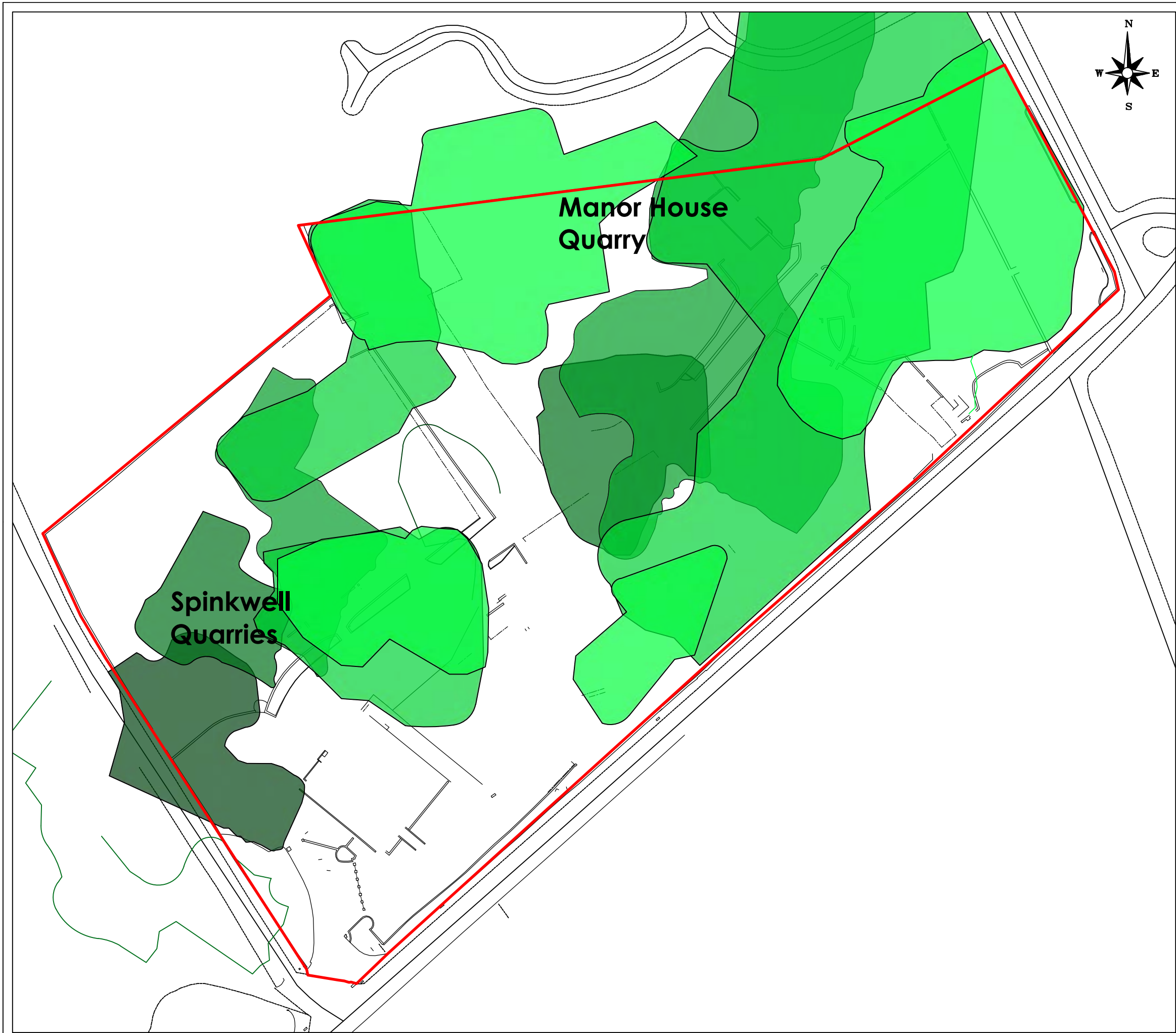
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HUDDERSFIELD

DRAWING TITLE

SITE FEATURES

DRAWN	DATE	STATUS
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CHECKED	DATE	FOR APPROVAL ☐
REG	29/01/2020	DRAFT ☐
		FINAL ☒

SCALE	SHEET	DRAWING NO.	REVISION
1:1,000	A3	3649/3	



NOTES

- Quarry 1892
- Quarry 1906
- Quarry 1916
- Quarry 1938
- Quarry 1960

REV.	DESCRIPTION	DATE

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Tel 01937 545330

CLIENT

REDROW HOMES

JOB TITLE

CROSLAND HILL ROAD,
HUDDERSFIELD

DRAWING TITLE

SITE FEATURES - QUARRY LOCATIONS

DRAWN	CR	DATE	30/01/2020	STATUS	FOR COMMENT	☐
CHECKED	REG	DATE	31/01/2020	FOR APPROVAL	DRAFT	☐
				FINAL	☒	

SCALE	1:1,000	SHEET	A3	DRAWING NO.	3649/3a	REVISION	



NOTES

Spoil Heap Extents

Refuse Tip

REV.	DESCRIPTION	DATE

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CONSULTING

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CLIENT

REDROW
HOMES

JOB TITLE

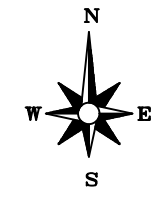
CROSLAND HILL
ROAD,
HUDDERSFIELD

DRAWING TITLE

SITE FEATURES - SPOIL HEAP &
REFUSE TIP LOCATIONS

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CHECKED	REG	DATE	31/01/2020	FOR APPROVAL	DRAFT	☐
				FINAL		☒

SCALE	1:1,000	SHEET	A3	DRAWING NO.	3649/3b	REVISION	



- NOTES
- GRASS & OVERGROWN AREAS
 - BUILDING
 - GRAVEL SURFACING
 - TARMAC HARDSTAND
 - CONCRETE PAVING/HARDSTAND/BRICK PAVING
 - APPROXIMATE SITE BOUNDARY
 - LOCATION & ORIENTATION OF PHOTOGRAPH

REV.	DESCRIPTION	DATE



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CLIENT

REDROW
HOMES

JOB TITLE

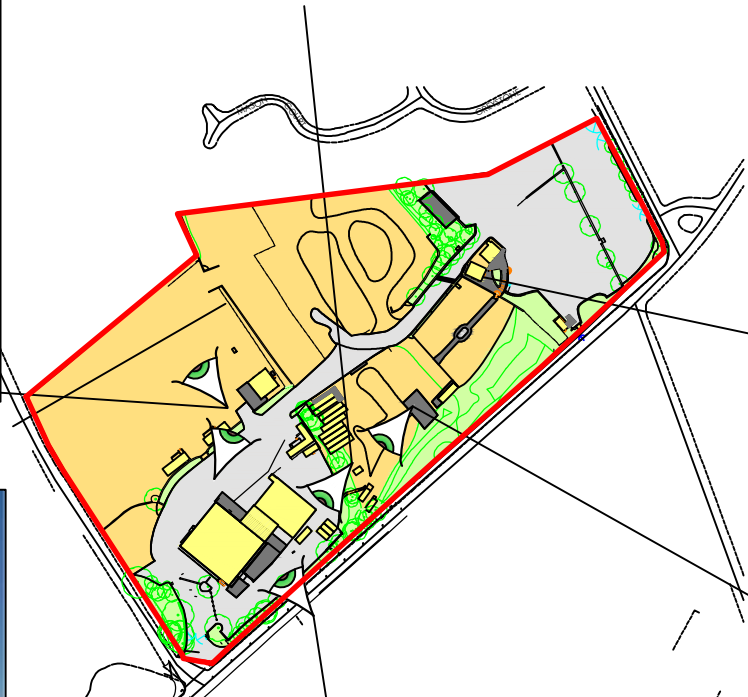
CROSLAND HILL
ROAD,
HUDDERSFIELD

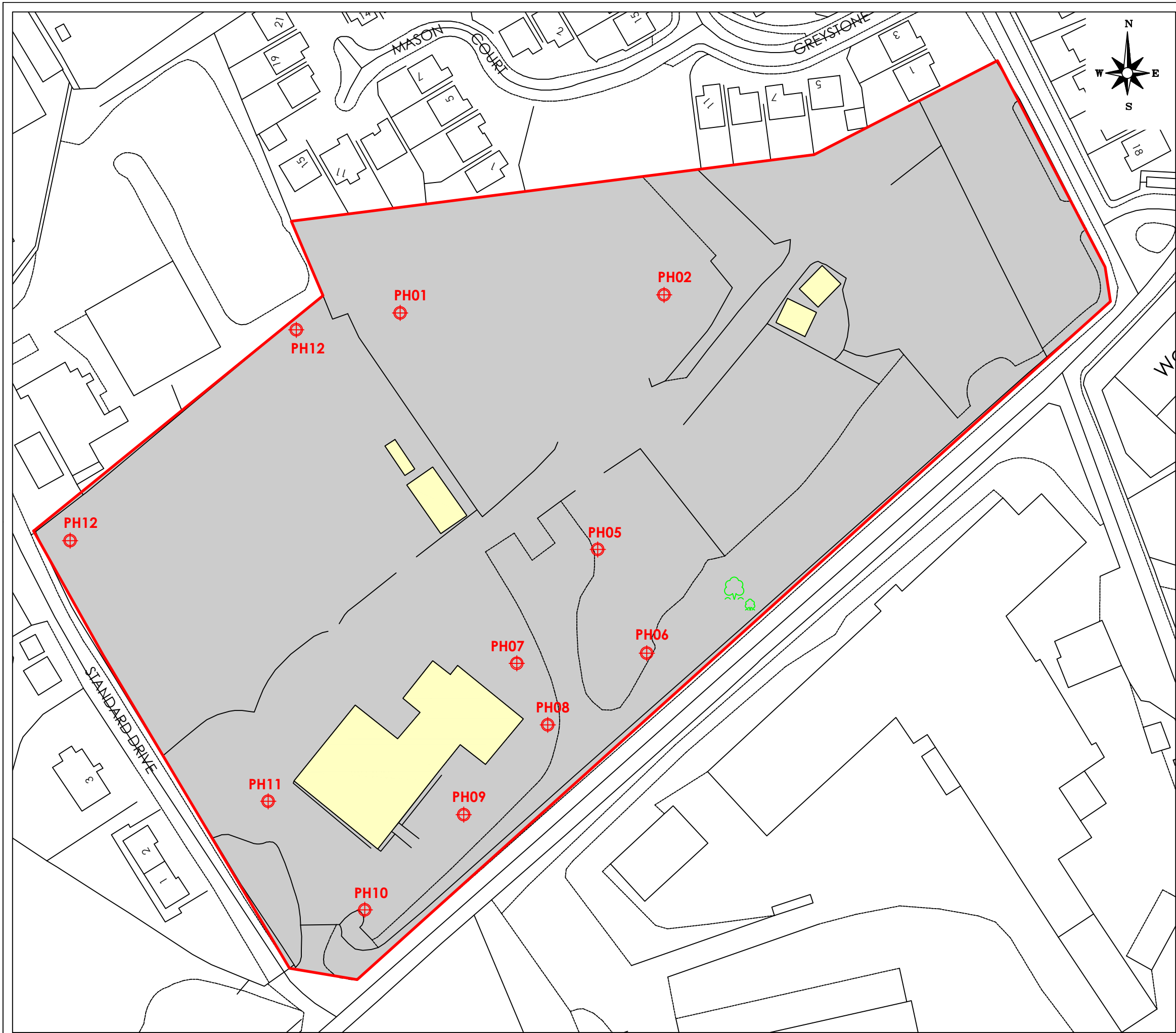
DRAWING TITLE

SITE PHOTOGRAPHS

DRAWN	MJT	DATE	29/01/2020	STATUS	FOR COMMENT	☐
CHECKED	REG	DATE	29/01/2020	FOR APPROVAL	DRAFT	☐
				FINAL		☒

SCALE	NOT TO SCALE	SHEET	A3	DRAWING NO.	3649/4	REVISION	





NOTES

WINDOW SAMPLE LOCATION;
ADVANCED BY QDS ON 12th/13th
DECEMBER 2002

WINDOW SAMPLE LOCATION;
ADVANCED BY QDS ON 12th/13th
DECEMBER 2002

BUILDING

HARDSTAND

APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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CLIENT

REDROW
HOMES

JOB TITLE

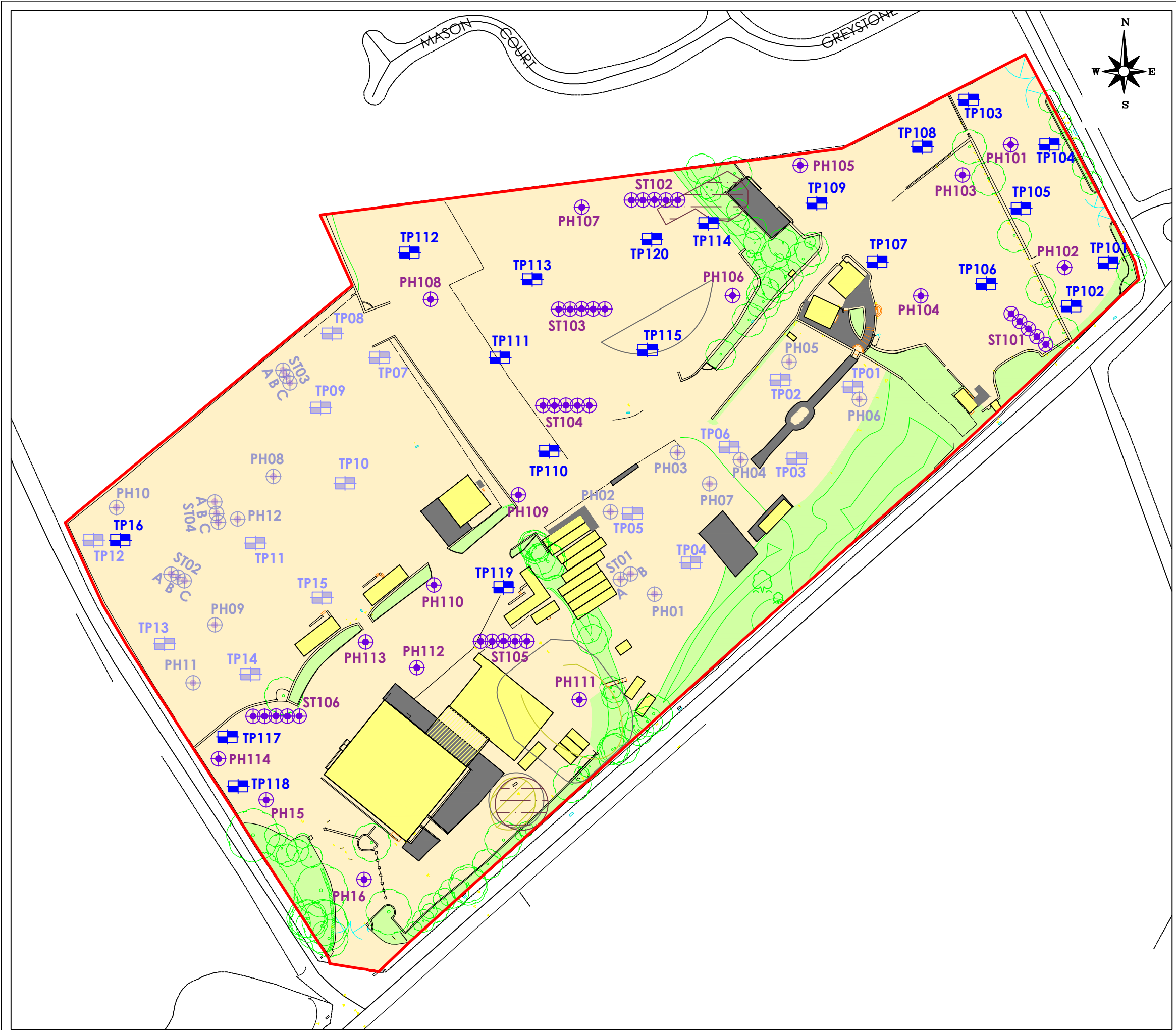
CROSS HILL
ROAD,
HUDDERSFIELD

DRAWING TITLE

EXPLORATORY HOLE LOCATIONS

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CHECKED	REG	DATE	19/11/2019	FOR APPROVAL	DRAFT	☐
				FINAL	☒	

SCALE	1:1000	SHEET	A3	DRAWING NO.	3649/6	REVISION	



NOTES

- TRIAL PIT LOCATION (LITHOS 2021)
- PROBEHOLE LOCATION (LITHOS 2020)
- STITCH PROBEHOLE LOCATION (LITHOS 2021)
- TRIAL PIT LOCATION (LITHOS 2020)
- PROBEHOLE LOCATION (LITHOS 2020)
- STITCH PROBEHOLE LOCATION (LITHOS 2020)
- APPROXIMATE SITE BOUNDARY

REV.	DESCRIPTION	DATE

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CLIENT

REDROW HOMES

JOB TITLE

CROSLAND HILL ROAD,
HUDDERSFIELD

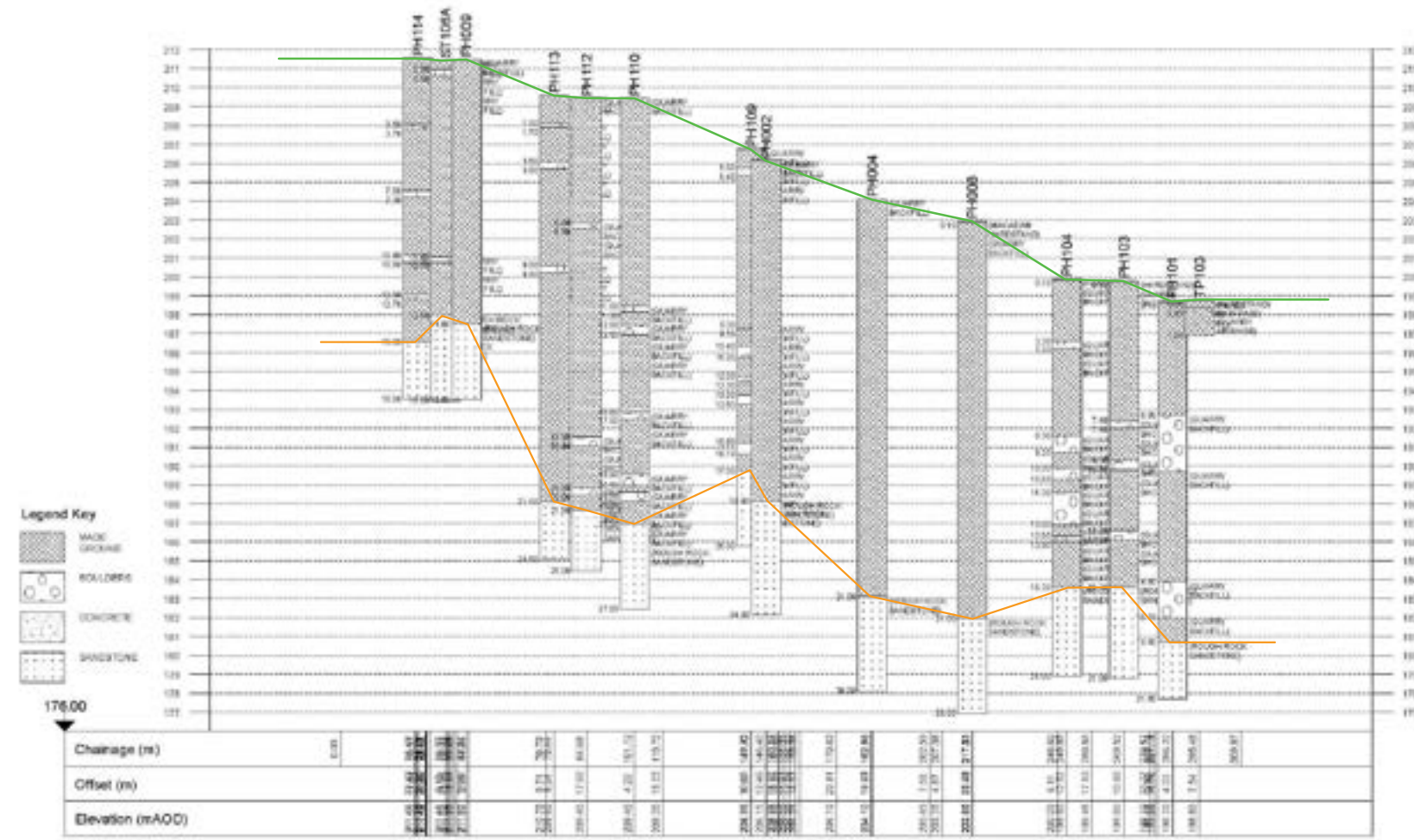
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EXPLORATORY HOLE LOCATIONS

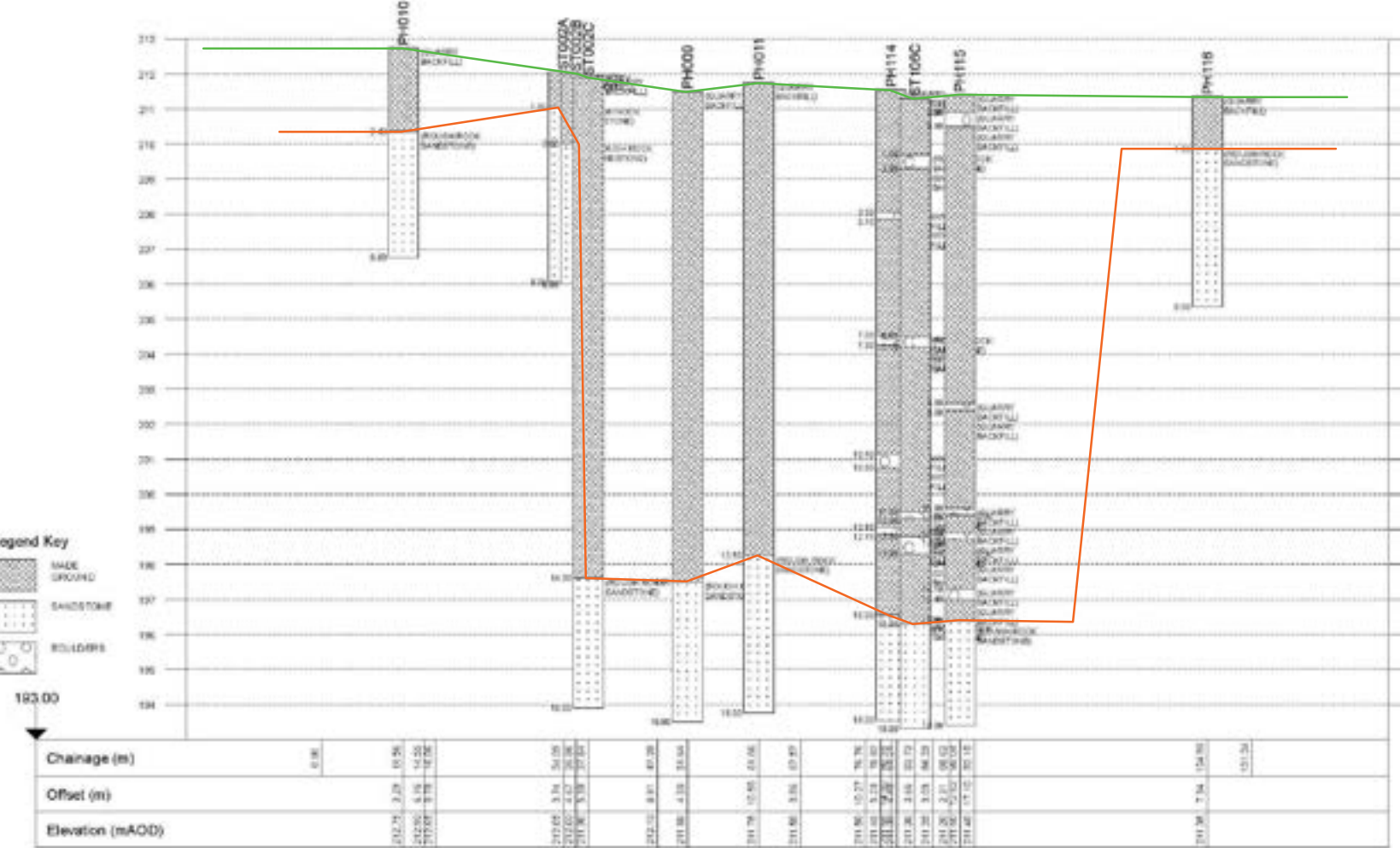
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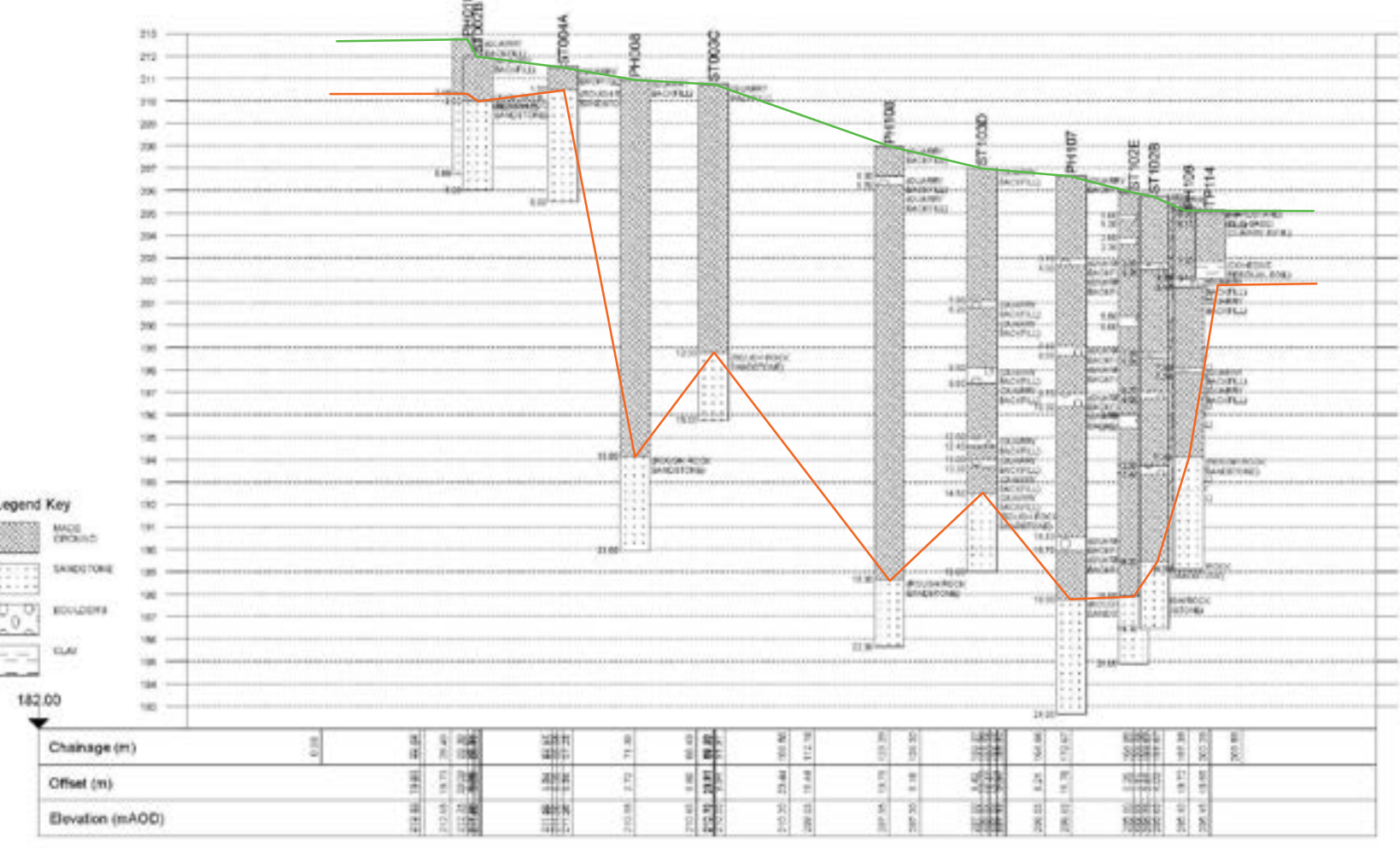
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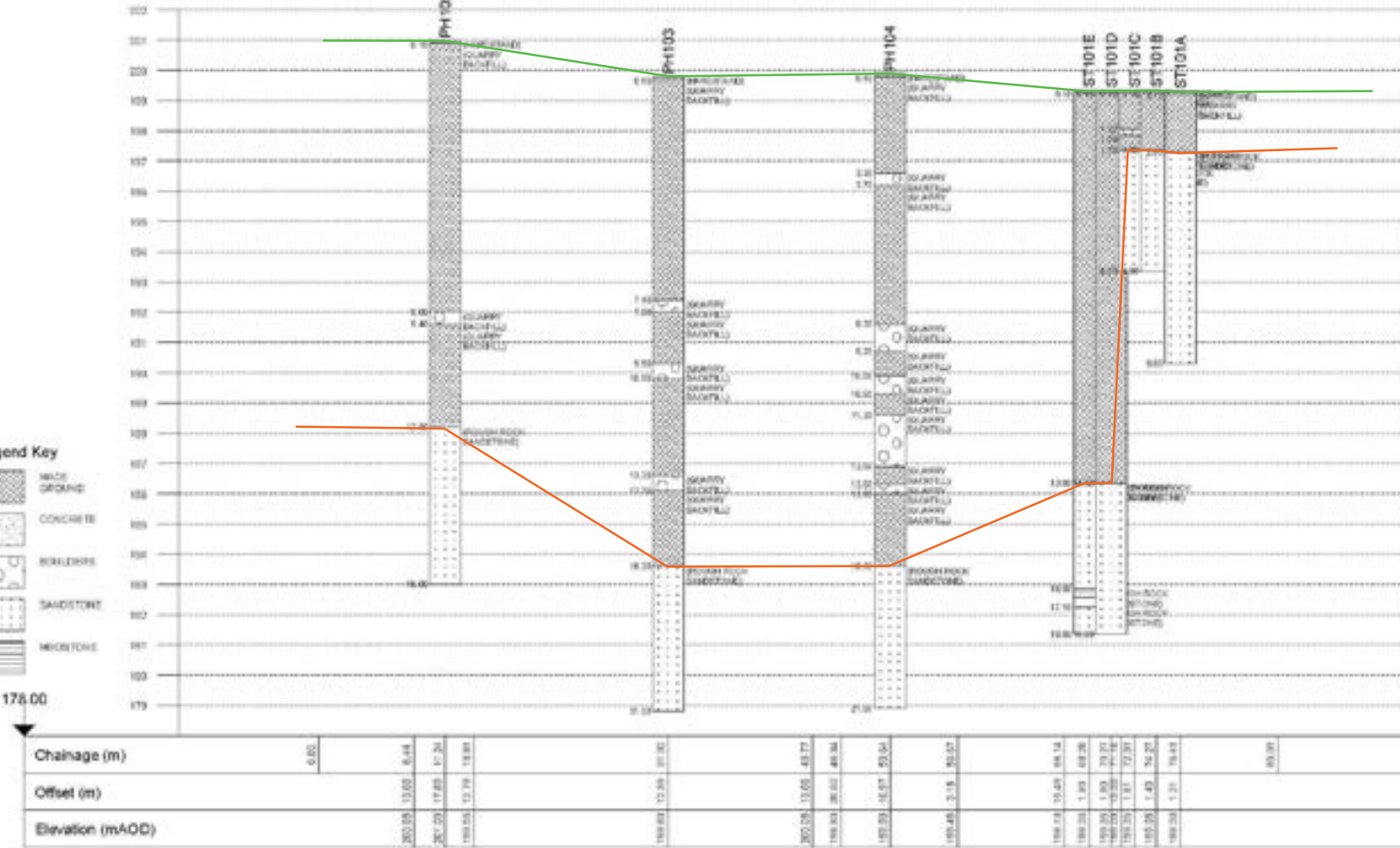
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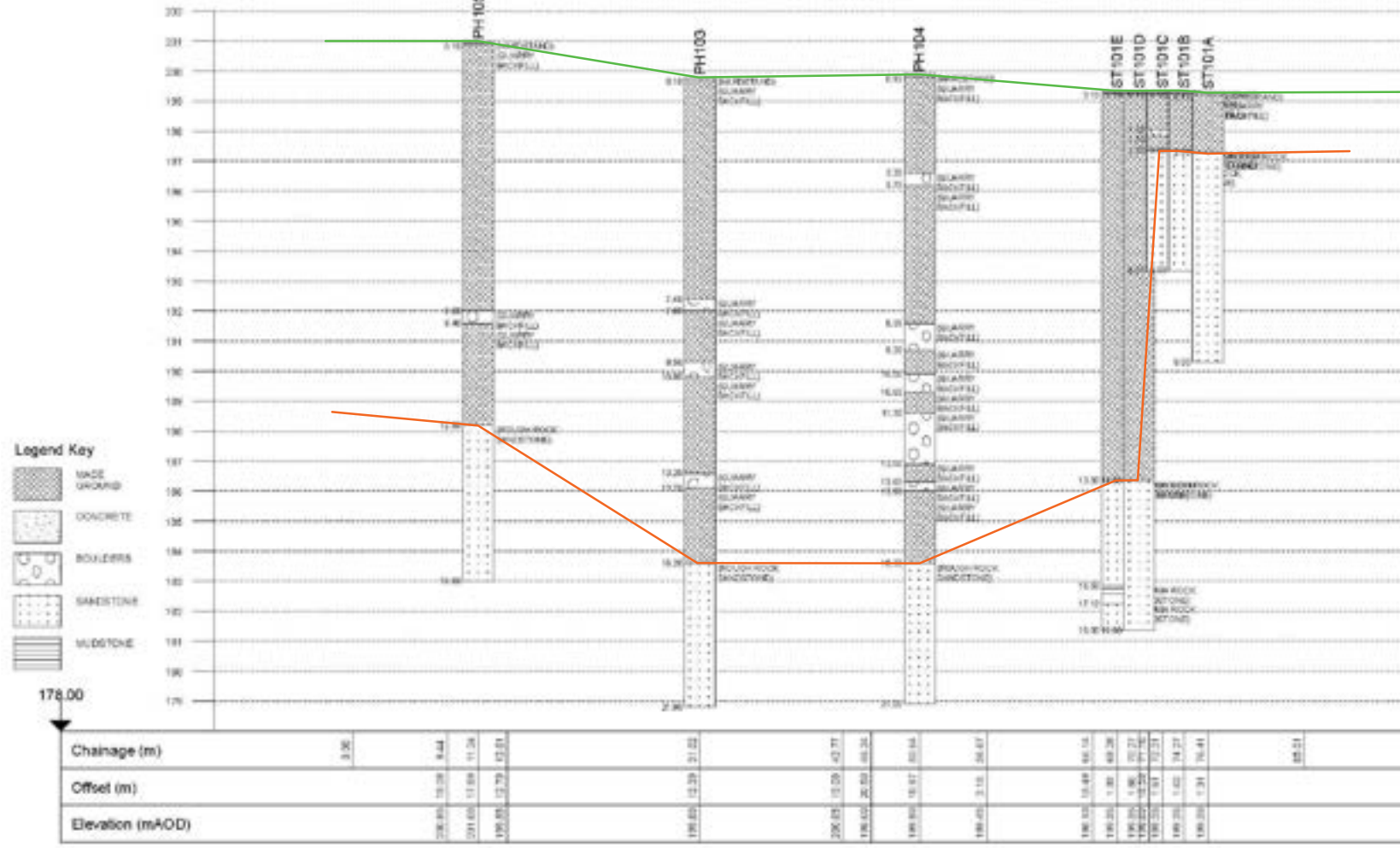
SECTION 3



SECTION 4



SECTION 5



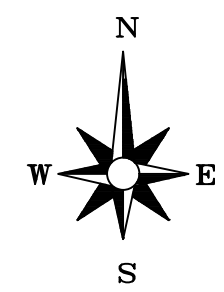
SECTION LINE 5

SECTION LINE 2

SECTION LINE 3

SECTION LINE 1

SECTION LINE 4



- NOTES
- GRASS & OVERGROWN AREAS
 - BUILDING
 - GRAVEL OR HARDCORE SURFACING
 - CONCRETE PAVING/HARDSTAND/BRICK PAVING
 - LINE OF CROSS SECTION
 - APPROXIMATE SITE BOUNDARY

REV	DESCRIPTION	DATE



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CLIENT

REDROW HOMES

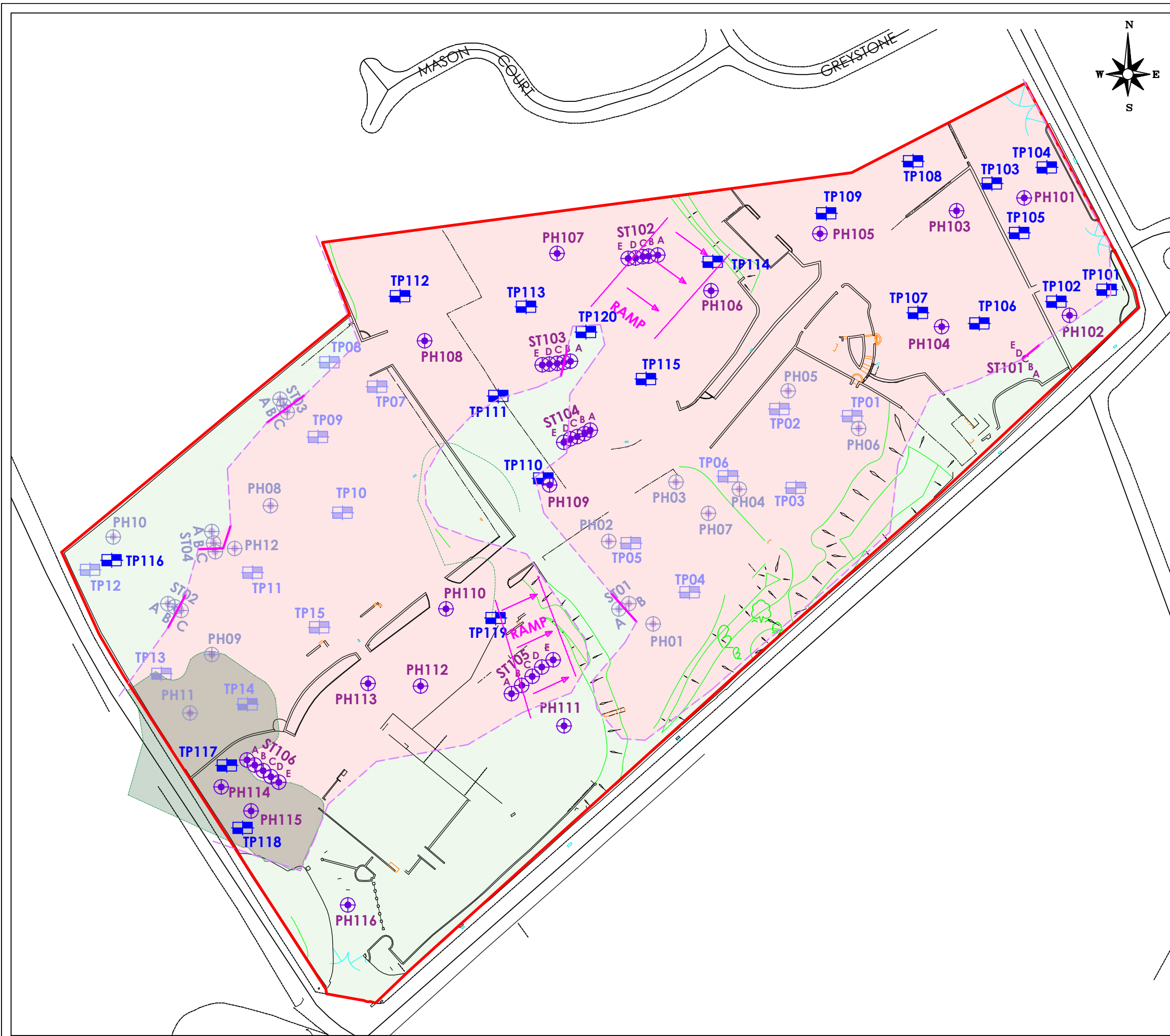
FOR TITLE

CROSLAND HILL
ROAD,
HUDDERSFIELD

DRAWING TITLE

CROSS SECTIONS

DRAWN	GLM	DATE	11/02/2021	FOR COMMENT	☐
CHECKED	REG	DATE	11/02/2021	FOR APPROVAL	☐
SCALE	NOT TO SCALE	SHEET	A1	DRAWING NO.	3649/10
				REVISION	



NOTES		
	TRIAL PIT LOCATION	
	PROBEHOLE LOCATION	
	STITCH PROBEHOLE LOCATION	
	INSIDE OF QUARRY FOOTPRINT (MADE GROUND IS DEEP)	
	OUTSIDE OF QUARRY FOOTPRINT (MADE GROUND IS SHALLOW)	
	LINE OF HIGHWALL - PROVEN	
	LINE OF HIGHWALL - INTERPRETED	
	APPROXIMATE SITE BOUNDARY	
REV.	DESCRIPTION	DATE

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REDROW
HOMES
YORKSHIRE

CROSLAND HILL
ROAD,
HUDDERSFIELD

LINE OF BURIED HIGHWALLS

DRAWN	GLM	DATE	12/02/2021	STATUS	FOR COMMENT	☐
CHECKED	REG	DATE	12/02/2021	FOR APPROVAL	DRAFT	☐
				FINAL		☒
SCALE	1:1000	SHEET	A3	DRAWING NO.	3649/11	REVISION

Appendix C

Commission

023/3649/REG

8th January 2021

Mr D Faraday
Redrow Homes (Yorkshire) Ltd
Redrow House
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WF2 0XJ



Registered in England 07068066

Parkhill
Wetherby
West Yorkshire
LS22 5DZ

T 01937 545 330

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Dear David

Crosland Hill Road, Huddersfield

Further to your recent invitation, please find attached our proposal for undertaking a site investigation on the above land. We understand that your proposed development will include traditional 2 storey domestic dwellings with associated gardens, POS and adoptable roads and sewers; although no layout is available yet.

We have already issued a Desk Study report (Ref. 3649/1, dated January '20), key findings of which were:

- The site was formerly occupied by two sandstone quarries which were filled by 1982, with possible landfill occurring c.1960. Quarrying has taken place beneath c. 65% of the site area.
- Deep made ground is expected where quarrying occurred; the nature of this fill is unknown.
- Beyond quarried areas, residual soils are expected, with bedrock (Rough Rock Sandstone) from relatively shallow depth (Likely <2m).
- This site is located beyond the Coal Authority's defined coalfields.

Ground investigation is required in order to assess the:

- line and steepness of high walls associated with former quarries;
- depth of backfill within the quarries;
- risks associated with hazardous gas;
- nature & extent of contamination.

However, current use as a caravan sales depot poses a significant constraint to the proposed investigation, most notably trial pitting & trenching (and possibly also rotary probing). Lowdhams have sub-divided the site into 5 areas and it is understood that they will arrange for each sub-area to be clear of cars, motorhomes & caravans for a day on a rolling programme.

Areas 1, 2 & 3 are predominantly surfaced with compact gravel; Areas 4 & 5 are predominantly tarmac. We have completed ground investigation in Areas 1 & 2 in February 2020 (although no soil samples were tested, and no monitoring wells were installed). This year, we anticipate starting in Area 3.

This proposal assumes that Redrow will obtain **permission** from **Harron** Homes for Lithos to use data obtained in February 2020 (desk study & ground investigation in Areas 1 & 2). We will require formal, written confirmation of this; you will understand that whilst we undertook the original ground investigation, the data does not 'belong' to Lithos; ownership rests with Harron since they paid for all the work.



We will use best endeavours (including hire of a roller) to leave each pit as smooth & close to original level as possible (arising will be compacted & 'swept' over each pit). However, we have made no allowance for the removal of surplus spoil (a skip could be hired at an E\O of £ , if required, but considered unlikely), nor for reinstatement with new tarmac. On completion of the investigation, "graves" of spoil (each about 3m long by 1m wide) possibly unsuitable for trafficking, will be left up to c. 300mm proud at each trial pit location.

Only about 3 pits will be dug in Area 4 due to the need to retain safe public access etc.

Our proposal allows for doing work in each of 3 remaining sub-areas on each of 3 consecutive days. In the event that an area is not satisfactorily cleared overnight, and we have to stand down, the cost would be £ per half-day.

Given significant site constraints and the need to work in "blocks" of 1 day (especially in January/February when days are short), there is a risk that we may not complete all the proposed exploratory holes in a given sub-area. If we consider it absolutely necessary, we will spend a 2nd day in a given sub-area. Hopefully, this will not be necessary, but if it is we would propose that the over-run cost be "shared"; so, please allow for E\O of £ for each time this occurs (we will inform you in advance if/when this is anticipated).

As discussed, the investigation proposed here is intended to be as robust as possible, but given the significant constraints associated with the need for ongoing caravan sales, some supplementary post-vacation investigation is likely to be required.

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

This proposal allows for the following works:

Fieldwork: We have allowed for: the excavation of about 17 no. trial pits and the drilling of about 45 rotary probeholes (subject to the nature of the quarry overburden; if temporary steel casing is required, the number of holes possible per shift will be significantly reduced). All trial pits and probeholes will be supervised and logged by an experienced geoenvironmental engineer. A proposed exploratory hole location plan ([Drawing 3649/X2](#)) is enclosed, but may need significant refinement in light of discussions with the vendor.

At this stage, no **cable percussion boreholes** are proposed. Such boreholes would allow the recovery of soil samples from greater depths than are possible via trial pitting (probeholes do not allow the recovery of any soil samples), but only if the quarry backfill does not contain significant boulders (because these would cause premature termination). Once we have done pitting & probing we should have a better idea as to whether or not boreholes will yield anything useful (and could do later with less extensive caravan movement). In any case, in the wider context, such boreholes are unlikely to result in show-stoppers.

Based on anticipated ground, **soakaways** will not provide a satisfactory solution for surface water drainage, and no allowance has been made for soakaway testing at this stage.

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.

This investigation should yield sufficient data to enable a foundation zoning plan.

Given the anticipated nature and thickness of drift strata here, piles are likely to be end-bearing in bedrock. In accordance with BS 8004:2015 and EC7, **piling contractors** may request that boreholes be extended a minimum 5m into competent bedrock using rotary coring techniques. It would be

prudent to liaise with your preferred piling contractor(s) in advance of commissioning this investigation and inform Lithos whether or not rotary coring is required.

The site is underlain by deep quarry backfill, and therefore we have allowed for the drilling of c. 45 rotary **probeholes** to check the depth of backfill within the quarries, and line and steepness of high walls associated with former quarries.

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 presence of backfilled quarries and areas of landfill within 250m of the site, we have allowed for the installation of wells in 15 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.

Testing: This will comprise routine **geotechnical** soils analysis, including 15 moisture content & Atterberg limits, and 20 pH & water-soluble sulphate. We will also schedule 10 compaction tests on samples of made ground to assess suitability for use in earthworks ground improvement.

This site is brownfield and therefore likely to be underlain by made ground which in turn is likely to be subject to re-engineering prior to the construction of new estate roads. Consequently, there is no merit in obtaining CBR values at this stage.

Appropriate **chemical analyses**, based on our knowledge of the site's history, have been allowed for; this will comprise 40 samples for a suite including heavy metals, speciated PAH, and banded TPH (with supplementary speciation as/where appropriate). In the event that ground contamination is more significant or different to that anticipated, it might be necessary to carry out additional chemical testing.

Within in our proposal we have allowed for the screening (ID) of 40 samples for asbestos. In the event that positive IDs are reported, it is likely that we will need to schedule further analysis (asbestos quantification), in order to determine the significance of the results. Asbestos quantification is currently a relatively expensive test and consequently we have not allowed for it at this stage. We will inform you immediately after receipt of results if we consider asbestos quantification is required.

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

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

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.

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

Given previous usage of this land, it is considered highly likely that a Remediation Strategy report will be required by the Local Authority, and our proposal allows for this.

It should be noted that a Remediation Strategy outlines the remediation objectives necessary to protect environmental receptors, and render a site suitable for the proposed end use. A Remediation Strategy is not the same as a Method Statement; the latter should be prepared subsequently, usually by a Contractor, in order to detail how the objectives will be achieved.

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

Invoicing: The attached proposals provide a breakdown of the costs associated with this project. These breakdowns are for information only and the proposal can be regarded as a lump sum prices of £ plus VAT.

Variation will only occur in the event that a given item is not undertaken or that substantial additional works are recommended, in which case we will inform you immediately, provide costs for the required works, and seek your prior consent.

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

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

- 1st milestone invoice (Items A to D) within 5 days of fieldwork completion, with exploratory hole logs and an interim letter report outlining our initial findings
- 2nd milestone invoice (Items E to H) on issue of the final SI report
- 3rd milestone invoice (Item I) on issue of the Remediation Strategy
- 4th and final invoice (Item J) after completion of the gas monitoring/issue of the supplementary letter report

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

Details of welfare will be included within the Method Statements. However, presumably Lowdham's will have already established welfare facilities on site, and Lithos' Engineer and the drilling operatives will be able to make use of these facilities as and when necessary, after removing PPE and washing hands.

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

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

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

Under the **CDM** Regulations 2015, Lithos must be provided with pre-construction information already in your possession, or information that can reasonably be obtained through sensible enquiry. This

information must be relevant to the project, have an appropriate level of detail, and be proportionate to the nature of the risks.

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

- Cable percussion boreholes
- Further trial pitting to 'tighten' the grid
- In accordance with BS 8004:2015 and EC7, if piled foundations are anticipated, piling contractors may request that boreholes be extended a minimum 5m into competent bedrock using rotary coring techniques.
- Groundwater sampling & analysis
- Detailed Quantitative Risk Assessment (dQRA)

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

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

Yours sincerely

A handwritten signature in dark ink, appearing to read "Mark Perrin".

Mark Perrin
Director

**for and on behalf of
LITHOS CONSULTING LIMITED**

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 to 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 five million pounds in the aggregate (unless it is a pollution, contamination or asbestos claim in which case it is two million pounds in the aggregate) or 10 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.

George Morton

From: David Faraday <david.faraday@redrow.co.uk>
Sent: 12 January 2021 16:24
To: Reg
Cc: Harriet Parker
Subject: Crosland Hill - SI

Hi Reg,

Further to our earlier conversation, please take this email as an instruction to proceed with the balance of the site investigation, (as outlined in your letter dated 08.01.21).

We are in discussions with Harron and we expect to purchase the data from them in the next few days to enable you to include it in your report.

I note your comments regarding the potential for a 2nd day in each area and your suggestion of sharing costs is acceptable. We would prefer a robust report given the impacts on the site viability.

I will set up a Purchase Order and ping it over shortly.

Harriet – can you please confirm if the report is to be in our name or joint beneficiaries and can you also please advise the landowner of the instruction so access can be arranged etc.

Regards,

David

David Faraday
Technical Director

Redrow Homes Limited
Redrow House
Brunel Road, Wakefield 41, Wakefield
West Yorkshire, WF2 0XG

Telephone: 01924 822566
Mobile: 07824 491 488
Extension: 3918
Website: www.redrow.co.uk

Appendix D

Historical OS Plans



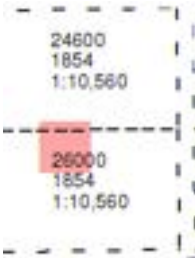
Yorkshire

Published 1854

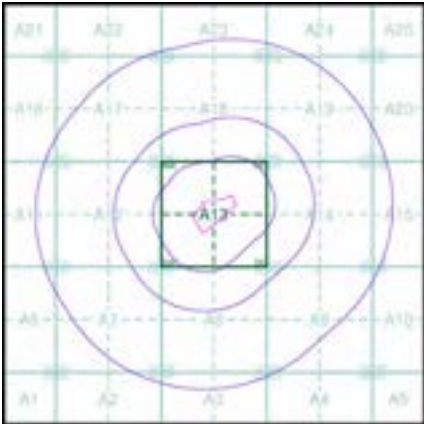
Source map scale - 1:10,560

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; these maps were used to update the 1:10,560 maps. The published date given therefore 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. In the late 1940's, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number: 229943670_1_1
Customer Ref: PO15529/JW/3649
National Grid Reference: 411690, 414700
Slice: A
Site Area (Ha): 3.34
Search Buffer (m): 1000

Site Details

Crosland Moor, HUDDERSFIELD, HD4 5NF



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



Yorkshire

Published 1916

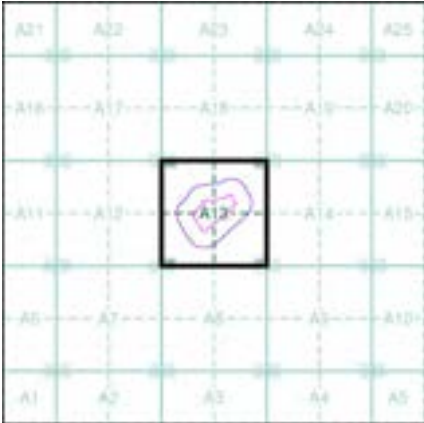
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 229943670_1_1
Customer Ref: PO15529/JW/3649
National Grid Reference: 411690, 414700
Slice: A
Site Area (Ha): 3.34
Search Buffer (m): 100

Site Details

Crosland Moor, HUDDERSFIELD, HD4 5NF



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



Ordnance Survey Plan
Published 1960 - 1963
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number: 229943670_1_1
Customer Ref: PO15529/JW/3649
National Grid Reference: 411690, 414700
Slice: A
Site Area (Ha): 3.34
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Site Details

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

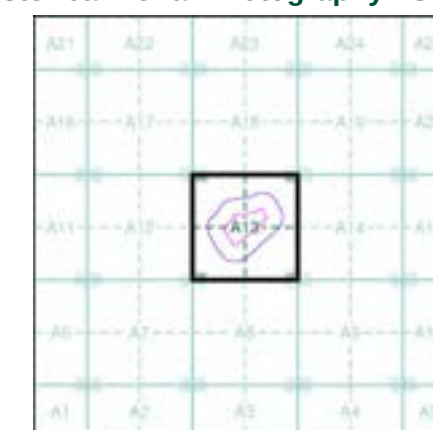


Historical Aerial Photography

Published 2000

This aerial photography was produced by Getmapping, these vertical aerial photographs provide a seamless, full colour survey of the whole of Great Britain

Historical Aerial Photography - Segment A13



Order Details

Order Number: 229943670_1_1
Customer Ref: PO15529/JW/3649
National Grid Reference: 411690, 414700
Slice: A
Site Area (Ha): 3.34
Search Buffer (m): 100

Site Details

Crosland Moor, HUDDERSFIELD, HD4 5NF



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

Appendix E

Search Responses & other Correspondence



Envirocheck[®] Report:

Datasheet

Order Details:

Order Number:

229943670_1_1

Customer Reference:

PO15529/JW/3649

National Grid Reference:

411690, 414700

Slice:

A

Site Area (Ha):

3.34

Search Buffer (m):

1000

Site Details:

Crosland Moor
HUDDERSFIELD
HD4 5NF

Client Details:

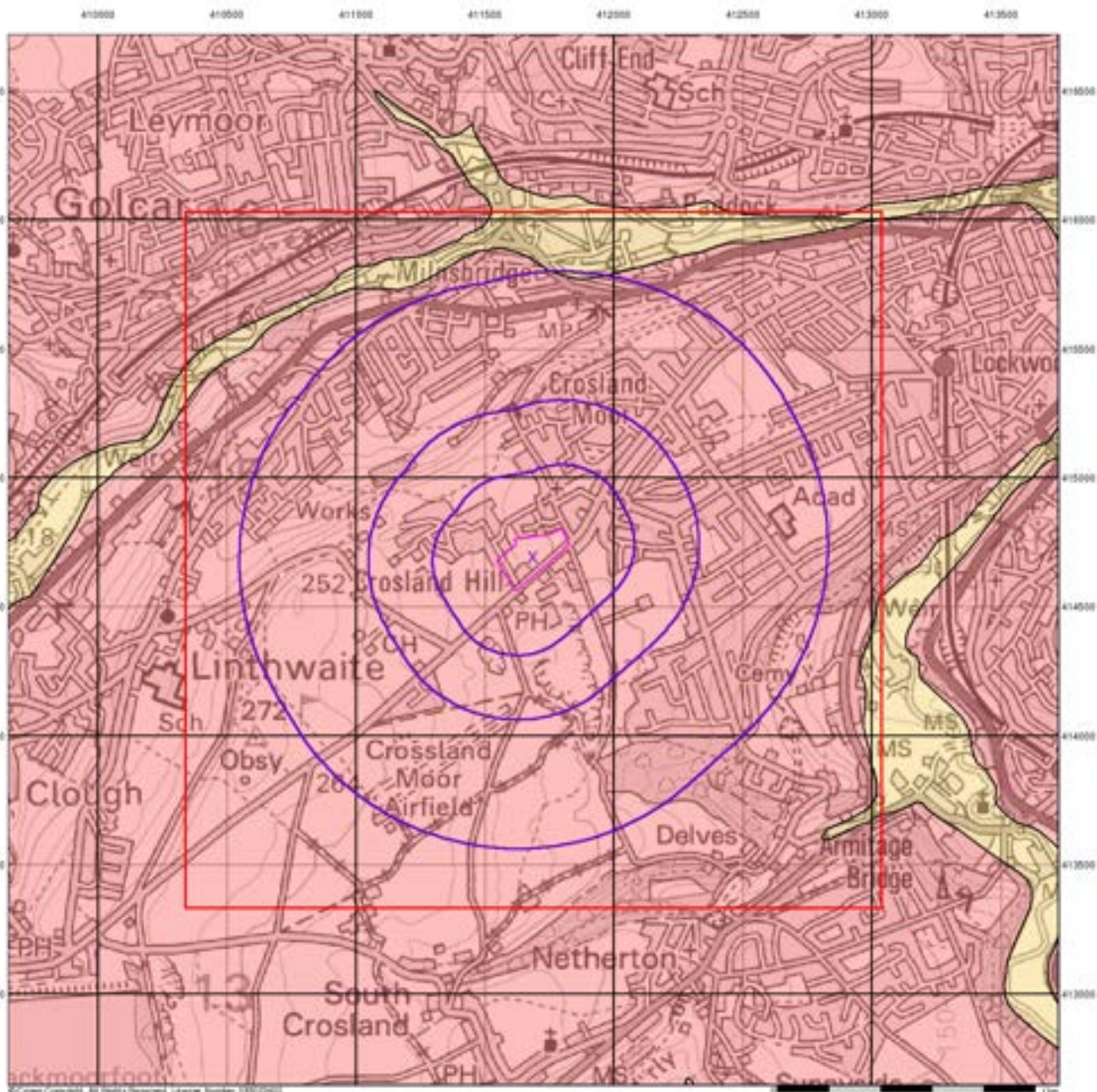
Mr M Perrin
Lithos Consulting Ltd
Parkhill
Walton Road
Wetherby
LS22 5DZ

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1	Yes	Yes	Yes	n/a
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 1				6
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control	pg 2		5		
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls	pg 4		1		3
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 4			Yes	
Pollution Incidents to Controlled Waters	pg 4			1	8
Prosecutions Relating to Authorised Processes					
Registered Radioactive Substances					
River Quality	pg 6				1
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register	pg 6				1
Water Abstractions	pg 6	1			7 (*57)
Water Industry Act Referrals					
Groundwater Vulnerability Map	pg 22	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 22	Yes	n/a	n/a	n/a
Superficial Aquifer Designations			n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
OS Water Network Lines	pg 23				15

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Waste					
BGS Recorded Landfill Sites	pg 25		1	1	1
Historical Landfill Sites	pg 25		2	3	2
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)	pg 26		3		
Licensed Waste Management Facilities (Locations)	pg 27		1		1
Local Authority Landfill Coverage	pg 27	1	n/a	n/a	n/a
Local Authority Recorded Landfill Sites					
Potentially Infilled Land (Non-Water)	pg 27	3	19	2	5
Potentially Infilled Land (Water)	pg 29			1	2
Registered Landfill Sites	pg 30		4		2
Registered Waste Transfer Sites					
Registered Waste Treatment or Disposal Sites					
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)	pg 33		1		
Explosive Sites	pg 33		1		
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
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 34	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 34	Yes	Yes	Yes	Yes
BGS Recorded Mineral Sites	pg 35	4	19	20	23
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
CBSCB Compensation District			n/a	n/a	n/a
Coal Mining Affected Areas			n/a	n/a	n/a
Mining Instability			n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain	pg 46	Yes	Yes	n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 46	Yes	Yes	n/a	n/a
Potential for Compressible Ground Stability Hazards	pg 46	Yes	Yes	n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 47	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 47	Yes	Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards				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 48		6	3	39
Fuel Station Entries	pg 52		1		1
Points of Interest - Commercial Services	pg 52		5	2	8
Points of Interest - Education and Health					
Points of Interest - Manufacturing and Production	pg 53	1	9	5	16
Points of Interest - Public Infrastructure	pg 56		1	1	6
Points of Interest - Recreational and Environmental	pg 57		2	1	8
Gas Pipelines					
Underground Electrical Cables					

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland	pg 58				1
Areas of Adopted Green Belt	pg 58		1		
Areas of Unadopted Green Belt	pg 58		1		
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones					
Ramsar Sites					
Sites of Special Scientific Interest					
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					



Groundwater Vulnerability

General

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

Agency and Hydrological

Bedrock Aquifers

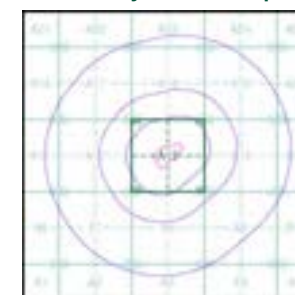
- High Vulnerability, Principal Aquifer
- High Vulnerability, Secondary Aquifer
- Medium Vulnerability, Principal Aquifer
- Medium Vulnerability, Secondary Aquifer
- Low Vulnerability, Principal Aquifer
- Low Vulnerability, Secondary Aquifer

Superficial Aquifers

- High Vulnerability, Principal Aquifer
- High Vulnerability, Secondary Aquifer
- Medium Vulnerability, Principal Aquifer
- Medium Vulnerability, Secondary Aquifer
- Low Vulnerability, Principal Aquifer
- Low Vulnerability, Secondary Aquifer

- Unproductive Aquifer
- Soluble Rock

Site Sensitivity Context Map - Slice A



Order Details

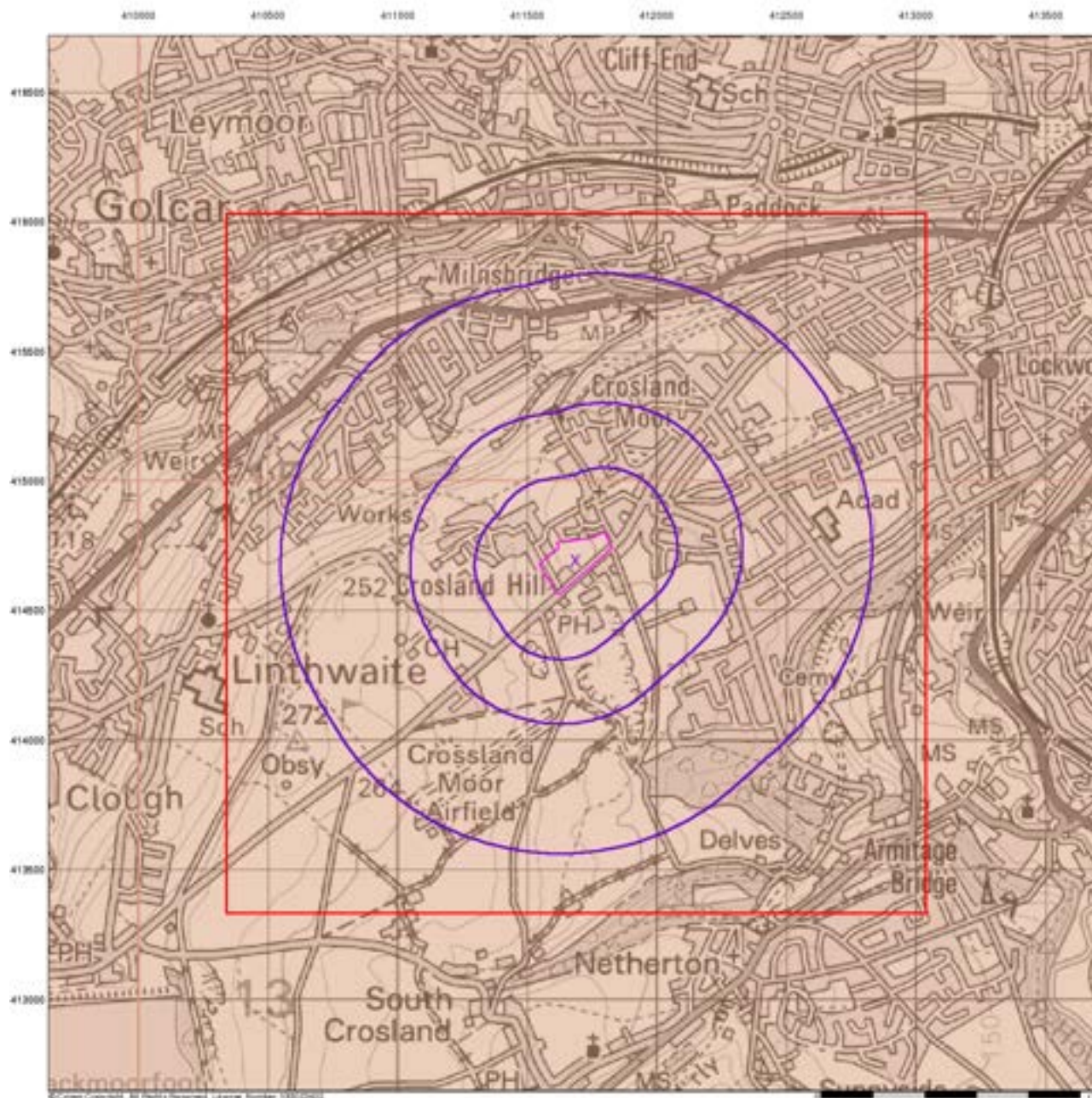
Order Number: 229943670_1_1
 Customer Ref: PO15529/JW/3649
 National Grid Reference: 411690, 414700
 Slice: A
 Site Area (Ha): 3.34
 Search Buffer (m): 1000

Site Details

Croxland Moor, HUDDERSFIELD, HD4 5NF



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



Bedrock Aquifer Designation

General

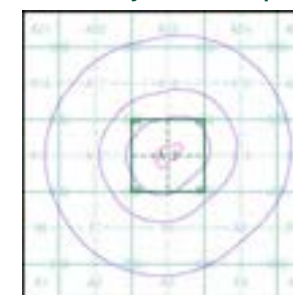
- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



Order Details

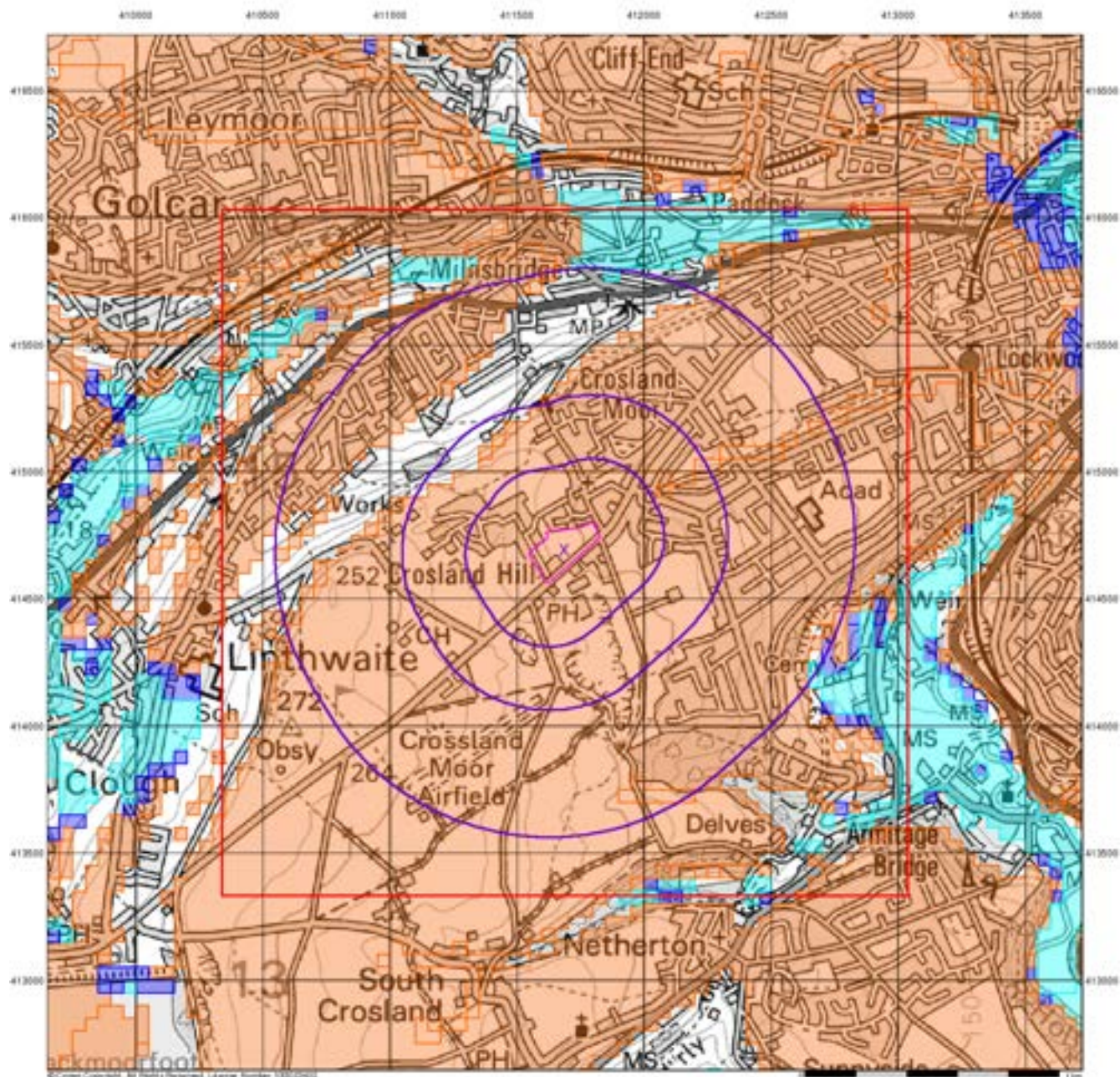
Order Number: 229943670_1_1
 Customer Ref: PO15529/JW/3649
 National Grid Reference: 411690, 414700
 Slice: A
 Site Area (Ha): 3.34
 Search Buffer (m): 1000

Site Details

Crosland Moor, HUDDERSFIELD, HD4 5NF



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



BGS Flood GFS Data

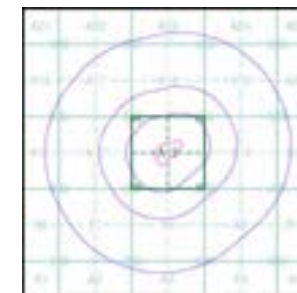
General

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

Agency and Hydrological (Flood)

- Limited Potential for Groundwater Flooding to Occur
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Potential for Groundwater Flooding to Occur at Surface

Site Sensitivity Context Map - Slice A



Order Details

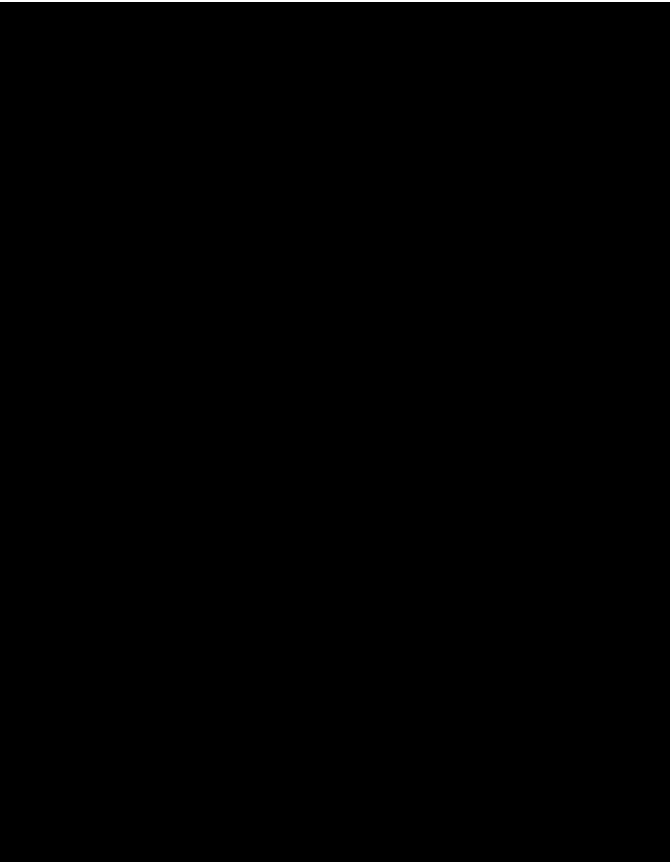
Order Number: 229943670_1_1
 Customer Ref: PO15529/JW/3649
 National Grid Reference: 411690, 414700
 Slice: A
 Site Area (Ha): 3.34
 Search Buffer (m): 1000

Site Details

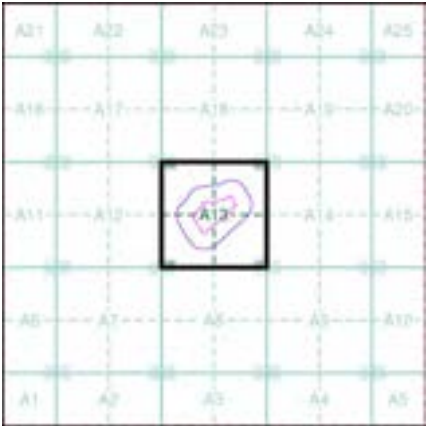
Croxland Moor, HUDDERSFIELD, HD4 5NF



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Site Sensitivity Map - Segment A13



Order Details

Order Number: 229943670_1_1
Customer Ref: PO15529/JW/3649
National Grid Reference: 411690, 414700
Slice: A
Site Area (Ha): 3.34
Plot Buffer (m): 100

Site Details

Crosland Moor, HUDDERSFIELD, HD4 5NF

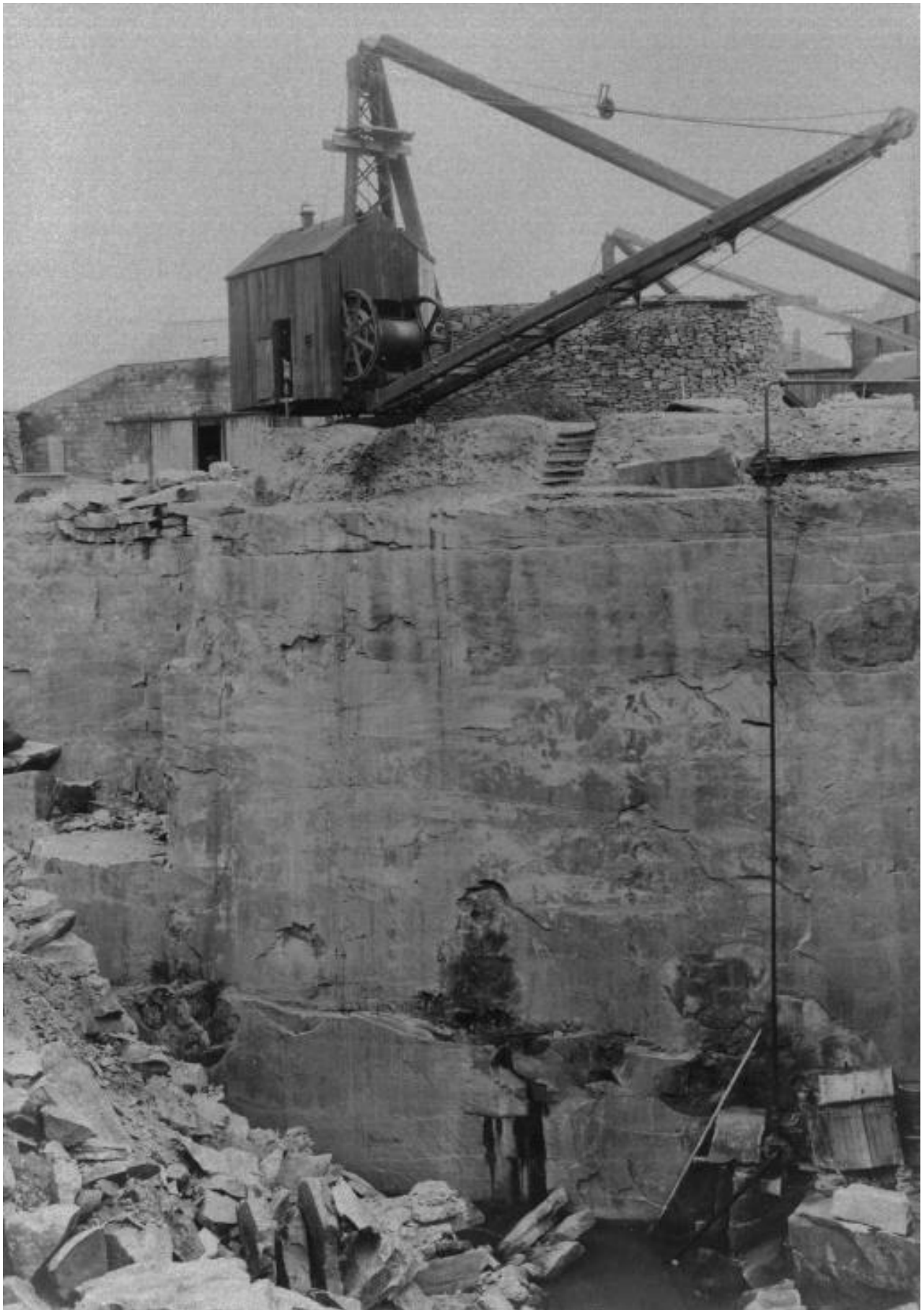


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SPINKWELL QUARRY C. 1926



SPINKWELL QUARRY C. 1926



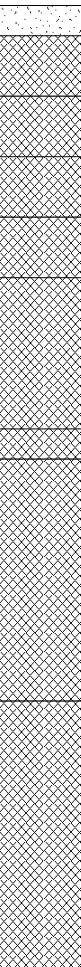
SPINKWELL QUARRY C. 1926



Appendix F

Trial Pit Logs

				Trial Pit Log				Trialpit No TP01 Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411752.62 - 414715.72 Level: 203.05		Date 21/02/2020	
Location: Brighouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 3.20		Logged JBA	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.05	T						
	0.20	J,K&T		0.10	202.95		Moderately weak dark grey MACADAM. 30% aggregate of subangular fine gravel. 30% tar matrix. 40% small irregular interconnected voids. (HARDSTAND) MADE GROUND: Grey sandy angular to subangular fine to coarse GRAVEL of limestone. (SUB-BASE) MADE GROUND: Orangish yellow slightly sandy GRAVEL with a low cobble content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles are of vitrified brick. (QUARRY INFILL) MADE GROUND: Dark grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies. (QUARRY INFILL) MADE GROUND: Yellowish orange gravelly SAND. Gravel is subangular to subrounded fine to coarse of sandstone. (QUARRY ARISINGS)	1
				0.30	202.75			
	0.60	J&T		0.50	202.55			
				0.70	202.35			
	1.00	J&T		0.90	202.15			
				1.40	201.65			
				1.50	201.55			
	1.70	T					MADE GROUND: Multicoloured sandy GRAVEL with low cobble content. Gravel is angular to subrounded fine to coarse of sandstone, brick, occasional timber, and rare pottery. Cobbles are of sandstone (c. 300mm diameter) and concrete (c. 200mm diameter). Rare fragments of rubber pipe. (QUARRY INFILL) MADE GROUND: Multicoloured sandy GRAVEL with medium cobble content and low boulder content. Gravel is subangular to subrounded fine to coarse of sandstone, macadam, brick, concrete, occasional glass and rare pottery. Cobbles are of sandstone, brick and concrete. Boulders are of sandstone and concrete. With rare fragments of metal wire. (QUARRY INFILL) 1.4m large boulder of concrete encountered in northern end of trial pit. MADE GROUND: Brown gravelly SAND with low cobble content and low boulder content. Gravel is subangular to subrounded fine to medium of mixed lithologies and occasional brick. Cobbles are of paving slabs, sandstone and brick. Boulders are of sandstone (c.400mm diameter). With rare fragments of metal, plastic and wire. (QUARRY INFILL)	2
				2.30	200.75			
				3.20	199.85		2.0m, 2 no. boulders excavated with dimensions of c. 1000mm x 300mm. MADE GROUND: Multicoloured sandy GRAVEL with medium cobble content. Gravel is angular to subangular fine to coarse of sandstone, brick and occasional pottery and concrete. Cobbles are of sandstone with occasional brick and concrete. Rare fragments of metal. (QUARRY INFILL)	3
						End of pit at 3.20 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.	
Stability: 1. The sides of the trial pit remained stable during excavation.	

				Trial Pit Log			Trialpit No TP02 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411733.64 - 414717.58 Level: 203.45		Date 21/02/2020	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.70		Logged JBA	

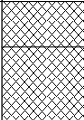
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.40	J&T		0.10	203.35	   	Moderately weak dark grey MACADAM. 30% aggregate of subangular to angular fine gravel. 40% tar matrix. 30% small irregular interconnected voids. (HARDSTAND) MADE GROUND: Grey slightly clayey sandy angular to subangular fine to coarse GRAVEL of sandstone and occasional brick and pottery. (SUB-BASE) MADE GROUND: Orangish yellow sandy subrounded fine to coarse GRAVEL of sandstone. (QUARRY ARISINGS) MADE GROUND: Multicoloured sandy angular to subangular fine to coarse GRAVEL of sandstone and occasional brick and pottery. (QUARRY INFILL)	1	
				0.30	203.15				
				0.50	202.95				
	1.20	J,K&T		1.10	202.35			From 0.5m Spalling and overbreak of trial pit walls during excavation. MADE GROUND: Dark brown slightly gravelly slightly clayey SAND with low cobble content. Sand is occasionally of ash. Gravel is rounded fine to medium of clinker, concrete, sandstone, limestone and rare glass. Cobbles are of sandstone and brick. Rare fragments of metal. (QUARRY INFILL)	2
				2.70	200.75		End of pit at 2.70 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation with some overbreak in the granular strata.		

				Trial Pit Log			Trialpit No TP03 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411737.92 - 414697.98 Level: 203.80		Date 21/02/2020	
Location: Brighouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.60		Logged JBA	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.45	J&T		0.10	203.70		Moderately weak dark grey MACADAM. 30% aggregate of angular fine gravel. 30% tar matrix. 40% small irregular interconnected voids. (HARDSTAND)	
			0.20	203.60	MADE GROUND: Grey sandy slightly clayey GRAVEL of angular to subangular fine to medium sandstone. (SUB-BASE)			
			0.40	203.40	MADE GROUND: Orangish yellow sandy subangular to subrounded fine to coarse GRAVEL of sandstone. (SUB-BASE)			
			0.50	203.30	MADE GROUND: Firm greyish green slightly sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and occasional brick and mortar. (QUARRY INFILL)			
	1.30	J&T			1.00		MADE GROUND: Brown sandy slightly gravelly CLAY with low cobble content and low boulder content. Gravel is angular to subrounded fine to coarse of mixed lithologies. Cobbles and boulders are subangular tabular of sandstone. (QUARRY ARISINGS)	1
					MADE GROUND: Multicoloured sandy GRAVEL with medium cobble content and low boulder content. Gravel is angular to subrounded fine to coarse of sandstone, brick and occasional pottery. Cobbles are of sandstone and brick. Boulders are of sandstone. Rare fragments of blue fabric. (QUARRY ARISINGS)			
					1.5m, 2 no. sandstone boulders excavated with diameters of c. 500mm. At 2.0m, 1 No. boulder excavated with a diameter of 500mm.			
				2.60	201.20		End of pit at 2.60 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.	
Stability: 1. The sides of the trial pit remained stable during excavation.	

				Trial Pit Log			Trialpit No TP04 Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411710.17 - 414669.73 Level: 204.65		Date 21/02/2020
Location: Brighthouse						Dimensions (m):		Scale 1:25
Client: Redrow Homes Yorkshire						Depth 2.50		Logged JBA
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	J,K&T		0.15	204.50		MADE GROUND: Grey sandy GRAVEL with low cobble content. Gravel is subangular fine to coarse of concrete, occasional glass and rare slag. (SUB-BASE) <i>Veneer of subrounded fine gravel of mixed lithologies at surface.</i>	1
			0.40	204.25	MADE GROUND: Yellowish orange subangular to subrounded fine to coarse GRAVEL of sandstone. (SUB-BASE)			
			0.60	204.05	MADE GROUND: Brown gravelly slightly sandy CLAY. Gravel is angular to subangular fine to coarse of sandstone, brick and occasional pottery and coal. Rare fragments of wire. (QUARRY INFILL)			
					MADE GROUND: Black sandy angular to subangular fine to coarse GRAVEL of brick, pottery, glass and clinker. Sand is of ash. With occasional fragments of metal wire, leather, rope and plastic and rare fragments of fabric and timber. (QUARRY INFILL) <i>From 0.6m Spalling and overbreak of trial pit walls during excavation.</i>			
							<i>From 1.9m, with many subangular sandstone boulders (c.400mm diameter).</i>	2
				2.50	202.15		End of pit at 2.50 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.								
Stability: 1. The sides of the trial pit were unstable during excavation with some overbreak in the granular strata.								



				Trial Pit Log			Trialpit No TP05 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411694.83 - 414682.55 Level: 205.75		Date 21/02/2020	
Location: Brighthouse				Dimensions (m): Depth 2.00				Scale 1:25	
Client: Redrow Homes Yorkshire								Logged JBA	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				1.10	204.65		MADE GROUND: Multicoloured sandy GRAVEL with low cobble content and low boulder content. Gravel is angular to subangular fine to coarse of sandstone, occasional brick, and rare macadam. Cobbles are angular tabular of sandstone and occasional brick. Boulders are subangular of sandstone. (QUARRY ARISINGS) <i>Veneer of subrounded fine gravel of mixed lithologies at surface. From 0.4m collapse of trial pit walls during excavation.</i> <i>1.0m, 1 No. boulder excavated with a diameter of c. 500mm.</i>	1
				2.00	203.75		MADE GROUND: Multicoloured sandy GRAVEL with high cobble content and medium boulder content. Gravel is angular to subrounded fine to coarse of sandstone. Cobbles and boulders are angular to subangular of sandstone. (QUARRY ARISINGS)	2
							End of pit at 2.00 m	3
								4
								5

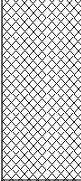
Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable during excavation.



				Trial Pit Log			Trialpit No TP06 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411721.41 - 414699.60 Level: 204.10		Date 21/02/2020	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 0.30		Logged JBA	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
				0.30	203.80		MADE GROUND: Grey slightly clayey sandy angular to subangular fine to coarse of sandstone. (QUARRY ARISINGS) <i>Veneer of subrounded fine gravel of mixed lithologies at surface. 0.15m Utility within grey plastic ducting struck. Excavation abandoned & backfilled on instruction of Lowdham site workers.</i> End of pit at 0.30 m		
							1		
							2		
							3		
							4		
							5		
Remarks:									
Stability:									

				Trial Pit Log			Trialpit No TP07 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411628.55 - 414723.41 Level: 209.55		Date 24/02/2020	
Location: Brighthouse				Dimensions (m): Depth 2.20				Scale 1:25 Logged JBA	
Client: Redrow Homes Yorkshire									

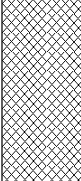
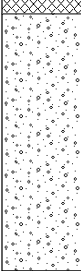
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.60	208.95		MADE GROUND: Brown sandy GRAVEL with low cobble content. Gravel is subrounded to subangular fine to coarse of sandstone and occasional brick. Cobbles are angular to subangular of sandstone with occasional brick. (SUB-BASE) <i>Veneer of subrounded fine gravel of mixed lithologies at surface.</i>	1
					MADE GROUND: Orangish brown gravelly SAND with low cobble and boulder content. Gravel is angular to subangular fine to coarse of sandstone, occasional brick and rare pottery and mortar. Cobbles are subangular of brick. Boulders are subangular of sandstone. (QUARRY ARISINGS) <i>From 1.0m overbreak and collapse of trial pit walls during excavation.</i>			
					<i>1.5m, 1 no. sandstone boulder was present with a diameter of c.1000mm.</i>			
					<i>1.7m, 1 no. cobble of brick and 1 no. boulder of sandstone were present with diameters of c.300mm and c.1000mm respectively.</i>			
					MADE GROUND: Orangish brown sandy slightly clayey GRAVEL with medium cobble content and low boulder content. Gravel is medium to coarse of sandstone. Cobbles and boulders are subangular of sandstone. (QUARRY ARISINGS)			
	2.00	J,K&T		2.00	207.55		MADE GROUND: Reddish black sandy subangular to subrounded fine to coarse GRAVEL of clinker and occasional brick. Sand is of ash. With occasional fragments of metal. (QUARRY INFILL) <i>End of pit at 2.20 m</i>	2
				2.20	207.35			

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. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable between during excavation with some collapse occurring.



				Trial Pit Log			Trialpit No TP08 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411616.89 - 414729.75 Level: 210.20		Date 24/02/2020	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.30		Logged JBA	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.05	J&T					MADE GROUND: Brown sandy GRAVEL with medium cobble content and occasional boulders. Gravel is of angular to subrounded fine to coarse sandstone, brick, macadam and concrete. Cobbles are subangular of sandstone and brick. Boulders are subangular of sandstone with c.500mm diameter. Occasional fragments of metal. (QUARRY INFILL) <i>Veneer of subrounded fine gravel of mixed lithologies at surface.</i>	1
	0.80	J,K&T		0.70	209.50			
	1.50	T		1.40	208.80		Orangish brown sandy subangular fine to coarse GRAVEL of sandstone. (GRANULAR RESIDUAL SOIL)	2
				2.25 2.30	207.95 207.90			
								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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable from 1m depth during excavation.		

				Trial Pit Log			Trialpit No TP09 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411613.11 - 414710.28 Level: 210.55		Date 24/02/2020	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.40		Logged JBA	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	J&T				[Pattern]	MADE GROUND: Grey sandy slightly clayey GRAVEL with low cobble and boulder content. Gravel is angular to subangular fine to coarse of sandstone, brick and occasional glass. Cobbles are angular to subangular of sandstone. Boulders are subangular to subrounded of concrete and sandstone with diameters of c.400mm. (QUARRY ARISINGS) <i>Veneer of subrounded fine gravel of mixed lithologies at surface.</i>	1
	0.50	D&B					<i>From 0.8m overbreak and spalling of trial pit walls during excavation.</i>	
	2.00	J&T		1.50	209.05		MADE GROUND: Grey slightly sandy slightly clayey GRAVEL with medium cobble content and low boulder content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles and boulders are of sandstone. Rare fragments of plastic. (QUARRY ARISINGS)	
				2.20	208.35	[Pattern]	MADE GROUND: Yellowish grey sandy slightly clayey GRAVEL with high cobble content and low boulder content. Gravel is angular fine to coarse of sandstone and rare macadam. Cobbles and boulders are subangular to angular of sandstone. (QUARRY ARISINGS)	3
				2.40	208.15		End of pit at 2.40 m	
								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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

				Trial Pit Log			Trialpit No TP10 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411619.52 - 414690.51 Level: 210.65		Date 24/02/2020	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.30		Logged JBA	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20	210.45		MADE GROUND: Grey sandy slightly clayey angular to subangular fine to coarse GRAVEL of sandstone with occasional brick. (SUB-BASE) <i>Veneer of subrounded fine gravel of mixed lithologies at surface.</i> MADE GROUND: Brown gravelly SAND with medium cobble content and low boulder content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles are angular tabular to subangular of sandstone and occasional brick and concrete. Boulders are subangular to subrounded of sandstone. (QUARRY ARISINGS) <i>0.8m, with many subangular tabular boulders of c.1000mm diameter.</i>	1
				1.20	209.45		MADE GROUND: Blackish brown slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone, brick and occasional pottery. Rare fragments of plastic. and rare plastic. (QUARRY INFILL)	
				1.80	208.85		MADE GROUND: Orangish brown sandy angular fine to coarse GRAVEL of sandstone and occasional brick. (QUARRY ARISINGS)	2
	2.00	D&B		2.00	208.65		MADE GROUND: COARSE SOIL: Light brown subangular COBBLES and subangular to subrounded BOULDERS of sandstone and occasional brick, concrete and limestone. With some finer material of sand and angular to subrounded fine to coarse gravel of sandstone and occasional brick, pottery, mortar, concrete and rare glass. (QUARRY ARISINGS)	
				2.30	208.35		End of pit at 2.30 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

				Trial Pit Log			Trialpit No TP11 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411596.01 - 414674.86 Level: 211.20		Date 24/02/2020	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.00		Logged JBA	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.10	J&T		0.20	211.00		MADE GROUND: Greyish orange sandy subangular to subrounded fine to coarse GRAVEL of sandstone. (SUB-BASE)		
	0.50	J&T					MADE GROUND: Greyish orange sandy GRAVEL with medium cobble content and low boulder content. Gravel is subangular to subrounded fine to coarse of sandstone and occasional brick, glass and slag. Cobbles are angular to subangular of sandstone, brick and slag. Boulders are angular tabular of sandstone. (QUARRY INFILL)		
	1.50	J&T					1.0m, 1 no. boulder excavated with a diameter of 1000mm x 600mm. 1.5m, large sandstone boulder encountered in eastern end of trial pit. 1.6m, 1 no. boulder excavated with a diameter of 1000mm x 400mm.		
				2.00	209.20		MADE GROUND: COARSE SOIL: Light brown angular to subrounded COBBLES with subangular boulders of predominantly sandstone and occasional well bonded brick and mortar, brick and concrete. With much clay, sand and subangular fine to coarse gravel of sandstone, brick, pottery and rare glass. Occasional fragments of wood, metal, wires and fabric. (QUARRY INFILL)		
				2.10	209.10		2.1m excavation difficult through coarse soils with much overbreak and collapse of trial pit walls. End of pit at 2.00 m		
1 2 3 4 5									
Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.									
Stability: 1. The sides of the trial pit were unstable during excavation.									



				Trial Pit Log			Trialpit No TP12 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411553.59 - 414675.60 Level: 212.90		Date 24/02/2020	
Location: Brighouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 1.60		Logged JBA	

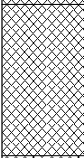
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	J&T		0.20	212.70	                         	MADE GROUND: Buff sandy subrounded to subangular fine to medium GRAVEL of limestone. (SUB-BASE) <i>Veneer of subrounded fine gravel of mixed lithologies at surface.</i> MADE GROUND: Black mottled grey sandy GRAVEL with high cobble content. Gravel is angular fine to coarse of sandstone, slate, brick and rare coal. Cobbles are subangular of brick, slag and sandstone. With rare fragments of rubber and metal (tin cans). Faint diesel smell and slight pearlescent sheen throughout. (QUARRY INFILL) <i>From 0.6m Spalling and overbreak of trial pit walls during excavation.</i>	1
				1.00	211.90		Orangish brown sandy GRAVEL with medium cobble content. Gravel is angular to subangular fine to coarse of sandstone. Cobbles are subangular of sandstone. (GRANULAR RESIDUAL SOIL)	2
				1.60 1.70	211.30 211.20		Strong buff sandstone. (ROUGH ROCK SANDSTONE) <i>Excavation refused on large sandstone boulder.</i> <i>End of pit at 1.60 m</i>	3

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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

				Trial Pit Log			Trialpit No TP13 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411572.21 - 414648.46 Level: 212.10		Date 24/02/2020	
Location: Brighouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.20		Logged JBA	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	J&T		0.20	211.90	[Pattern]	MADE GROUND: Grey sandy slightly clayey GRAVEL of subangular to subrounded fine to coarse limestone with rare glass and pottery. (SUB-BASE) <i>Veneer of subrounded fine gravel of mixed lithologies at surface.</i>
	0.30	J&T					
				0.60	211.50	[Pattern]	MADE GROUND: Greyish brown sandy slightly clayey GRAVEL with medium cobble content. Gravel is angular to subangular fine to coarse of mixed lithologies including brick, sandstone and rare pottery. Cobbles are of brick and sandstone. (QUARRY ARISINGS)
	0.80	J&T					
				2.20	209.90	[Pattern]	MADE GROUND: Orangish brown sandy GRAVEL with medium cobble content and low boulder content. Gravel is subangular to subrounded fine to coarse of sandstone with rare plastic and brick. Cobbles and boulders are of sandstone. Boulders are c.400mm diameter. (QUARRY ARISINGS) <i>From 1.0m spalling and overbreak of trial pit walls during excavation.</i>

				Trial Pit Log			Trialpit No TP14 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411594.72 - 414640.49 Level: 211.50		Date 24/02/2020	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.00		Logged JBA	

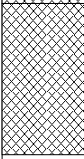
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.05	J&T		0.10	211.40		MADE GROUND: Buff sandy subangular to subrounded fine to medium GRAVEL of limestone. (SUB-BASE) <i>Veneer of subrounded fine gravel of mixed lithologies at surface.</i>		
	0.30	J&T						MADE GROUND: Dark brownish grey gravelly SAND with medium cobble content. Gravel is angular to subangular fine to coarse of sandstone, brick, slag, and clinker. Cobbles are subangular to angular tabular of brick and sandstone. (QUARRY INFILL)	
	0.40	D&B							
				0.80	210.70		MADE GROUND: Orangish brown slightly sandy GRAVEL with medium cobble content and low boulder content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles and boulders are subangular of sandstone with largest being c.350mm in diameter. (QUARRY ARISINGS)	1	
	1.00	J&T		1.30	210.20			<i>From 1.0m spalling of trial pit walls during excavation.</i> MADE GROUND: Brown sandy GRAVEL with high cobble content and low boulder content. Gravel is subangular to subrounded fine to coarse of sandstone. Cobbles and boulders are angular to subrounded of sandstone and rare brick and concrete with the largest being c.350mm in diameter. (QUARRY ARISINGS)	
	1.70	D&B		2.00	209.50		End of pit at 2.00 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

				Trial Pit Log			Trialpit No TP15 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: 411613.45 - 414660.58 Level: 210.75		Date 24/02/2020	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.20		Logged JBA	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
				0.30	210.45	[Pattern]	MADE GROUND: Buff sandy subrounded to subangular fine to coarse GRAVEL of limestone. (SUB-BASE) <i>Veneer of subrounded fine gravel of mixed lithologies at surface.</i>		
	0.40 0.50	J&T D&B					MADE GROUND: Dark blackish brown sandy GRAVEL with low cobble and boulder content. Gravel is subangular to subrounded fine to coarse of sandstone, brick, clinker and rare glass. Cobbles are of subangular to subrounded brick and clinker. Boulders are subangular of sandstone with the largest being c.1000mm diameter. Rare fragments of plastic bag. (QUARRY INFILL)		
	1.40	T		1.20 1.40	209.55 209.35	[Pattern]	MADE GROUND: COARSE SOIL: Light brown subangular COBBLES and subangular BOULDERS of predominantly sandstone and occasional brick, mortar, concrete and limestone. With some fines of sand and subangular fine to coarse GRAVEL of sandstone and brick. (QUARRY ARISINGS) <i>From 1.2m overbreak and collapse of trial pit walls during excavation.</i>		
	1.80	J&T		2.20	208.55		MADE GROUND: Dark blackish brown sandy GRAVEL with low cobble and boulder content. Sand is predominantly of ash. Gravel is angular to subrounded fine to coarse of clinker, slag and occasional pottery, sandstone, brick and rare fragments of cement sheeting (possible ACM). Cobbles are subrounded of slag, clinker and occasional brick, sandstone and pottery. Some fragments of plastic, wire, metal and leather. A single boulder of consolidated ash, sawdust and fibrous material with diameter of c. 400mm. (QUARRY INFILL) <i>End of pit at 2.20 m</i>		
1 2 3 4 5 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. Exploratory hole surveyed in (level and co-ordinates) on completion.									
Stability: 1. The sides of the trial pit were unstable during excavation.									



				Trial Pit Log			Trialpit No TP101 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 25/01/2021	
Location: Brighouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 0.90		Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.05	T		0.10			Medium strong black MACADAM. 70% aggregate of subangular fine gravel. 15% tar matrix. 15% small irregular interconnected voids. (HARDSTAND)
	0.20	J&T					
	0.60	J&T					
				0.90			MADE GROUND: Buff sandy slightly clayey subangular fine to coarse GRAVEL of sandstone and limestone. Medium subangular cobble content of brick and sandstone. Rare subangular small boulder of well bonded brick and mortar. (SUB-BASE) MADE GROUND: Grey and brown clayey slightly sandy subangular to angular GRAVEL of brick, sandstone and occasional concrete and clinker. Medium subangular cobble content and medium subangular small boulder content of brick and sandstone. (QUARRY ARISINGS) <i>0.9m Refusal on sandstone obstruction. Possible bedrock or possible large boulder.</i> 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. Exploratory hole surveyed in (level and co-ordinates) on completion.
Stability:	1. The sides of the trial pit remained stable during excavation.

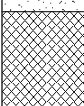
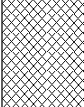


				Trial Pit Log			Trialpit No TP102 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 25/01/2021	
Location: Brighthouse				Dimensions (m):				Scale 1:25	
Client: Redrow Homes Yorkshire				Depth 1.60				Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.08			Medium strong black MACADAM. 65% aggregate of subangular fine gravel. 20% tar matrix. 15% small irregular isolated voids. (HARDSTAND)	
	0.40	J&T		0.30			MADE GROUND: Buff sandy slightly clayey subangular fine to coarse GRAVEL of sandstone and sandstone. Low subangular cobble content of brick and sandstone. (SUB-BASE)	
	0.80	J&T		0.60			MADE GROUND: Brownish grey sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone and occasional brick, pottery and concrete. Medium subangular cobble content of sandstone and brick. (QUARRY INFILL)	1
	0.90	D&B		1.60			MADE GROUND: COARSE SOIL: Brown subangular COBBLES with some subangular tabular small boulders of sandstone and occasional brick and well bonded brick and mortar. With much finer material of slightly clayey sand and subangular to very angular fine to coarse gravel of sandstone and occasional pottery and concrete. (QUARRY ARISINGS) <i>From 0.8, with high subangular large sandstone boulder content and overbreak of trial pit walls.</i> <i>1.6m Refusal on frequent small to large sandstone boulders in base of trial pit.</i> End of pit at 1.60 m	2
								3
								4
								5

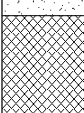
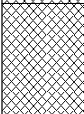
Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

				Trial Pit Log			Trialpit No TP103 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 25/01/2021	
Location: Brighthouse				Dimensions (m): Depth 1.90				Scale 1:25 Logged GLM	
Client: Redrow Homes Yorkshire									

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.05	T		0.08			Medium strong black MACADAM. 7% aggregate of subangular fine gravel. 10% tar matrix. 15% small irregular isolated voids. (HARDSTAND)	1
	0.30	J&T		0.40			MADE GROUND: Buff sandy slightly clayey subangular to subrounded fine to medium GRAVEL of sandstone and limestone. Low subangular cobble content of sandstone. (SUB-BASE)	
	0.70	J&T					MADE GROUND: Brown clayey sandy angular to subangular GRAVEL of sandstone and occasional brick, concrete, limestone and macadam. High angular tabular cobble content of sandstone and occasional brick and concrete. Medium subangular small boulder content of sandstone and occasional well bonded brick and mortar. Rare cobble sized fragments of wood. (QUARRY ARISINGS) <i>From 0.8 with high subangular sandstone boulder content and overbreak of trial pit walls.</i>	
				1.90			<i>1.9m Refusal on sandstone boulders.</i> End of pit at 1.90 m	2
								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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

				Trial Pit Log			Trialpit No TP104 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 25/01/2021	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 1.80		Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.07			Medium strong black MACADAM. 70% aggregate of subangular fine gravel. 20% tar matrix. 10% small irregular isolated voids. (HARDSTAND)	
				0.40			MADE GROUND: Buff sandy subangular to subrounded fine to medium GRAVEL of sandstone. (SUB-BASE)	
	0.60	J&T					MADE GROUND: Brownish grey clayey slightly sandy subangular to angular fine to coarse GRAVEL of sandstone, occasional concrete, brick, limestone and rare clinker. High subangular cobble content of sandstone, brick and concrete. Low angular tabular small sandstone boulder content. (QUARRY ARISINGS)	
	0.80	D&B						
							<i>From 1.3m medium subangular small and large sandstone boulder content and overbreak of trial pit walls.</i>	
				1.80			<i>1.8m Refusal on large sandstone boulder.</i> End of pit at 1.80 m	

Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

				Trial Pit Log			Trialpit No TP106 Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 26/01/2021
Location: Brighthouse				Dimensions (m): Depth 2.80				Scale 1:25 Logged GLM
Client: Redrow Homes Yorkshire								

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.05	T		0.10			Moderately weak black MACADAM. 60% aggregate of subangular fine gravel. 25% tar matrix. 15% small irregular interconnected voids. (HARDSTAND)	
	0.50	J&T		0.30			MADE GROUND: Buff sandy subangular fine to coarse GRAVEL of sandstone. Medium subangular cobble content of sandstone and brick at base. (SUB-BASE)	
	1.00	J&T		0.90			MADE GROUND: Brown and dark brown sandy angular to subangular fine to coarse GRAVEL of sandstone and occasional brick, macadam, pottery and concrete. Medium subangular sandstone and brick cobble content. Rare cobble sized fragments of wood. (QUARRY INFILL)	1
	1.50	D&B		2.80			MADE GROUND: Light brown slightly clayey slightly sandy subangular medium to coarse GRAVEL of sandstone. High subangular sandstone cobble content. Low subangular small sandstone boulder content. (QUARRY ARISINGS) <i>From .2m overbreak of trial pit walls.</i>	2
							End of pit at 2.80 m	3
								4
								5

Remarks: Stability:	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. Exploratory hole surveyed in (level and co-ordinates) on completion. 1. The sides of the trial pit were unstable during excavation.	

				Trial Pit Log			Trialpit No TP107 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 26/01/2021	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.40		Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.09			Moderately weak black MACADAM. 75% aggregate of angular to subangular fine gravel. 15% tar matrix. 10% small irregular isolated voids. (HARDSTAND) MADE GROUND: Buff sandy subangular fine to coarse GRAVEL of sandstone. Medium subangular brick cobble content. (SUB-BASE) MADE GROUND: Brown sandy angular fine to coarse GRAVEL of sandstone, occasional brick and concrete and rare clinker and pottery. High subangular brick and sandstone cobble content. Low angular tabular small boulder content of sandstone and well bonded brick and mortar. (QUARRY ARISINGS)	1
	0.30	D&B		0.40				2
	0.70	J&T		2.40				3
							End of pit at 2.40 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit remained stable during excavation.		

				Trial Pit Log			Trialpit No TP108 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 26/01/2021	
Location: Brighthouse				Dimensions (m):				Scale 1:25	
Client: Redrow Homes Yorkshire				Depth 2.50				Logged GLM	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.02	T		0.05			Moderately weak dark grey MACADAM. 60% aggregate of subangular fine gravel. 35% tar matrix. 5% small irregular isolated voids. (HARDSTAND)		
	0.20	J&T		0.40			MADE GROUND: Buff sandy subangular fine to coarse GRAVEL of sandstone and brick. Medium subangular brick and sandstone cobble content. (SUB-BASE)		
	0.60	J&T		1.50			MADE GROUND: Grey clayey slightly sandy angular to subangular fine to coarse GRAVEL of sandstone, brick, concrete and occasional pottery. Medium subangular cobble content of sandstone, brick and concrete. (QUARRY INFILL) <i>0.5m Concrete obstruction (likely large boulder) in northeastern end of trial pit.</i> <i>From 0.9m with frequently fragments of wood and metal rebar.</i> <i>From 1.1m overbreak and little spalling of trial pit walls.</i>		
				2.50			MADE GROUND: Light brown sandy slightly clayey angular to subangular fine to coarse GRAVEL of sandstone. Medium subangular sandstone cobble content. Low subangular tabular small sandstone boulder content. (QUARRY ARISINGS) <i>From 2.0m excavation through ground is difficult.</i>		
							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. Exploratory hole surveyed in (level and co-ordinates) on completion.									
Stability: 1. The sides of the trial pit were unstable during excavation.									



				Trial Pit Log			Trialpit No TP109 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 26/01/2021	
Location: Brighouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.80		Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	D&B		0.05		 Moderately weak black MACADAM. 70% aggregate of angular to subangular fine gravel. 20% tar matrix. 10% irregular small isolated voids. (HARDSTAND)  MADE GROUND: Buff sandy subangular fine to coarse GRAVEL of sandstone. Medium subangular sandstone cobble content. (SUB-BASE)  MADE GROUND: COARSE SOIL: Brown subangular COBBLES of sandstone and brick with many angular to subangular small and large boulders of sandstone and occasional well bonded brick and mortar. With much finer material of sandy subangular fine to coarse gravel of sandstone and occasional brick, slate, concrete and clinker. With rare fragments of wood and metal. Sand is predominantly ash. (QUARRY INFILL) <i>From 0.m overbreak and spalling of trial pit walls.</i>		
	0.80	J&T		0.50				1
				2.80			End of pit at 2.80 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

				Trial Pit Log			Trialpit No TP110 Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 26/01/2021
Location: Brighthouse				Dimensions (m):		Scale 1:25		
Client: Redrow Homes Yorkshire				Depth 3.00		Logged GLM		

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.05			MADE GROUND: Multicoloured subrounded fine GRAVEL of mixed lithologies. Becoming clayey with depth. (HARDSTAND)	
	0.50	J&T		0.30			MADE GROUND: Brown sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone. (SUB-BASE)	
				0.55			MADE GROUND: Dark grey gravelly sandy SILT. Gravel is subangular to subrounded fine to medium of sandstone. (RELICT TOPSOIL)	
				0.80			MADE GROUND: Grey and brown clayey/silty sandy angular to subangular fine to coarse GRAVEL of sandstone and occasional concrete. (QUARRY ARISINGS)	
							MADE GROUND: Light brown sandy angular to subangular fine to coarse GRAVEL of sandstone. High angular tabular sandstone cobble content. Low subangular small sandstone boulder content. (QUARRY ARISINGS)	
							From 1.3m overbreak and spalling of trial pit walls.	
							From 2.0m excavation through ground is difficult.	
				3.00			End of pit at 3.00 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. Exploratory hole surveyed in (level and co-ordinates) on completion.	
Stability:	1. The sides of the trial pit were unstable during excavation.	

				Trial Pit Log			Trialpit No TP111 Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021
Location: Brighthouse						Dimensions (m): Depth 2.60		Scale 1:25 Logged GLM
Client: Redrow Homes Yorkshire								

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.40	J&T					MADE GROUND: Brownish grey clayey sandy angular to subangular fine to coarse GRAVEL of sandstone, brick and occasional slate, concrete, mortar and pottery. High subangular cobble content of brick and sandstone. (QUARRY INFILL)	1
	0.60	D&B						
	1.50	J&T		1.30			MADE GOUND: Light brown sandy angular fine to coarse GRAVEL of sandstone. Medium angular tabular sandstone cobble and subangular small boulder content (QUARRY ARISINGS) <i>From 1.5m spalling and overbreak of trial pit walls.</i>	2
				2.60				End of pit at 2.60 m
								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. Exploratory hole surveyed in (level and co-ordinates) on completion.

Stability: 1. The sides of the trial pit were unstable during excavation.

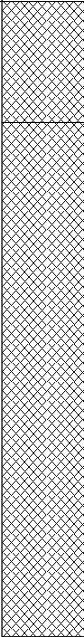


				Trial Pit Log			Trialpit No TP112 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021	
Location: Brighthouse				Dimensions (m):				Scale 1:25	
Client: Redrow Homes Yorkshire				Depth 2.00				Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	J&T		0.05			MADE GROUND: Multicoloured slightly silty subrounded fine GRAVEL of mixed lithologies. (HARDSTAND)	1
				0.40			MADE GROUND: Grey slightly clayey subangular fine to medium GRAVEL of limestone. Medium subangular brick cobble content at base. (SUB-BASE)	
	0.60	J&T					MADE GROUND: Brown and grey very gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone, siltstone, brick, concrete, mortar and occasional slate and clinker. High subangular brick cobble content. Occasional gravel to cobble sized fragments of plastic, wood and metal. (QUARRY INFILL)	
							From 1.5m with low subangular small sandstone and concrete boulder content.	
				2.00			2.0m Refusal on large concrete boulder. End of pit at 2.00 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit remained stable during excavation.		

				Trial Pit Log			Trialpit No TP113 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021	
Location: Brighthouse						Dimensions (m): Depth		Scale 1:25	
Client: Redrow Homes Yorkshire								Logged GLM	

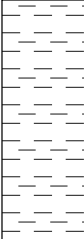
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.50	J&T		0.40			MADE GROUND: Grey and buff sandy slightly silty subangular fine to coarse GRAVEL of predominantly limestone and occasional brick, concrete and mixed lithologies. Low subangular brick and sandstone cobble content at base. (SUB-BASE)
	0.60	D&B					MADE GROUND: Brown very clayey slightly sandy subangular to angular fine to coarse GRAVEL of sandstone, brick and concrete. Medium subangular brick and sandstone cobble content. Low subangular small sandstone boulder content. (QUARRY ARISINGS)
				2.10			2.1m Refusal on sandstone boulders. 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. Exploratory hole surveyed in (level and co-ordinates) on completion.

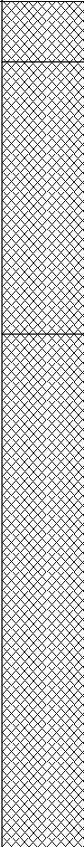
Stability: 1. The sides of the trial pit remained stable during excavation.



				Trial Pit Log			Trialpit No TP114 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021	
Location: Brighthouse				Dimensions (m):				Scale 1:25	
Client: Redrow Homes Yorkshire				Depth 3.10				Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	J&T		0.05			MADE GROUND: Multicoloured subrounded fine GRAVEL of mixed lithologies. (HARDSTAND)	
	0.50	J&T		0.15				
	2.50	D	HVP=46 HVP=60	2.30			Firm light brown CLAY. (COHESIVE RESIDUAL SOIL)	
				3.10				

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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit remained stable during excavation.		

				Trial Pit Log			Trialpit No TP115 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021	
Location: Brighouse						Dimensions (m): Depth 2.80		Scale 1:25	
Client: Redrow Homes Yorkshire								Logged GLM	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
	0.40	J&T		0.20			MADE GROUND: Buff sandy subangular fine to medium GRAVEL of sandstone. (SUB-BASE)		
				1.10			MADE GROUND: Brownish grey sandy slightly clayey angular to subangular fine to coarse GRAVEL of sandstone and occasional brick, pottery, slate and clinker. Medium subangular brick and sandstone cobble content. Low subangular tabular sandstone boulder content. Occasional fragments of metal rebar and plastic. (QUARRY INFILL)		
	1.40	J&T		2.80			MADE GROUND: Dark grey very clayey/silty slightly sandy subangular medium to coarse GRAVEL of sandstone, pottery, brick, concrete and clinker. Low subangular brick cobble content. (QUARRY INFILL)		
							End of pit at 2.80 m		
1 2 3 4 5									
Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.									
Stability: 1. The sides of the trial pit remained stable during excavation.									



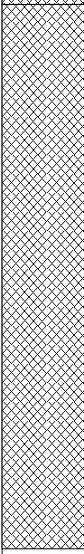
				Trial Pit Log			Trialpit No TP116 Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021
Location: Brighthouse						Dimensions (m):		Scale 1:25
Client: Redrow Homes Yorkshire						Depth 1.50		Logged GLM

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.05			MADE GROUND: Multicoloured subrounded fine GRAVEL of mixed lithologies. (HARDSTAND)
	0.40	J&T		0.25			MADE GROUND: Grey and buff sandy subangular fine to medium GRAVEL of limestone and sandstone. (SUB-BASE)
	0.60	D		0.50			MADE GROUND: Dark grey sandy slightly clayey GRAVEL of brick and sandstone. Medium subangular cobble content of brick and concrete. Some fragments of plastic and metal. (QUARRY INFILL)
	1.20	D		1.00			Orangish brown very sandy subangular medium to coarse GRAVEL of sandstone. Low subangular sandstone cobble content. (GRANULAR RESIDUAL SOIL)
				1.50			Medium strong brownish grey fine grained SANDSTONE. Recovered as sandy angular tabular medium gravel. (ROUGH ROCK SANDSTONE)
							1.5m Unable to excavate further into bedrock. End of pit at 1.50 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. Exploratory hole surveyed in (level and co-ordinates) on completion.
Stability:	1. The sides of the trial pit remained stable during excavation.



				Trial Pit Log			Trialpit No TP117 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 3.00		Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	J&T		0.30			MADE GROUND: Buff sandy slightly silty fine to medium GRAVEL of limestone and sandstone. (SUB-BASE)	1
	0.50	J&T					MADE GROUND: Brownish grey slightly sandy slightly clayey angular to subangular fine to coarse GRAVEL of brick, sandstone and occasional limestone and concrete. Medium subangular cobble content of brick and sandstone. (QUARRY INFILL)	
	0.80	D&B					From 1.0m spalling of trial pit walls.	
	1.50	D&B		1.20			MADE GROUND: Light yellowish brown sandy subangular tabular fine to coarse GRAVEL of sandstone and rare pottery. Low subangular tabular sandstone cobble content. (QUARRY ARISINGS)	2
				3.00			End of pit at 3.00 m	3
								4
								5

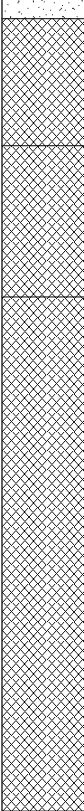
Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

				Trial Pit Log			Trialpit No TP118 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.40		Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30			MADE GROUND: Buff sandy subangular fine to coarse GRAVEL of limestone and sandstone. (SUB-BASE)	
	0.70	J&T					MADE GROUND: Greyish brown sandy angular to subrounded fine to coarse GRAVEL of brick, clinker and sandstone. Sand is predominantly of ash High subangular brick and sandstone cobble content. Low subangular small sandstone boulder content. (QUARRY INFILL)	1
				1.10			MADE GROUND: Light brown very sandy slightly clayey subangular fine to coarse GRAVEL of sandstone. Medium angular sandstone cobble content. (QUARRY ARISINGS) <i>From 1.2m Overbreak and spalling of trial pit walls.</i>	
	1.90	J&T		1.60			MADE GROUND: COARSE SOIL: Brown angular COBBLES of sandstone with many angular to subangular small sandstone boulders. With much finer material of sand and angular fine to coarse gravel of sandstone. (QUARRY ARISINGS)	2
				2.40			End of pit at 2.40 m	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. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit were unstable during excavation.		

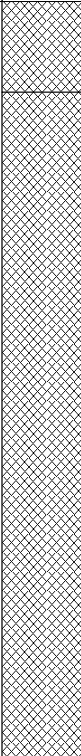
				Trial Pit Log			Trialpit No TP119 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021	
Location: Brighthouse						Dimensions (m):		Scale 1:25	
Client: Redrow Homes Yorkshire						Depth 2.70		Logged GLM	

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.05	T		0.08			Moderately weak dark grey MACADAM. 80% aggregate of subangular fine gravel. 20% tar matrix. Rare small isolated voids. (HARDSTAND)	1 5
	0.40	J&T		0.50			MADE GROUND: Buffish brown sandy slightly clayey subangular fine to medium GRAVEL of sandstone and occasional brick and limestone. (SUB-BASE)	
	0.70	J&T		1.00			MADE GROUND: Dark grey ash SAND and subangular to subrounded fine to coarse GRAVEL of clinker, sandstone, brick, pottery and glass. Occasional fragments of glass amend metal. (ASH & CLINKER) <i>From 0.7m overbreak and spalling of trial pit walls.</i>	
	1.20	J&T					MADE GROUND: Brown clayey sandy subangular fine to coarse GRAVEL of pottery, sandstone, concrete, brick and clinker. Low subangular cobble content of pottery, brick and well bonded brick and mortar. Some fragments of plastic, metal and wood.	
	1.40	D&B					(QUARRY INFILL) <i>From 1.4m high subangular brick cobble content.</i>	
				2.70			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. Exploratory hole surveyed in (level and co-ordinates) on completion.	
Stability:		1. The sides of the trial pit were unstable during excavation.	



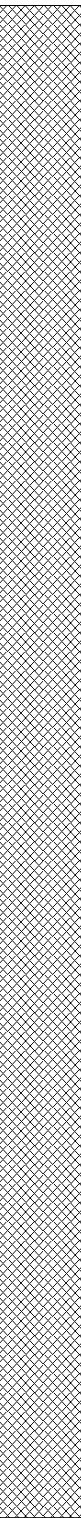
				Trial Pit Log			Trialpit No TP120 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: - Level:		Date 27/01/2021	
Location: Brighthouse				Dimensions (m): Depth 2.50				Scale 1:25 Logged GLM	
Client: Redrow Homes Yorkshire									

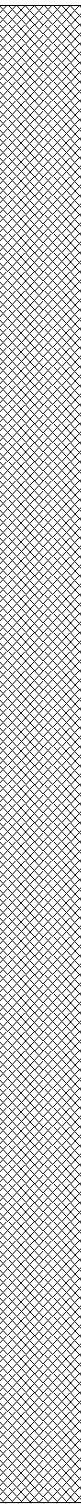
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
▼				0.30			MADE GROUND: Buff grey sandy slightly silty angular to subangular fine to coarse GRAVEL of sandstone and limestone. (SUB-BASE)
							MADE GROUND: Dark greyish brown sandy slightly clayey angular to subrounded fine to coarse GRAVEL of sandstone, brick and occasional pottery, clinker, mortar and concrete. High subangular brick and sandstone cobble content. (QUARRY INFILL) <i>0.35m Slight inflow of groundwater from northeastern trial pit wall.</i> <i>0.5m 0.8m diameter sandstone boulder excavated.</i>
							<i>From 1.4m with medium subangular sandstone and concrete boulder concrete. Difficult to excavate.</i>
				2.50			<i>2.5m Refusal on well bonded brick and mortar and concrete boulders.</i> End of pit at 2.50 m

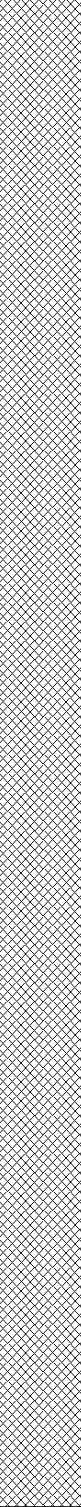
Remarks: 1. Prior to excavation a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater ingress at 0.35m during excavation. 3. Backfilled with materials arising upon completion. 4. Exploratory hole surveyed in (level and co-ordinates) on completion.		
Stability: 1. The sides of the trial pit remained stable during excavation.		

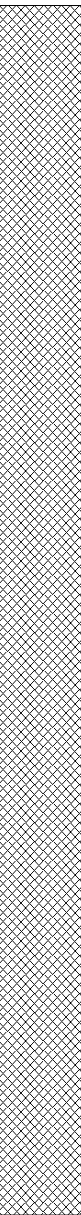
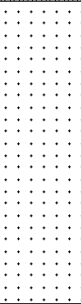
Appendix G

Probehole & 'stitch' Logs

					Borehole Log			Borehole No. PH01 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411700.66 - 414661.44		Hole Type PH
Location: Brighthouse					Level: 205.40		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
								2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	
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. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH01 Sheet 2 of 3			
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411700.66 - 414661.44		Hole Type PH		
Location: Brighthouse					Level: 205.40		Scale 1:50				
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
								) From 10.0m to rockhead with large sandstone boulders (up to 1.0m) with voids between boulders.			
						19.90		185.50		Continued on next sheet	20
	Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.										

					Borehole Log			Borehole No. PH02 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411689.08 - 414683.01		Hole Type PH
Location: Brighthouse					Level: 206.15		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH02 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411689.08 - 414683.01		Hole Type PH
Location: Brighthouse					Level: 206.15		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
						18.00	188.15		
									12
									13
									14
									15
									16
									17
									18
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	19
									20
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. Very poor flush returns throughout drilling.									



PH02

Sheet 3 of 3

Project Name: Crosland Hill Road

Project No.
3649

Co-ords: 411689.08 - 414683.01

Hole Type
PH

Location: Brighthouse

Level: 206.15

Scale
1:50

Client: Redrow Homes Yorkshire

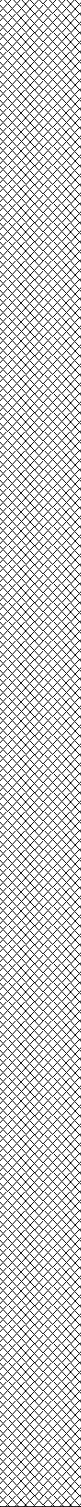
Dates: 21/02/2020 - 21/02/2020

Logged By
GLM

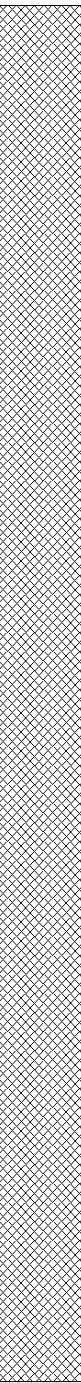
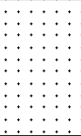
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					24.00	182.15			21
									22
									23
									24
									25
									26
									27
									28
									29
									30

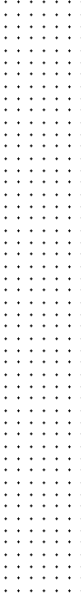
Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.

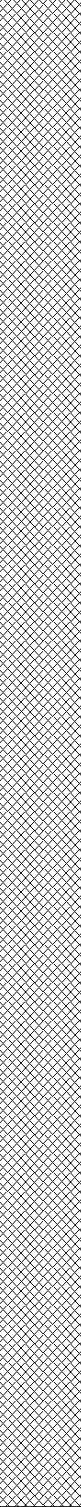


					Borehole Log			Borehole No. PH03 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling. 4. Unable to retrieve co-ordinates on completion due to ongoing site operations.									

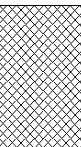
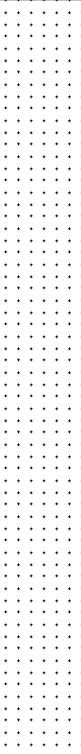


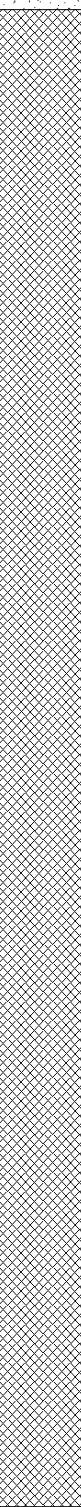
					Borehole Log			Borehole No. PH03 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									11
						19.10			
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	20
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. Very poor flush returns throughout drilling. 4. Unable to retrieve co-ordinates on completion due to ongoing site operations.									

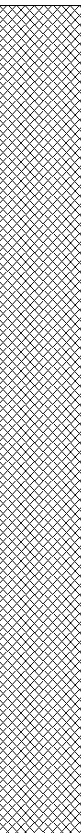
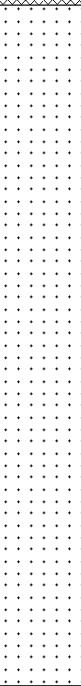
				Borehole Log				Borehole No. PH03 Sheet 3 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 21/02/2020 - 21/02/2020		Logged By GLM			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					24.00			End of borehole at 24.00 m	21 22 23 24 25 26 27 28 29 30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling. 4. Unable to retrieve co-ordinates on completion due to ongoing site operations.									

					Borehole Log			Borehole No. PH04 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411722.76 - 414698.19		Hole Type PH
Location: Brighthouse					Level: 204.10		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH04 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411722.76 - 414698.19		Hole Type PH
Location: Brighthouse					Level: 204.10		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									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 was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH04 Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411722.76 - 414698.19		Hole Type PH
Location: Brighthouse					Level: 204.10		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00	183.10		Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	21
									22
									23
									24
									25
					26.00	178.10		End of borehole at 26.00 m	26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH05 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411735.94 - 414722.29		Hole Type PH
Location: Brighthouse					Level: 203.25		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10	203.15		Dark grey MACADAM. (MACADAM HARDSTAND) MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH05 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411735.94 - 414722.29		Hole Type PH
Location: Brighthouse					Level: 203.25		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									11
						15.50	187.75		
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	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 was not apparent during drilling. 3. Very poor flush returns throughout drilling.									



Borehole No.

PH05

Sheet 3 of 3

Project Name: Crosland Hill Road

Project No.
3649

Co-ords: 411735.94 - 414722.29

Hole Type
PH

Location: Brighthouse

Level: 203.25

Scale
1:50

Client: Redrow Homes Yorkshire

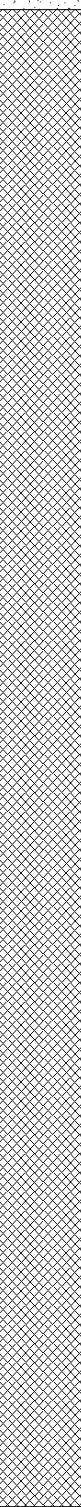
Dates: 21/02/2020 - 21/02/2020

Logged By
GLM

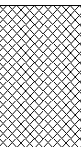
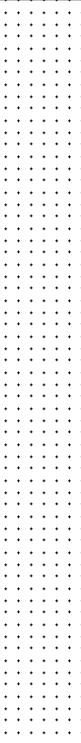
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00	182.25		End of borehole at 21.00 m	21
							22		
							23		
							24		
							25		
							26		
							27		
							28		
							29		
							30		

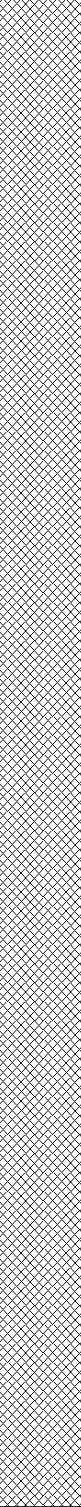
Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.

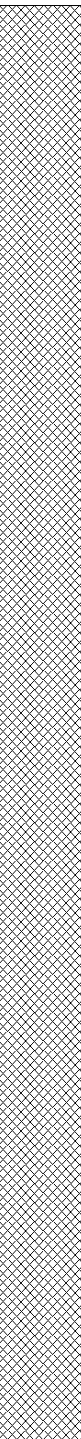


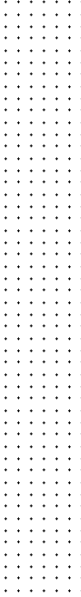
					Borehole Log			Borehole No. PH06 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411754.33 - 414712.48		Hole Type PH
Location: Brighthouse					Level: 202.95		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10	202.85		Dark grey MACADAM. (MACADAM HARDSTAND) MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling.									

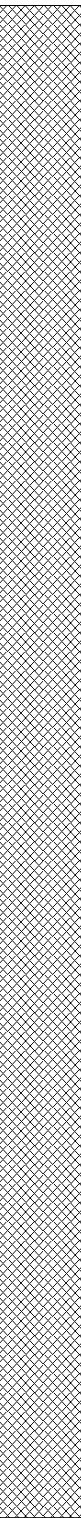
					Borehole Log			Borehole No. PH06 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411754.33 - 414712.48		Hole Type PH
Location: Brighthouse					Level: 202.95		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									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 was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

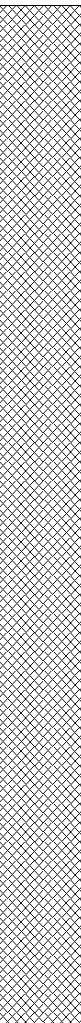
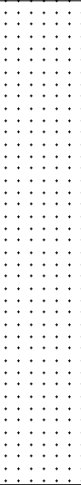
					Borehole Log			Borehole No. PH06 Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411754.33 - 414712.48		Hole Type PH
Location: Brighthouse					Level: 202.95		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00	181.95		Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	21
									22
									23
									24
									25
					26.00	176.95		End of borehole at 26.00 m	26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH07 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By GLM
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling. 4. Unable to retrieve co-ordinates on completion due to ongoing site operations.									

					Borehole Log			Borehole No. PH07 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					19.50				11 12 13 14 15 16 17 18 19 20
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	
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. Very poor flush returns throughout drilling. 4. Unable to retrieve co-ordinates on completion due to ongoing site operations.									

				Borehole Log				Borehole No. PH07 Sheet 3 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 21/02/2020 - 21/02/2020		Logged By GLM			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					24.00			End of borehole at 24.00 m	21 22 23 24 25 26 27 28 29 30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling. 4. Unable to retrieve co-ordinates on completion due to ongoing site operations.									

					Borehole Log			Borehole No. PH08 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411600.74 - 414692.31		Hole Type PH
Location: Brighthouse					Level: 210.95		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH08 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411600.74 - 414692.31		Hole Type PH
Location: Brighthouse					Level: 210.95		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									11
									12
									13
									14
									15
									16
									17
									18
									19
									20
						16.80	194.15	 	Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)
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. Very poor flush returns throughout drilling.									



Borehole No.

PH08

Sheet 3 of 3

Project Name: Crosland Hill Road

Project No.
3649

Co-ords: 411600.74 - 414692.31

Hole Type
PH

Location: Brighthouse

Level: 210.95

Scale
1:50

Client: Redrow Homes Yorkshire

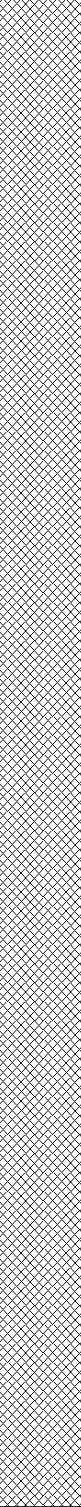
Dates: 24/02/2020 - 24/02/2020

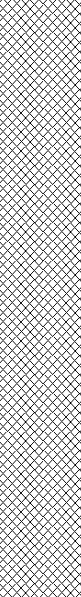
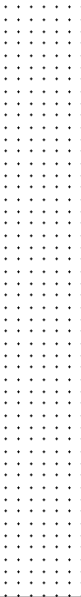
Logged By
GLM

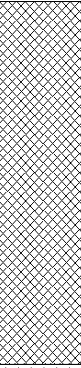
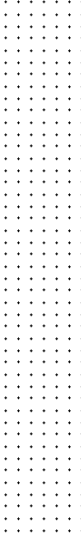
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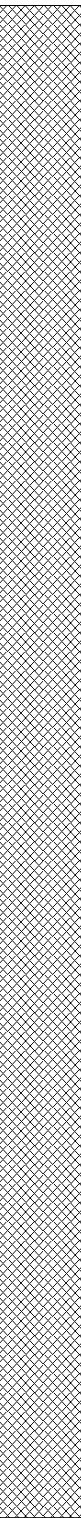
Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.



					Borehole Log			Borehole No. PH09 Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411585.41 - 414653.44		Hole Type PH
Location: Brighthouse					Level: 211.50		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
								From 2.0m to rockhead with some large boulders (up to 2.0m).	2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH09 Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411585.41 - 414653.44		Hole Type PH
Location: Brighthouse					Level: 211.50		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					14.00	197.50			11
									12
									13
									14
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	15
									16
									17
					18.00	193.50			18
								End of borehole at 18.00 m	19
									20
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH10 Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411559.64 - 414684.16		Hole Type PH
Location: Brighthouse					Level: 212.75		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					2.40	210.35		MADE GROUND: Fill. (QUARRY BACKFILL)	1
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	2
					6.00	206.75		End of borehole at 6.00 m	3
									4
									5
									6
									7
									8
									9
									10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH11 Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411579.71 - 414636.21		Hole Type PH
Location: Brighthouse					Level: 211.75		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. PH11 Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411579.71 - 414636.21		Hole Type PH
Location: Brighthouse					Level: 211.75		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					13.50	198.25			11
									12
									13
									14
									15
									16
									17
					18.00	193.75			18
									19
									20

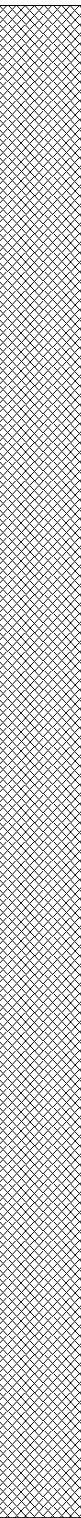
Buffish yellow SANDSTONE.
 (ROUGH ROCK SANDSTONE)

End of borehole at 18.00 m

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.



					Borehole Log			Borehole No. PH12 Sheet 1 of 3							
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411591.39 - 414681.15		Hole Type PH						
Location: Brighthouse					Level: 211.35		Scale 1:50								
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM								
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description							
		Depth (m)	Type	Results											
								MADE GROUND: Fill. (QUARRY BACKFILL)	1						
															2
															3
															4
															5
															6
															7
															8
															9
															10
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. Very poor flush returns throughout drilling.															



PH12

Project Name: Crosland Hill Road

Project No.
3649

Co-ords: 411591.39 - 414681.15

Hole Type
PH

Location: Brighthouse

Level: 211.35

Scale
1:50

Client: Redrow Homes Yorkshire

Dates: 24/02/2020 - 24/02/2020

Logged By
GLM

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description									
		Depth (m)	Type	Results													
					17.50	193.85			11								
									12								
									13								
									14								
									15								
									16								
									17								
									18								
									19								
									20								
									Continued on next sheet								

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. Very poor flush returns throughout drilling.





Borehole No.

PH12

Sheet 3 of 3

Project Name: Crosland Hill Road

Project No.
3649

Co-ords: 411591.39 - 414681.15

Hole Type
PH

Location: Brighthouse

Level: 211.35

Scale
1:50

Client: Redrow Homes Yorkshire

Dates: 24/02/2020 - 24/02/2020

Logged By
GLM

[illegible]

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.



					Borehole Log			Borehole No. PH101 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 25/01/2021 - 25/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 Black MACADAM (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
									2
									3
					6.00		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	4	
								5	
					9.00		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	6	
								7	
								8	
								9	
								10	

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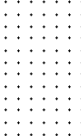
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. PH101 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 25/01/2021 - 25/01/2021				

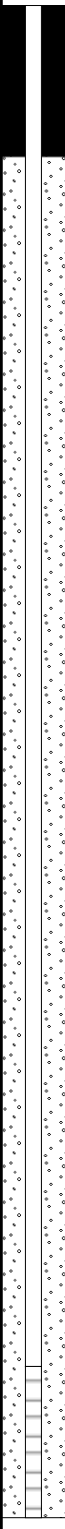
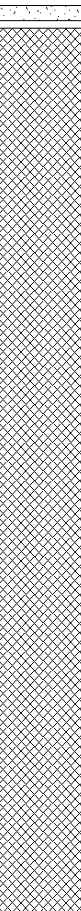
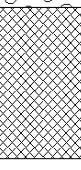
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									11
									12
									13
									14
					14.80				15
							MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		16
					16.70				17
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		18
					18.00				19
							Buff SANDSTONE. (ROUGH ROCK SANDSTONE)		20

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.		

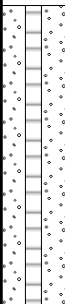
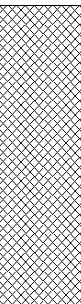
					Borehole Log			Borehole No. PH101 Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 25/01/2021 - 25/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00			End of borehole at 21.00 m	21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

					Borehole Log			Borehole No. PH101A Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By
Client: Redrow Homes Yorkshire					Dates: 25/01/2021 - 25/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			MADE GROUND: Black TARMAC. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
									2
									3
									4
					6.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	6
					9.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	9
								Continued on next sheet	10

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

				Borehole Log				Borehole No. PH101A Sheet 2 of 2	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50		Logged By	
Client: Redrow Homes Yorkshire				Dates: 25/01/2021 - 25/01/2021					

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					12.00			End of borehole at 12.00 m	11 12 13 14 15 16 17 18 19 20

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

					Borehole Log			Borehole No. PH102 Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 25/01/2021 - 25/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
					2.00		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	2	
					3.00		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	3	
								4	
								5	
								6	
								7	
					8.50		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	9	
					9.50		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	10	
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.		

					Borehole Log			Borehole No. PH102 Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 25/01/2021 - 25/01/2021				

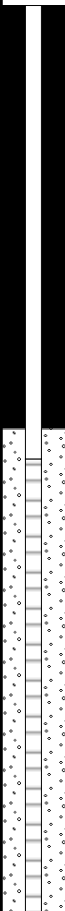
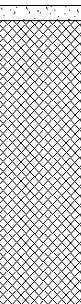
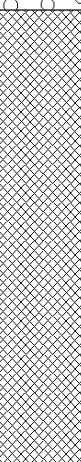
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					12.00				11
									12
									13
									14
									15
									16
									17
					18.00				18
									19
									20

Sandstone bedrock.
 (ROUGH ROCK SANDSTONE)

End of borehole at 18.00 m

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

					Borehole Log			Borehole No. PH102A Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 25/01/2021 - 25/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 MADE GROUND: Black TARMAC. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1	
					2.00		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	2	
					3.00		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	3	
					6.00		End of borehole at 6.00 m	6	
								4	
								5	
								7	
								8	
								9	
								10	

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

					Borehole Log			Borehole No. PH103 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 25/01/2021 - 25/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
								2	
								3	
								4	
								5	
								6	
								7	
					7.40		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
					7.80		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8	
								9	
					9.50		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
					10.00			10	

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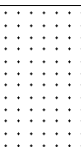
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. PH103 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 25/01/2021 - 25/01/2021				

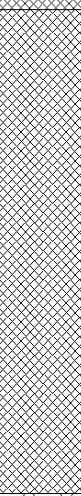
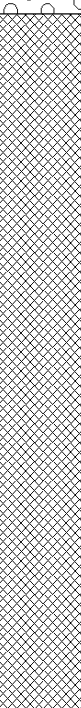
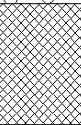
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	11
					13.20			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	13
					13.70			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	14
					16.20			Buff SANDSTONE. (ROUGH ROCK SANDSTONE)	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 was not apparent during drilling.		

				Borehole Log				Borehole No. PH103 Sheet 3 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 25/01/2021 - 25/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00			End of borehole at 21.00 m	21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

					Borehole Log			Borehole No. PH104 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
					3.30		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	2	
					3.70		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	3	
					8.30		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	4	
					9.20		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	5	
				10.00		Continued on next sheet		6	

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

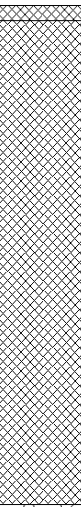
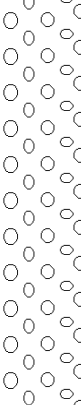
					Borehole Log			Borehole No. PH104 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.60			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
					11.30			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	11
					13.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	12
					13.60			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	13
					13.90			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	14
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	15
					16.30			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	16
							Buff sandstone. (ROUGH ROCK SANDSTONE)	17	
								18	
								19	
								20	

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.		

				Borehole Log			Borehole No. PH104A Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 26/01/2021 - 26/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
					3.30		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	2 3 4	
					6.00		End of borehole at 6.00 m	5 6 7 8 9 10	

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. PH105 Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) From 1.0m loss of flush returns.		1
									2
									3
									4
									5
									6
									7
									8
					9.00		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		9
					9.40		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		10

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.		

					Borehole Log			Borehole No. PH105 Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					12.80			Buff sandstone. (ROUGH ROCK SANDSTONE)	11
					18.00				13
									14
									15
									16
									17
									18
									19
									20

End of borehole at 18.00 m

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

				Borehole Log			Borehole No. PH105A Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 26/01/2021 - 26/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
									1
									2
									3
									4
									5
					6.00			End of borehole at 6.00 m	6
									7
									8
									9
									10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

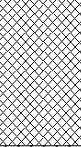
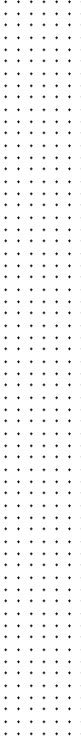
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Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
					3.00					2
					3.40			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	3	
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	4	
									5	
									6	
					7.00				7	
					7.20			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8	
									9	
									10	

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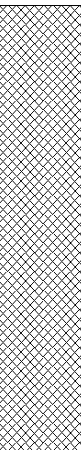
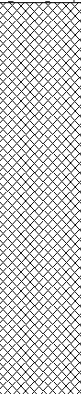
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. PH106 Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					11.00			Buff sandstone. (ROUGH ROCK SANDSTONE)	11
									12
									13
									14
									15
					16.00			End of borehole at 16.00 m	16
									17
									18
									19
									20

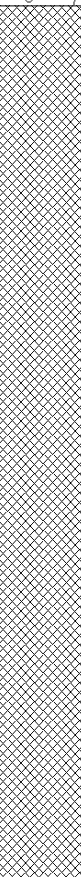
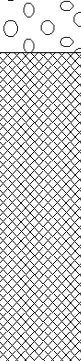
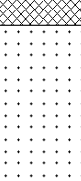
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

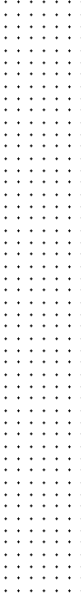
				Borehole Log			Borehole No. PH106A Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 26/01/2021 - 26/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1	
							 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	3	
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	4	
							End of borehole at 6.00 m	6	
					3.00				
					3.40				
					6.00				
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

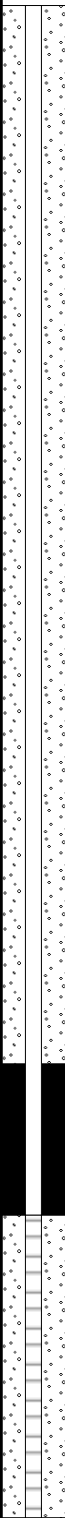
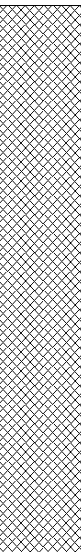
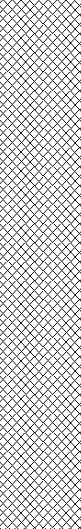
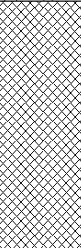


					Borehole Log			Borehole No. PH107 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
									2
									3
					3.70				
					4.00		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		4
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		5
									6
									7
					7.60		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		8
					8.00		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		9
								10	
				9.70		 MADE GROUND: Sandstone Boulder.			
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.									

					Borehole Log			Borehole No. PH107 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.30		 (QUARRY BACKFILL)		11 12 13 14 15 16 17 18 19 20
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
							MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
					16.10				
					16.70				
					18.90		 Buff sandstone. (ROUGH ROCK SANDSTONE)		
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.									

					Borehole Log			Borehole No. PH107 Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					24.00				21 22 23 24 25 26 27 28 29 30
End of borehole at 24.00 m									
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									
									

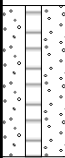
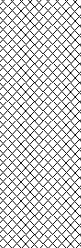
				Borehole Log			Borehole No. PH107A Sheet 1 of 2	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
									2
									3
									4
									5
					3.70			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
					4.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	6
									7
					7.60			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
					8.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8
									9
					9.70			MADE GROUND: Sandstone Boulder.	10

Continued on next sheet

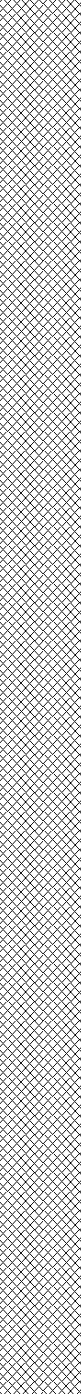
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

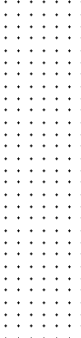
					Borehole Log			Borehole No. PH107A Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.30		 (QUARRY BACKFILL)		
					12.00		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <u>At 11.0m hole collapsing.</u>	11 12 13 14 15 16 17 18 19 20	
End of borehole at 12.00 m									

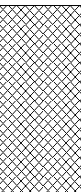
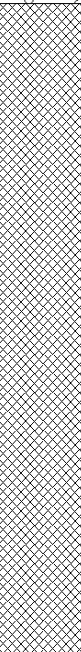
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

					Borehole Log			Borehole No. PH108 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					1.30			From 1.0m loss of flush returns.	1
					1.70			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	
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.									

					Borehole Log			Borehole No. PH108 Sheet 2 of 3									
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH								
Location: Brighthouse					Level:		Scale 1:50		Logged By RR								
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021												
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description									
		Depth (m)	Type	Results													
					19.30				11								
									12								
									13								
									14								
									15								
									16								
									17								
									18								
									19								
									20								
									Buff sandstone. (ROUGH ROCK SANDSTONE)								
									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.																	
																	

					Borehole Log			Borehole No. PH108 Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					22.30			End of borehole at 22.30 m	21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

				Borehole Log			Borehole No. PH108A Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 28/01/2021 - 28/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					1.30			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
					1.70			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	2
					6.00			End of borehole at 6.00 m	3
									4
									5
									6
									7
									8
									9
									10

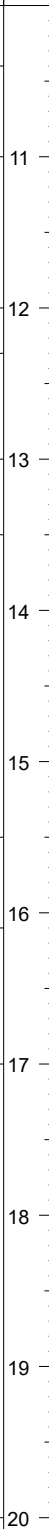
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. PH109 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					1.00		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1	
					1.40		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
					9.30				
					9.50		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
							MADE GROUND: Buff & brown gravel, cobbles & boulders.	10	

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.		

					Borehole Log			Borehole No. PH109 Sheet 2 of 3							
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH						
Location: Brighthouse					Level:		Scale 1:50								
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR								
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description							
		Depth (m)	Type	Results											
					10.40			(QUARRY BACKFILL)							
					11.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)							
					12.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)							
					12.30			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)							
					13.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)							
					13.50			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)							
					15.50			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)							
					16.10			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)							
					17.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)							
								Buff sandstone. (ROUGH ROCK SANDSTONE)							
					Continued on next sheet								20		
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.															



PH109

Hole Type
PH

Co-ords: -

Level:

Scale
1:50

Dates: 28/01/2021 - 28/01/2021

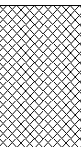
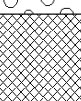
Logged By
RR

[illegible]

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



					Borehole Log			Borehole No. PH109A Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					1.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
					1.40			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL) <i>Unable to install pipework due to loose boulders collapsing within the borehole.</i>	
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
									3
									4
									5
					6.00			End of borehole at 6.00 m	6
									7
									8
									9
									10

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								



Borehole No.

PH110

Sheet 1 of 3

Project Name: Crosland Hill Road

Project No.	3649

Co-ords: -

Hole Type
PH

Location: Brighthouse

Level:

Scale
1:50

Client: Redrow Homes Yorkshire

Dates: 28/01/2021 - 28/01/2021

Logged By
RR

[illegible]

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Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 22m.



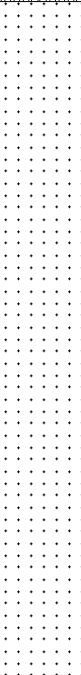
					Borehole Log			Borehole No. PH110 Sheet 2 of 3										
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH									
Location: Brighthouse					Level:		Scale 1:50											
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR											
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description										
		Depth (m)	Type	Results														
										11.00								
										11.30								
										12.00								
										12.50								
										16.60								
										17.00								
										19.90								
										Continued on next sheet								

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 22m.

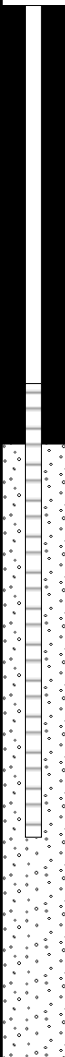
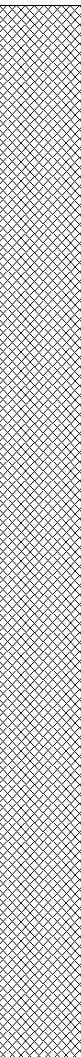


				Borehole Log			Borehole No. PH110 Sheet 3 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 28/01/2021 - 28/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
	▼				20.50			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
					20.80			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	21
					21.30			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	22
					22.50			At 22.00m water encountered.	
					27.00			Buff sandstone. (ROUGH ROCK SANDSTONE)	23
									24
									25
									26
									27
								End of borehole at 27.00 m	28
									29
									30

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 22m.		

				Borehole Log			Borehole No. PH110A Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 29/01/2021 - 29/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
					7.00			At 6.0m water encountered.	7
								End of borehole at 7.00 m	8
									9
									10

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was encountered at 6.0m.		

					Borehole Log			Borehole No. PH111 Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021				

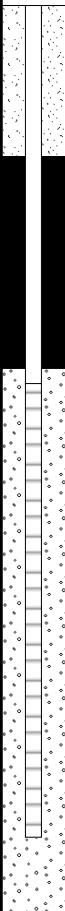
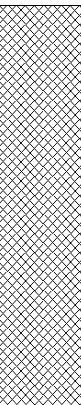
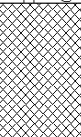
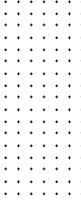
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
								2	
					2.70				
					3.10			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	3
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	4
				4.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	4	
				4.30			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	5	
				4.50			Buff sandstone. (ROUGH ROCK SANDSTONE)	5	
								6	
								7	
								8	
								9	
								10	

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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.		

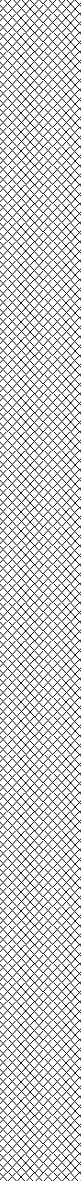
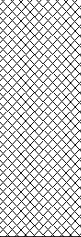
					Borehole Log			Borehole No. PH111 Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					12.00				
End of borehole at 12.00 m									
11 12 13 14 15 16 17 18 19 20									
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

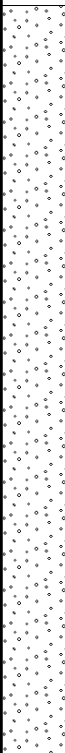
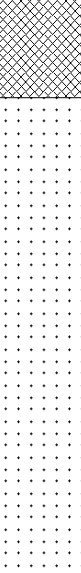
				Borehole Log			Borehole No. PH111A Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 29/01/2021 - 29/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		1
							 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		2
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		3
							 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		4
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		5
							 Buff sandstone. (ROUGH ROCK SANDSTONE)		6
					6.00		End of borehole at 6.00 m		7
									8
									9
									10

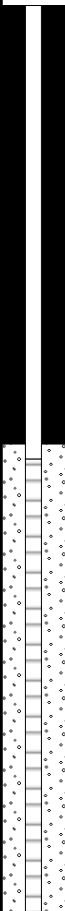
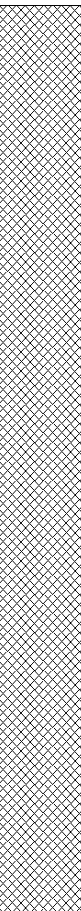
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

				Borehole Log				Borehole No. PH112 Sheet 1 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 29/01/2021 - 29/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>		
					6.60				1
					6.90				2
									3
									4
									5
									6
									7
									8
									9
									10
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.									

					Borehole Log			Borehole No. PH112 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					17.90				11 12 13 14 15 16 17 18 19 20
					18.40			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
								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.									

					Borehole Log			Borehole No. PH112 Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					20.60			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	21 22 23 24 25 26 27 28 29 30
					21.00				
					21.80			Buff sandstone. (ROUGH ROCK SANDSTONE)	
					25.00		End of borehole at 25.00 m		
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									
									

				Borehole Log			Borehole No. PH112A Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 29/01/2021 - 29/01/2021		Logged By RR		

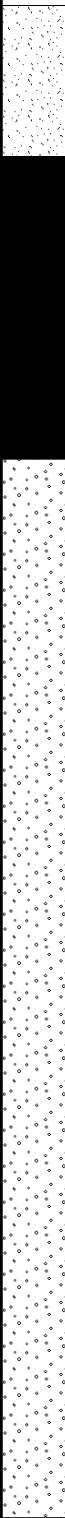
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					6.00		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
								2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	

6.00

End of borehole at 6.00 m

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. PH113 Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
							<i>From 1.0m loss of flush returns.</i>	1	
					1.50				
					1.70		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	2	
									3
					3.50		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
					3.90		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	4	
									5
									6
								7	
								8	
								9	
								10	

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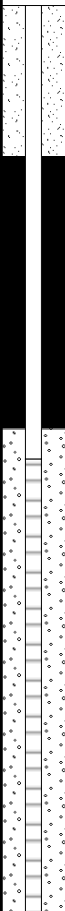
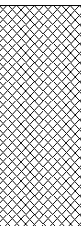
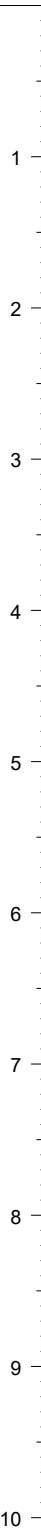
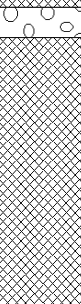
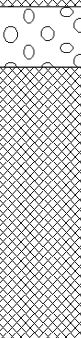
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. PH113 Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									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 was not apparent during drilling.									

					Borehole Log			Borehole No. PH113 Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.50			Buff sandstone. (ROUGH ROCK SANDSTONE)	21
					24.50				
							End of borehole at 24.50 m		23
									24
									25
									26
									27
									28
									29
									30

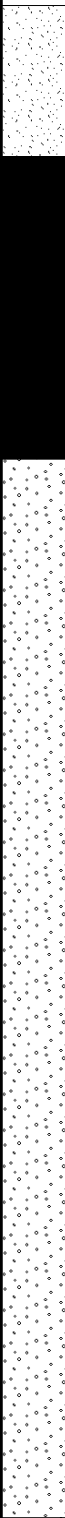
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

				Borehole Log			Borehole No. PH113A Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 29/01/2021 - 29/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					1.50			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					1.70			From 1.0m loss of flush returns. MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					3.50			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
					3.90			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					6.00			End of borehole at 6.00 m	

Remarks
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

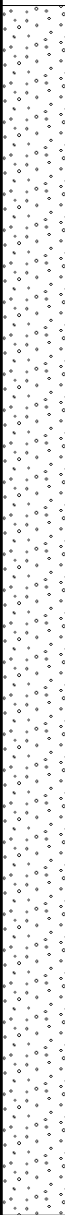
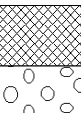
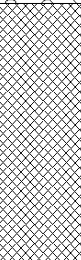
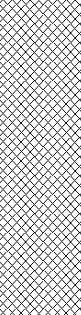
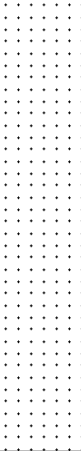


					Borehole Log			Borehole No. PH114 Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021				

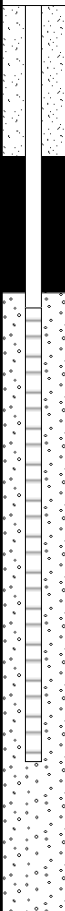
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1	
							<i>From 1.0m loss of flush returns.</i>	2	
									3
									4
					3.50		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
					3.70		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
								5	
								6	
								7	
					7.00		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
					7.30		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
								8	
								9	
								10	

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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.		

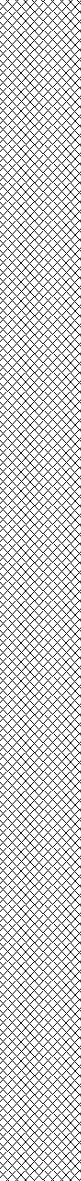
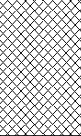
					Borehole Log			Borehole No. PH114 Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.40			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	11 12 13 14 15 16 17 18 19 20
					10.80			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					12.50			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
					12.70			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					15.00			Buff sandstone. (ROUGH ROCK SANDSTONE)	
					18.00		End of borehole at 18.00 m		
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

				Borehole Log			Borehole No. PH114A Sheet 1 of 1	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 01/02/2021 - 01/02/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1	
							<i>From 1.0m loss of flush returns.</i>	2	
					3.50 3.70		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	3 4	
					6.00		End of borehole at 6.00 m	5 6 7 8 9 10	

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.	

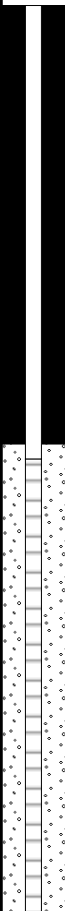
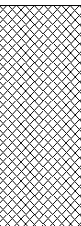
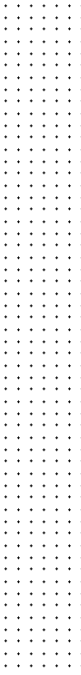
				Borehole Log			Borehole No. PH115 Sheet 1 of 2	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 01/02/2021 - 01/02/2021		Logged By RR		

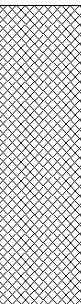
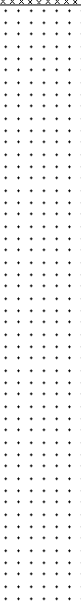
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.50			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					0.90			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 1.0m loss of flush returns.</i>	1
									2
									3
									4
									5
									6
									7
									8
					8.80 9.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	9
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	10

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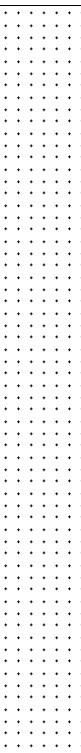
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

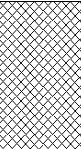
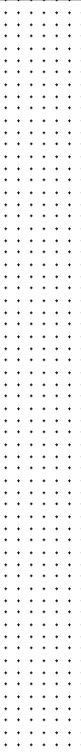


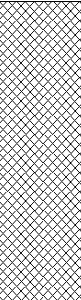
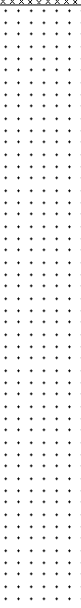
				Borehole Log			Borehole No. PH116 Sheet 1 of 1		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 01/02/2021 - 01/02/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					1.50			MADE GROUND: Quarry backfill. (QUARRY BACKFILL)	1
					6.00			Buff sandstone. (ROUGH ROCK SANDSTONE)	2
							End of borehole at 6.00 m		3
									4
									5
									6
									7
									8
									9
									10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

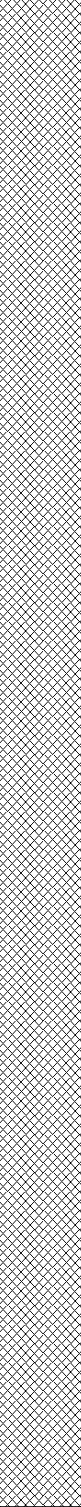
					Borehole Log			Borehole No. ST01A Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411691.73 - 414665.35		Hole Type PH
Location: Brighthouse					Level: 205.80		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					2.00	203.80		MADE GROUND: Fill. (QUARRY BACKFILL)	1
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	2
					6.00	199.80		End of borehole at 6.00 m	6
									7
									8
									9
									10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

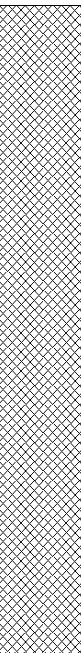
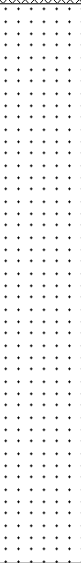
					Borehole Log			Borehole No. ST01B Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411694.34 - 414666.76		Hole Type PH
Location: Brighthouse					Level: 205.70		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
					9.50	196.20		Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	10
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. Very poor flush returns throughout drilling.									

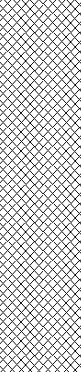
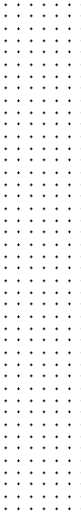
					Borehole Log			Borehole No. ST01B Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411694.34 - 414666.76		Hole Type PH
Location: Brighthouse					Level: 205.70		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 21/02/2020 - 21/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					15.00	190.70			11
									12
									13
									14
									15
								End of borehole at 15.00 m	16
									17
									18
									19
									20
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

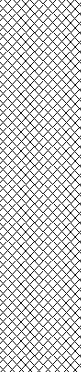
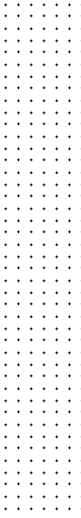
					Borehole Log			Borehole No. ST02A Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411573.93 - 414666.73		Hole Type PH
Location: Brighthouse					Level: 212.05		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
	▼				1.00	211.05		MADE GROUND: Fill. (QUARRY BACKFILL)	1
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE) 2.0m Groundwater ingress.	2
					6.00	206.05		End of borehole at 6.00 m	6
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was apparent at 2.0m during drilling. 3. Very poor flush returns throughout drilling.									

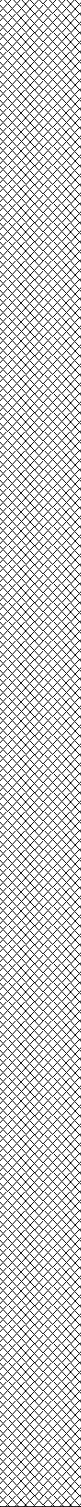
					Borehole Log			Borehole No. ST02B Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411575.75 - 414665.91		Hole Type PH
Location: Brighthouse					Level: 212.00		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					2.00	210.00		MADE GROUND: Fill. (QUARRY BACKFILL)	1
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	2
					6.00	206.00		End of borehole at 6.00 m	6
									7
									8
									9
									10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

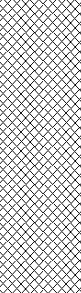
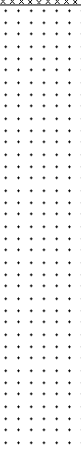
					Borehole Log			Borehole No. ST02C Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411577.41 - 414664.96		Hole Type PH
Location: Brighthouse					Level: 211.90		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Very poor flush returns throughout drilling.									

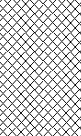
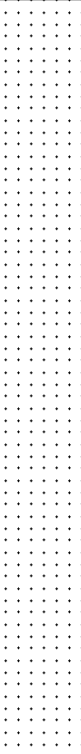
					Borehole Log			Borehole No. ST02C Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411577.41 - 414664.96		Hole Type PH
Location: Brighthouse					Level: 211.90		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					14.30	197.60			11
									12
									13
									14
									15
									16
									17
					18.00	193.90		Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	18
									19
									20
End of borehole at 18.00 m									
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

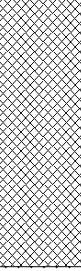
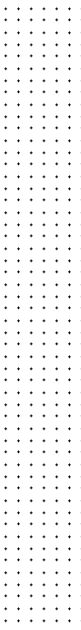
					Borehole Log			Borehole No. ST03A Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411603.24 - 414720.12		Hole Type PH
Location: Brighthouse					Level: 210.75		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					2.50	208.25		MADE GROUND: Fill. (QUARRY BACKFILL)	1
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	2 3 4 5
					6.00	204.75		End of borehole at 6.00 m	6 7 8 9 10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

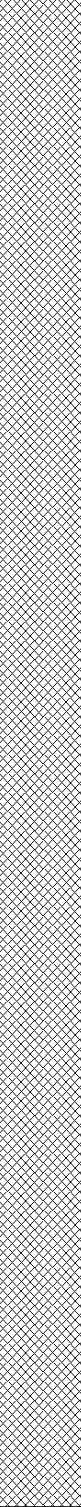
					Borehole Log			Borehole No. ST03B Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411604.19 - 414718.54		Hole Type PH
Location: Brighthouse					Level: 210.70		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					2.50	208.20		MADE GROUND: Fill. (QUARRY BACKFILL)	1
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	2
					6.00	204.70		End of borehole at 6.00 m	3
									4
									5
									6
									7
									8
									9
									10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. ST03C Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411605.07 - 414716.75		Hole Type PH
Location: Brighthouse					Level: 210.75		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
								2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	
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. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. ST03C Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411605.07 - 414716.75		Hole Type PH
Location: Brighthouse					Level: 210.75		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					12.00	198.75		Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	11
					15.00	195.75			12
							End of borehole at 15.00 m		13
									14
									15
									16
									17
									18
									19
									20
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. ST04A Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411585.40 - 414685.60		Hole Type PH
Location: Brighthouse					Level: 211.50		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					1.00	210.50		MADE GROUND: Fill. (QUARRY BACKFILL)	1
								Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	2
									3
									4
									5
					6.00	205.50		End of borehole at 6.00 m	6
									7
									8
									9
									10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. ST04B Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411585.87 - 414682.58		Hole Type PH
Location: Brighthouse					Level: 211.50		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					1.80	209.70		MADE GROUND: Fill. (QUARRY BACKFILL)	1
					6.00	205.50		Buffish yellow SANDSTONE. (ROUGH ROCK SANDSTONE)	2
								End of borehole at 6.00 m	6
									7
									8
									9
									10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.									

					Borehole Log			Borehole No. ST04C Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411586.33 - 414680.32		Hole Type PH
Location: Brighthouse					Level: 211.50		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Fill. (QUARRY BACKFILL)	1
								2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	
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. Very poor flush returns throughout drilling.									

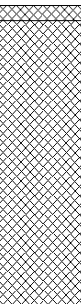
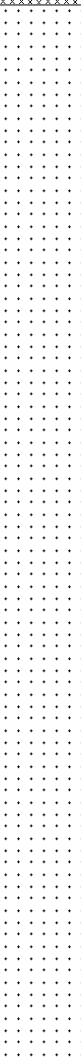
					Borehole Log			Borehole No. ST04C Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: 411586.33 - 414680.32		Hole Type PH
Location: Brighthouse					Level: 211.50		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 24/02/2020 - 24/02/2020		Logged By GLM		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					15.50	196.00			11
									12
									13
									14
									15
									16
									17
									18
					18.00	193.50			19
									20

Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Very poor flush returns throughout drilling.



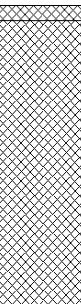
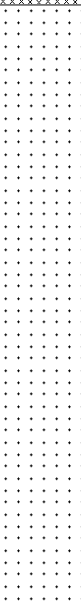
					Borehole Log			Borehole No. ST101A Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1	
					2.00		 Sandstone bedrock. (ROUGH ROCK SANDSTONE)	2	
					9.00		End of borehole at 9.00 m	9	
								10	

Remarks
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Full returns.

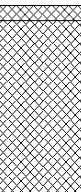
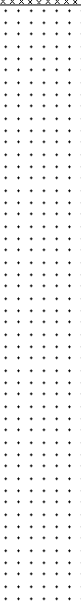


					Borehole Log			Borehole No. ST101B Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1	
					2.00		 Sandstone bedrock. (ROUGH ROCK SANDSTONE)	2	
					6.00		End of borehole at 6.00 m	6	
								7	
								8	
								9	
								10	

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Full returns.								

					Borehole Log			Borehole No. ST101C Sheet 1 of 1	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		 Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 1.0m loss of flush returns.</i>		1
					1.30 1.50				
					2.00		 Boulder of sandstone. (QUARRY BACKFILL) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)  Sandstone bedrock. (ROUGH ROCK SANDSTONE)		2
					6.00				3
									4
									5
									6
									7
									8
									9
									10

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. ST101D Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10		Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) From 0.5m loss of flush returns.		1
									2
									3
									4
									5
									6
									7
									8
									9
									10

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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.



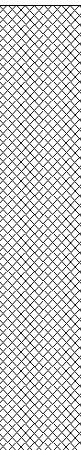
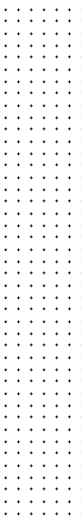
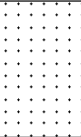
					Borehole Log			Borehole No. ST101D Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					13.00			Buff sandstone. (ROUGH ROCK SANDSTONE)	11
					18.00				13
									14
									15
									16
									17
									18
									19
									20

End of borehole at 18.00 m

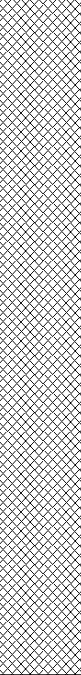
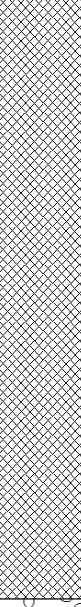
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

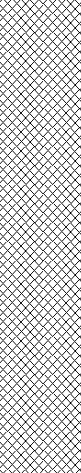
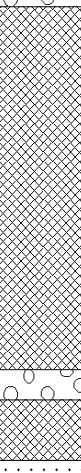
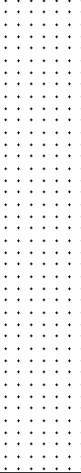
					Borehole Log			Borehole No. ST101E Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Black MACADAM. (HARDSTAND) MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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. Full returns.									

					Borehole Log			Borehole No. ST101E Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 26/01/2021 - 26/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					13.00				11
									12
									13
									14
									15
					16.50			Buff sandstone. (ROUGH ROCK SANDSTONE)	16
					17.10			Dark grey MUDSTONE. (ROUGH ROCK SANDSTONE)	17
					18.00			Buff sandstone. (ROUGH ROCK SANDSTONE)	18
								End of borehole at 18.00 m	19
									20

Remarks
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling. 3. Full returns.



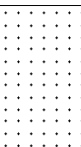
				Borehole Log				Borehole No. ST102A Sheet 1 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					4.50			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
									2
									3
									4
					5.50			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	5
									6
									7
									8
					9.50			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	9
									10
Continued on next sheet									10
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

					Borehole Log			Borehole No. ST102A Sheet 2 of 3			
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH		
Location: Brighthouse					Level:		Scale 1:50				
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
					13.20 13.50			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	11		
											12
											13
											14
					15.90 16.10 16.50			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	14		
											15
											16
											17
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	18		
											19
											20

Continued on next sheet

20

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.	

				Borehole Log				Borehole No. ST102A Sheet 3 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00			End of borehole at 21.00 m	21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

				Borehole Log				Borehole No. ST102B Sheet 1 of 2	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021		Logged By RR			

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 1.0m loss of flush returns.</i>	1	
									2
					3.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	3
					3.30			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	4
									5
									6
					7.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	7
					7.20			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8
					8.70			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	9
					9.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	10

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.		

					Borehole Log			Borehole No. ST102B Sheet 2 of 2		
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse					Level:		Scale 1:50			
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
									11	
					12.00					12
					12.40			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		12
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		13
									14	
									15	
									16	
					16.30			Buff sandstone. (ROUGH ROCK SANDSTONE)	17	
									18	
									19	
					19.30			End of borehole at 19.30 m	20	

Remarks
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



					Borehole Log			Borehole No. ST102C Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	
					1.10			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	1
					1.30			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					2.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	2
					2.20		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	

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.		

					Borehole Log			Borehole No. ST102C Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					13.00		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		13
					13.40		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		14
					16.60		Buff sandstone. (ROUGH ROCK SANDSTONE)		17
					19.60		End of borehole at 19.60 m		20

Remarks
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



				Borehole Log			Borehole No. ST102D Sheet 1 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021		Logged By RR		

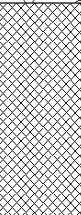
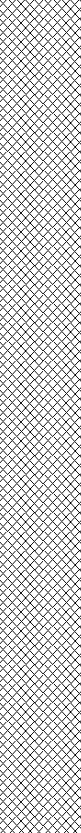
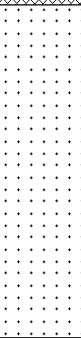
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
					3.30					2
					3.50			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		3
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		4
					6.50				5	
					6.70			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	7	
									8	
									9	
					9.90				10	

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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.



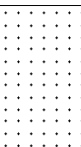
				Borehole Log			Borehole No. ST102D Sheet 2 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.50		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	11	
					12.00 12.20		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	12	
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	13 14 15 16 17	
					17.80		 Buff sandstone. (ROUGH ROCK SANDSTONE)	18 19 20	

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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.



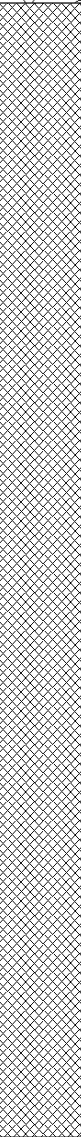
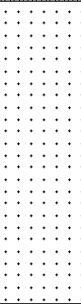
				Borehole Log				Borehole No. ST102D Sheet 3 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00			End of borehole at 21.00 m	21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

					Borehole Log			Borehole No. ST102E Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR		

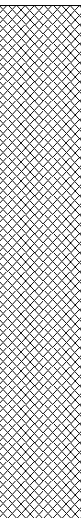
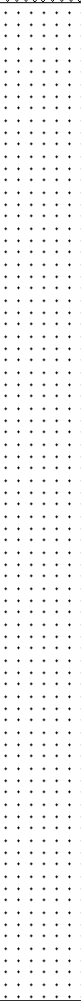
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
					1.00				1
					1.20		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL) <i>From 1.0m loss of flush returns.</i>		
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
					2.00				2
					2.30		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
									3
									4
									5
					5.50		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
					6.00		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
								6	
								7	
								8	
								9	
					9.90				10

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.		

					Borehole Log			Borehole No. ST102E Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.50		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
							 Buff sandstone. (ROUGH ROCK SANDSTONE)		
					18.00		Continued on next sheet		20
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

					Borehole Log			Borehole No. ST102E Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:			Scale 1:50	
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021			Logged By RR	
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00			End of borehole at 21.00 m	21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

				Borehole Log			Borehole No. ST103A Sheet 1 of 3		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					3.40		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
							 Buff sandstone. (ROUGH ROCK SANDSTONE)	2	
								3	
								4	
								5	
								6	
								7	
								8	
								9	
								10	
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.									

					Borehole Log			Borehole No. ST103A Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									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 was not apparent during drilling.									



ST103A

Sheet 3 of 3

Project Name: Crosland Hill Road

Project No.
3649

Co-ords: -

Hole Type
PH

Location: Brighthouse

Level:

Scale
1:50

Client: Redrow Homes Yorkshire

Dates: 27/01/2021 - 27/01/2021

Logged By
RR

[illegible]

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.

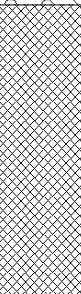
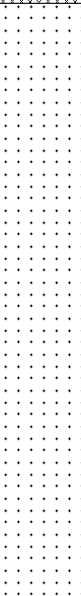


					Borehole Log			Borehole No. ST103B Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
								From 1.0m loss of flush returns.	2
									3
									4
					3.70		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
					4.00		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
									5
									6
									7
									8
									9
					10.00				10
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.									

				Borehole Log				Borehole No. ST103B Sheet 2 of 2	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50		Logged By RR	
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021					
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Buff sandstone. (ROUGH ROCK SANDSTONE)	11
									12
									13
									14
					15.00				15
								End of borehole at 15.00 m	16
									17
									18
									19
									20
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

					Borehole Log			Borehole No. ST103C Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
								From 1.0m loss of flush returns.	2
									3
						3.70			4
						5.20		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	5
						6.30		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	6
						6.90		MADE GROUND: Sandstone Boulder. (ROUGH ROCK SANDSTONE)	7
						8.50		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8
						9.50		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	9
						10.00		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	10
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.									
									

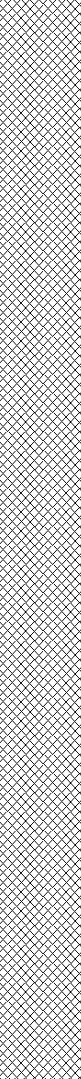
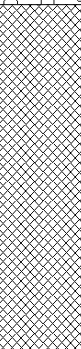
					Borehole Log			Borehole No. ST103C Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.40			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
					11.40			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	11
					12.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
					14.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	12 13
					18.00			Buff sandstone. (ROUGH ROCK SANDSTONE)	14 15 16 17
							End of borehole at 18.00 m		18
									19
									20

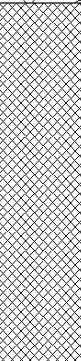
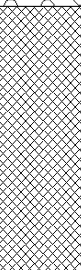
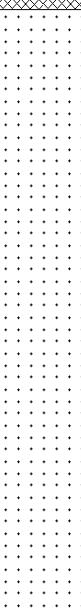
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

				Borehole Log				Borehole No. ST103D Sheet 1 of 2	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse				Level:		Scale 1:50			
Client: Redrow Homes Yorkshire				Dates: 27/01/2021 - 27/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1
								<i>From 1.0m loss of flush returns.</i>	2
									3
									4
									5
					5.90			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	6
					6.20			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	7
									8
					8.90			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	9
					9.60			MADE GROUND: Buff & brown gravel, cobbles & boulders.	10
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.									



					Borehole Log			Borehole No. ST103E Sheet 1 of 2								
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH							
Location: Brighthouse					Level:		Scale 1:50									
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR									
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description								
		Depth (m)	Type	Results												
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1							
															2	
																3
																4
									5							
									6							
									7							
					7.20											
					7.50			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)								
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8							
									9							
					9.80			MADE GROUND: Sandstone Boulder.	10							
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.																

					Borehole Log			Borehole No. ST103E Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 27/01/2021 - 27/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.50		 (QUARRY BACKFILL)		
						 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	11		
					12.90		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	13	
					13.20		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	14	
					15.00		 Buff sandstone. (ROUGH ROCK SANDSTONE)	15	
								16	
								17	
								18	
					19.00		----- End of borehole at 19.00 m	19	
								20	

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

				Borehole Log			Borehole No. ST104A Sheet 1 of 3	
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse				Level:		Scale 1:50		
Client: Redrow Homes Yorkshire				Dates: 28/01/2021 - 28/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
					3.20			2	
					4.00		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	3	
					4.50		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	4	
					5.10		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	5	
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	6	
								7	
								8	
								9	
								10	

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.		

					Borehole Log			Borehole No. ST104A Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									11
									12
									13
									14
					15.20				15
					15.80		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		16
									17
					17.80				
							Buff sandstone. (ROUGH ROCK SANDSTONE)		18
									19
									20

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.		



ST104A

Sheet 3 of 3

Project Name: Crosland Hill Road

Project No.
3649

Co-ords: -

Hole Type
PH

Location: Brighthouse

Level:

Scale
1:50

Client: Redrow Homes Yorkshire

Dates: 28/01/2021 - 28/01/2021

Logged By
RR

[illegible]

Remarks
1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



					Borehole Log			Borehole No. ST104B Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
					1.00				1
					1.30		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL) <i>From 1.0m loss of flush returns.</i>		
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		2
					2.70				
					3.10		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		3
					3.50		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
					4.00		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		4
							 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		5
					5.70				
				6.00		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		6	
						 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)			
				6.90					
				7.10		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		7	
						 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		8	
								9	
								10	

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.		

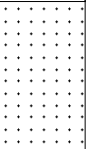
					Borehole Log			Borehole No. ST104B Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									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 was not apparent during drilling.

					Borehole Log			Borehole No. ST104C Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>		
					1.00		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	1	
					1.30		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	2	
					2.80		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	3	
					3.10		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	4	
								5	
								6	
					6.40		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	7	
					6.70		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8	
								9	
							10		

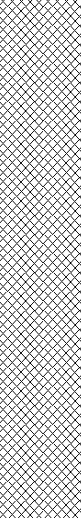
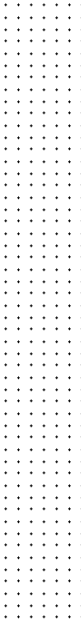
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Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. ST104C Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:			Scale 1:50	
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021			Logged By RR	
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00				
									21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

LITHOS CONSULTING					Borehole Log			Borehole No. ST104D Sheet 1 of 2		
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse					Level:		Scale 1:50		Logged By RR	
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021					
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
									2	
									3	
						3.50				
						3.70		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
						4.00		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		4
						4.30		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
						5.00		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		5
						5.50		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
				6.00		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)		6		
				6.30		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		7		
								8		
								9		
								10		
					9.80		MADE GROUND: Sandstone Boulder.			
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.

					Borehole Log			Borehole No. ST104D Sheet 2 of 2		
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse					Level:		Scale 1:50			
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					10.30		 (QUARRY BACKFILL)	 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	11	
										12
										13
					13.80		 Buff sandstone. (ROUGH ROCK SANDSTONE)	 End of borehole at 18.00 m	14	
							15			
							16			
					18.00				17	
									18	
									19	
									20	

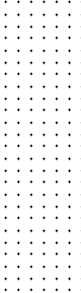
Remarks
 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



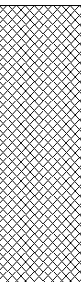
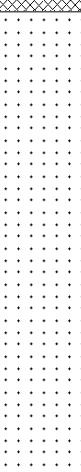
					Borehole Log			Borehole No. ST104E Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
					2.00		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	2	
					2.30		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	3	
					3.50		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	4	
					3.70		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	5	
					6.60		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	7	
					6.90		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8	
					7.50		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	9	
					7.80		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	10	
					9.00		Buff sandstone. (ROUGH ROCK SANDSTONE)		
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.

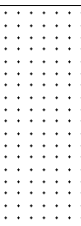


					Borehole Log			Borehole No. ST104E Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 28/01/2021 - 28/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					12.00			End of borehole at 12.00 m	11 12 13 14 15 16 17 18 19 20
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

					Borehole Log			Borehole No. ST105A Sheet 2 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
									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 was not apparent during drilling.									

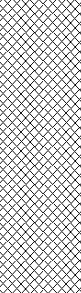
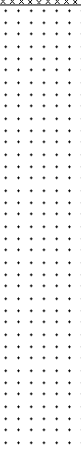
					Borehole Log			Borehole No. ST105A Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.90				21
					25.00			Buff sandstone. (ROUGH ROCK SANDSTONE)	22
								End of borehole at 25.00 m	25
									26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

					Borehole Log			Borehole No. ST105B Sheet 1 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	
									1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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.									

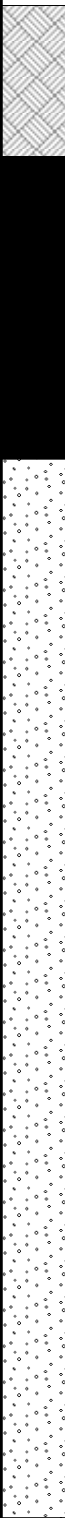
					Borehole Log			Borehole No. ST105B Sheet 3 of 3	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.50			End of borehole at 21.50 m	21
									22
									23
									24
									25
									26
									27
									28
									29
									30
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									



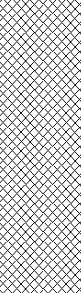
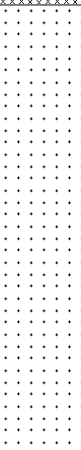
					Borehole Log			Borehole No. ST105C Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					12.00				11
								Buff sandstone. (ROUGH ROCK SANDSTONE)	12
					15.00			End of borehole at 15.00 m	13
									14
									15
									16
									17
									18
									19
									20

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

				Borehole Log				Borehole No. ST105D Sheet 1 of 2		
Project Name: Crosland Hill Road				Project No. 3649		Co-ords: -		Hole Type PH		
Location: Brighthouse				Level:		Scale 1:50				
Client: Redrow Homes Yorkshire				Dates: 29/01/2021 - 29/01/2021		Logged By RR				
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	1	
								<i>From 1.0m loss of flush returns.</i>	2	
										3
										4
						5.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	5
						5.30			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	6
						5.90			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	7
						6.40			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8
						7.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	9
						7.40			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	10
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.										

					Borehole Log			Borehole No. ST105D Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021				

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					12.00				11
								Buff sandstone. (ROUGH ROCK SANDSTONE)	12
					15.00			End of borehole at 15.00 m	15
									16
									17
									18
									19
									20

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								



					Borehole Log			Borehole No. ST105E Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 29/01/2021 - 29/01/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					12.00				11
					15.00				13
									14
									15
									16
									17
									18
									19
									20

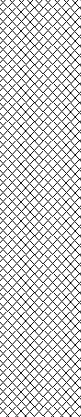
Remarks

1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.



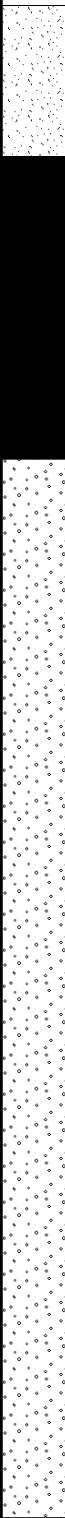
					Borehole Log			Borehole No. ST106A Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.50			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					0.80			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 1.0m loss of flush returns.</i>	1
									2
									3
									4
									5
									6
									7
									8
									9
									10
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.									

					Borehole Log			Borehole No. ST106A Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					10.40				
					10.70			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	11
					13.50				12
									13
									14
									15
									16
									17
									18
					18.00			End of borehole at 18.00 m	19
									20

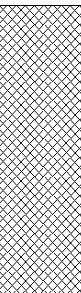
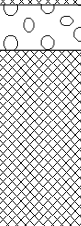
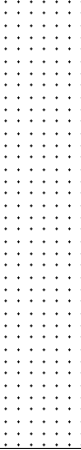
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

					Borehole Log			Borehole No. ST106B Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		Logged By RR
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021				

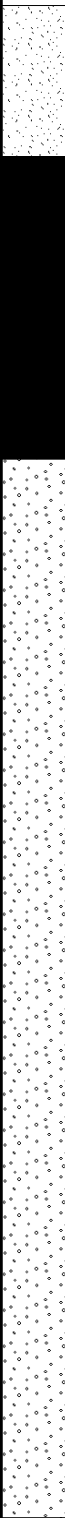
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
									2
									3
					4.60			4	
					5.00		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	5	
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	6	
								7	
								8	
								9	
								10	

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.		

					Borehole Log			Borehole No. ST106B Sheet 2 of 2		
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH	
Location: Brighthouse					Level:		Scale 1:50			
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
									11	
						12.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	12
					12.30					MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)
					13.50			Buff sandstone. (ROUGH ROCK SANDSTONE)	14	
										15
					16.50			End of borehole at 16.50 m	16	
									17	
									18	
									19	
									20	
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.										

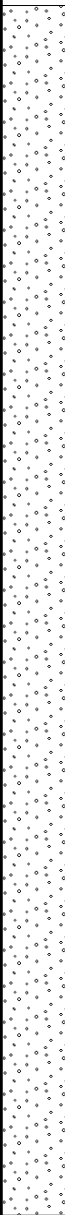
					Borehole Log			Borehole No. ST106C Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 0.5m loss of flush returns.</i>	1	
					1.60		 MADE GROUND: Sandstone Boulder. (ROUGH ROCK SANDSTONE)	2	
					2.00		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	3	
									4
								5	
								6	
								7	
					6.80		 MADE GROUND: Sandstone Boulder. (ROUGH ROCK SANDSTONE)	7	
					7.10		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8	
								9	
								10	

Continued on next sheet

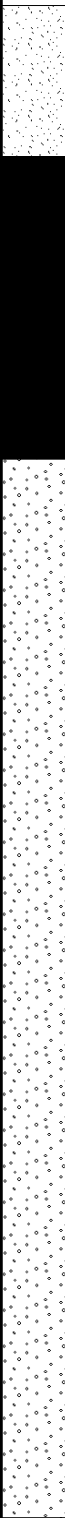
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. ST106C Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
									11	
					11.80					
					12.00			MADE GROUND: Sandstone Boulder. (ROUGH ROCK SANDSTONE)		12
					12.50			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
					13.00			MADE GROUND: Sandstone Boulder. (ROUGH ROCK SANDSTONE)		13
									14	
					15.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
									15	
								Buff sandstone. (ROUGH ROCK SANDSTONE)		
									16	
									17	
					18.00				18	
								End of borehole at 18.00 m		
									19	
									20	

Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

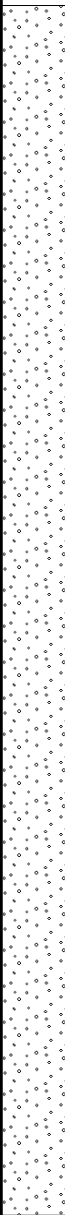
					Borehole Log			Borehole No. ST106D Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)		
					1.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	1
					1.30			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL) <i>From 1.0m loss of flush returns.</i>	
								MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	2
					4.80			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	5
					5.00			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	
					6.10			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	6
					6.30			MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	7
					9.50			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	10
					9.90				

Continued on next sheet

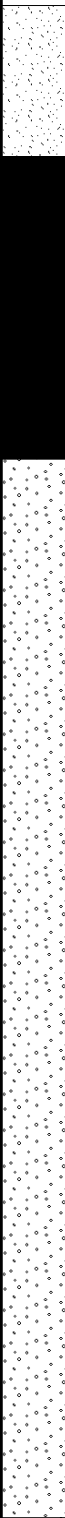
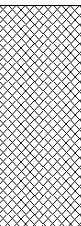
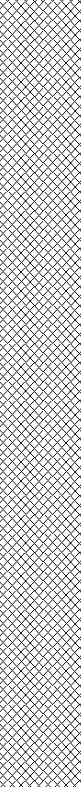
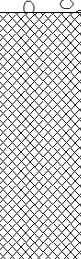
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.		

					Borehole Log			Borehole No. ST106D Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					11.70		MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	11	
					12.00		MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	12	
							MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	13	
								14	
					15.00		Buff sandstone. (ROUGH ROCK SANDSTONE)	15	
					18.00		End of borehole at 18.00 m	18	
								19	
								20	

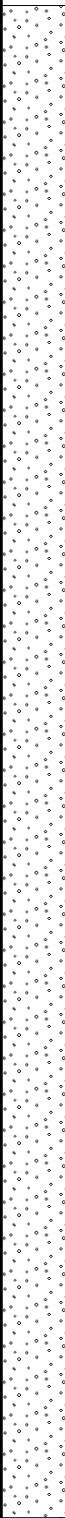
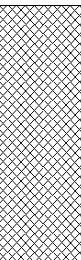
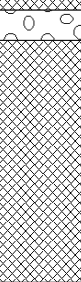
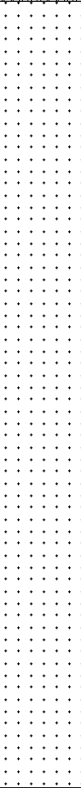
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.								

					Borehole Log			Borehole No. ST106E Sheet 1 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR		

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					1.50		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL) <i>From 1.0m loss of flush returns.</i>	1	
					1.70		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)  MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	2	
									3
									4
									5
									6
					7.00		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	7	
					7.40		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	8	
					9.10		 MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	9	
					9.50		 MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)	10	

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.		

					Borehole Log			Borehole No. ST106E Sheet 2 of 2	
Project Name: Crosland Hill Road					Project No. 3649		Co-ords: -		Hole Type PH
Location: Brighthouse					Level:		Scale 1:50		
Client: Redrow Homes Yorkshire					Dates: 01/02/2021 - 01/02/2021		Logged By RR		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					11.70				11
					12.10				
					13.00			MADE GROUND: Sandstone Boulder. (QUARRY BACKFILL)	13
					13.20				MADE GROUND: Buff & brown gravel, cobbles & boulders. (QUARRY BACKFILL)
					14.80			Buff sandstone. (ROUGH ROCK SANDSTONE)	15
					20.00		End of borehole at 20.00 m		20
Remarks 1. Prior to drilling a Cable Avoidance Tool (CAT) survey was carried out. 2. Groundwater was not apparent during drilling.									

Appendix H
Chemical Test Results



Certificate of Analysis

Certificate Number 21-01937

Issued: 08-Feb-21

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference 21-01937

Client Reference 3649

Order No PO7028-GLM

Contract Title Crosland Hill Road

Description 35 Soil samples, 8 Leachate samples.

Date Received 01-Feb-21

Date Started 01-Feb-21

Date Completed 08-Feb-21

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

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in black ink, appearing to read "A. Fenwick", is placed over the "Approved By" text.

Adam Fenwick
Contracts Manager



Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794597	1794598	1794599	1794600	1794601	1794602
Sample ID	TP119	TP101	TP103	TP106	TP108	TP119
Depth	0.70	0.05	0.05	0.05	0.02	0.05
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	30					
Moisture Content	DETSC 1004	0.1	%	11					
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	25					
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.6					
Cadmium	DETSC 2301#	0.1	mg/kg	1.1					
Chromium	DETSC 2301#	0.15	mg/kg	23					
Chromium III	DETSC 2301*	0.15	mg/kg	23					
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0					
Copper	DETSC 2301#	0.2	mg/kg	100					
Lead	DETSC 2301#	0.3	mg/kg	95					
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10					
Mercury	DETSC 2325#	0.05	mg/kg	0.15					
Nickel	DETSC 2301#	1	mg/kg	25					
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5					
Vanadium	DETSC 2301#	0.8	mg/kg	44					
Zinc	DETSC 2301#	1	mg/kg	94					
Inorganics									
pH	DETSC 2008#		pH	8.1					
Calorific Value	DETSC 5008	1	MJ/kg	1.8					
Total Organic Carbon	DETSC 2084#	0.5	%	7.2					
Chloride Aqueous Extract	DETSC 2055	1	mg/l	8.4					
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	3.6					
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	100					
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1					
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10					
EPH (C12-C16)	DETSC 3311	10	mg/kg	62					
EPH (C16-C21)	DETSC 3311	10	mg/kg	350					
EPH (C21-C35)	DETSC 3311	10	mg/kg	1400					
EPH (C35-C40)	DETSC 3311	10	mg/kg	190					
EPH (C10-C40)	DETSC 3311#	10	mg/kg	2000					

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794597	1794598	1794599	1794600	1794601	1794602
Sample ID	TP119	TP101	TP103	TP106	TP108	TP119
Depth	0.70	0.05	0.05	0.05	0.02	0.05
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	0.27	8.4	4.8	< 0.03	0.04	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.29	0.14	< 0.03	0.06	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.52	3.1	1.6	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	0.34	0.90	0.63	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	3.3	9.3	4.0	0.03	0.11	0.03
Anthracene	DETSC 3303	0.03	mg/kg	0.73	1.7	0.85	< 0.03	0.14	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	5.3	2.7	2.0	0.04	1.3	0.07
Pyrene	DETSC 3303#	0.03	mg/kg	4.9	2.8	2.1	0.07	1.6	0.13
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	2.0	0.85	0.52	< 0.03	0.48	0.08
Chrysene	DETSC 3303	0.03	mg/kg	2.0	1.5	0.89	0.32	0.42	0.43
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	2.2	0.57	0.36	0.11	0.65	0.20
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.84	0.15	0.08	0.09	0.23	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	2.1	0.42	0.21	0.08	0.41	0.11
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.79	0.13	0.07	< 0.03	0.08	0.07
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.23	0.06	0.04	< 0.03	0.03	0.05
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.85	0.17	0.12	0.17	0.09	0.12
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	26	33	18	0.93	5.6	1.3

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794603	1794604	1794605	1794606	1794607	1794608
Sample ID	TP101	TP102	TP103	TP104	TP105	TP106
Depth	0.60	0.20	0.70	0.60	0.60	1.00
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	45	28	52	33	38	30
Moisture Content	DETSC 1004	0.1	%	13	9.5	11	11	10	15
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	3.7	1.3	24	35	7.3	14
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.4	< 0.2	< 0.2	0.4	0.5	0.4
Cadmium	DETSC 2301#	0.1	mg/kg	0.4	0.1	0.5	0.1	0.3	0.3
Chromium	DETSC 2301#	0.15	mg/kg	16	12	15	18	12	17
Chromium III	DETSC 2301*	0.15	mg/kg	16	12	15	18	12	17
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	18	8.3	23	67	15	31
Lead	DETSC 2301#	0.3	mg/kg	13	6.2	22	390	56	55
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10	< 10	< 10			< 10
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	0.23	< 0.05	0.08
Nickel	DETSC 2301#	1	mg/kg	12	9.4	14	15	9.8	14
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	20	13	19	22	16	23
Zinc	DETSC 2301#	1	mg/kg	51	21	67	54	55	45
Inorganics									
pH	DETSC 2008#		pH	8.2	8.3	8.2	7.8	8.2	7.6
Calorific Value	DETSC 5008	1	MJ/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	0.6	< 0.5	0.6	3.5	0.7	1.6
Chloride Aqueous Extract	DETSC 2055	1	mg/l	7.7	5.6	2.7			6.5
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	< 1.0	< 1.0	< 1.0			4.5
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	43	< 10	11			40
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	12	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	< 10	16	60	20	13
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	< 10	70	120	140	48
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	39	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	< 10	96	200	210	77

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794603	1794604	1794605	1794606	1794607	1794608
Sample ID	TP101	TP102	TP103	TP104	TP105	TP106
Depth	0.60	0.20	0.70	0.60	0.60	1.00
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	2.6	1.4	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.53	0.45	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.41	0.30	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.14	< 0.03	0.08	3.2	1.7	0.15
Anthracene	DETSC 3303	0.03	mg/kg	0.03	< 0.03	< 0.03	0.73	0.31	0.04
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.19	< 0.03	0.10	3.0	1.5	0.20
Pyrene	DETSC 3303#	0.03	mg/kg	0.18	< 0.03	0.09	2.5	1.3	0.18
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.07	< 0.03	0.03	0.97	0.40	0.06
Chrysene	DETSC 3303	0.03	mg/kg	0.08	< 0.03	0.03	0.97	0.40	0.07
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.08	< 0.03	0.03	0.87	0.28	0.06
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.28	0.09	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03	< 0.03	0.69	0.21	0.04
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	< 0.03	0.23	0.07	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.08	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.21	0.06	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.87	< 0.10	0.37	17	8.4	0.79

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794609	1794610	1794611	1794612	1794613	1794614
Sample ID	TP107	TP111	TP113	TP118	TP102	TP106
Depth	0.70	1.50	0.50	1.90	0.40	0.50
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	15	41	21	17	53	60
Moisture Content	DETSC 1004	0.1	%	16	8.0	14	13	13	8.5
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	13	3.4	13	5.6	7.2	17
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.3	0.3	0.9	0.2	1.1	0.3
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	< 0.1	0.3	0.3	0.8	1.0
Chromium	DETSC 2301#	0.15	mg/kg	20	12	20	15	20	9.9
Chromium III	DETSC 2301*	0.15	mg/kg	20	12	20	15	20	9.9
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	34	12	47	15	38	42
Lead	DETSC 2301#	0.3	mg/kg	42	21	110	15	170	80
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10			< 10	< 10	< 10
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	0.28	< 0.05	0.11	0.06
Nickel	DETSC 2301#	1	mg/kg	16	9.3	20	15	12	9.9
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	0.6	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	28	14	29	21	35	18
Zinc	DETSC 2301#	1	mg/kg	46	32	79	50	59	58
Inorganics									
pH	DETSC 2008#		pH	8.0	7.9	7.9	8.2	9.8	8.2
Calorific Value	DETSC 5008	1	MJ/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	2.3	< 0.5	4.9	< 0.5	2.8	2.7
Chloride Aqueous Extract	DETSC 2055	1	mg/l	14			6.4	11	14
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	1.7			1.3	1.1	11
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	30			18	190	21
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	46	< 10	< 10	36
EPH (C16-C21)	DETSC 3311	10	mg/kg	22	< 10	200	< 10	< 10	110
EPH (C21-C35)	DETSC 3311	10	mg/kg	67	< 10	350	< 10	< 10	570
EPH (C35-C40)	DETSC 3311	10	mg/kg	17	< 10	17	< 10	< 10	140
EPH (C10-C40)	DETSC 3311#	10	mg/kg	120	< 10	620	< 10	< 10	860



Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794609	1794610	1794611	1794612	1794613	1794614
Sample ID	TP107	TP111	TP113	TP118	TP102	TP106
Depth	0.70	1.50	0.50	1.90	0.40	0.50
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	0.36	< 0.03	0.38	0.23
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03	2.5	< 0.03	1.7	0.30
Fluorene	DETSC 3303	0.03	mg/kg	0.04	< 0.03	2.4	< 0.03	1.7	0.23
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.38	0.21	13	0.12	7.1	1.9
Anthracene	DETSC 3303	0.03	mg/kg	0.08	0.05	2.8	< 0.03	2.5	0.43
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.63	0.34	10	0.21	6.4	2.0
Pyrene	DETSC 3303#	0.03	mg/kg	0.58	0.32	7.9	0.18	5.5	1.8
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.19	0.12	3.2	0.08	1.8	0.59
Chrysene	DETSC 3303	0.03	mg/kg	0.23	0.12	2.9	0.09	1.8	0.60
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.21	0.11	2.9	0.09	1.3	0.56
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.08	0.04	1.1	0.03	0.44	0.19
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.17	0.09	2.7	0.07	1.3	0.40
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.08	0.04	1.1	0.05	0.45	0.15
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.32	< 0.03	0.15	0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.08	0.03	0.94	0.05	0.43	0.14
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	2.9	1.5	54	0.97	33	9.6

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794615	1794616	1794617	1794618	1794619	1794620
Sample ID	TP109	TP111	TP112	TP115	TP115	TP116
Depth	0.80	0.40	0.60	0.40	1.40	0.40
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	58	18	62	22	58	66
Moisture Content	DETSC 1004	0.1	%	19	11	15	14	17	4.4
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	160	9.3	19	8.1	23	2.1
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	2.5	0.8	1.2	0.3	1.6	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.9	0.2	0.3	0.4	0.3	0.6
Chromium	DETSC 2301#	0.15	mg/kg	25	15	16	14	16	5.0
Chromium III	DETSC 2301*	0.15	mg/kg	25	15	16	14	16	5.0
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	160	32	41	34	53	8.6
Lead	DETSC 2301#	0.3	mg/kg	310	110	200	61	85	12
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	14	25		< 10	10	
Mercury	DETSC 2325#	0.05	mg/kg	2.0	0.18	0.34	0.19	0.39	< 0.05
Nickel	DETSC 2301#	1	mg/kg	33	13	18	18	15	4.1
Selenium	DETSC 2301#	0.5	mg/kg	1.0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	56	20	25	23	26	9.0
Zinc	DETSC 2301#	1	mg/kg	150	52	94	120	56	35
Inorganics									
pH	DETSC 2008#		pH	8.4	8.5	8.2	8.0	7.8	8.0
Calorific Value	DETSC 5008	1	MJ/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	9.5	1.8	3.0	2.8	7.8	3.1
Chloride Aqueous Extract	DETSC 2055	1	mg/l	7.2	6.2		5.7	18	
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	5.0	2.0		1.7	4.4	
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	190	100		24	86	
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	16	27	15	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	64	110	50	40	15	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	190	200	81	68	22	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg	15	16	< 10	< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	290	360	150	120	47	< 10

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794615	1794616	1794617	1794618	1794619	1794620
Sample ID	TP109	TP111	TP112	TP115	TP115	TP116
Depth	0.80	0.40	0.60	0.40	1.40	0.40
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	0.12	0.76	0.30	0.35	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.04	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.04	0.17	0.96	0.15	0.24	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	0.04	0.10	0.74	0.18	0.17	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.41	0.81	3.1	1.3	1.1	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	0.09	0.17	0.90	0.27	0.25	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.83	0.93	2.7	1.3	0.88	0.03
Pyrene	DETSC 3303#	0.03	mg/kg	0.78	0.82	2.2	1.1	0.78	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.28	0.28	0.73	0.37	0.22	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	0.30	0.27	0.68	0.36	0.23	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.36	0.26	0.60	0.34	0.18	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.12	0.10	0.18	0.09	0.06	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.30	0.20	0.49	0.26	0.14	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.15	0.08	0.15	0.08	0.05	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	0.06	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.17	0.07	0.14	0.08	0.04	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	3.9	4.4	14	6.3	4.6	< 0.10

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794621	1794622	1794623	1794624	1794625	1794626
Sample ID	TP117	TP118	TP110	TP101	TP103	TP104
Depth	0.50	0.70	0.50	0.20	0.30	0.20
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Preparation									
Stones >10mm	DETSC 1003*	1	% m/m	72	68	57	65	52	61
Moisture Content	DETSC 1004	0.1	%	8.3	8.3	17	7.6	6.0	8.2
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	5.7	3.6	6.8	1.7	2.3	2.0
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	< 0.2	< 0.2	0.4	< 0.2	< 0.2	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.3	0.2	0.3	0.1	0.2
Chromium	DETSC 2301#	0.15	mg/kg	14	11	14	7.5	14	13
Chromium III	DETSC 2301*	0.15	mg/kg	14	11	14	7.5	14	13
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	76	18	16	6.8	16	12
Lead	DETSC 2301#	0.3	mg/kg	56	20	41	4.8	4.4	16
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10		11	< 10		< 10
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	0.09	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	24	10	9.9	5.9	10	11
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	18	15	21	8.8	15	16
Zinc	DETSC 2301#	1	mg/kg	42	42	34	27	19	61
Inorganics									
pH	DETSC 2008#		pH	7.7	8.1	7.6	8.3	8.2	8.3
Calorific Value	DETSC 5008	1	MJ/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	1.5	1.1	1.9	< 0.5	< 0.5	0.6
Chloride Aqueous Extract	DETSC 2055	1	mg/l	4.2		5.1	8.4		8.6
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	< 1.0		19	< 1.0		< 1.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	15		35	< 10		24
Petroleum Hydrocarbons									
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10	15
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	25	< 10	< 10	13	94
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	190	< 10	< 10	230	1000
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	10	< 10	< 10	75	270
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	240	< 10	< 10	320	1400

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794621	1794622	1794623	1794624	1794625	1794626
Sample ID	TP117	TP118	TP110	TP101	TP103	TP104
Depth	0.50	0.70	0.50	0.20	0.30	0.20
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.04	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	0.05	< 0.03	< 0.03	0.04
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	0.04	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.16	0.12	0.28	< 0.03	0.03	0.14
Anthracene	DETSC 3303	0.03	mg/kg	0.03	0.03	0.05	0.03	< 0.03	0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.24	0.25	0.28	< 0.03	0.05	0.16
Pyrene	DETSC 3303#	0.03	mg/kg	0.21	0.23	0.23	0.04	0.05	0.16
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.08	0.10	0.08	< 0.03	< 0.03	0.08
Chrysene	DETSC 3303	0.03	mg/kg	0.09	0.10	0.08	< 0.03	< 0.03	0.11
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.07	0.13	0.08	< 0.03	< 0.03	0.10
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	< 0.03	< 0.03	< 0.03	0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.05	0.10	0.05	< 0.03	< 0.03	0.08
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.05	< 0.03	< 0.03	< 0.03	0.04
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.07	< 0.03	< 0.03	< 0.03	0.04
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.96	1.2	1.3	< 0.10	0.14	1.0

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794627	1794628	1794629	1794630	1794631
Sample ID	TP108	TP110	TP112	TP114	TP119
Depth	0.02	0.20	0.20	0.10	0.40
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m	24	42	70	67	68
Moisture Content	DETSC 1004	0.1	%	8.5	5.3	3.9	11	4.3
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg	1.3	7.7	3.3	24	2.2
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	< 0.2	< 0.2	< 0.2	0.4	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	4.4	0.9	0.5	1.0
Chromium	DETSC 2301#	0.15	mg/kg	10	4.3	3.2	38	7.6
Chromium III	DETSC 2301*	0.15	mg/kg	10	4.3	3.2	38	7.6
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	7.6	56	7.7	60	11
Lead	DETSC 2301#	0.3	mg/kg	6.9	44	8.6	30	30
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l		< 10		< 10	< 10
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.42	< 0.05	0.09	< 0.05
Nickel	DETSC 2301#	1	mg/kg	8.0	6.0	4.3	38	7.1
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	11	7.8	8.5	54	12
Zinc	DETSC 2301#	1	mg/kg	27	230	43	74	28
Inorganics								
pH	DETSC 2008#		pH	8.3	8.7	8.8	10.8	9.0
Calorific Value	DETSC 5008	1	MJ/kg					
Total Organic Carbon	DETSC 2084#	0.5	%	< 0.5	4.2	2.8	5.2	2.6
Chloride Aqueous Extract	DETSC 2055	1	mg/l		6.1		25	11
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l		< 1.0		2.4	< 1.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		< 10		83	16
Petroleum Hydrocarbons								
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	38
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	280
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	940
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	91
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	< 10	< 10	< 10	1400

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794627	1794628	1794629	1794630	1794631
Sample ID	TP108	TP110	TP112	TP114	TP119
Depth	0.02	0.20	0.20	0.10	0.40
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.10
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.07
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.25
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.17
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.08	< 0.03	< 0.03	0.07	1.4
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.36
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.11	< 0.03	< 0.03	0.11	3.3
Pyrene	DETSC 3303#	0.03	mg/kg	0.10	< 0.03	< 0.03	0.10	3.1
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	0.03	1.5
Chrysene	DETSC 3303	0.03	mg/kg	0.04	< 0.03	< 0.03	0.04	1.5
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	0.03	1.9
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.68
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	< 0.03	< 0.03	1.8
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	1.0
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.28
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	1.2
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.45	< 0.10	< 0.10	0.39	19

Summary of Chemical Analysis

Leachate Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794632	1794633	1794634	1794635	1794636	1794637	1794638	1794639
Sample ID	TP119	TP101	TP106	TP102	TP109	TP115	TP104	TP114
Depth	0.70	0.60	1.00	0.40	0.80	0.40	0.20	0.10
Other ID								
Sample Type	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units								
Preparation											
NRA Leachate Preparation	DETSC 1009*			Y	Y	Y	Y	Y	Y	Y	Y
Metals											
Arsenic, Dissolved	DETSC 2306	0.16	ug/l	0.40	0.19	0.26	0.32	4.5	0.67	0.23	0.22
Boron, Dissolved	DETSC 2306*	12	ug/l	< 12	< 12	< 12	< 12	< 12	< 12	< 12	< 12
Cadmium, Dissolved	DETSC 2306	0.03	ug/l	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chromium, Dissolved	DETSC 2306	0.25	ug/l	< 0.25	< 0.25	< 0.25	< 0.25	0.31	< 0.25	< 0.25	< 0.25
Copper, Dissolved	DETSC 2306	0.4	ug/l	1.0	1.0	0.6	0.7	2.0	0.7	0.5	0.7
Lead, Dissolved	DETSC 2306	0.09	ug/l	0.41	0.11	0.10	0.15	0.65	0.28	0.12	0.10
Mercury, Dissolved	DETSC 2306	0.01	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	0.04	< 0.01	< 0.01	< 0.01
Nickel, Dissolved	DETSC 2306	0.5	ug/l	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Selenium, Dissolved	DETSC 2306	0.25	ug/l	< 0.25	< 0.25	< 0.25	< 0.25	0.35	< 0.25	< 0.25	< 0.25
Zinc, Dissolved	DETSC 2306	1.3	ug/l	< 1.3	< 1.3	< 1.3	< 1.3	2.6	< 1.3	< 1.3	< 1.3
Inorganics											
pH	DETSC 2008		pH	7.0	7.1	7.2	7.0	6.9	7.3	8.1	7.8

Summary of Asbestos Analysis Soil Samples

Our Ref 21-01937

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1794597	TP119 0.70	SOIL	Chrysotile	Bundles of Chrysotile Fibres	Darryl Fletcher
1794603	TP101 0.60	SOIL	NAD	none	Darryl Fletcher
1794604	TP102 0.20	SOIL	NAD	none	Darryl Fletcher
1794605	TP103 0.70	SOIL	NAD	none	Darryl Fletcher
1794606	TP104 0.60	SOIL	Chrysotile	Chrysotile present in Visible Cement debris & Bundles of Chrysotile	Darryl Fletcher
1794607	TP105 0.60	SOIL	NAD	none	Darryl Fletcher
1794608	TP106 1.00	SOIL	NAD	none	Darryl Fletcher
1794609	TP107 0.70	SOIL	NAD	none	Darryl Fletcher
1794610	TP111 1.50	SOIL	NAD	none	Darryl Fletcher
1794611	TP113 0.50	SOIL	NAD	none	Darryl Fletcher
1794612	TP118 1.90	SOIL	NAD	none	Darryl Fletcher
1794613	TP102 0.40	SOIL	Chrysotile	Bundles of Chrysotile Fibres	Darryl Fletcher
1794614	TP106 0.50	SOIL	NAD	none	Darryl Fletcher
1794615	TP109 0.80	SOIL	Chrysotile	Bundles of Chrysotile Fibres	Darryl Fletcher
1794616	TP111 0.40	SOIL	NAD	none	Darryl Fletcher
1794617	TP112 0.60	SOIL	NAD	none	Darryl Fletcher
1794618	TP115 0.40	SOIL	NAD	none	Darryl Fletcher
1794619	TP115 1.40	SOIL	NAD	none	Darryl Fletcher
1794620	TP116 0.40	SOIL	NAD	none	Darryl Fletcher
1794621	TP117 0.50	SOIL	NAD	none	Darryl Fletcher
1794622	TP118 0.70	SOIL	NAD	none	Darryl Fletcher
1794623	TP110 0.50	SOIL	Chrysotile	Chrysotile present in Visible Insulation debris & Bundles of Chrysotile	Darryl Fletcher
1794624	TP101 0.20	SOIL	NAD	none	Darryl Fletcher
1794625	TP103 0.30	SOIL	NAD	none	Darryl Fletcher
1794626	TP104 0.20	SOIL	NAD	none	Darryl Fletcher
1794627	TP108 0.02	SOIL	NAD	none	Darryl Fletcher
1794628	TP110 0.20	SOIL	NAD	none	Darryl Fletcher
1794629	TP112 0.20	SOIL	NAD	none	Darryl Fletcher
1794630	TP114 0.10	SOIL	NAD	none	Darryl Fletcher
1794631	TP119 0.40	SOIL	NAD	none	Darryl Fletcher

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 21-01937
 Client Ref 3649
 Contract Crosland Hill Road

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1794597	TP119 0.70 SOIL	27/01/21	GJ 250ml, PT 1L		
1794598	TP101 0.05 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794599	TP103 0.05 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794600	TP106 0.05 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794601	TP108 0.02 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794602	TP119 0.05 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794603	TP101 0.60 SOIL	27/01/21	GJ 250ml, PT 1L		
1794604	TP102 0.20 SOIL	27/01/21	GJ 250ml, PT 1L		
1794605	TP103 0.70 SOIL	27/01/21	GJ 250ml, PT 1L		
1794606	TP104 0.60 SOIL	27/01/21	GJ 250ml, PT 1L		
1794607	TP105 0.60 SOIL	27/01/21	GJ 250ml, PT 1L		
1794608	TP106 1.00 SOIL	27/01/21	GJ 250ml, PT 1L		
1794609	TP107 0.70 SOIL	27/01/21	GJ 250ml, PT 1L		
1794610	TP111 1.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794611	TP113 0.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794612	TP118 1.90 SOIL	27/01/21	GJ 250ml, PT 1L		
1794613	TP102 0.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794614	TP106 0.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794615	TP109 0.80 SOIL	27/01/21	GJ 250ml, PT 1L		
1794616	TP111 0.40 SOIL	27/01/21	GJ 250ml		
1794617	TP112 0.60 SOIL	27/01/21	GJ 250ml, PT 1L		
1794618	TP115 0.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794619	TP115 1.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794620	TP116 0.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794621	TP117 0.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794622	TP118 0.70 SOIL	27/01/21	GJ 250ml, PT 1L		
1794623	TP110 0.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794624	TP101 0.20 SOIL	27/01/21	GJ 250ml, PT 1L		
1794625	TP103 0.30 SOIL	27/01/21	GJ 250ml, PT 1L		
1794626	TP104 0.20 SOIL	27/01/21	GJ 250ml		
1794627	TP108 0.02 SOIL	27/01/21	PT 1L		BTEX, Naphthalene, PAH MS, EPH/TPH
1794628	TP110 0.20 SOIL	27/01/21	GJ 250ml, PT 1L		
1794629	TP112 0.20 SOIL	27/01/21	GJ 250ml, PT 1L		
1794630	TP114 0.10 SOIL	27/01/21	GJ 250ml, PT 1L		
1794631	TP119 0.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794632	TP119 0.70 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794633	TP101 0.60 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794634	TP106 1.00 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794635	TP102 0.40 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794636	TP109 0.80 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794637	TP115 0.40 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794638	TP104 0.20 LEACHATE	27/01/21	GJ 250ml		
1794639	TP114 0.10 LEACHATE	27/01/21	GJ 250ml, PT 1L		

Information in Support of the Analytical Results

Our Ref 21-01937

Client Ref 3649

Contract Crosland Hill Road

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report



Certificate of Analysis

Certificate Number 21-01937-1

Issued: 09-Feb-21

Client Lithos Consulting Ltd
Parkhill
Walton Rd
Wetherby
LS22 5DZ

Our Reference 21-01937-1

Client Reference 3649

Order No PO7028-GLM

Contract Title Crosland Hill Road

Description 35 Soil samples, 8 Leachate samples.

Date Received 01-Feb-21

Date Started 01-Feb-21

Date Completed 09-Feb-21

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

Notes **This report supersedes 21-01937, extra testing.**

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in blue ink, appearing to read "A. Fenwick", is placed over a faint, larger signature.

Adam Fenwick
Contracts Manager



Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794597	1794598	1794599	1794600	1794601
Sample ID	TP119	TP101	TP103	TP106	TP108
Depth	0.70	0.05	0.05	0.05	0.02
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
Asbestos Quantification	DETSC 1102	0.001	%	< 0.001				
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m	30				
Moisture Content	DETSC 1004	0.1	%	11				
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg	25				
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.6				
Cadmium	DETSC 2301#	0.1	mg/kg	1.1				
Chromium	DETSC 2301#	0.15	mg/kg	23				
Chromium III	DETSC 2301*	0.15	mg/kg	23				
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0				
Copper	DETSC 2301#	0.2	mg/kg	100				
Lead	DETSC 2301#	0.3	mg/kg	95				
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10				
Mercury	DETSC 2325#	0.05	mg/kg	0.15				
Nickel	DETSC 2301#	1	mg/kg	25				
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5				
Vanadium	DETSC 2301#	0.8	mg/kg	44				
Zinc	DETSC 2301#	1	mg/kg	94				
Inorganics								
pH	DETSC 2008#		pH	8.1				
Calorific Value	DETSC 5008	1	MJ/kg	1.8				
Total Organic Carbon	DETSC 2084#	0.5	%	7.2				
Chloride Aqueous Extract	DETSC 2055	1	mg/l	8.4				
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	3.6				
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	100				
Petroleum Hydrocarbons								
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1				
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10				
EPH (C12-C16)	DETSC 3311	10	mg/kg	62				
EPH (C16-C21)	DETSC 3311	10	mg/kg	350				
EPH (C21-C35)	DETSC 3311	10	mg/kg	1400				
EPH (C35-C40)	DETSC 3311	10	mg/kg	190				
EPH (C10-C40)	DETSC 3311#	10	mg/kg	2000				

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794597	1794598	1794599	1794600	1794601
Sample ID	TP119	TP101	TP103	TP106	TP108
Depth	0.70	0.05	0.05	0.05	0.02
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	0.27	8.4	4.8	< 0.03	0.04
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.29	0.14	< 0.03	0.06
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.52	3.1	1.6	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	0.34	0.90	0.63	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	3.3	9.3	4.0	0.03	0.11
Anthracene	DETSC 3303	0.03	mg/kg	0.73	1.7	0.85	< 0.03	0.14
Fluoranthene	DETSC 3303#	0.03	mg/kg	5.3	2.7	2.0	0.04	1.3
Pyrene	DETSC 3303#	0.03	mg/kg	4.9	2.8	2.1	0.07	1.6
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	2.0	0.85	0.52	< 0.03	0.48
Chrysene	DETSC 3303	0.03	mg/kg	2.0	1.5	0.89	0.32	0.42
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	2.2	0.57	0.36	0.11	0.65
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.84	0.15	0.08	0.09	0.23
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	2.1	0.42	0.21	0.08	0.41
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.79	0.13	0.07	< 0.03	0.08
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.23	0.06	0.04	< 0.03	0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.85	0.17	0.12	0.17	0.09
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	26	33	18	0.93	5.6

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794602	1794603	1794604	1794605	1794606
Sample ID	TP119	TP101	TP102	TP103	TP104
Depth	0.05	0.60	0.20	0.70	0.60
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
Asbestos Quantification	DETSC 1102	0.001	%					0.11
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m		45	28	52	33
Moisture Content	DETSC 1004	0.1	%		13	9.5	11	11
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg		3.7	1.3	24	35
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg		0.4	< 0.2	< 0.2	0.4
Cadmium	DETSC 2301#	0.1	mg/kg		0.4	0.1	0.5	0.1
Chromium	DETSC 2301#	0.15	mg/kg		16	12	15	18
Chromium III	DETSC 2301*	0.15	mg/kg		16	12	15	18
Chromium, Hexavalent	DETSC 2204*	1	mg/kg		< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg		18	8.3	23	67
Lead	DETSC 2301#	0.3	mg/kg		13	6.2	22	390
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l		< 10	< 10	< 10	
Mercury	DETSC 2325#	0.05	mg/kg		< 0.05	< 0.05	< 0.05	0.23
Nickel	DETSC 2301#	1	mg/kg		12	9.4	14	15
Selenium	DETSC 2301#	0.5	mg/kg		< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg		20	13	19	22
Zinc	DETSC 2301#	1	mg/kg		51	21	67	54
Inorganics								
pH	DETSC 2008#		pH		8.2	8.3	8.2	7.8
Calorific Value	DETSC 5008	1	MJ/kg					
Total Organic Carbon	DETSC 2084#	0.5	%		0.6	< 0.5	0.6	3.5
Chloride Aqueous Extract	DETSC 2055	1	mg/l		7.7	5.6	2.7	
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l		< 1.0	< 1.0	< 1.0	
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		43	< 10	11	
Petroleum Hydrocarbons								
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg		< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg		< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg		< 10	< 10	< 10	12
EPH (C16-C21)	DETSC 3311	10	mg/kg		< 10	< 10	16	60
EPH (C21-C35)	DETSC 3311	10	mg/kg		< 10	< 10	70	120
EPH (C35-C40)	DETSC 3311	10	mg/kg		< 10	< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg		< 10	< 10	96	200

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794602	1794603	1794604	1794605	1794606
Sample ID	TP119	TP101	TP102	TP103	TP104
Depth	0.05	0.60	0.20	0.70	0.60
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	2.6
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.53
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.41
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.03	0.14	< 0.03	0.08	3.2
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	0.03	< 0.03	< 0.03	0.73
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.07	0.19	< 0.03	0.10	3.0
Pyrene	DETSC 3303#	0.03	mg/kg	0.13	0.18	< 0.03	0.09	2.5
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.08	0.07	< 0.03	0.03	0.97
Chrysene	DETSC 3303	0.03	mg/kg	0.43	0.08	< 0.03	0.03	0.97
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.20	0.08	< 0.03	0.03	0.87
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.28
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.11	0.06	< 0.03	< 0.03	0.69
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.07	0.03	< 0.03	< 0.03	0.23
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.05	< 0.03	< 0.03	< 0.03	0.08
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.12	< 0.03	< 0.03	< 0.03	0.21
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	1.3	0.87	< 0.10	0.37	17

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794607	1794608	1794609	1794610	1794611
Sample ID	TP105	TP106	TP107	TP111	TP113
Depth	0.60	1.00	0.70	1.50	0.50
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
Asbestos Quantification	DETSC 1102	0.001	%					
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m	38	30	15	41	21
Moisture Content	DETSC 1004	0.1	%	10	15	16	8.0	14
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg	7.3	14	13	3.4	13
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.5	0.4	0.3	0.3	0.9
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.3	0.3	< 0.1	0.3
Chromium	DETSC 2301#	0.15	mg/kg	12	17	20	12	20
Chromium III	DETSC 2301*	0.15	mg/kg	12	17	20	12	20
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	15	31	34	12	47
Lead	DETSC 2301#	0.3	mg/kg	56	55	42	21	110
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l		< 10	< 10		
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.08	< 0.05	< 0.05	0.28
Nickel	DETSC 2301#	1	mg/kg	9.8	14	16	9.3	20
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	16	23	28	14	29
Zinc	DETSC 2301#	1	mg/kg	55	45	46	32	79
Inorganics								
pH	DETSC 2008#		pH	8.2	7.6	8.0	7.9	7.9
Calorific Value	DETSC 5008	1	MJ/kg					
Total Organic Carbon	DETSC 2084#	0.5	%	0.7	1.6	2.3	< 0.5	4.9
Chloride Aqueous Extract	DETSC 2055	1	mg/l		6.5	14		
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l		4.5	1.7		
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		40	30		
Petroleum Hydrocarbons								
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	46
EPH (C16-C21)	DETSC 3311	10	mg/kg	20	13	22	< 10	200
EPH (C21-C35)	DETSC 3311	10	mg/kg	140	48	67	< 10	350
EPH (C35-C40)	DETSC 3311	10	mg/kg	39	< 10	17	< 10	17
EPH (C10-C40)	DETSC 3311#	10	mg/kg	210	77	120	< 10	620

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794607	1794608	1794609	1794610	1794611
Sample ID	TP105	TP106	TP107	TP111	TP113
Depth	0.60	1.00	0.70	1.50	0.50
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	1.4	< 0.03	0.04	< 0.03	0.36
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.45	< 0.03	0.06	< 0.03	2.5
Fluorene	DETSC 3303	0.03	mg/kg	0.30	< 0.03	0.04	< 0.03	2.4
Phenanthrene	DETSC 3303#	0.03	mg/kg	1.7	0.15	0.38	0.21	13
Anthracene	DETSC 3303	0.03	mg/kg	0.31	0.04	0.08	0.05	2.8
Fluoranthene	DETSC 3303#	0.03	mg/kg	1.5	0.20	0.63	0.34	10
Pyrene	DETSC 3303#	0.03	mg/kg	1.3	0.18	0.58	0.32	7.9
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.40	0.06	0.19	0.12	3.2
Chrysene	DETSC 3303	0.03	mg/kg	0.40	0.07	0.23	0.12	2.9
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.28	0.06	0.21	0.11	2.9
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.09	< 0.03	0.08	0.04	1.1
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.21	0.04	0.17	0.09	2.7
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.07	< 0.03	0.08	0.04	1.1
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.32
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03	0.08	0.03	0.94
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	8.4	0.79	2.9	1.5	54

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794612	1794613	1794614	1794615	1794616
Sample ID	TP118	TP102	TP106	TP109	TP111
Depth	1.90	0.40	0.50	0.80	0.40
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
Asbestos Quantification	DETSC 1102	0.001	%		0.004		0.004	
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m	17	53	60	58	18
Moisture Content	DETSC 1004	0.1	%	13	13	8.5	19	11
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg	5.6	7.2	17	160	9.3
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	0.2	1.1	0.3	2.5	0.8
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.8	1.0	0.9	0.2
Chromium	DETSC 2301#	0.15	mg/kg	15	20	9.9	25	15
Chromium III	DETSC 2301*	0.15	mg/kg	15	20	9.9	25	15
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	15	38	42	160	32
Lead	DETSC 2301#	0.3	mg/kg	15	170	80	310	110
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l	< 10	< 10	< 10	14	25
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.11	0.06	2.0	0.18
Nickel	DETSC 2301#	1	mg/kg	15	12	9.9	33	13
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	0.6	< 0.5	1.0	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	21	35	18	56	20
Zinc	DETSC 2301#	1	mg/kg	50	59	58	150	52
Inorganics								
pH	DETSC 2008#		pH	8.2	9.8	8.2	8.4	8.5
Calorific Value	DETSC 5008	1	MJ/kg					
Total Organic Carbon	DETSC 2084#	0.5	%	< 0.5	2.8	2.7	9.5	1.8
Chloride Aqueous Extract	DETSC 2055	1	mg/l	6.4	11	14	7.2	6.2
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l	1.3	1.1	11	5.0	2.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	18	190	21	190	100
Petroleum Hydrocarbons								
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	36	16	27
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	< 10	110	64	110
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	< 10	570	190	200
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	140	15	16
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	< 10	860	290	360

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794612	1794613	1794614	1794615	1794616
Sample ID	TP118	TP102	TP106	TP109	TP111
Depth	1.90	0.40	0.50	0.80	0.40
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	0.38	0.23	< 0.03	0.12
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	1.7	0.30	0.04	0.17
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	1.7	0.23	0.04	0.10
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.12	7.1	1.9	0.41	0.81
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	2.5	0.43	0.09	0.17
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.21	6.4	2.0	0.83	0.93
Pyrene	DETSC 3303#	0.03	mg/kg	0.18	5.5	1.8	0.78	0.82
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.08	1.8	0.59	0.28	0.28
Chrysene	DETSC 3303	0.03	mg/kg	0.09	1.8	0.60	0.30	0.27
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.09	1.3	0.56	0.36	0.26
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.03	0.44	0.19	0.12	0.10
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.07	1.3	0.40	0.30	0.20
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.05	0.45	0.15	0.15	0.08
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.15	0.03	0.04	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.05	0.43	0.14	0.17	0.07
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.97	33	9.6	3.9	4.4

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794617	1794618	1794619	1794620	1794621
Sample ID	TP112	TP115	TP115	TP116	TP117
Depth	0.60	0.40	1.40	0.40	0.50
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
Asbestos Quantification	DETSC 1102	0.001	%					
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m	62	22	58	66	72
Moisture Content	DETSC 1004	0.1	%	15	14	17	4.4	8.3
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg	19	8.1	23	2.1	5.7
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	1.2	0.3	1.6	< 0.2	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.4	0.3	0.6	0.2
Chromium	DETSC 2301#	0.15	mg/kg	16	14	16	5.0	14
Chromium III	DETSC 2301*	0.15	mg/kg	16	14	16	5.0	14
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	41	34	53	8.6	76
Lead	DETSC 2301#	0.3	mg/kg	200	61	85	12	56
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l		< 10	10		< 10
Mercury	DETSC 2325#	0.05	mg/kg	0.34	0.19	0.39	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	18	18	15	4.1	24
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	25	23	26	9.0	18
Zinc	DETSC 2301#	1	mg/kg	94	120	56	35	42
Inorganics								
pH	DETSC 2008#		pH	8.2	8.0	7.8	8.0	7.7
Calorific Value	DETSC 5008	1	MJ/kg					
Total Organic Carbon	DETSC 2084#	0.5	%	3.0	2.8	7.8	3.1	1.5
Chloride Aqueous Extract	DETSC 2055	1	mg/l		5.7	18		4.2
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l		1.7	4.4		< 1.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		24	86		15
Petroleum Hydrocarbons								
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	15	< 10	< 10	< 10	< 10
EPH (C16-C21)	DETSC 3311	10	mg/kg	50	40	15	< 10	< 10
EPH (C21-C35)	DETSC 3311	10	mg/kg	81	68	22	< 10	< 10
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C10-C40)	DETSC 3311#	10	mg/kg	150	120	47	< 10	< 10

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794617	1794618	1794619	1794620	1794621
Sample ID	TP112	TP115	TP115	TP116	TP117
Depth	0.60	0.40	1.40	0.40	0.50
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	0.76	0.30	0.35	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.96	0.15	0.24	< 0.03	0.03
Fluorene	DETSC 3303	0.03	mg/kg	0.74	0.18	0.17	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	3.1	1.3	1.1	< 0.03	0.16
Anthracene	DETSC 3303	0.03	mg/kg	0.90	0.27	0.25	< 0.03	0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	2.7	1.3	0.88	0.03	0.24
Pyrene	DETSC 3303#	0.03	mg/kg	2.2	1.1	0.78	< 0.03	0.21
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.73	0.37	0.22	< 0.03	0.08
Chrysene	DETSC 3303	0.03	mg/kg	0.68	0.36	0.23	< 0.03	0.09
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.60	0.34	0.18	< 0.03	0.07
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.18	0.09	0.06	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.49	0.26	0.14	< 0.03	0.05
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.15	0.08	0.05	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.14	0.08	0.04	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	14	6.3	4.6	< 0.10	0.96

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794622	1794623	1794624	1794625	1794626
Sample ID	TP118	TP110	TP101	TP103	TP104
Depth	0.70	0.50	0.20	0.30	0.20
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
Asbestos Quantification	DETSC 1102	0.001	%		0.080			
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m	68	57	65	52	61
Moisture Content	DETSC 1004	0.1	%	8.3	17	7.6	6.0	8.2
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg	3.6	6.8	1.7	2.3	2.0
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	< 0.2	0.4	< 0.2	< 0.2	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.2	0.3	0.1	0.2
Chromium	DETSC 2301#	0.15	mg/kg	11	14	7.5	14	13
Chromium III	DETSC 2301*	0.15	mg/kg	11	14	7.5	14	13
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	18	16	6.8	16	12
Lead	DETSC 2301#	0.3	mg/kg	20	41	4.8	4.4	16
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l		11	< 10		< 10
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.09	< 0.05	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	10	9.9	5.9	10	11
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	15	21	8.8	15	16
Zinc	DETSC 2301#	1	mg/kg	42	34	27	19	61
Inorganics								
pH	DETSC 2008#		pH	8.1	7.6	8.3	8.2	8.3
Calorific Value	DETSC 5008	1	MJ/kg					
Total Organic Carbon	DETSC 2084#	0.5	%	1.1	1.9	< 0.5	< 0.5	0.6
Chloride Aqueous Extract	DETSC 2055	1	mg/l		5.1	8.4		8.6
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l		19	< 1.0		< 1.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		35	< 10		24
Petroleum Hydrocarbons								
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	15
EPH (C16-C21)	DETSC 3311	10	mg/kg	25	< 10	< 10	13	94
EPH (C21-C35)	DETSC 3311	10	mg/kg	190	< 10	< 10	230	1000
EPH (C35-C40)	DETSC 3311	10	mg/kg	10	< 10	< 10	75	270
EPH (C10-C40)	DETSC 3311#	10	mg/kg	240	< 10	< 10	320	1400

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794622	1794623	1794624	1794625	1794626
Sample ID	TP118	TP110	TP101	TP103	TP104
Depth	0.70	0.50	0.20	0.30	0.20
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.05	< 0.03	< 0.03	0.04
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	0.04	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.12	0.28	< 0.03	0.03	0.14
Anthracene	DETSC 3303	0.03	mg/kg	0.03	0.05	0.03	< 0.03	0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.25	0.28	< 0.03	0.05	0.16
Pyrene	DETSC 3303#	0.03	mg/kg	0.23	0.23	0.04	0.05	0.16
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.10	0.08	< 0.03	< 0.03	0.08
Chrysene	DETSC 3303	0.03	mg/kg	0.10	0.08	< 0.03	< 0.03	0.11
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.13	0.08	< 0.03	< 0.03	0.10
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	< 0.03	0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.10	0.05	< 0.03	< 0.03	0.08
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.05	< 0.03	< 0.03	< 0.03	0.04
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.07	< 0.03	< 0.03	< 0.03	0.04
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	1.2	1.3	< 0.10	0.14	1.0

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794627	1794628	1794629	1794630	1794631
Sample ID	TP108	TP110	TP112	TP114	TP119
Depth	0.02	0.20	0.20	0.10	0.40
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
Asbestos Quantification	DETSC 1102	0.001	%					
Preparation								
Stones >10mm	DETSC 1003*	1	% m/m	24	42	70	67	68
Moisture Content	DETSC 1004	0.1	%	8.5	5.3	3.9	11	4.3
Metals								
Arsenic	DETSC 2301#	0.2	mg/kg	1.3	7.7	3.3	24	2.2
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	< 0.2	< 0.2	< 0.2	0.4	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	4.4	0.9	0.5	1.0
Chromium	DETSC 2301#	0.15	mg/kg	10	4.3	3.2	38	7.6
Chromium III	DETSC 2301*	0.15	mg/kg	10	4.3	3.2	38	7.6
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	7.6	56	7.7	60	11
Lead	DETSC 2301#	0.3	mg/kg	6.9	44	8.6	30	30
Magnesium Aqueous Extract	DETSC 2076*	10	mg/l		< 10		< 10	< 10
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.42	< 0.05	0.09	< 0.05
Nickel	DETSC 2301#	1	mg/kg	8.0	6.0	4.3	38	7.1
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	11	7.8	8.5	54	12
Zinc	DETSC 2301#	1	mg/kg	27	230	43	74	28
Inorganics								
pH	DETSC 2008#		pH	8.3	8.7	8.8	10.8	9.0
Calorific Value	DETSC 5008	1	MJ/kg					
Total Organic Carbon	DETSC 2084#	0.5	%	< 0.5	4.2	2.8	5.2	2.6
Chloride Aqueous Extract	DETSC 2055	1	mg/l		6.1		25	11
Nitrate Aqueous Extract as NO3	DETSC 2055	1	mg/l		< 1.0		2.4	< 1.0
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		< 10		83	16
Petroleum Hydrocarbons								
EPH (C6-C10)	DETSC 3321*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
EPH (C10-C12)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	< 10
EPH (C12-C16)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	38
EPH (C16-C21)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	280
EPH (C21-C35)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	940
EPH (C35-C40)	DETSC 3311	10	mg/kg	< 10	< 10	< 10	< 10	91
EPH (C10-C40)	DETSC 3311#	10	mg/kg	< 10	< 10	< 10	< 10	1400

Summary of Chemical Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794627	1794628	1794629	1794630	1794631
Sample ID	TP108	TP110	TP112	TP114	TP119
Depth	0.02	0.20	0.20	0.10	0.40
Other ID					
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.10
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.07
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.25
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.17
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.08	< 0.03	< 0.03	0.07	1.4
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.36
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.11	< 0.03	< 0.03	0.11	3.3
Pyrene	DETSC 3303#	0.03	mg/kg	0.10	< 0.03	< 0.03	0.10	3.1
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	0.03	1.5
Chrysene	DETSC 3303	0.03	mg/kg	0.04	< 0.03	< 0.03	0.04	1.5
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	0.03	1.9
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.68
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.03	< 0.03	< 0.03	< 0.03	1.8
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	1.0
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.28
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	1.2
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.45	< 0.10	< 0.10	0.39	19

Summary of Chemical Analysis

Leachate Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794632	1794633	1794634	1794635	1794636	1794637	1794638	1794639
Sample ID	TP119	TP101	TP106	TP102	TP109	TP115	TP104	TP114
Depth	0.70	0.60	1.00	0.40	0.80	0.40	0.20	0.10
Other ID								
Sample Type	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units								
Preparation											
NRA Leachate Preparation	DETSC 1009*			Y	Y	Y	Y	Y	Y	Y	Y
Metals											
Arsenic, Dissolved	DETSC 2306	0.16	ug/l	0.40	0.19	0.26	0.32	4.5	0.67	0.23	0.22
Boron, Dissolved	DETSC 2306*	12	ug/l	< 12	< 12	< 12	< 12	< 12	< 12	< 12	< 12
Cadmium, Dissolved	DETSC 2306	0.03	ug/l	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Chromium, Dissolved	DETSC 2306	0.25	ug/l	< 0.25	< 0.25	< 0.25	< 0.25	0.31	< 0.25	< 0.25	< 0.25
Copper, Dissolved	DETSC 2306	0.4	ug/l	1.0	1.0	0.6	0.7	2.0	0.7	0.5	0.7
Lead, Dissolved	DETSC 2306	0.09	ug/l	0.41	0.11	0.10	0.15	0.65	0.28	0.12	0.10
Mercury, Dissolved	DETSC 2306	0.01	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	0.04	< 0.01	< 0.01	< 0.01
Nickel, Dissolved	DETSC 2306	0.5	ug/l	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Selenium, Dissolved	DETSC 2306	0.25	ug/l	< 0.25	< 0.25	< 0.25	< 0.25	0.35	< 0.25	< 0.25	< 0.25
Zinc, Dissolved	DETSC 2306	1.3	ug/l	< 1.3	< 1.3	< 1.3	< 1.3	2.6	< 1.3	< 1.3	< 1.3
Inorganics											
pH	DETSC 2008		pH	7.0	7.1	7.2	7.0	6.9	7.3	8.1	7.8

Summary of Asbestos Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1794597	TP119 0.70	SOIL	Chrysotile	Bundles of Chrysotile Fibres	Darryl Fletcher
1794603	TP101 0.60	SOIL	NAD	none	Darryl Fletcher
1794604	TP102 0.20	SOIL	NAD	none	Darryl Fletcher
1794605	TP103 0.70	SOIL	NAD	none	Darryl Fletcher
1794606	TP104 0.60	SOIL	Chrysotile	Chrysotile present in Visible Cement debris & Bundles of Chrysotile	Darryl Fletcher
1794607	TP105 0.60	SOIL	NAD	none	Darryl Fletcher
1794608	TP106 1.00	SOIL	NAD	none	Darryl Fletcher
1794609	TP107 0.70	SOIL	NAD	none	Darryl Fletcher
1794610	TP111 1.50	SOIL	NAD	none	Darryl Fletcher
1794611	TP113 0.50	SOIL	NAD	none	Darryl Fletcher
1794612	TP118 1.90	SOIL	NAD	none	Darryl Fletcher
1794613	TP102 0.40	SOIL	Chrysotile	Bundles of Chrysotile Fibres	Darryl Fletcher
1794614	TP106 0.50	SOIL	NAD	none	Darryl Fletcher
1794615	TP109 0.80	SOIL	Chrysotile	Bundles of Chrysotile Fibres	Darryl Fletcher
1794616	TP111 0.40	SOIL	NAD	none	Darryl Fletcher
1794617	TP112 0.60	SOIL	NAD	none	Darryl Fletcher
1794618	TP115 0.40	SOIL	NAD	none	Darryl Fletcher
1794619	TP115 1.40	SOIL	NAD	none	Darryl Fletcher
1794620	TP116 0.40	SOIL	NAD	none	Darryl Fletcher
1794621	TP117 0.50	SOIL	NAD	none	Darryl Fletcher
1794622	TP118 0.70	SOIL	NAD	none	Darryl Fletcher
1794623	TP110 0.50	SOIL	Chrysotile	Chrysotile present in Visible Insulation debris & Bundles of Chrysotile	Darryl Fletcher
1794624	TP101 0.20	SOIL	NAD	none	Darryl Fletcher
1794625	TP103 0.30	SOIL	NAD	none	Darryl Fletcher
1794626	TP104 0.20	SOIL	NAD	none	Darryl Fletcher
1794627	TP108 0.02	SOIL	NAD	none	Darryl Fletcher
1794628	TP110 0.20	SOIL	NAD	none	Darryl Fletcher
1794629	TP112 0.20	SOIL	NAD	none	Darryl Fletcher
1794630	TP114 0.10	SOIL	NAD	none	Darryl Fletcher
1794631	TP119 0.40	SOIL	NAD	none	Darryl Fletcher

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * -not included in laboratory scope of accreditation.

Summary of Asbestos Quantification Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794597	1794606	1794613	1794615
Sample ID	TP119	TP104	TP102	TP109
Depth	0.70	0.60	0.40	0.80
Other ID				
Sample Type	SOIL	SOIL	SOIL	SOIL
Sampling Date	27/01/2021	27/01/2021	27/01/2021	27/01/2021
Sampling Time				

Test	Method	Units				
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	< 0.001	0.109	0.004	0.004
Gravimetric Quantification (a)	DETSC 1102	Mass %	na	0.108	na	na
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	<0.001	<0.001	0.004	0.004
Quantification by PCOM (c)	DETSC 1102	Mass %	na	na	na	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na	na	na	na
Breakdown of Gravimetric Analysis (a)						
Mass of Sample		g	497.04	597.92	364.08	400.53
ACMs present*		type		Cement		
Mass of ACM in sample		g		4.30		
% ACM by mass		%		0.72		
% asbestos in ACM		%		15		
% asbestos in sample		%		0.108		
Breakdown of Detailed Gravimetric Analysis (b)						
% Amphibole bundles in sample		Mass %	na	na	na	na
% Chrysotile bundles in sample		Mass %	<0.001	<0.001	0.004	0.004
Breakdown of PCOM Analysis (c)						
% Amphibole fibres in sample		Mass %	na	na	na	na
% Chrysotile fibres in sample		Mass %	na	na	na	na
Breakdown of Potentially Respirable Fibre Analysis (d)						
Amphibole fibres		Fibres/g	na	na	na	na
Chrysotile fibres		Fibres/g	na	na	na	na

* Denotes test or material description outside of UKAS accreditation.
 % asbestos in Asbestos Containing Materials (ACMs) is determined by
 by reference to HSG 264.
 Recommended sample size for quantification is approximately 1kg
 # denotes deviating sample

Summary of Asbestos Quantification Analysis

Soil Samples

Our Ref 21-01937-1

Client Ref 3649

Contract Title Crosland Hill Road

Lab No	1794623
Sample ID	TP110
Depth	0.50
Other ID	
Sample Type	SOIL
Sampling Date	27/01/2021
Sampling Time	

Test	Method	Units	
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	0.080
Gravimetric Quantification (a)	DETSC 1102	Mass %	0.074
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	0.006
Quantification by PCOM (c)	DETSC 1102	Mass %	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na
Breakdown of Gravimetric Analysis (a)			
Mass of Sample		g	264.25
ACMs present*		type	Insulation
Mass of ACM in sample		g	0.23
% ACM by mass		%	0.09
% asbestos in ACM		%	85
% asbestos in sample		%	0.074
Breakdown of Detailed Gravimetric Analysis (b)			
% Amphibole bundles in sample		Mass %	na
% Chrysotile bundles in sample		Mass %	0.006
Breakdown of PCOM Analysis (c)			
% Amphibole fibres in sample		Mass %	na
% Chrysotile fibres in sample		Mass %	na
Breakdown of Potentially Respirable Fibre Analysis (d)			
Amphibole fibres		Fibres/g	na
Chrysotile fibres		Fibres/g	na

* Denotes test or material description outside of UKAS accreditation.
 % asbestos in Asbestos Containing Materials (ACMs) is determined by
 by reference to HSG 264.
 Recommended sample size for quantification is approximately 1kg
 # denotes deviating sample

Information in Support of the Analytical Results

Our Ref 21-01937-1
 Client Ref 3649
 Contract Crosland Hill Road

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1794597	TP119 0.70 SOIL	27/01/21	GJ 250ml, PT 1L		
1794598	TP101 0.05 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794599	TP103 0.05 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794600	TP106 0.05 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794601	TP108 0.02 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794602	TP119 0.05 SOIL	27/01/21	PT 1L		Naphthalene, PAH MS
1794603	TP101 0.60 SOIL	27/01/21	GJ 250ml, PT 1L		
1794604	TP102 0.20 SOIL	27/01/21	GJ 250ml, PT 1L		
1794605	TP103 0.70 SOIL	27/01/21	GJ 250ml, PT 1L		
1794606	TP104 0.60 SOIL	27/01/21	GJ 250ml, PT 1L		
1794607	TP105 0.60 SOIL	27/01/21	GJ 250ml, PT 1L		
1794608	TP106 1.00 SOIL	27/01/21	GJ 250ml, PT 1L		
1794609	TP107 0.70 SOIL	27/01/21	GJ 250ml, PT 1L		
1794610	TP111 1.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794611	TP113 0.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794612	TP118 1.90 SOIL	27/01/21	GJ 250ml, PT 1L		
1794613	TP102 0.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794614	TP106 0.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794615	TP109 0.80 SOIL	27/01/21	GJ 250ml, PT 1L		
1794616	TP111 0.40 SOIL	27/01/21	GJ 250ml		
1794617	TP112 0.60 SOIL	27/01/21	GJ 250ml, PT 1L		
1794618	TP115 0.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794619	TP115 1.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794620	TP116 0.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794621	TP117 0.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794622	TP118 0.70 SOIL	27/01/21	GJ 250ml, PT 1L		
1794623	TP110 0.50 SOIL	27/01/21	GJ 250ml, PT 1L		
1794624	TP101 0.20 SOIL	27/01/21	GJ 250ml, PT 1L		
1794625	TP103 0.30 SOIL	27/01/21	GJ 250ml, PT 1L		
1794626	TP104 0.20 SOIL	27/01/21	GJ 250ml		
1794627	TP108 0.02 SOIL	27/01/21	PT 1L		BTEX, Naphthalene, PAH MS, EPH/TPH
1794628	TP110 0.20 SOIL	27/01/21	GJ 250ml, PT 1L		
1794629	TP112 0.20 SOIL	27/01/21	GJ 250ml, PT 1L		
1794630	TP114 0.10 SOIL	27/01/21	GJ 250ml, PT 1L		
1794631	TP119 0.40 SOIL	27/01/21	GJ 250ml, PT 1L		
1794632	TP119 0.70 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794633	TP101 0.60 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794634	TP106 1.00 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794635	TP102 0.40 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794636	TP109 0.80 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794637	TP115 0.40 LEACHATE	27/01/21	GJ 250ml, PT 1L		
1794638	TP104 0.20 LEACHATE	27/01/21	GJ 250ml		
1794639	TP114 0.10 LEACHATE	27/01/21	GJ 250ml, PT 1L		

Information in Support of the Analytical Results

Our Ref 21-01937-1

Client Ref 3649

Contract Crosland Hill Road

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

Appendix I
Geotechnical Test Results



LABORATORY REPORT



4043

Contract Number: PSL21/0987

Report Date: 19 February 2021

Client's Reference: 3649

Client Name: Lithos Consulting
Parkhill
Walton Road
Wetherby
North Yorkshire
LS22 5DZ

For the attention of: George Morton

Contract Title: Crosland Hill Road

Date Received: 2/2/2021

Date Commenced: 2/2/2021

Date Completed: 19/2/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)


S Royle
(Laboratory Manager)

L Knight
(Senior Technician)

S Eyre
(Senior Technician)

T Watkins
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
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Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP102	4	D&B	0.90		MADE GROUND brown sandy slightly clayey gravel of cobbles.
TP104	3	D&B	0.80		MADE GROUND brown very sandy clayey gravel of cobbles.
TP106	4	D&B	1.50		MADE GROUND brown very sandy very clayey gravel.
TP107	2	D&B	0.30		Brown very sandy clayey GRAVEL.
TP109	1	D&B	0.30		Brown clayey SAND & GRAVEL.
TP111	2	D&B	0.60		MADE GROUND brown clayey sand & gravel with many cobbles.
TP113	2	D&B	0.60		MADE GROUND brown sandy clayey gravel with many cobbles.
TP114	3	D	2.50		Brown gravelly sandy CLAY.
TP117	3	D&B	0.80		MADE GROUND brown sandy slightly clayey gravel with many cobbles.
TP117	4	D&B	1.50		Brown very sandy clayey GRAVEL with many cobbles.
TP119	5	D&B	1.40		Grey sandy clayey GRAVEL.



4043



Crosland Hill Road

Contract No:

PSL21/0987

Client Ref:

3649

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



4043

PSL
Professional Soils Laboratory

Crosland Hill Road

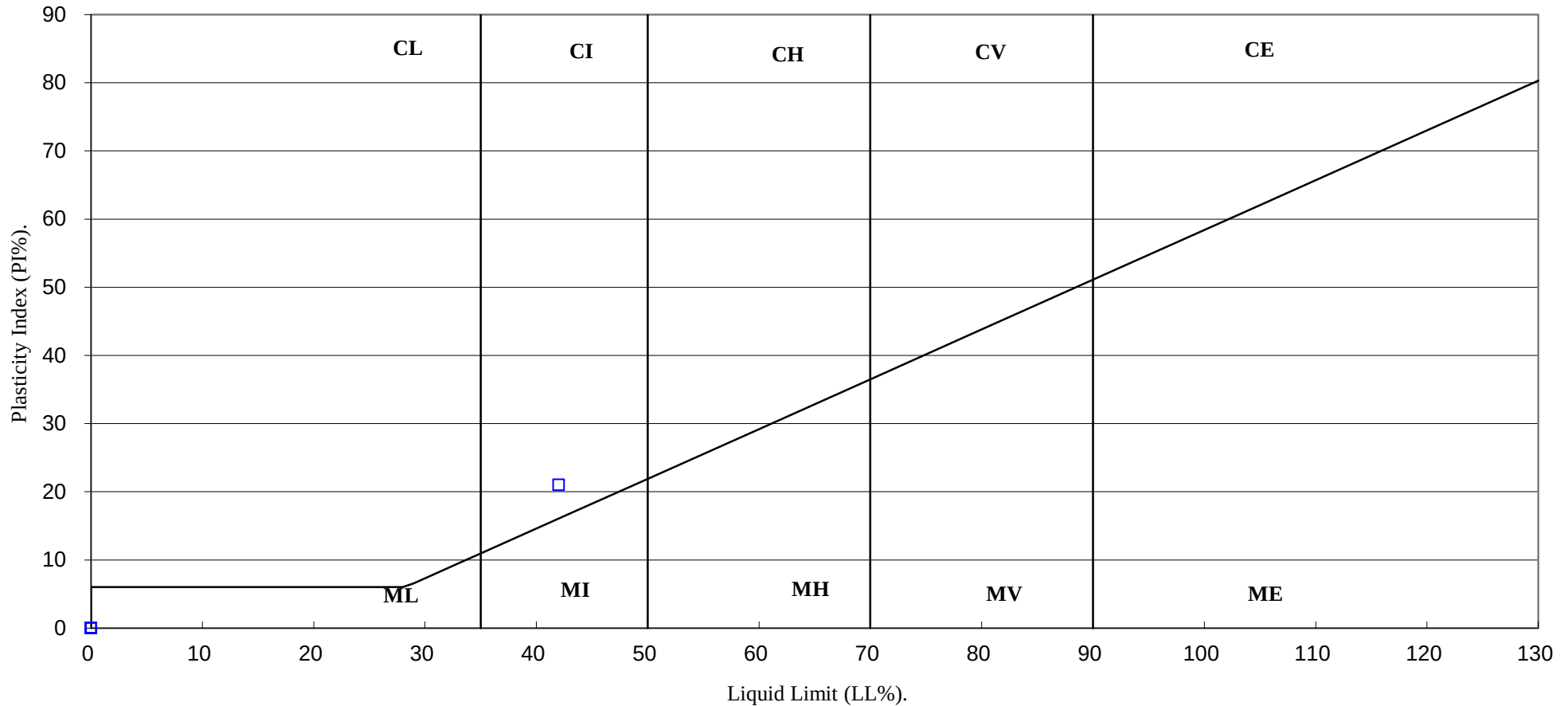
Contract No:

PSL21/0987

Client Ref:

3649

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



4043

PSL
Professional Soils Laboratory

Crosland Hill Road

Contract No:

PSL21/0987

Client Ref:

3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

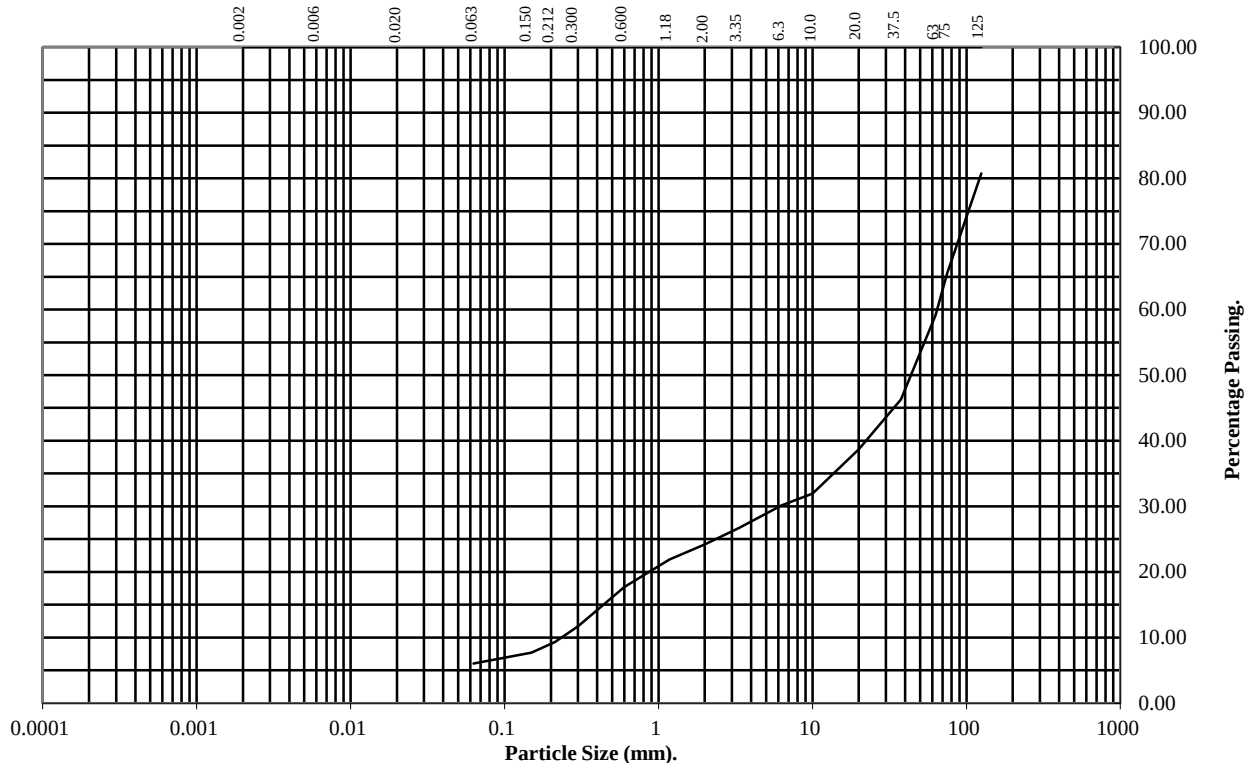
Hole Number: TP102

Top Depth (m): 0.90

Sample Number: 4

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	81
75	65
63	59
37.5	46
20	39
10	32
6.3	30
3.35	27
2	24
1.18	22
0.6	18
0.3	12
0.212	9
0.15	8
0.063	6

Soil Fraction	Total Percentage
Cobbles	41
Gravel	35
Sand	18
Silt/Clay	6

Remarks:

See Summary of Soil Descriptions



Crosland Hill Road

Contract No:
PSL21/0987
Client Ref:
3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

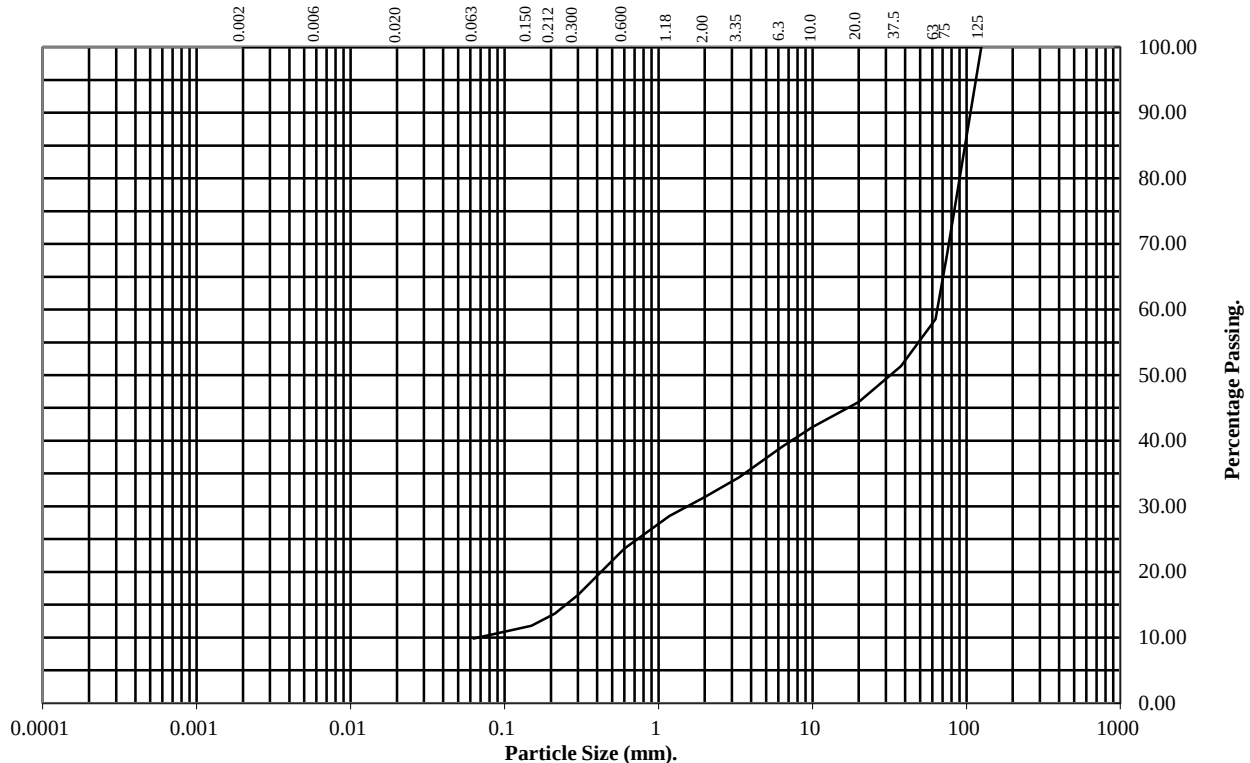
Hole Number: TP104

Top Depth (m): 0.80

Sample Number: 3

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	68
63	59
37.5	51
20	46
10	42
6.3	39
3.35	34
2	31
1.18	29
0.6	24
0.3	16
0.212	14
0.15	12
0.063	10

Soil Fraction	Total Percentage
Cobbles	41
Gravel	28
Sand	21
Silt/Clay	10

Remarks:

See Summary of Soil Descriptions



Crosland Hill Road

Contract No:

PSL21/0987

Client Ref:

3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

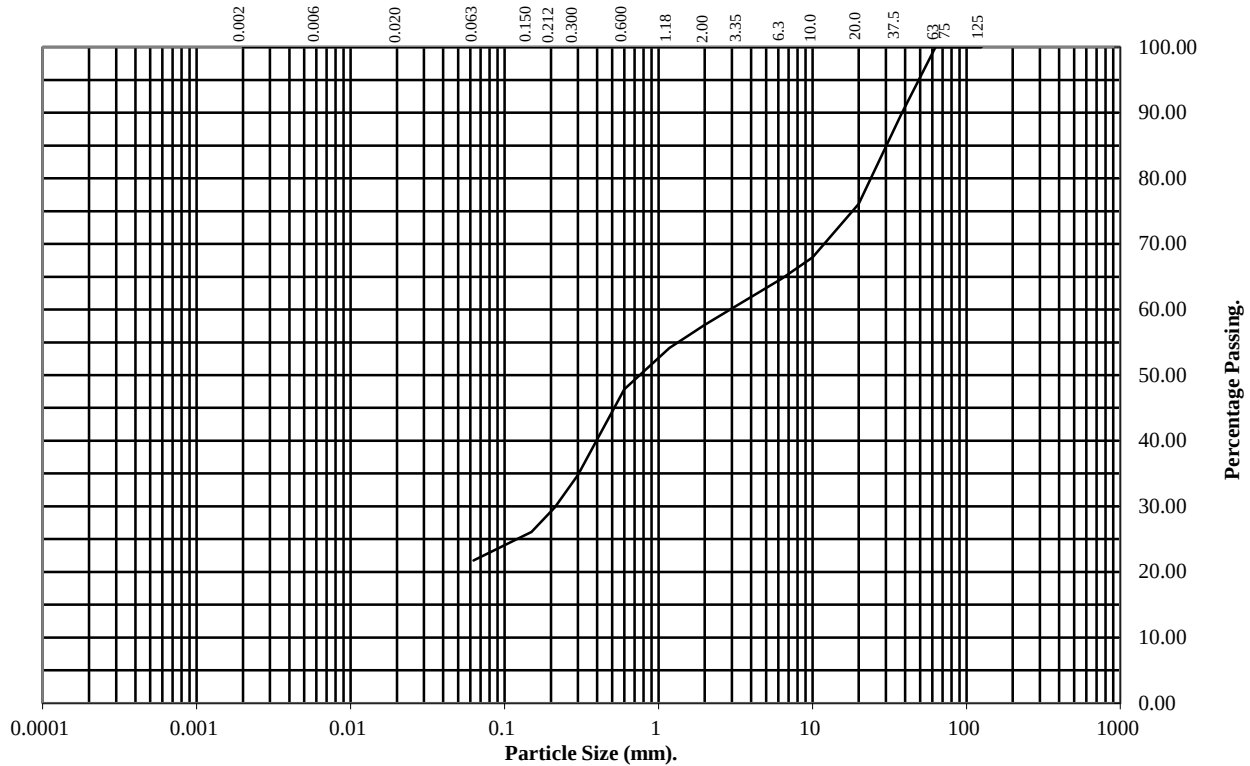
Hole Number: TP106

Top Depth (m): 1.50

Sample Number: 4

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	90
20	76
10	68
6.3	65
3.35	61
2	58
1.18	54
0.6	48
0.3	35
0.212	30
0.15	26
0.063	22

Soil Fraction	Total Percentage
Cobbles	0
Gravel	42
Sand	36
Silt/Clay	22

Remarks:

See Summary of Soil Descriptions



Crosland Hill Road

Contract No:
PSL21/0987
Client Ref:
3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

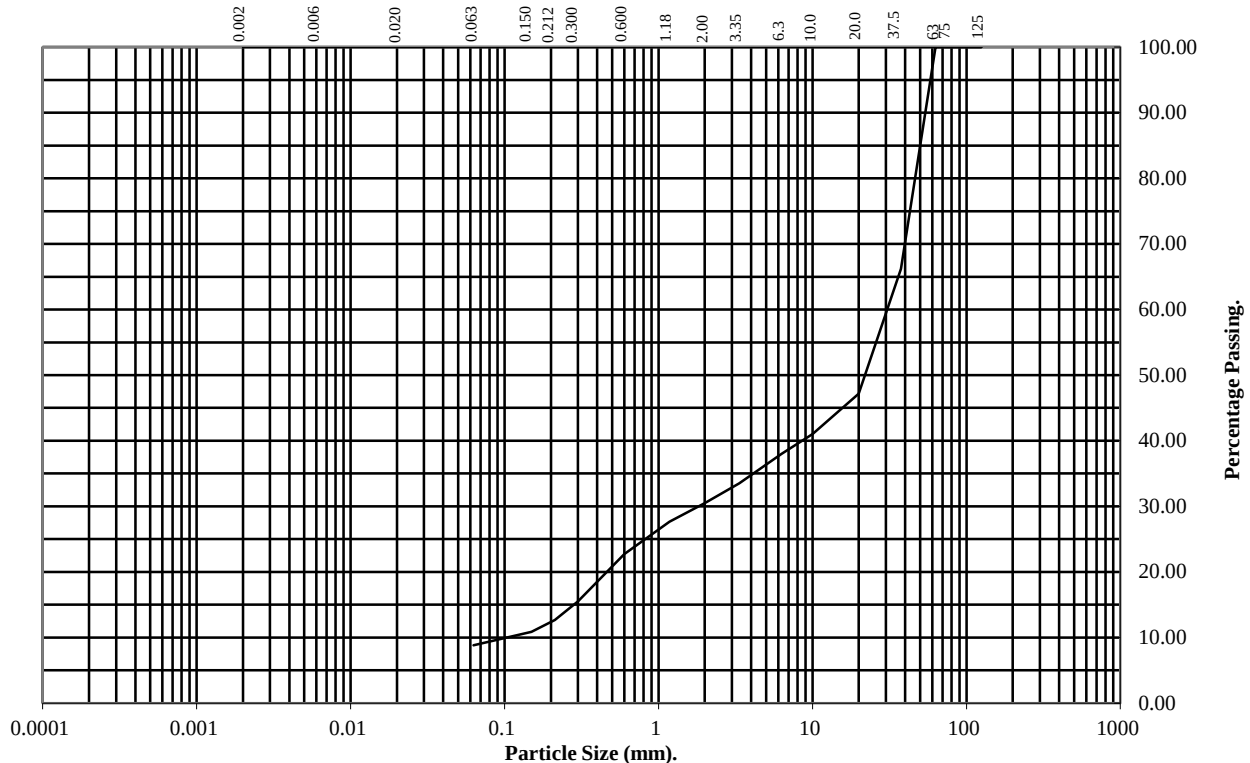
Hole Number: TP107

Top Depth (m): 0.30

Sample Number: 2

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	66
20	47
10	41
6.3	38
3.35	34
2	31
1.18	28
0.6	23
0.3	15
0.212	13
0.15	11
0.063	9

Soil Fraction	Total Percentage
Cobbles	0
Gravel	69
Sand	22
Silt/Clay	9

Remarks:

See Summary of Soil Descriptions



Crosland Hill Road

Contract No:
PSL21/0987
Client Ref:
3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

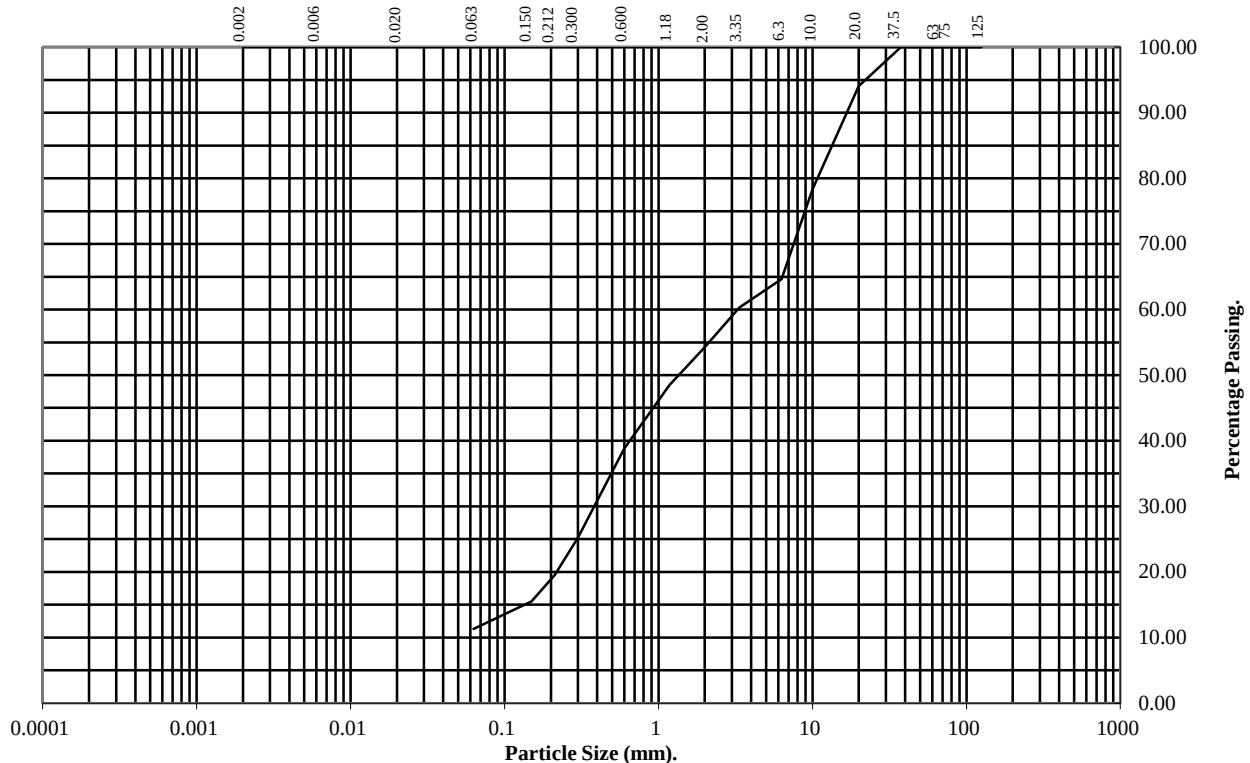
Hole Number: TP109

Top Depth (m): 0.30

Sample Number: 1

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	94
10	78
6.3	65
3.35	60
2	54
1.18	48
0.6	39
0.3	25
0.212	20
0.15	16
0.063	11

Soil Fraction	Total Percentage
Cobbles	0
Gravel	46
Sand	43
Silt/Clay	11

Remarks:

See Summary of Soil Descriptions



Crosland Hill Road

Contract No:
PSL21/0987
Client Ref:
3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

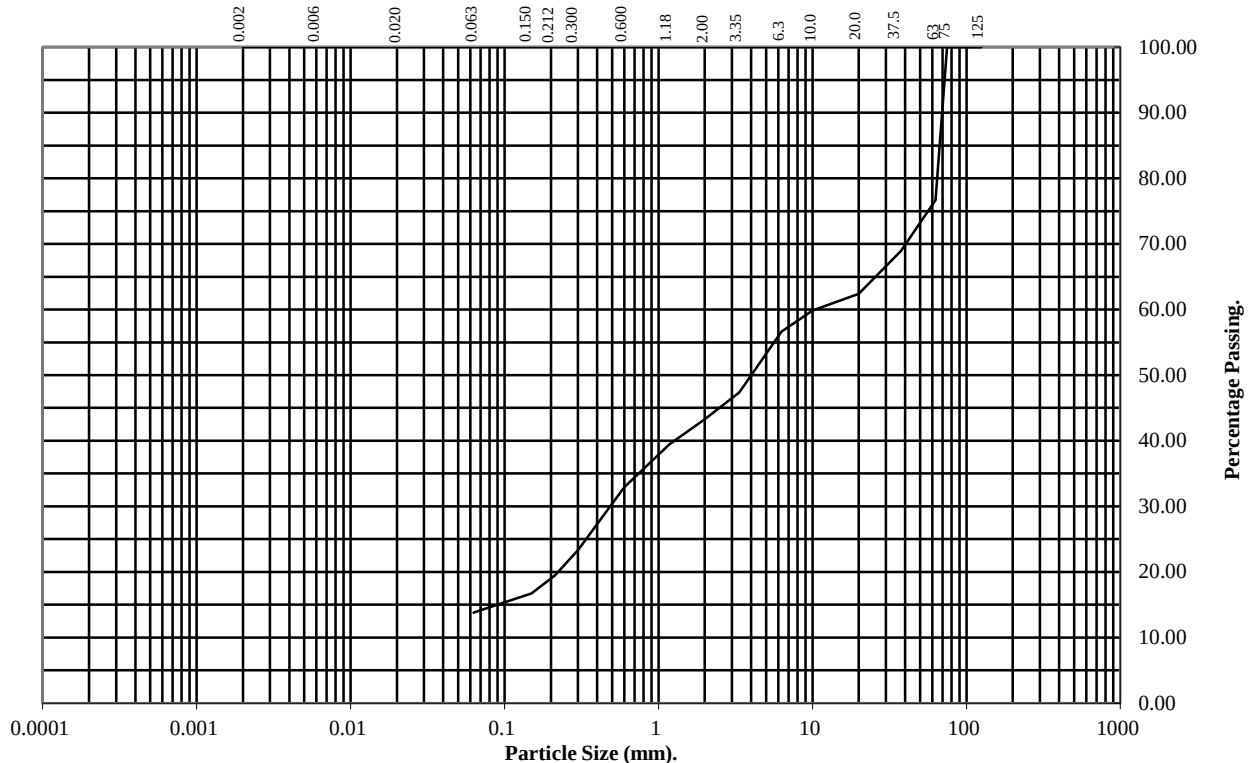
Hole Number: TP111

Top Depth (m): 0.60

Sample Number: 2

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	77
37.5	69
20	62
10	60
6.3	57
3.35	47
2	43
1.18	39
0.6	33
0.3	23
0.212	19
0.15	17
0.063	14

Soil Fraction	Total Percentage
Cobbles	23
Gravel	34
Sand	29
Silt/Clay	14

Remarks:

See Summary of Soil Descriptions



Crosland Hill Road

Contract No:

PSL21/0987

Client Ref:

3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

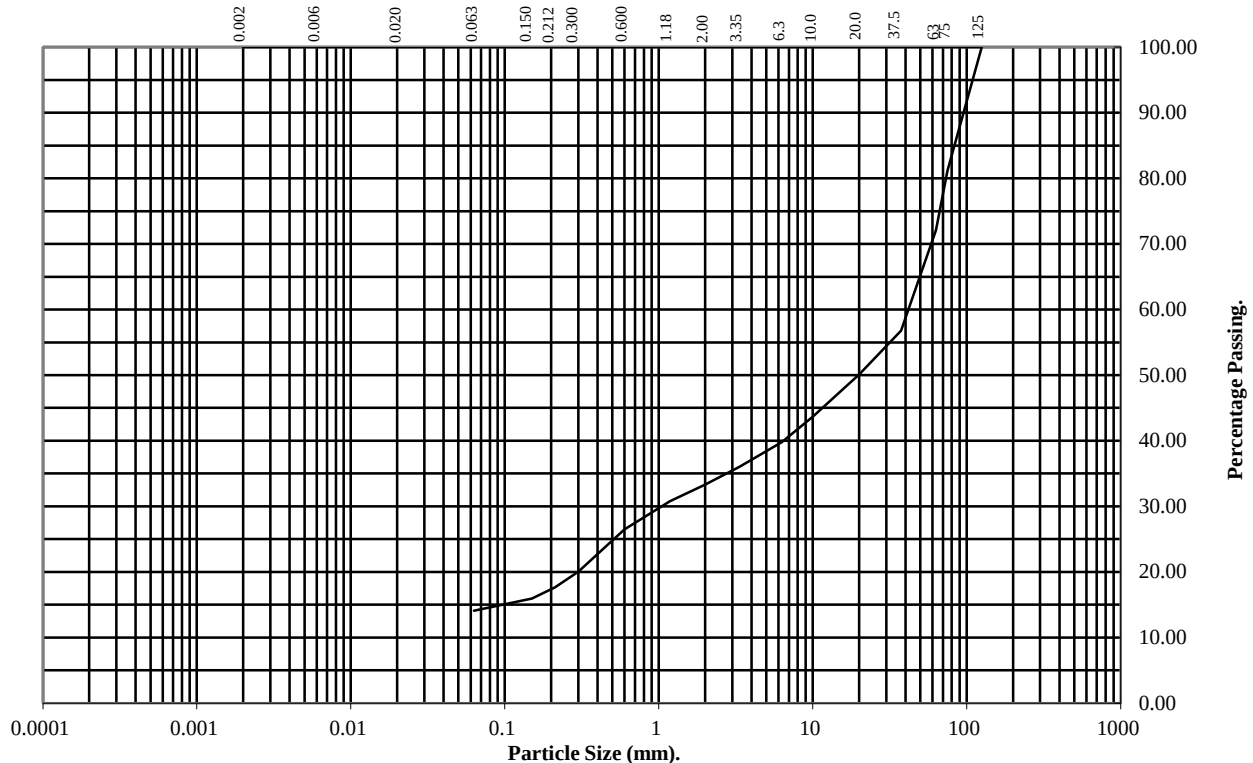
Hole Number: TP113

Top Depth (m): 0.60

Sample Number: 2

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	81
63	72
37.5	57
20	50
10	44
6.3	40
3.35	36
2	33
1.18	31
0.6	26
0.3	20
0.212	18
0.15	16
0.063	14

Soil Fraction	Total Percentage
Cobbles	28
Gravel	39
Sand	19
Silt/Clay	14

Remarks:

See Summary of Soil Descriptions



Crosland Hill Road

Contract No:

PSL21/0987

Client Ref:

3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

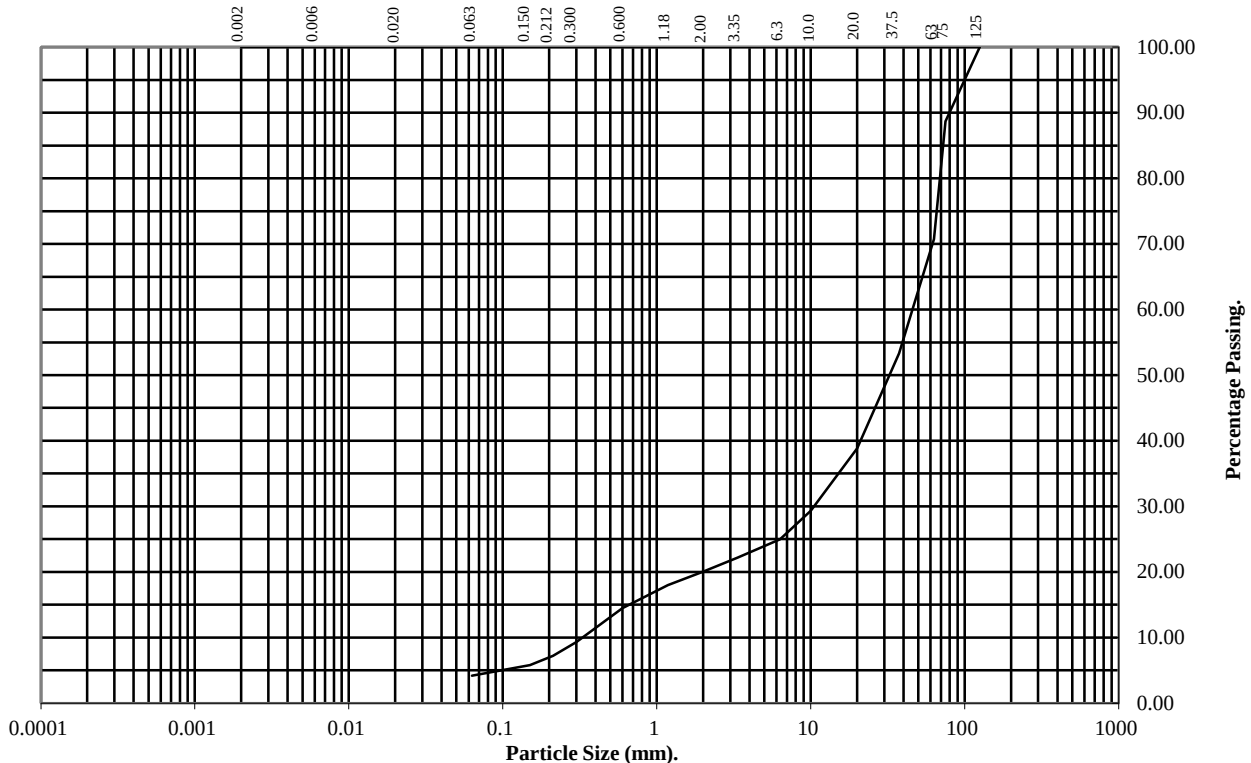
Hole Number: TP117

Top Depth (m): 0.80

Sample Number: 3

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	89
63	71
37.5	53
20	39
10	29
6.3	25
3.35	22
2	20
1.18	18
0.6	14
0.3	9
0.212	7
0.15	6
0.063	4

Soil Fraction	Total Percentage
Cobbles	29
Gravel	51
Sand	16
Silt/Clay	4

Remarks:

See Summary of Soil Descriptions



Crosland Hill Road

Contract No:

PSL21/0987

Client Ref:

3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

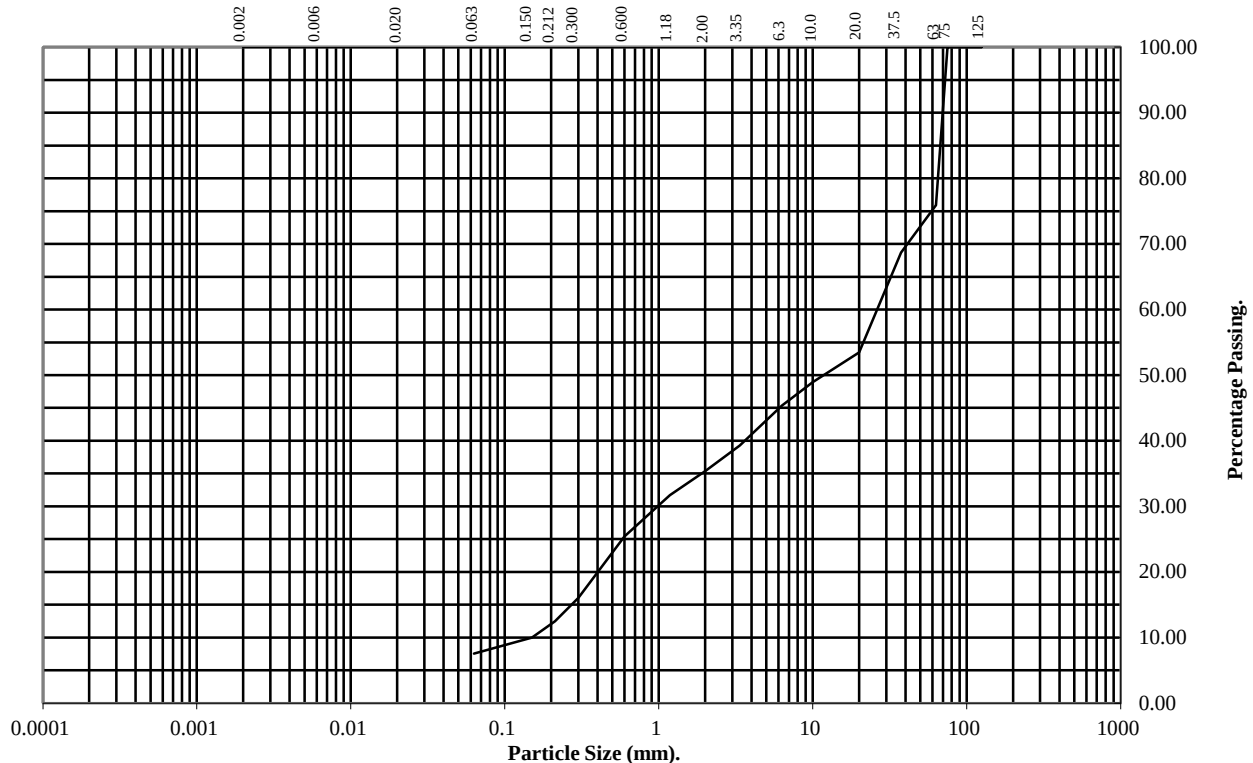
Hole Number: TP117

Top Depth (m): 1.50

Sample Number: 4

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	76
37.5	69
20	53
10	49
6.3	45
3.35	39
2	35
1.18	32
0.6	25
0.3	16
0.212	12
0.15	10
0.063	8

Soil Fraction	Total Percentage
Cobbles	24
Gravel	41
Sand	27
Silt/Clay	8

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

Crosland Hill Road

Contract No:

PSL21/0987

Client Ref:

3649

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

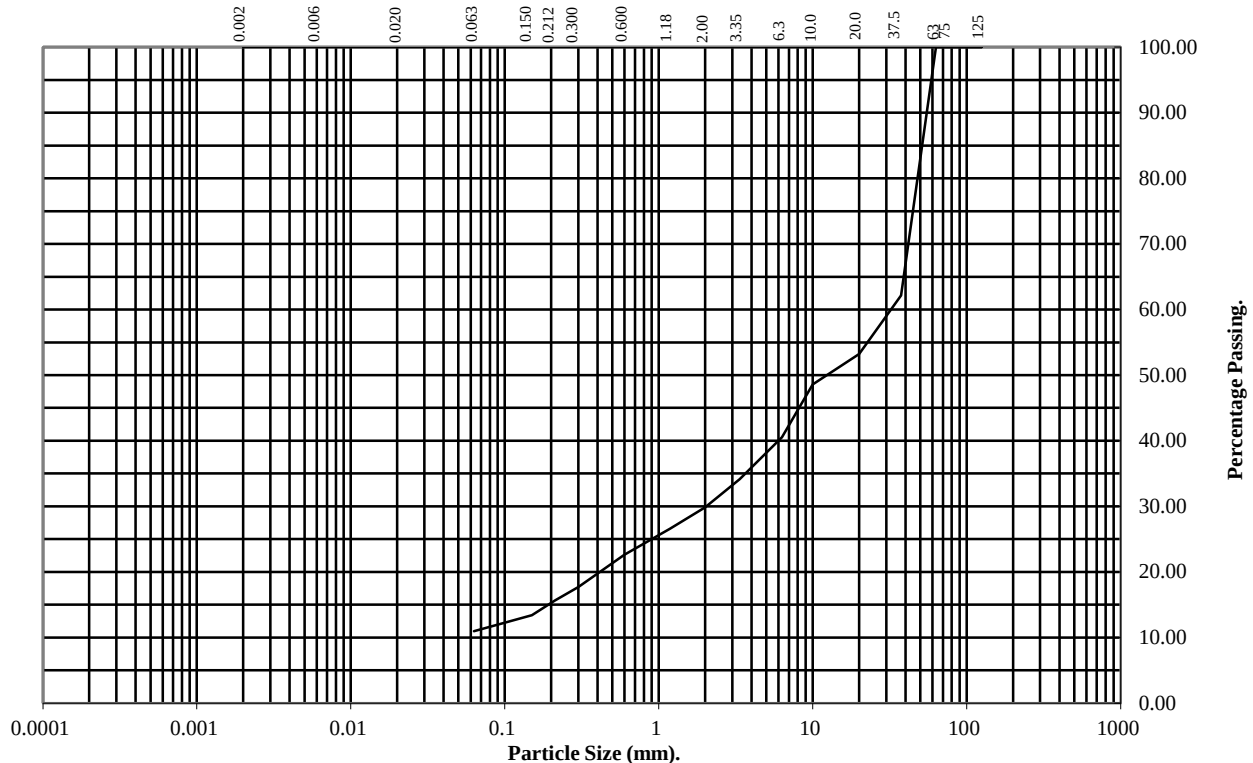
Hole Number: TP119

Top Depth (m): 1.40

Sample Number: 5

Base Depth(m):

Sample Type: D&B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	62
20	53
10	49
6.3	41
3.35	34
2	30
1.18	27
0.6	23
0.3	18
0.212	16
0.15	13
0.063	11

Soil Fraction	Total Percentage
Cobbles	0
Gravel	70
Sand	19
Silt/Clay	11

Remarks:

See Summary of Soil Descriptions



Crosland Hill Road

Contract No:

PSL21/0987

Client Ref:

3649

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

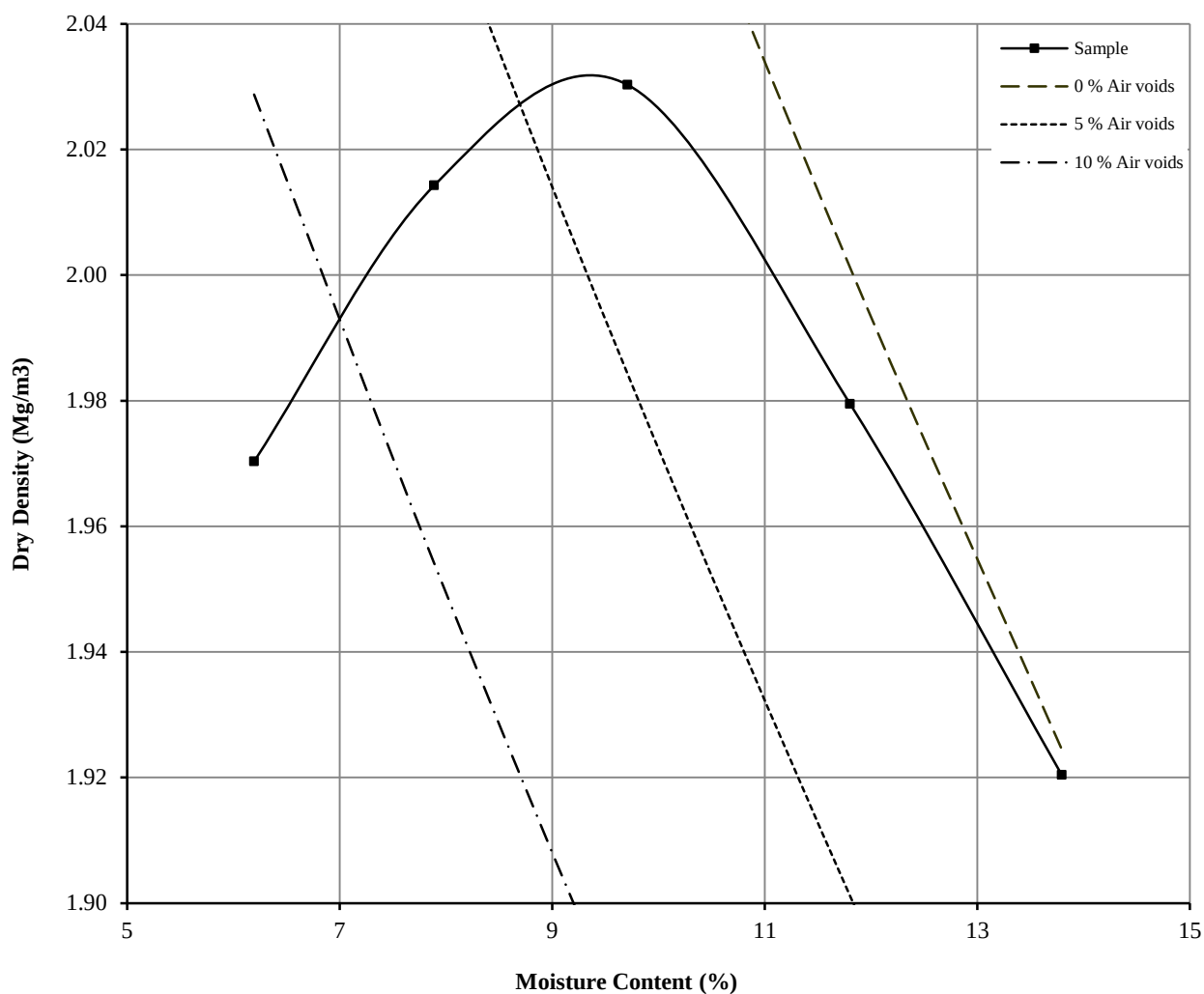
Hole Number: TP102

Top Depth (m) : 0.90

Sample Number: 4

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	9.7	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.62	Measured	Material Retained on 37.5 mm Test Sieve (%):	54
Maximum Dry Density (Mg/m3):	2.03		Material Retained on 20.0 mm Test Sieve (%):	7
Optimum Moisture Content (%):	10			
Remarks See summary of soil descriptions				



Crosland Hill Road

Contract
PSL21/0987
Client Ref
3649

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

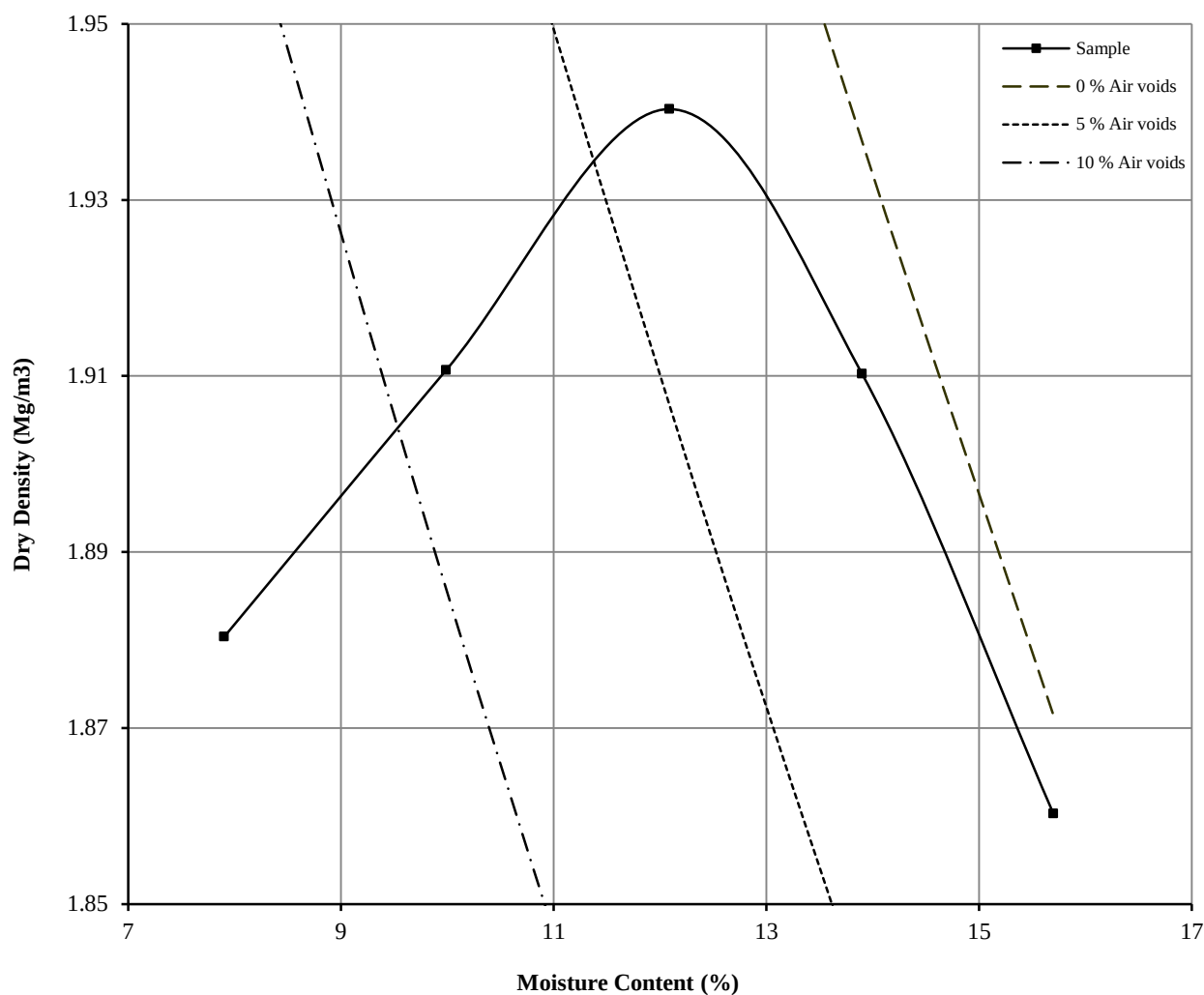
Hole Number: TP104

Top Depth (m) : 0.80

Sample Number: 3

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	12	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m ³):	2.65	Measured	Material Retained on 37.5 mm Test Sieve (%):	49
Maximum Dry Density (Mg/m ³):	1.94		Material Retained on 20.0 mm Test Sieve (%):	5
Optimum Moisture Content (%):	12			
Remarks See summary of soil descriptions				



Crosland Hill Road

Contract
PSL21/0987
Client Ref
3649

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.6 : 1990

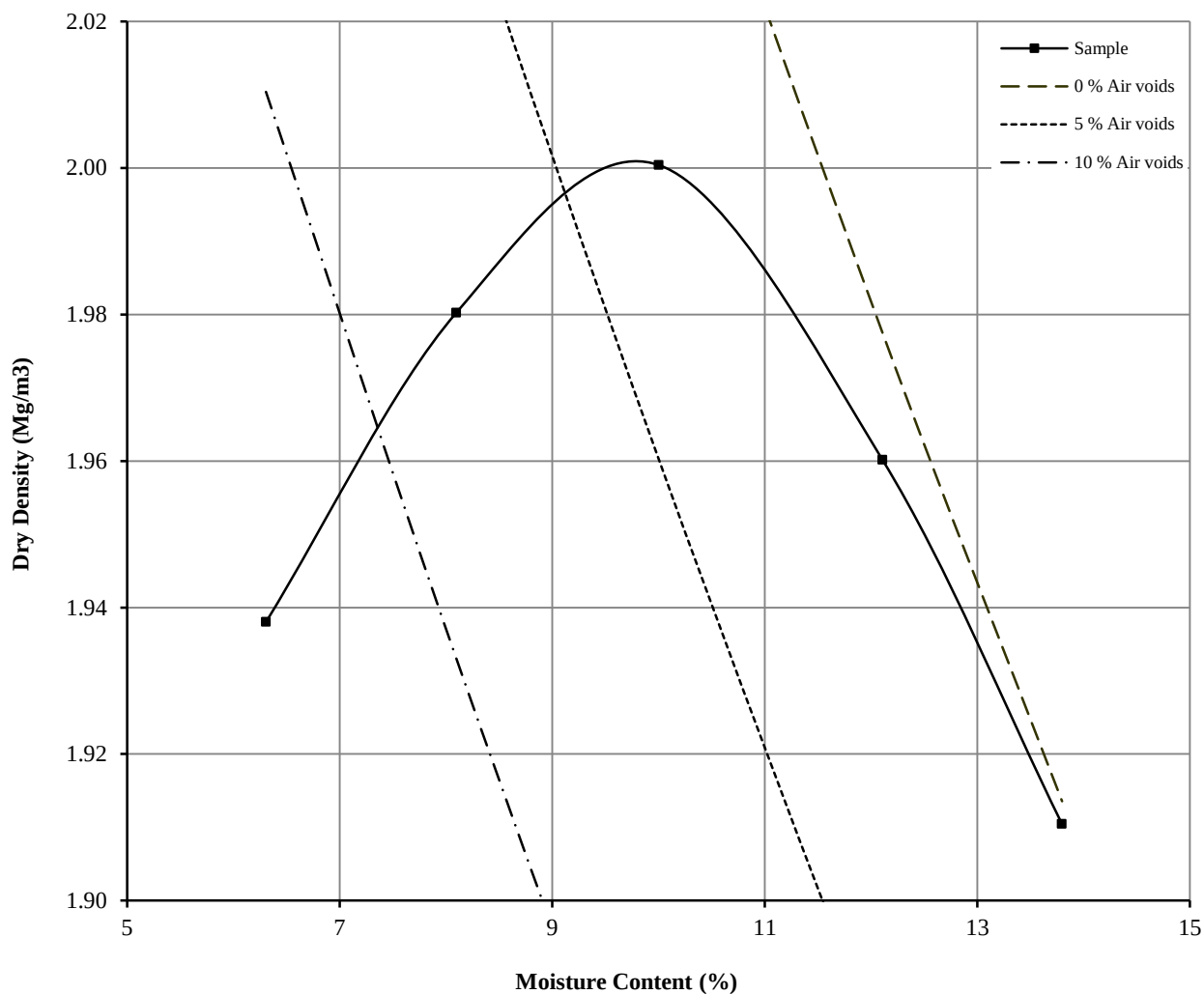
Hole Number: TP106

Top Depth (m) : 1.50

Sample Number: 4

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	16	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m ³):	2.60	Measured	Material Retained on 37.5 mm Test Sieve (%):	10
Maximum Dry Density (Mg/m ³):	2.00		Material Retained on 20.0 mm Test Sieve (%):	14
Optimum Moisture Content (%):	10			
Remarks See summary of soil descriptions				

 4043		Crosland Hill Road	Contract
			PSL21/0987
			Client Ref
			3649

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

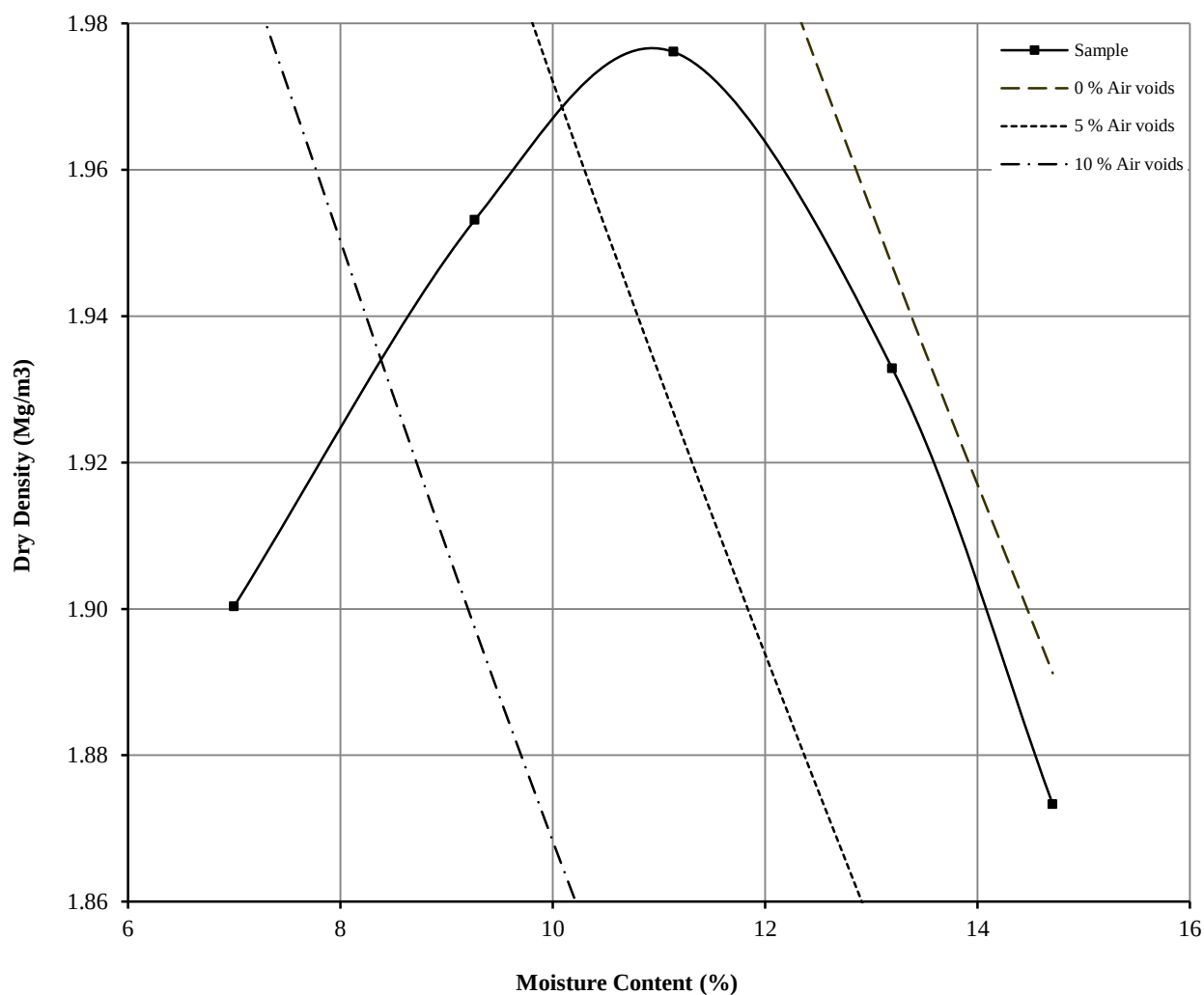
Hole Number: TP107

Top Depth (m) : 0.30

Sample Number: 2

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	9.3	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.62	Measured	Material Retained on 37.5 mm Test Sieve (%):	34
Maximum Dry Density (Mg/m3):	1.98		Material Retained on 20.0 mm Test Sieve (%):	19
Optimum Moisture Content (%):	11			
Remarks See summary of soil descriptions				



Crosland Hill Road

Contract
PSL21/0987
Client Ref
3649

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.6 : 1990

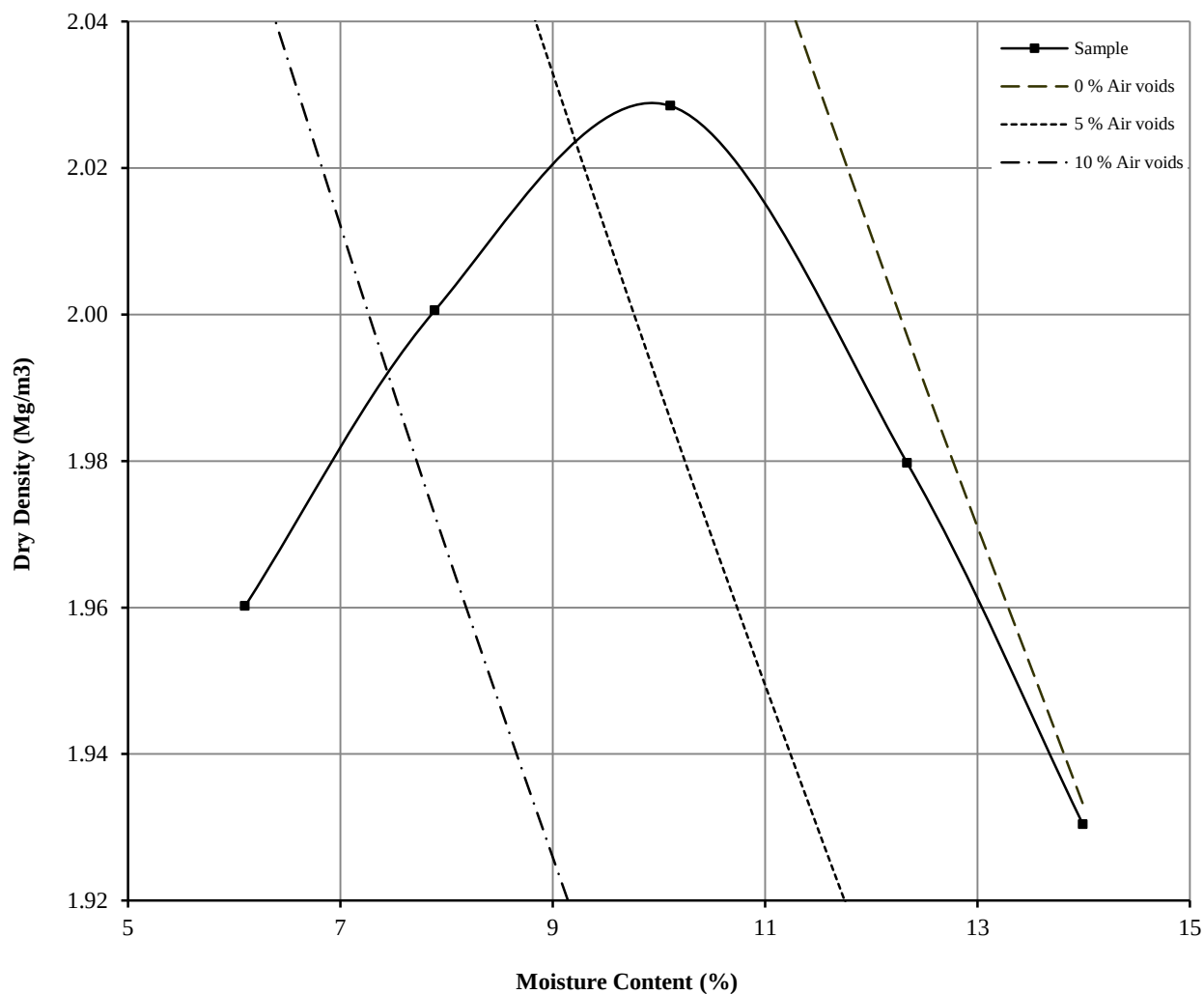
Hole Number: TP109

Top Depth (m) : 0.30

Sample Number: 1

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	12	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m ³):	2.65	Measured	Material Retained on 37.5 mm Test Sieve (%):	0
Maximum Dry Density (Mg/m ³):	2.03		Material Retained on 20.0 mm Test Sieve (%):	6
Optimum Moisture Content (%):	10			
Remarks See summary of soil descriptions				



Crosland Hill Road

Contract
PSL21/0987
Client Ref
3649

DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

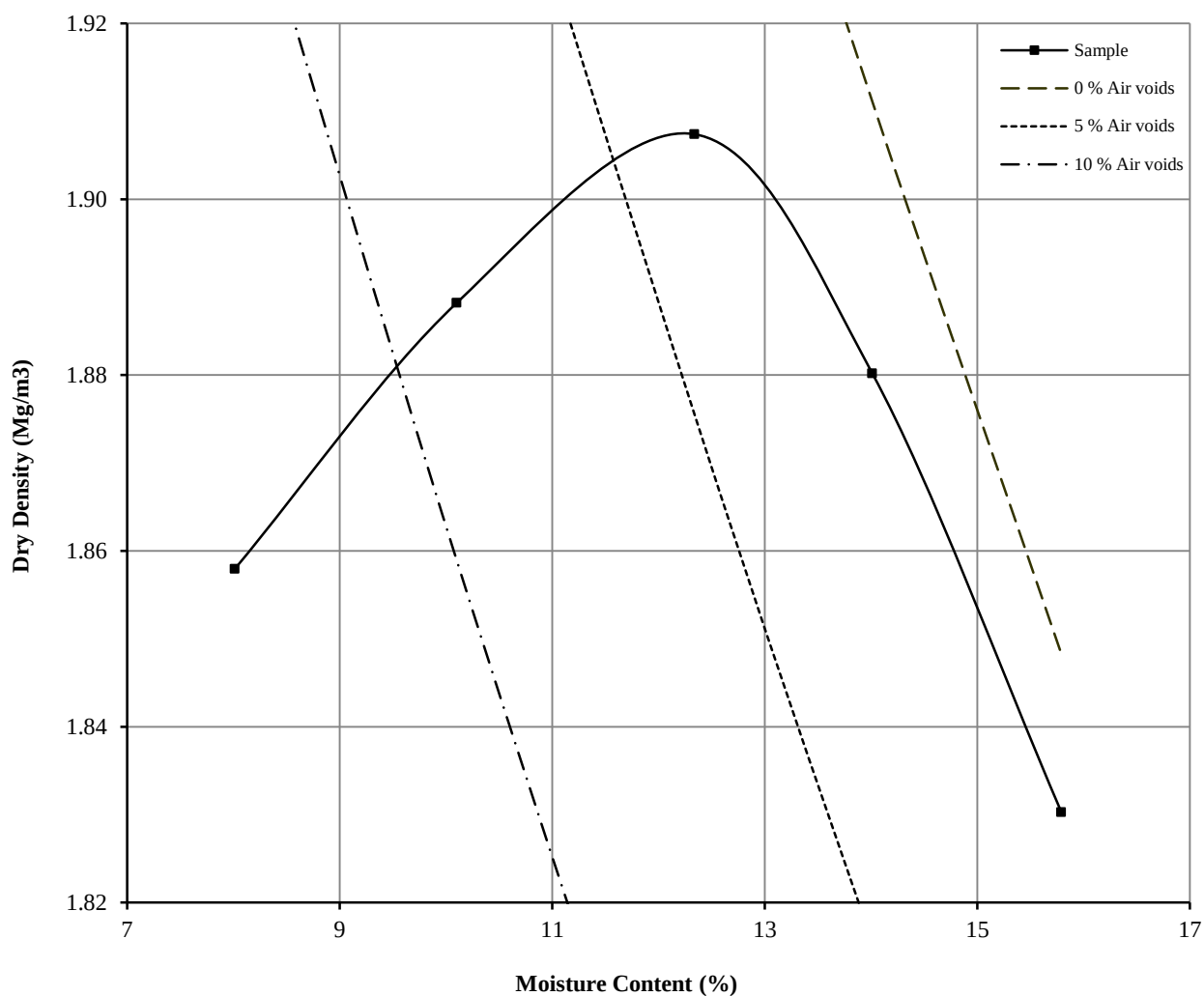
Hole Number: TP111

Top Depth (m) : 0.60

Sample Number: 2

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	12	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m ³):	2.61	Measured	Material Retained on 37.5 mm Test Sieve (%):	31
Maximum Dry Density (Mg/m ³):	1.91		Material Retained on 20.0 mm Test Sieve (%):	7
Optimum Moisture Content (%):	12			
Remarks See summary of soil descriptions				



Crosland Hill Road

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DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

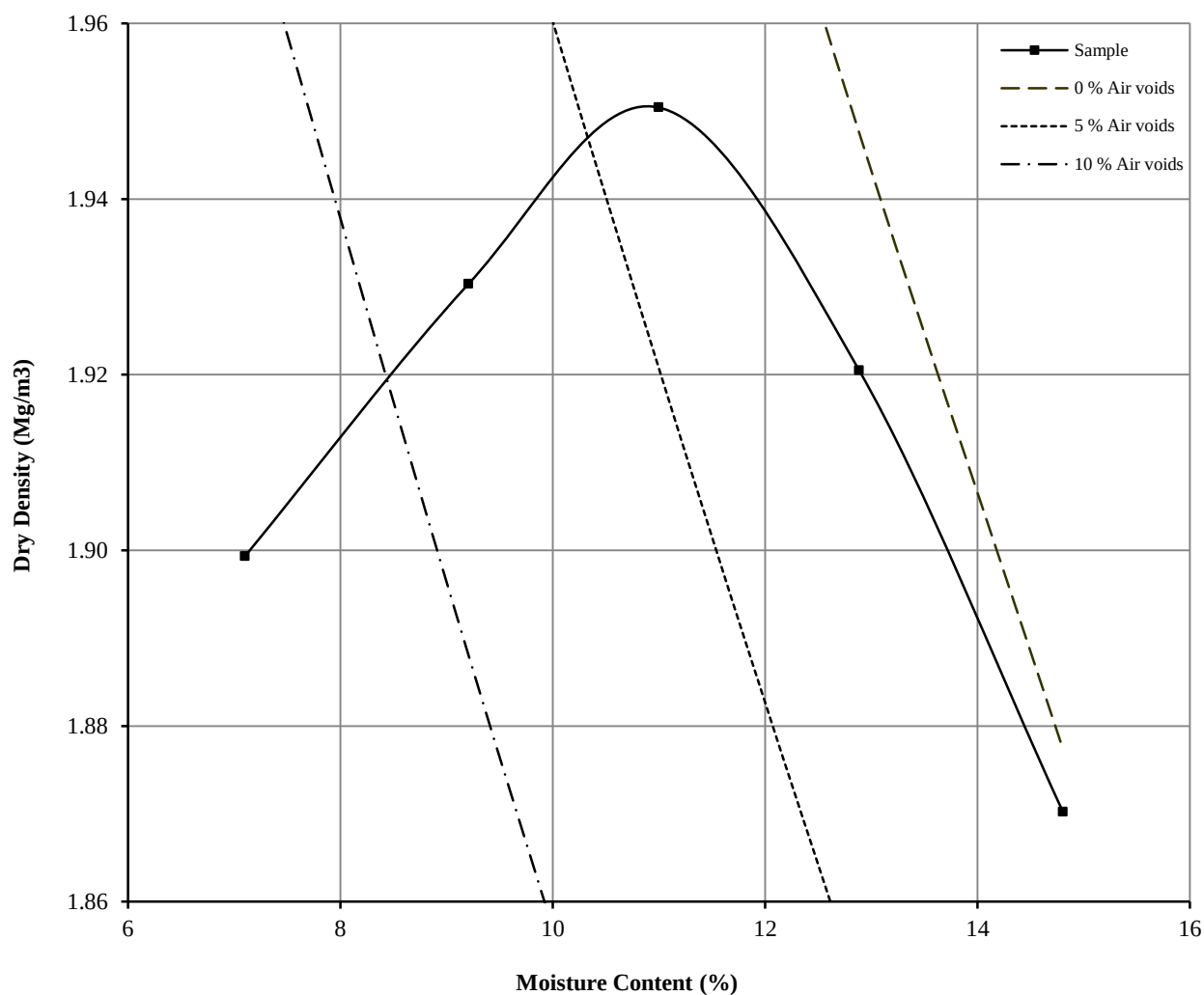
Hole Number: TP113

Top Depth (m) : 0.60

Sample Number: 2

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	13	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m ³):	2.60	Measured	Material Retained on 37.5 mm Test Sieve (%):	43
Maximum Dry Density (Mg/m ³):	1.95		Material Retained on 20.0 mm Test Sieve (%):	7
Optimum Moisture Content (%):	11			
Remarks See summary of soil descriptions				



Crosland Hill Road

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DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

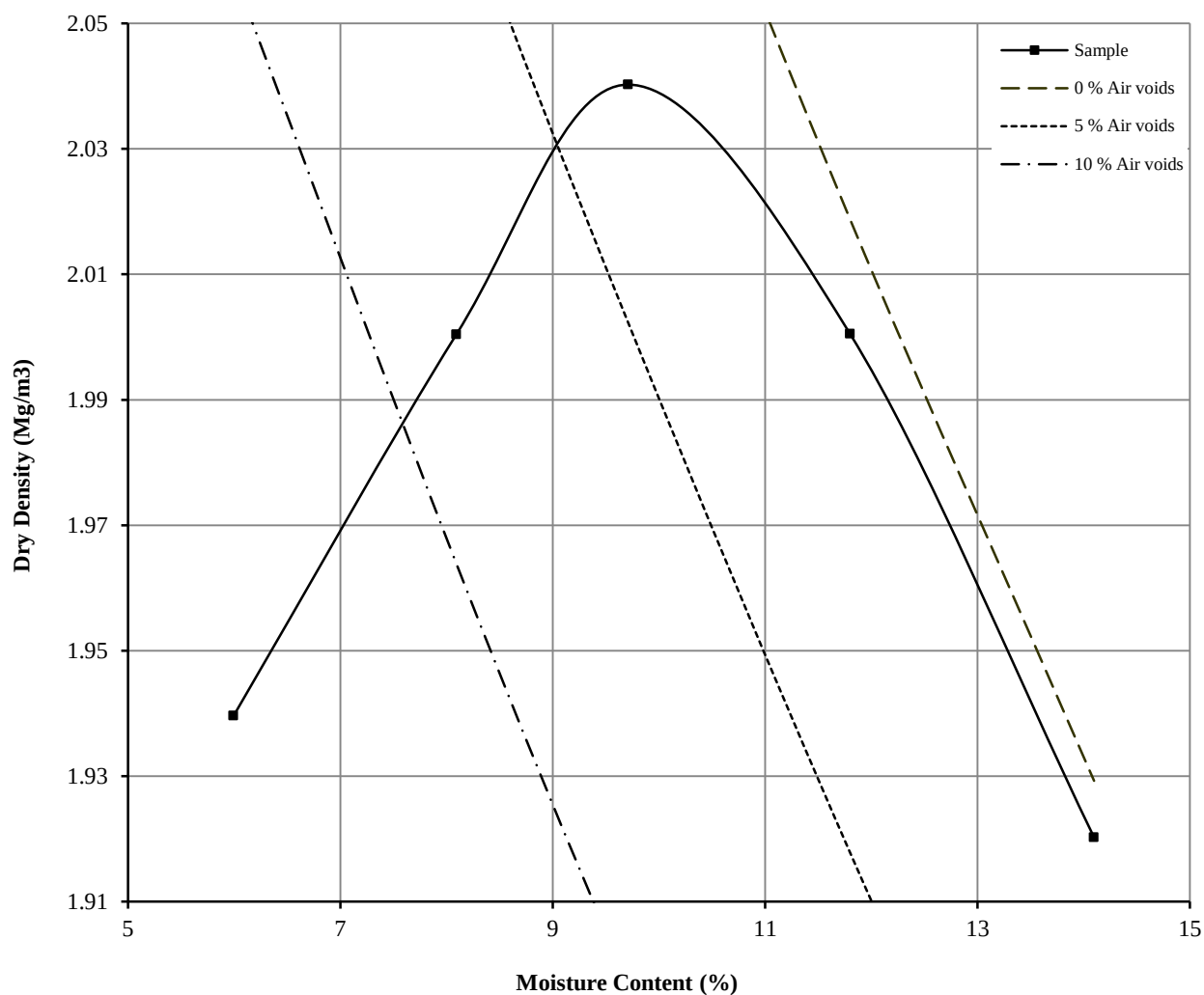
Hole Number: TP117

Top Depth (m) : 0.80

Sample Number: 3

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	9.7	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m ³):	2.65	Measured	Material Retained on 37.5 mm Test Sieve (%):	47
Maximum Dry Density (Mg/m ³):	2.04		Material Retained on 20.0 mm Test Sieve (%):	14
Optimum Moisture Content (%):	10			
Remarks See summary of soil descriptions				



Crosland Hill Road

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DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

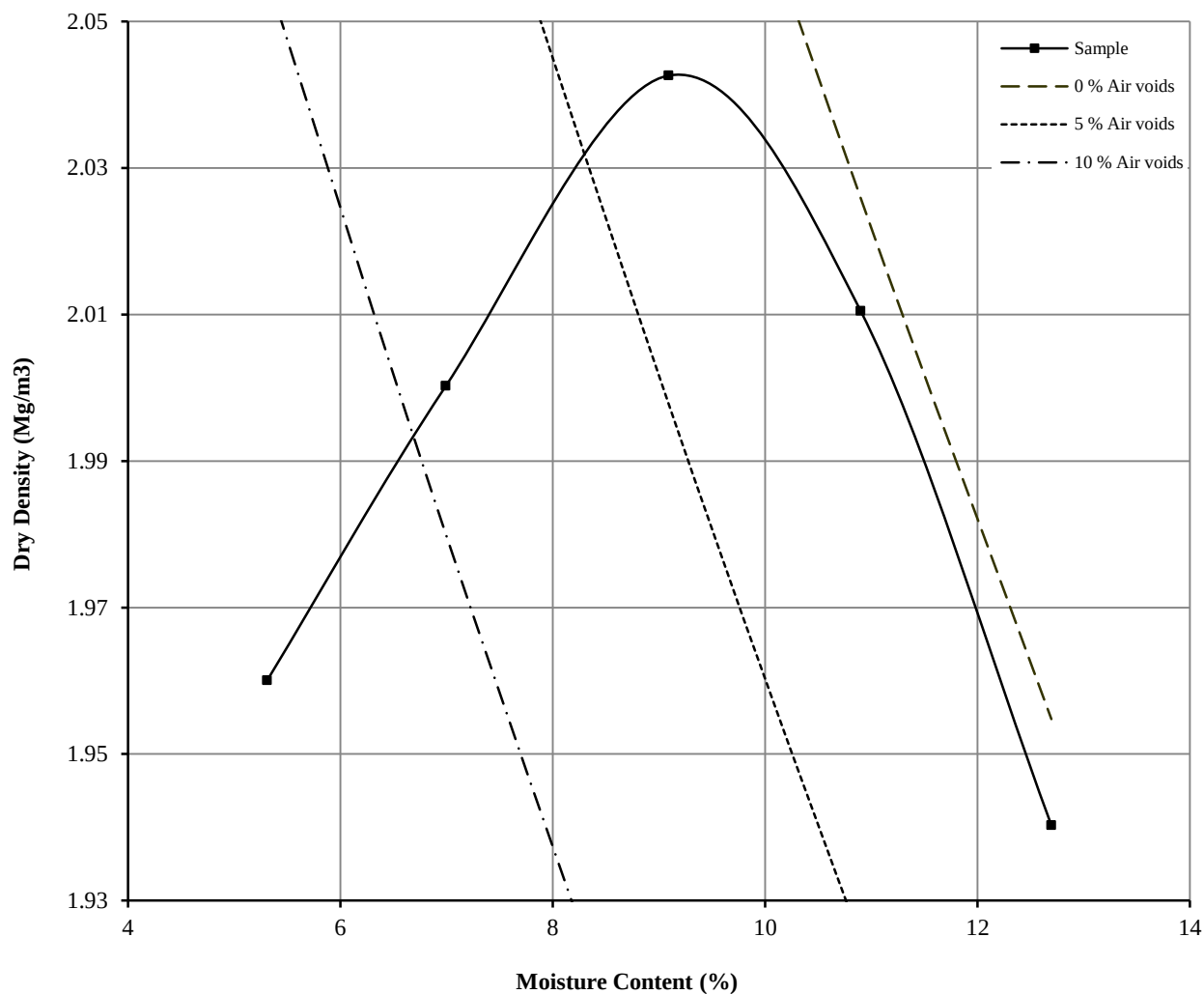
Hole Number: TP117

Top Depth (m) : 1.50

Sample Number: 4

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	9.1	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m3):	2.60	Measured	Material Retained on 37.5 mm Test Sieve (%):	31
Maximum Dry Density (Mg/m3):	2.04		Material Retained on 20.0 mm Test Sieve (%):	16
Optimum Moisture Content (%):	9			
Remarks See summary of soil descriptions				



Crosland Hill Road

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DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

Non compliance with BS 1377 : Part 4 : Clause 3.6 : 1990

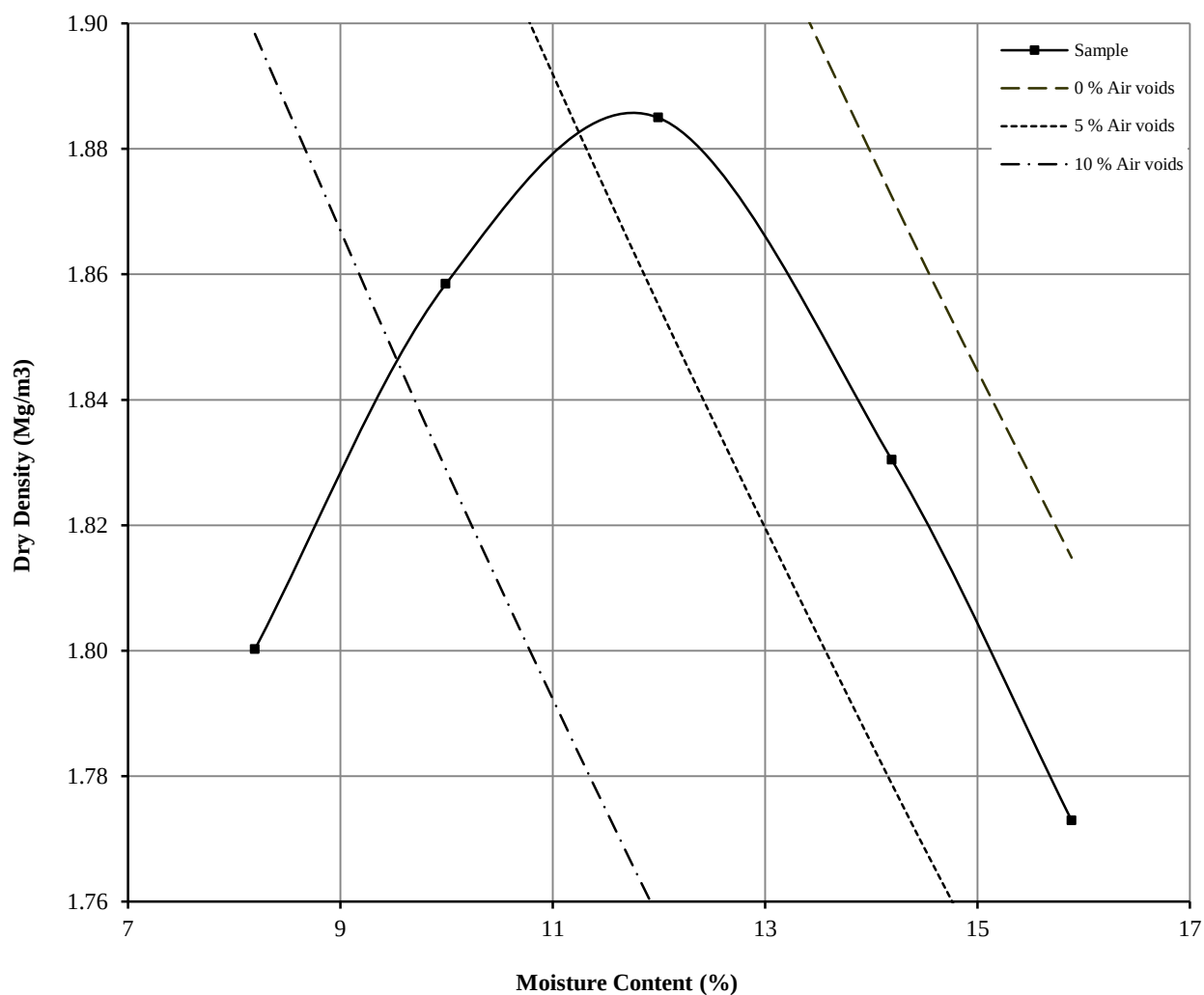
Hole Number: TP119

Top Depth (m) : 1.40

Sample Number: 5

Base Depth (m) :

Sample Type: D&B



Initial Moisture Content:	16	Method of Compaction:	4.5kg	Separate Samples
Particle Density (Mg/m ³):	2.55	Measured	Material Retained on 37.5 mm Test Sieve (%):	38
Maximum Dry Density (Mg/m ³):	1.88		Material Retained on 20.0 mm Test Sieve (%):	9
Optimum Moisture Content (%):	12			
Remarks See summary of soil descriptions				



Crosland Hill Road

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ANALYTICAL TEST REPORT

Contract no: 93215
Contract name: Crosland Hill Road
Client reference: PSL21/0987
Clients name: Professional Soils Laboratory
Clients address: 5/7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 05 February 2021

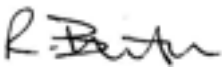
Analysis started: 05 February 2021

Analysis completed: 11 February 2021

Report issued: 11 February 2021

Notes: Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key: U UKAS accredited test
M MCERTS & UKAS accredited test
\$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing

Approved by: 
Rachael Burton
Customer Support Squad Leader

Chemtech Environmental Limited

SOILS

Lab number			93215-1	93215-2	93215-3
Sample id			TP114	TP116	TP116
Depth (m)			2.50	0.60	1.20
Date sampled			04/02/2021	04/02/2021	04/02/2021
Test	Method	Units			
pH	CE004 ^U	units	8.1	8.4	8.3
Sulphate (2:1 water soluble)	CE061	mg/l SO ₄	42	35	13

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE004	pH	Based on BS 1377, pH Meter	As received	U	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry		10	mg/l SO ₄

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
93215-1	TP114	2.50	N	
93215-2	TP116	0.60	N	
93215-3	TP116	1.20	N	

Appendix J
Gas Monitoring Results

Job Title:										Job No:	
Crosland Hill Road, Huddersfield										3649	
Client:										Sheet :	
Redrow Homes										1 of 1	
Date:		Arrival Time:		Depart Time:		Operator:					
17/02/2021		09:15		12:20		Lander Latta					



Gas Monitoring Results:													
Ambient Concentration (% Volume):		CH ₄ :		ND		CO ₂ :		ND		O ₂ :		20.6	

Monitoring Point	Groundwater level (m) bgl	Concentrations					Gas Flow Rates			Bottom of well m	Remarks
		Initial / Highest		Steady concentrations		Lowest concn	Initial / Maximum litre/hr	Steady litre/hr	Time to fall from highest to steady secs		
		CH ₄	CO ₂	CH ₄	CO ₂	O ₂					
		% v/v	(%)	% v/v	(%)	(%)					
PH101	11.58	ND	1.3	ND	1.3	17.3	ND	ND	ND	12.17	
PH102	ND	ND	0.2	ND	0.2	20.1	ND	ND	ND	5.58	
PH104	5.45	ND	1.1	ND	1.1	18.8	ND	ND	ND	6.00	
PH105	ND	ND	ND	ND	ND	20.3	ND	ND	ND	4.03	
PH106	ND	ND	0.3	ND	0.3	19.8	ND	ND	ND	5.54	
PH107	ND	ND	0.3	ND	0.3	20.0	ND	ND	ND	10.92	
PH108	ND	ND	0.9	ND	0.9	19.6	ND	ND	ND	5.93	
PH110	3.53	ND	0.1	ND	0.1	20.2	ND	ND	ND	3.85	
PH111	ND	ND	ND	ND	ND	20.3	ND	ND	ND	5.53	Well Flooded. Bung Released to drain. Monitored Immediately.
PH112	4.15	ND	0.5	ND	0.5	20.0	ND	ND	ND	4.21	
PH113	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	Well Flooded. Can not release bung as the top is blocked up by gravel and water.
PH114	ND	ND	0.4	ND	0.4	20.2	ND	ND	ND	2.99	
PH115	ND	ND	0.4	ND	0.4	20.3	ND	ND	ND	6.94	
PH116	4.58	ND	0.7	ND	0.7	19.0	ND	ND	ND	5.93	Bailed 10:24 - 10:28 to 5.80m (4l). 5.58m Dip at 11:00.

Equipment Used:					Next Calibration Date					Key									
Gas Data GFM436 Infrared Gas Analyser Geotechnical Instruments Dipmeter					22/02/2021					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 (Crosland Moor Weather Station)					
	Temp (°C):	7 to 9		Barometric Pressure Trend: Fluctuating					
Time:	09:15	11:30	12:20	00:04	09:14	11:29	12:19	17:59	19:59
Pressure (mb):	973	974	973	989	987	988	988	987	986
Remarks:	Weather Conditions:		Cloudy/ Breezy						
	Surface Ground Conditions:		Damp						

	CH ₄	CO ₂	O ₂
Trigger level 1	1.0	5.0	16.0
Trigger level 2	5.0	10.0	10.0