

**Rotary Drilling**

**264 BARNSELY ROAD  
FLOCKTON  
WAKEFIELD**

for

**Mr. R. Price**

Report Number 4438

March 2025



**Michael D Joyce Associates LLP**  
Geotechnical and Geoenvironmental Consultants

Registered Office: 531 Denby Dale Road West, Calder Grove, Wakefield, WF4 3ND UK  
**T** +44(0)1924 360458 **E** [mdja@geoenvironmental.co.uk](mailto:mdja@geoenvironmental.co.uk) **W** [www.geoenvironmental.co.uk](http://www.geoenvironmental.co.uk)

## **Rotary Drilling**

### **264 BARNSELEY ROAD, FLOCKTON, WAKEFIELD**

#### ***Contents***

- 1.** Introduction
- 2.** The Site
- 3.** Existing Coal Mining Risk Assessment
- 4.** The Investigation
- 5.** Strata Profile
- 6.** Conclusions and Recommendations

#### ***Figures***

- Figure 1 Site Location and Development Proposals
- Figure 2 Development Proposals with Rotary Borehole Locations

#### ***Appendices***

- Appendix 1 Existing Coal Mining Risk Assessment
- Appendix 2 Abandoned Mine Plan
- Appendix 3 Borehole Records
- Standard Appendix A

## **1 INTRODUCTION**

- 1.1 A Coal Mining Risk Assessment (CMRA) has previously been carried out for a proposed new detached dwelling at 264 Barnsley Road in Flockton, following demolition of the existing building. The CMRA report was prepared by M.A. Lyons, and is presented in full in Appendix 1. It recommended rotary drilling be carried out to prove or disprove potential shallow mine workings beneath the site. This report presents the findings of the recommended drilling.

## **2 THE SITE**

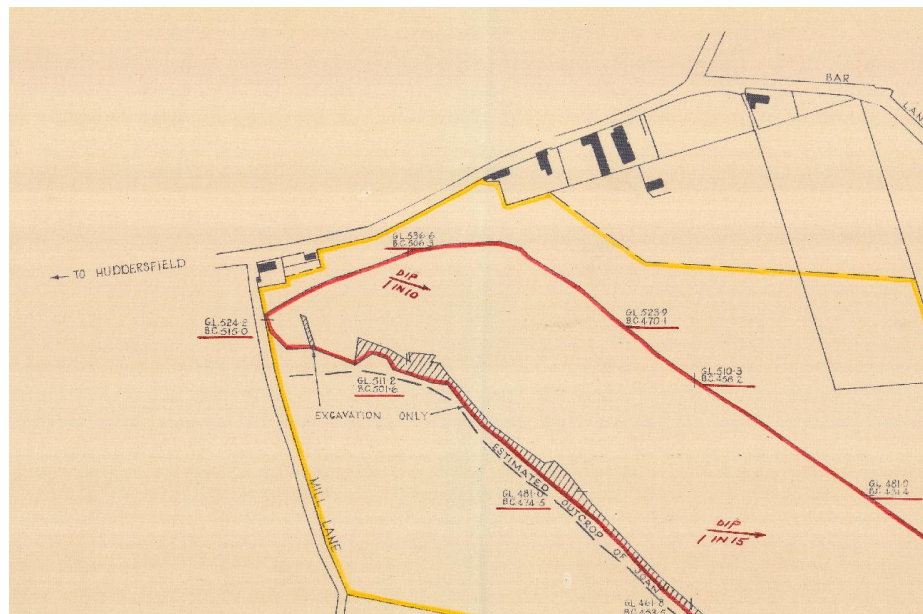
2.1 The property is located at 264 Barnsley Road in Flockton, approximately 5km southwest of the centre of Wakefield. The Ordnance National Survey Grid Reference is E424589, N415104. Figure 1 shows the general site location and the position of the rotary boreholes.

2.2 The site lies to the south side of Barnsley Road. It is presently occupied by an old timber built workshop in the east of the plot, and an unused grassed area in the western half. An open arable field lies to the south and east, which a detached residential property (No. 262 Barnsley Road) lies to the west, and further to the north.

---

### **3 EXISTING COAL MINING RISK ASSESSMENT**

- 3.1 The Coal Mining Risk Assessment (CMRA) concluded that three water-flush boreholes be drilled to determine the depth and thickness of any former opencast, and also to determine if there are any workings in the shallowest coal seam (namely the Joan Coal) and the underlying Tankersley Ironstone.
- 3.2 A former mine shaft is located to the south side of No. 262 Barnsley Road. It is approximately 15m from the boundary of the development site, and approximately 25m from the proposed property. As such, it is considered sufficiently distant so as not to affect the development, after allowing for +/- 10m uncertainty regarding its position.
- 3.3 The CMRA refers to former opencast workings close to the site. The relevant abandoned mine plan has therefore been obtained from the Mining Remediation Authority (Ref: NE88) and is presented in Appendix 2. The area of opencast closest to the site is shown below.



*Extract from Abandoned Mine Plan NE88*

- 3.4 Road level adjacent to the property is approximately 164.0 mAOD, whilst the base of the Joan Coal is recorded at approximately 155.5 mAOD, i.e. at a depth of 8.5m. The seam is recorded as being 0.64m thick and dips at 1 in 10 to the southeast, with the opencasting having taken place in 1955.
- 3.5 The base of the coal is shown in red on the above plan. It is not clear where the top of the highwall was, i.e. whether it was vertical or inclined. However, the area of land requisitioned is shown in yellow and extends to the boundary of the existing site. It is therefore reasonable to assume the highwall did not encroach onto the present site.

## **4 THE INVESTIGATION**

- 4.1 The investigation was designed to provide information on any shallow coal seams under the site, together with identifying any potential mineworkings and opencast. The investigation was undertaken in accordance with the principles of BS5930: 2015 Code of Practice for Site Investigations and CIRIA's Abandoned Mine Workings Manual (C758D).
- 4.2 The investigation was carried out on the 14<sup>th</sup> March 2025 and comprised three rotary open-hole boreholes (R1 and R3). The exploratory borehole positions are shown on figure 1.
- 4.3 It was not possible to drill adjacent to northern, eastern and southern elevations of the existing building, due to access restrictions. Drilling was therefore carried out to the west.
- 4.4 The boreholes were close to the southern boundary in order to identify the presence of former opencast. Services were also present along the northern boundary which further restricted where drilling was possible.
- 4.5 The rotary drilling was carried out using a Beretta T25 rig, using a water flush technique. The openhole technique meant that logging was carried out by inspecting the arisings that were brought to the surface in the water flush. On completion the boreholes were backfilled with bentonite and arisings.
- 4.6 Supervision and logging was provided by a Chartered Engineer from Michael D Joyce Associates LLP.

## 5 STRATA PROFILE

- 5.1 All three boreholes encountered a very similar sequence of strata. The full borehole records are presented in Appendix 3.
- 5.2 The boreholes encountered between 0.6m and 0.8m of Made Ground at the surface, comprising topsoil over a grey clay with occasional ash and sandstone gravels.
- 5.3 This was underlain by a brown and grey sandy clay, below which was a grey silty clay.
- 5.4 A dark grey and black shaly mudstone was encountered at between 2.5m and 2.6m depth, and which became a grey silty mudstone at depth.
- 5.5 An intact coal was encountered at between 5.0m and 5.2m depth in all three boreholes. This seam is believed to be the Joan Coal, and was recorded as being approximately 0.7m in thickness.
- 5.6 Borehole R1 was extended to a depth of 25m. No further coal seams or workings were encountered, with the strata comprising a grey silty mudstone with bands of sandstone. Ironstone nodules associated with the Tankersley Ironstone were not encountered, indicating the ironstone horizon lies at depth.

## 6 CONCLUSIONS AND RECOMMENDATIONS

- 6.1 The drilling encountered the Joan Coal intact and at relatively shallow depth in all three boreholes. The drilling also appears to confirm the abandoned mine plan of the opencast, in that the opencast highwall lies to the south of the site. Whilst drilling was not possible to the southeast corner of the building, there is no reason to suspect the opencast encroached onto this part of the site, and the abandonment plan is correct.
- 6.2 Similarly, there is no reason to suspect that the Joan Coal has been worked beneath the building (future plot). The geological memoir "The Geology of the Country around Huddersfield and Halifax" published in 1930, states that the seam was worked under "Flockton Green". However, Flockton Green appears to comprise land around the junction of Barnsley Road and Hardcastle Lane, which is to the northeast. Furthermore, the memoir states that whilst the seam was 0.6m thick in total at Flockton Green, only the lower 0.3m of the seam was extracted, this being considered an *"inferior house coal"*.
- 6.3 In conclusion, the risk of the Joan Coal having been extracted below the proposed property is considered very low. Whilst workings cannot be entirely precluded, there is no evidence to suggest that such workings are present. In the unlikely event they are present, only 0.3m of the seam was of any commercial value. This would provide a 10:1 rock cover to extraction thickness, such that any subsidence is unlikely to extend to the underside of the foundations.
- 6.4 As a precautionary measure, it is recommended that the footings are lightly reinforced.

A D Joyce

BSc MSc ARSM CEng CGeol CEnv MICE FGS SiLC SQP

March 2025

This report is subject to the provisions of the Copyright Acts and is for the sole benefit of Mr. R. Price in respect of rotary drilling of the site. The report cannot be assigned to, or relied on, by any other party without prior permission.

## Procedure Notes

The desk study and/or ground investigation have been carried out using reasonable skill and care in accordance with the principles of Ground Investigation and Testing", BS5930: 2013 and BS10175:2011+A1:2013, and the terms of the client's brief. The report has been prepared for the specific purposes notified at the time of the initial enquiry.

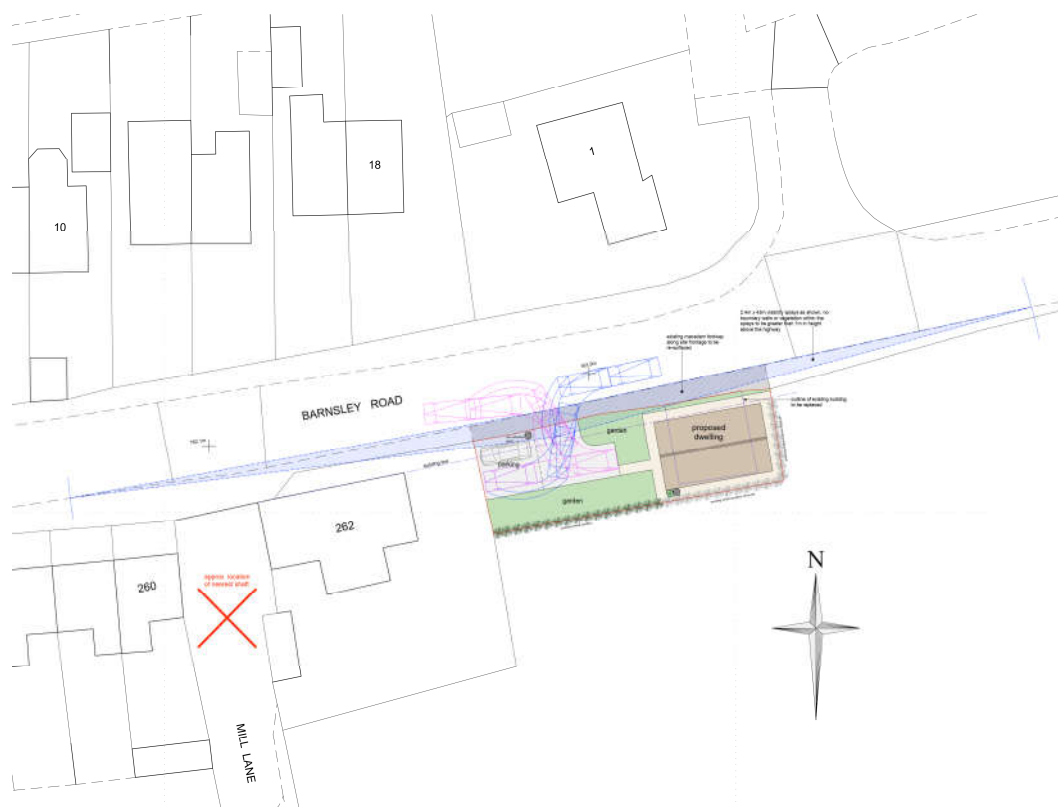
By its very nature any ground investigation only encounters and samples a small percentage of the ground. Consequently changes in ground conditions and soil properties can occur between any two exploratory points, for example local features such as soft ground, pockets of contamination and faults. This is also true of the exploration of mineworkings and such features can extend beneath parts of the site not investigated. Unrecorded bell pits and shafts can also exist between exploratory points. The ground investigation is designed to minimize such risks. Conclusions and recommendations are based on the information presented in this report, but unforeseen features may exist. No liability can be accepted for conditions not revealed by the exploratory holes. Therefore, actual ground conditions should be noted during construction and further advice sought if they differ from those predicted. Michael D. Joyce LLP reserves the right to amend the conclusions and recommendations in the light of further information. Actual methods of construction or alternative designs should be notified to Michael D. Joyce Associates LLP, such that the recommendations made can be reconsidered in the light of any changes.

Further investigation can be carried out to further reduce uncertainty and risk but ultimately these risks cannot be eliminated. Similarly a desk study normally only considers readily available information and further information could be held by other sources. In commissioning further research or investigation the cost/benefit of doing so must be considered.

It is assumed that groundlevels will not change significantly from those at present. The groundwater conditions are based on observations made at the time of the investigation, unless stated otherwise. It should be noted that the observations are subject to the method of the boring or excavation and that groundwater levels will vary due to seasonal or other effects.

Where buildings are present on a site, structural and asbestos surveys have not been carried out, unless specifically stated. An Unexploded Ordnance Survey has not been carried out unless specifically stated. In relevant situations it would be prudent to commission such surveys.

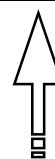
Where information has been obtained from Third Parties, no liability can be accepted for the accuracy or completeness of this information. Where anecdotal evidence or speculations are presented, they must be treated as such and cannot be relied upon.



**264 Barnsley Road, Flockton**  
Site Location and Development Proposals

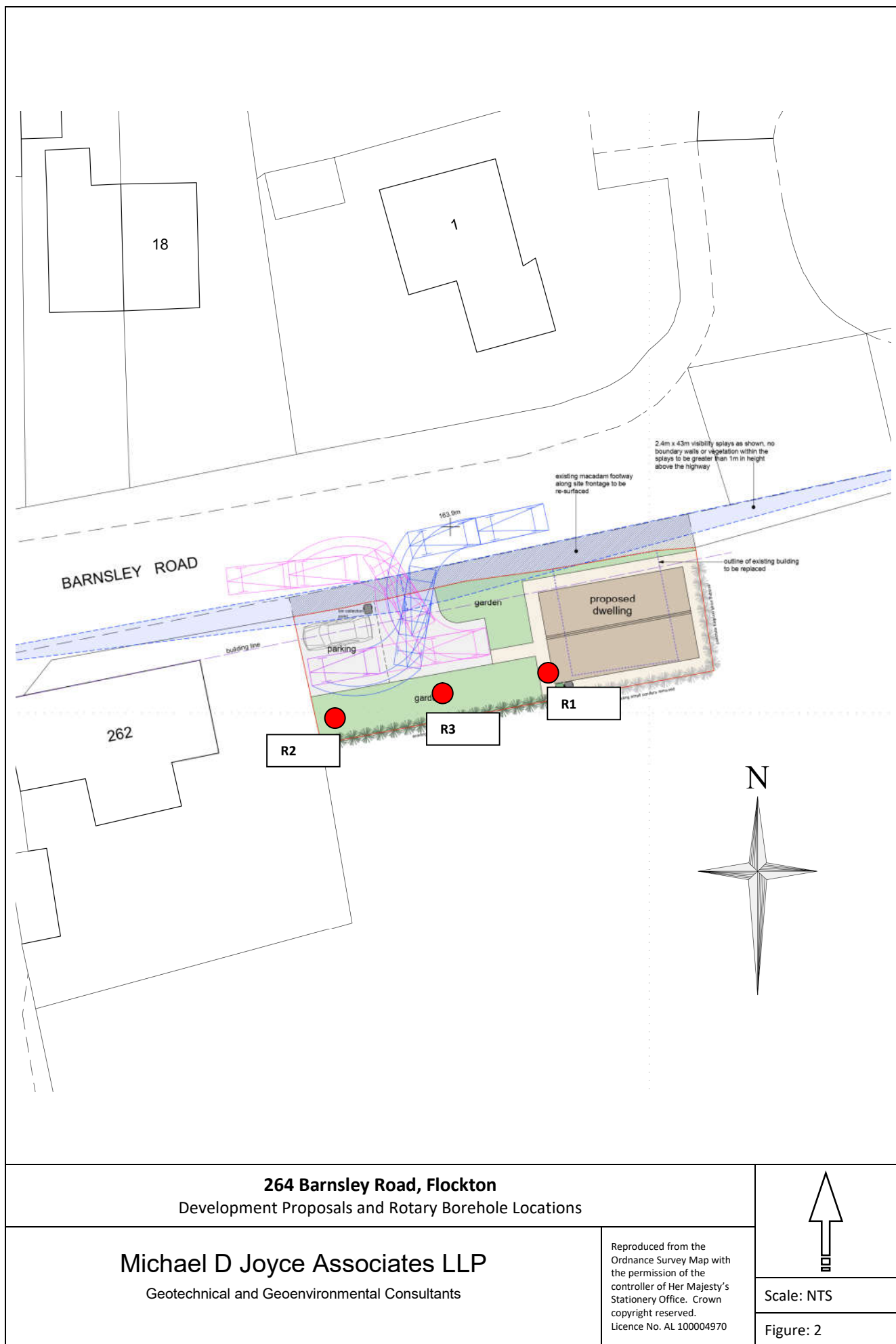
**Michael D Joyce Associates LLP**  
Geotechnical and Geoenvironmental Consultants

Reproduced from the  
Ordnance Survey Map with  
the permission of the  
controller of Her Majesty's  
Stationery Office. Crown  
copyright reserved.  
Licence No. AL 100004970



Scale: NTS

Figure: 1



## **Appendix 1**

### Existing Coal Mining Risk Assessment

**Mr Kirk Braithwaite  
Bramble Grange  
Briestfield Road  
Briestfield  
Dewsbury  
WF12 0NX**

Date: 22<sup>nd</sup> August 2023  
Your ref: (WF4 4AJ).  
My Ref: CMRA 00367

**FOR THE ATTENTION OF KIRK BRAITHWAITE**

Dear Sir,

**COAL MINING RISK ASSESSMENT (CMRA)  
FOR PROPOSED RESIDENTIAL DEVELOPMENT AT LAND AT 264 BARNSELY ROAD,  
FLOCKTON, WAKEFIELD WF4 4AJ**

**Introduction**

Planning permission is being considered for a new detached dwelling at the above named site, the location of which can be seen on the attached plan No. 00367/A in Appendix 1. The site is centred around national grid reference 424589E / 415104N. A Coal Mining Risk Assessment is required for the proposals in order to competently address the mining legacy for the site and determine what impact this may have had upon the land. The assessment is intended to be included as a supporting document to a future planning application to Wakefield Council.

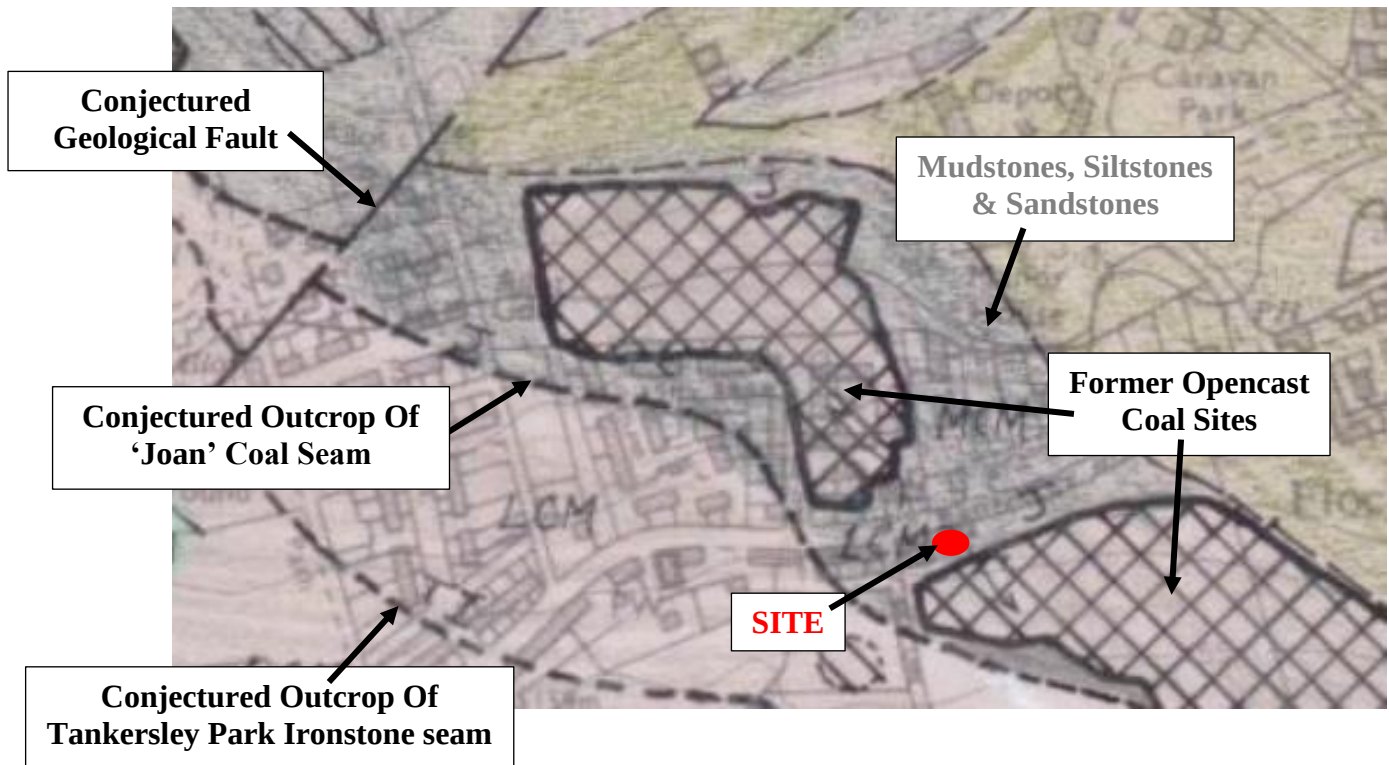
**Scope of the Coal Mining Risk Assessment**

The purpose of this Coal Mining Risk Assessment Report is to:

- Present a desk-based review of all available information on the coal mining issues which are relevant to the application site;
- Use that information to identify and assess the risks to the proposed development from coal mining legacy, including the cumulative impact of issues;
- Set out appropriate mitigation measures to address the coal mining legacy issues affecting the site, including any further works that may be necessary; and
- Demonstrate to the Local Planning Authority that the application site is, or can be made, safe and stable to meet the requirements of national planning policy with regard to development on unstable land.
- The report will not consider other geotechnical or geo-environmental issues.

## Surface Geology (inc. any superficial deposits)

Records indicate the site to be located on mudstones/siltstones/sandstones of the Middle Coal Measure series from the Carboniferous formation. No superficial deposits are indicated in the vicinity of the site itself. A summary of the surface geology is illustrated on the image below which is an extract from the BGS Sheet SE21NW 1999 Edition:



## Fault Planes or Fissures

No geological faulting is known or conjectured within 100m of the site and given the anticipated geology the likelihood of fissures within sandstone bedrock is considered low in this instance.

## Coal Seam Outcrops

As outlined on the extract image above from the BGS Onshore Interactive Viewer, the 'Joan' coal seam is conjectured to outcrop some 60m away to the south-west, dipping steadily beneath the site in a north-easterly direction. Given the topography (quite steep slope to the SW) this coal seam is likely to be circa 10m to 15m deep beneath the site. Nearby historic shaft section details indicate the past 'Boring at Flockton' some 600m away to the south-east, from the mid-19<sup>th</sup> century, which proved the Joan coal seam as 1foot 4 inches thick (0.4m) at that location. The next workable seam below the Joan coal is the Flockton Thick seam at circa 1.2m thick some 23m below the Joan seam.

## Ironstone Seam Outcrop

As outlined on the extract image above from the BGS Onshore Interactive Viewer, the 'Tankersley Park Ironstone' seam is conjectured to outcrop some 130m away to the south-west, dipping beneath the site at circa 20m deep. Little information is available to predict likely thicknesses of such deposits, and associated workings (known in the wider area rather than within/close to the site itself) are generally known to be via historic 'bell pits' which involve a central mine shaft for access. A slight potential will therefore exist for discovering an old shaft of which there are no records where this deposit is within 30m of the surface.

## Made Ground

BGS records show no made ground beneath the site; however, note the former adjacent opencast site as detailed below.

## Opencast Coal Workings.

As detailed on the above plan, the site is located adjacent to a former opencast coal operation which worked the Joan coal seam at this location. The site may therefore encounter an element of made ground associated with the backfilling of the operations and it may be close to the 'high wall' (former quarry side) itself. In such circumstances it is difficult to predict whether the former high wall was either vertical, near vertical or a slope to the base of the coal seam. Further abandonment information could be requested from the Coal Authority to better determine this position/detail.

## Underground Coal Workings - Deep

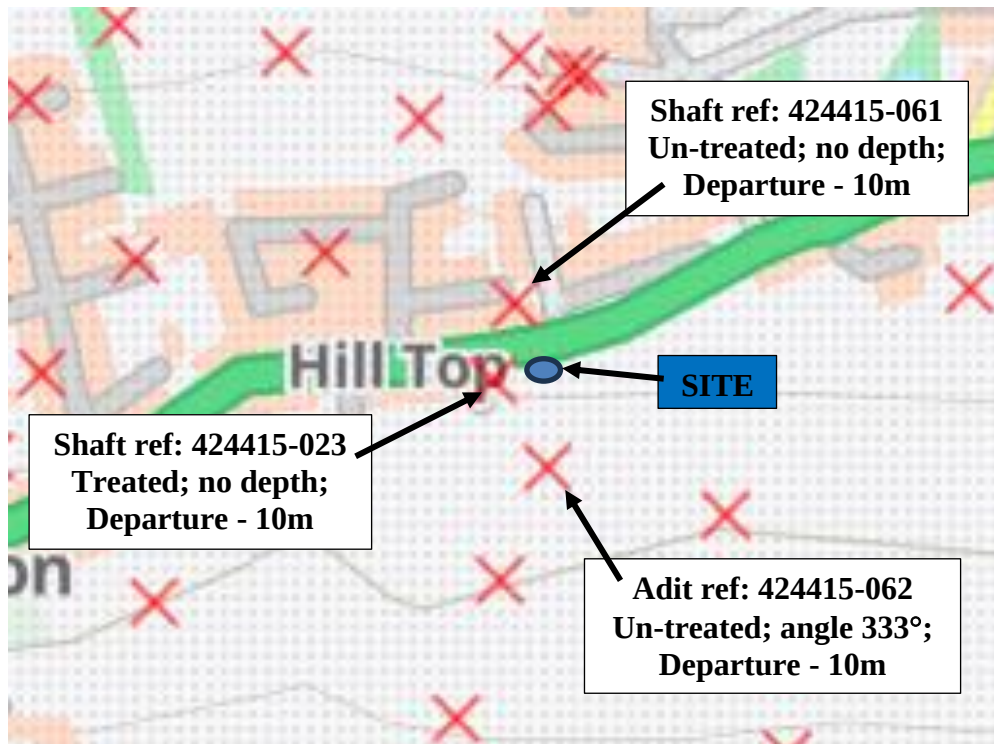
Deep coal mining (over 50m deep) has taken place beneath the site in various coal seams, all settlement from which will be long complete. As no coalfields now exist, the site should remain stable from the deep coal mining perspective for the foreseeable future.

## Underground Coal Workings - Shallow

No recorded workings are known in the 'Joan' coal seam, and given its nature/thickness the likelihood of unrecorded, possibly illicit, workings being present is considered low. The site is however located in a Coal Authority area of 'probable shallow coal workings' which may relate to both the shallow Joan Coal seam and the Ironstone seam. As such, the potential for historic shallow mining issues cannot be entirely ruled out at this stage. ***Note informatives nos. 1 & 2 in appendix 2.***

## Mine Entries

The nearby mine entries to the site are illustrated on the following image which forms an extract from the Coal Authorities interactive viewer information. As can be seen, shaft ref: 424415-023 lies within 20m of the site – as illustrated on the attached plan no. 00367/A in Appendix 1. This shaft is known to have been treated but no information is indicated as to its depth.



Given the possible shallow workable coal and ironstone, a slight risk will be present for discovering old mine entries of which there are no records. Grey circular areas of fill material within natural ground would be an indication of an old back filled mine shaft for example.

## Fugitive Gases

As far as we are aware, no evidence of coal mining related fugitive gas emissions are known within 250m of the site. Given the information there will be some associated risks given the relatively shallow coal and nearby opencast backfill. These risks will increase if old mining voids are proved and more so if any old mine entries are discovered.

## Coal Mining Risk Assessment (based on the above).

| Coal Seam / Coal Mining Issue               | Risk Assessment<br>(VeryHigh/High/Moderate/Low/VeryLow) |
|---------------------------------------------|---------------------------------------------------------|
| Underground coal mining (at shallow depths) | <b>Low to Moderate</b>                                  |
| Mine entries (shafts and adits)             | <b>Low to Moderate</b>                                  |
| Geological faulting                         | <b>Low</b>                                              |
| Geological fissures                         | <b>Low</b>                                              |
| Fugitive gas emissions                      | <b>Moderate to Low</b>                                  |
| Surface mining (opencast workings)          | <b>Moderate to High</b>                                 |
| Aggressive ground                           | <b>Moderate</b>                                         |
| Coal exposed / near foundation level        | <b>Low</b>                                              |

## Defined Risk Assessment (Where 'Underground Coal Mining' above = Very High to Moderate)

|                                                                                                                                |                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Extent of known underground mining in this/these shallow coal seam/s in the wider vicinity                                     | (Extensive / Much / Occasional / None Known)<br><b>Occasional</b> |
| Intrusive Site Investigation of Coal Seam / Mines of Coal (given nature of proposals).                                         | (Required / Recommended / Unnecessary)**<br><b>Required</b>       |
| Advised critical depth beneath foundation/rock-head level to investigate considering geology and nature of the shallow coal/s* | <b>25m</b>                                                        |

### Key:

*\* The critical depth is calculated according to Ciria C758D guidance which details that for the land to be regarded as stable from any voided mineworkings, then a suitable section of competent rock cover above the workings should be proved that is equal or greater than ten times the 'in-tact' coal seam thickness. The advised critical depth to investigate to in this report takes into account the available geological information, any nearby mining records and may include a contingency for the seam to be of a slightly greater thickness than anticipated. Due care and diligence should be employed on-site to ensure that sound information is gathered of the in-tact seam thickness, particularly if concluding that old workings are outside the critical depth of affecting stability for the proposed development.*

**\*\* Where :**

|                           |                                                                                                                                                                                                                                      |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><i>Required</i></b>    | <i>Intrusive Site Investigation <b>required</b> of the shallow coal/s and/or mine entries to determine any necessary stabilisation works for the given development.</i>                                                              |
| <b><i>Recommended</i></b> | <i>Intrusive Site investigation <b>recommended</b> – given a lower level of risk in relation to the nature of proposed development some proposals may reduce the risk to an acceptable level via suitable design considerations.</i> |
| <b><i>Unnecessary</i></b> | <i>Intrusive Site Investigation deemed <b>unnecessary</b> – given geological/mining information.</i>                                                                                                                                 |

## **Coal Authority**

Prior written permission from The Coal Authority is required for intrusive activities which will disturb or enter any coal seams, coal mine workings or coal mine entries (shafts and adits). Further information on The Coal Authority's permissions process can be found at:

[www.coal.gov.uk/services/permissions/index.cfm](http://www.coal.gov.uk/services/permissions/index.cfm)

## **Information sources:**

- *British Geological Survey Map Sheet SE21NW 1999 Edition*
- *British Geological Survey – Geology Of Britain Viewer*
- *Coal Authority Interactive Viewer and Mine Abandonment Plans*
- *Historical Mapping – old-maps.co.uk*

## CONCLUSIONS

- 1) The site can be regarded as stable from the **Deep Coal Mining** perspective, and as no coal fields now remain this position should continue for the foreseeable future.
- 2) Given the **Shallow Mining** position (coal & ironstone) along with the adjacent former opencast site, a limited intrusive mining investigation should be undertaken to a) determine the depth/thickness/nature of any made ground/opencast backfill (which should also disprove the presence of any highwall); and b) to check the nature of Joan coal seam & Tankersley Park Ironstone, if present. Three water-flush boreholes to 25m below rock-head/foundation level would suffice for this in the outset; preferably two holes on the southern corners of the proposed buildings with the third along the northern elevation to provide a triangulated determination. ***Note informatives 1 & 2 in Appendix 2.*** A permit from the Coal Authority should be secured prior to such an investigation. If any mining voids are encountered then further stabilisation works and/or appropriate foundation designs would need to be considered.
- 3) Any made ground encountered will require appropriate considerations for suitable foundation designs, particularly if there is any discontinuity of depths to rock-head (i.e deeper on one side from the other) which would give rise to possible differential settlement issues and/or rotational slip potential.
- 4) It is considered that the nearby mineshaft ref: 424415-023 will be in a position (above the 10m departure as specified) that should not affect the stability of the proposed dwelling – provided its location remains as is proposed herein. This aspect should be confirmed with the Coal Authority who will have a more precise location for this mine shaft.
- 5) A watching brief should be employed during future grounds works for any signs of unrecorded mine entries. A site scrape to natural ground is the most effective procedure to check for such features, circular areas of grey fill within bedrock would be an indication. If suspected the Coal Authority (as owners) should be notified immediately for appropriate deliberations.
- 6) In terms of the fugitive mine gas risks from the potential shallow coal, opencast backfill material and nearby mine shaft, it would be prudent, in the absence of any further gas monitoring (*note informative no. 3 in appendix 2*), to include gas protection measures (such as a methane membrane and/or positive ventilation layers) within future foundation designs; which could also protect from radon issues if required. All usual safety precautions should be employed regarding possible fugitive gases in any deep excavation work taking place.

- 7) If no evidence of any shallow mining, opencast backfill and/or mine entries are determined to be of effect for the development then usual foundation solutions can be considered in line with the appointed Building Control departments advice/requirements.

***Note: should there be any uncertainty of actual conditions during future ground works Lyons CMC or indeed the Coal Authority themselves can be further consulted for on site assessment if necessary.***

A suitably qualified and competent professional should be employed to use this report to determine the conditions on site, and ultimately advise on what action, if any, is necessary to safeguard the development. It should be noted that any future works to investigate any coal seam, mines of coal or associated mine entries will need the prior consent of the Coal Authority via their permitting procedure.

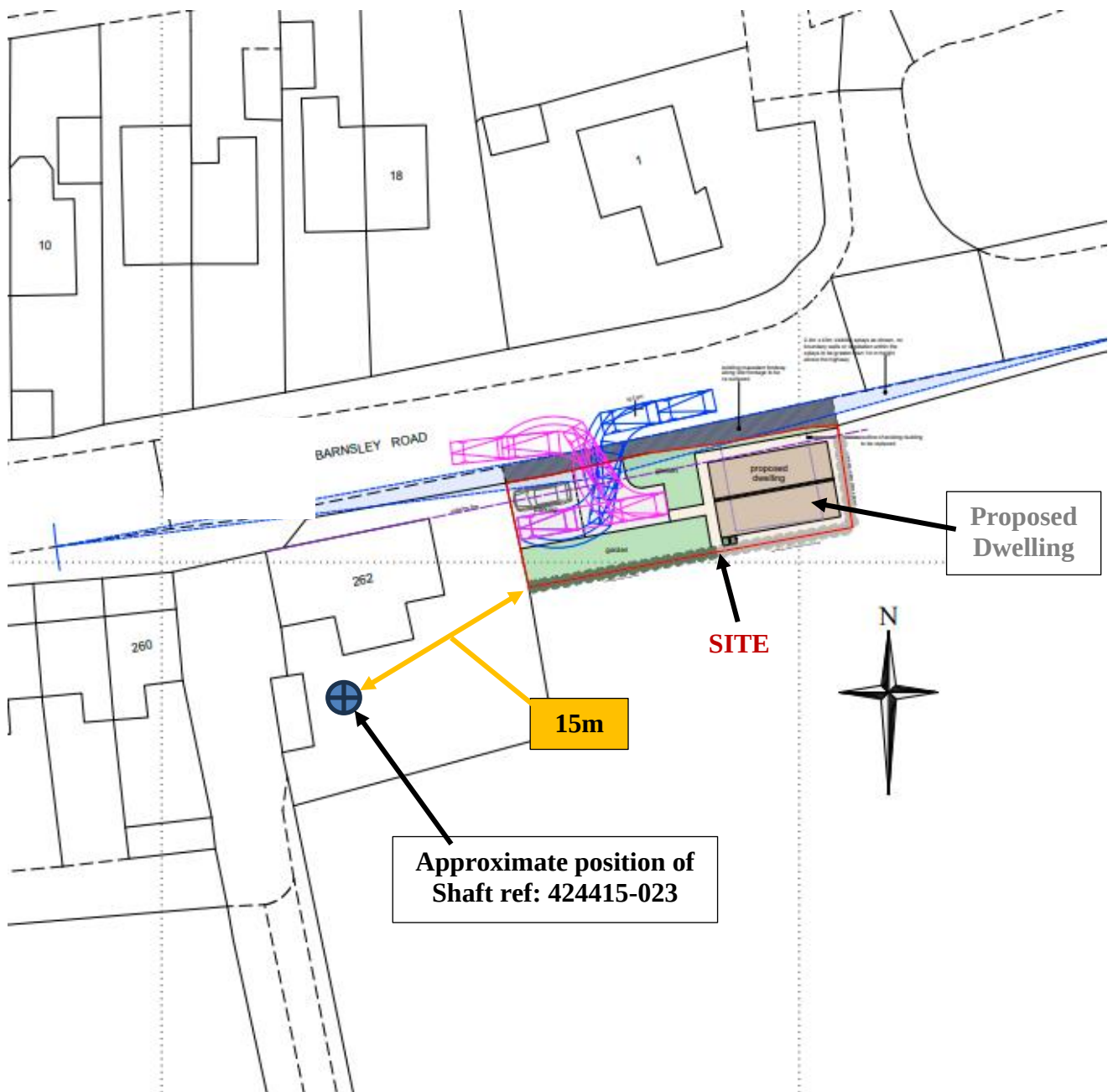
I trust that this satisfies your requirements, however please do not hesitate to contact myself at any time for further clarification or advice.

Yours Sincerely,

Enc.

THIS COAL MINING RISK ASSESSMENT IS BASED ON AND LIMITED TO THE INFORMATION IN MY RECORD AT THE TIME THE ENQUIRY IS ANSWERED. It is based on my professional opinion in line with the guidelines set out in CIRIA C758D "Abandoned mine workings manual." The opinion may be overruled by Government Authorities decisions based on other information not in my record. If a site investigation is recommended then this risk assessment will be superseded by the factual findings of that investigation. All site investigation work should be carried out by a competent professional from which independent conclusions and recommendations for safe development should be provided. It should be noted that: no operation should be undertaken that intersects, disturbs or interferes with any coal or mines of coal without the permission of the Coal Authority. The investigation of coal seams/former mines of coal may have the potential to generate and/or displace underground gases; these risks both under and adjacent the site should be fully considered in any proposals both for personnel and public safety. Copyright in this CMRA belongs to M.A.Lyons. All rights are reserved and unauthorised use is prohibited. Copyright is not transferred to external parties by possession of this report, however, those for whom the report is compiled have the right to use it. If any unauthorised third party comes into possession of this report, they rely upon it entirely at their own risk and the author does not owe them any Duty of Care or Skill.

**Appendix 1 – Location Plan No. 00367/A**  
**(Not To Scale)**  
**Site centred at NGR: 424589E / 415104N**



**Appendix 2 - Informatives**

- 1) The relatively recently revised CIRIA document titled 'Abandoned Mine Workings Manual', which replaced Special Publication 32 (1984), indicates that the use of empirical or 'rule of thumb' guides, as the design basis for treatment depth, has been successfully observed for many years for a wide range of abandoned mine workings and overlying rock/soil strata scenarios. As such, the guidance indicates that further design/ground stabilisation considerations will be required if there is less than 10 times the aggregate measured height of mine workings as competent rock cover above the workings.
- 2) For information, should the grouting of any mine workings be required, a 10:1 PFA/cement mix or similar would need to be injected into the workings and any other disturbed strata above it under pressure on an OS coordinated treatment grid approved by the Coal Authority (and Building Control/third-party Warranty provider as required). Specific proposals to treat any mine workings would need to be submitted in the form of a standalone 'Specification', with a separate permit to treat being obtained from the Coal Authority. The method of consolidation is dependent on the nature of the bedrock strata and the underground mining conditions encountered, although fissile strata, such as shales and mudstone deposits, do permit mining voids to migrate upwards to quite high levels. All grouting works would need to be supervised by a competent engineer, with a final validation report being produced to confirm what works were undertaken and whether they were successful or not.
- 3) Ground gas monitoring can be undertaken to confirm or discount the presence of an elevated gassing regime within the underlying soils. Elevated concentrations of mine gases (e.g. CO<sub>2</sub>, CH<sub>4</sub>) may be present within the coal seams, voids in or above any shallow mine workings, areas of made ground/opencast backfill, and in any permeable bedrock strata (and any organic rich surficial soils). The period of monitoring to be undertaken should be broadly completed in accordance with current guidance [BS8485]. Piezometers would need to be installed (during drilling works for example) to facilitate this.

## **Appendix 2**

### Abandoned Mine Plan



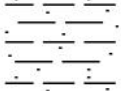
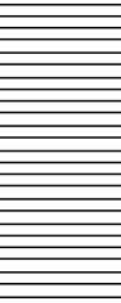
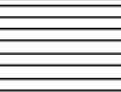
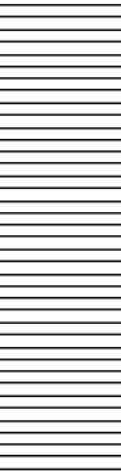
## **Appendix 3**

### Borehole Records

Site: 264 BARNSELEY ROAD (4438)  
Location: FLOCKTON  
Method: Rotary Openhole  
Date: 14th March 2025  
Client: Mr. R. Price

Borehole No: R1

Michael D Joyce Associates LLP

| Depth (m) | TCR (%) | SCR (%) | RQD (%) | FI (%) | Field Records | Depth (mAOD) | Reduced Level (m) | Description                                                                    | Legend                                                                                |
|-----------|---------|---------|---------|--------|---------------|--------------|-------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|           |         |         |         |        |               | 0            | 0                 | Ground level.                                                                  |                                                                                       |
|           |         |         |         |        |               |              |                   | MADE GROUND: Topsoil over grey clay with occasional ash and sandstone gravels. |    |
|           |         |         |         |        |               | -0.6         |                   | Brown and grey sandy CLAY.                                                     |    |
|           |         |         |         |        |               | -1.4         | 1                 | Grey silty CLAY.                                                               |    |
|           |         |         |         |        |               | -2.6         | 2                 | Dark grey and black shaly MUDSTONE.                                            |   |
|           |         |         |         |        |               | -5.1         | 5                 | Grey-brown silty MUDSTONE.                                                     |  |
|           |         |         |         |        |               |              |                   | Intact COAL.                                                                   |  |
|           |         |         |         |        |               | -5.9         | 6                 | Grey silty MUDSTONE with some bands of sandstone.                              |  |
|           |         |         |         |        |               |              | 7                 |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 8                 |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 9                 |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 10                |                                                                                |                                                                                       |

Equipment: Beretta T25 Rig  
Flush: Water flush  
Groundwater: Not encountered.  
Returns: Good  
Remarks: No gases encountered.

Site: 264 BARNSELEY ROAD (4438)  
Location: FLOCKTON  
Method: Rotary Openhole  
Date: 14th March 2025  
Client: Mr. R. Price

Borehole No: R1

Michael D Joyce Associates LLP

| Depth (m) | TCR (%) | SCR (%) | RQD (%) | FI (%) | Field Records | Depth (mAOD) | Reduced Level (m) | Description                                       | Legend |
|-----------|---------|---------|---------|--------|---------------|--------------|-------------------|---------------------------------------------------|--------|
|           |         |         |         |        |               |              |                   | Grey silty MUDSTONE with some bands of sandstone. |        |
|           |         |         |         |        |               |              | 11                |                                                   |        |
|           |         |         |         |        |               |              | 12                |                                                   |        |
|           |         |         |         |        |               |              | 13                |                                                   |        |
|           |         |         |         |        |               |              | 14                |                                                   |        |
|           |         |         |         |        |               |              | 15                |                                                   |        |
|           |         |         |         |        |               |              | 16                |                                                   |        |
|           |         |         |         |        |               |              | 17                |                                                   |        |
|           |         |         |         |        |               |              | 18                |                                                   |        |
|           |         |         |         |        |               |              | 19                |                                                   |        |
|           |         |         |         |        |               |              | 20                |                                                   |        |

Equipment: Beretta T25 Rig  
Flush: Water flush  
Groundwater: Not encountered.  
Returns: Good  
Remarks: No gases encountered.

Site: 264 BARNSELEY ROAD (4438)  
Location: FLOCKTON  
Method: Rotary Openhole  
Date: 14th March 2025  
Client: Mr. R. Price

Borehole No: R1

Michael D Joyce Associates LLP

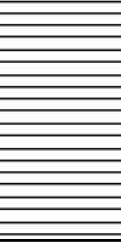
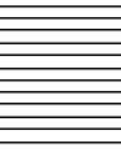
| Depth (m) | TCR (%) | SCR (%) | RQD (%) | FI (%) | Field Records | Depth (mAOD) | Reduced Level (m) | Description     | Legend |
|-----------|---------|---------|---------|--------|---------------|--------------|-------------------|-----------------|--------|
|           |         |         |         |        |               |              | 21                |                 |        |
|           |         |         |         |        |               |              | 22                |                 |        |
|           |         |         |         |        |               |              | 23                |                 |        |
|           |         |         |         |        |               |              | 24                |                 |        |
|           |         |         |         |        |               | -25          | 25                | End of Borehole |        |
|           |         |         |         |        |               |              | 26                |                 |        |
|           |         |         |         |        |               |              | 27                |                 |        |
|           |         |         |         |        |               |              | 28                |                 |        |
|           |         |         |         |        |               |              | 29                |                 |        |
|           |         |         |         |        |               |              | 30                |                 |        |
|           |         |         |         |        |               |              | 31                |                 |        |

Equipment: Beretta T25 Rig  
Flush: Water flush  
Groundwater: Not encountered.  
Returns: Good  
Remarks: No gases encountered.

Site: 264 BARNSELEY ROAD (4438)  
Location: FLOCKTON  
Method: Rotary Openhole  
Date: 14th March 2025  
Client: Mr. R. Price

Borehole No: R2

Michael D Joyce Associates LLP

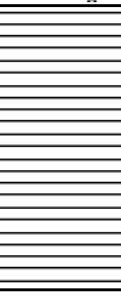
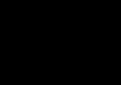
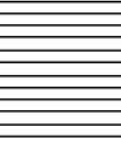
| Depth (m) | TCR (%) | SCR (%) | RQD (%) | FI (%) | Field Records | Depth (mAOD) | Reduced Level (m) | Description                                                                    | Legend                                                                                |
|-----------|---------|---------|---------|--------|---------------|--------------|-------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|           |         |         |         |        |               | 0            | 0                 | Ground level.                                                                  |                                                                                       |
|           |         |         |         |        |               |              |                   | MADE GROUND: Topsoil over grey clay with occasional ash and sandstone gravels. |    |
|           |         |         |         |        |               | -0.8         | 1                 | Brown and grey sandy CLAY.                                                     |    |
|           |         |         |         |        |               |              | 2                 |                                                                                |                                                                                       |
|           |         |         |         |        |               | -2.5         |                   | Grey silty MUDSTONE.                                                           |    |
|           |         |         |         |        |               | -2.8         | 3                 | Dark grey and black shaly MUDSTONE.                                            |   |
|           |         |         |         |        |               |              | 4                 |                                                                                |                                                                                       |
|           |         |         |         |        |               | -4.8         |                   | Grey-brown silty MUDSTONE.                                                     |  |
|           |         |         |         |        |               | -5           | 5                 | Intact COAL.                                                                   |  |
|           |         |         |         |        |               | -5.6         |                   | Grey silty MUDSTONE.                                                           |  |
|           |         |         |         |        |               |              | 6                 |                                                                                |                                                                                       |
|           |         |         |         |        |               | -7           | 7                 | End of Borehole                                                                |                                                                                       |
|           |         |         |         |        |               |              | 8                 |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 9                 |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 10                |                                                                                |                                                                                       |

Equipment: Beretta T25 Rig  
Flush: Water flush  
Groundwater: Not encountered.  
Returns: Good  
Remarks: No gases encountered.

Site: 264 BARNSELEY ROAD (4438)  
Location: FLOCKTON  
Method: Rotary Openhole  
Date: 14th March 2025  
Client: Mr. R. Price

Borehole No: R3

Michael D Joyce Associates LLP

| Depth (m) | TCR (%) | SCR (%) | RQD (%) | FI (%) | Field Records | Depth (mAOD) | Reduced Level (m) | Description                                                                    | Legend                                                                                |
|-----------|---------|---------|---------|--------|---------------|--------------|-------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|           |         |         |         |        |               | 0            | 0                 | Ground level.                                                                  |                                                                                       |
|           |         |         |         |        |               |              |                   | MADE GROUND: Topsoil over grey clay with occasional ash and sandstone gravels. |    |
|           |         |         |         |        |               | -0.7         |                   |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 1                 | Brown and grey sandy CLAY.                                                     |    |
|           |         |         |         |        |               | -1.8         |                   |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 2                 | Grey silty CLAY.                                                               |    |
|           |         |         |         |        |               | -2.6         |                   |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 3                 | Dark grey and black shaly MUDSTONE.                                            |   |
|           |         |         |         |        |               | -4.9         |                   |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 5                 | Grey-brown silty MUDSTONE.<br>Intact COAL.                                     |  |
|           |         |         |         |        |               | -5.7         |                   |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 6                 | Grey silty MUDSTONE.                                                           |  |
|           |         |         |         |        |               | -7           |                   |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 7                 | End of Borehole                                                                |                                                                                       |
|           |         |         |         |        |               |              | 8                 |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 9                 |                                                                                |                                                                                       |
|           |         |         |         |        |               |              | 10                |                                                                                |                                                                                       |

Equipment: Beretta T25 Rig  
Flush: Water flush  
Groundwater: Not encountered.  
Returns: Good  
Remarks: No gases encountered.

## **Standard Appendix A**

1. **GENERAL.** The ground investigation has been carried out in accordance with the requirements of BS5930: 2015 and A1: 2020 and BS10175: 2011+A1: 2017. By its very nature, any ground investigation only samples a small percentage of the ground. Consequently, changes in ground conditions and soil properties can occur between any two exploratory points, for example local features such as soft ground, pockets of contamination and faults. This is also true of the exploration of mineworkings and such features can extend beneath parts of the site not investigated. Unrecorded bell pits and shafts can also exist between exploratory points. The ground investigation is designed to minimise such risks but they cannot be eliminated.
2. **GROUND INVESTIGATION.**
  - 2.1 **BOREHOLE AND TRIAL PIT RECORDS.** These illustrate the ground conditions only at the location of the particular borehole or trial pit. Correlation between boreholes is for guidance only and its accuracy cannot be guaranteed.
  - 2.2 **SHELL AND AUGER BORING.** This technique uses a tripod winch and an essentially percussive action using a variety of tools. Disturbed and undisturbed samples can be taken. This is the most suitable method for soft ground investigation, enabling the maximum amount of information to be obtained. However, minor changes in lithology may be overlooked unless continuous undisturbed sampling is used.
  - 2.3 **GROUNDWATER.** Groundwater levels vary seasonally and the details given on the borehole logs relate only to the dates and the conditions described in the borehole records. The rate of boring may not have allowed an equilibrium water level to be established and the use of casing may seal off certain seepages.
  - 2.4 **SAMPLING.** Disturbed samples of soils are taken for identification and classification purposes. In cohesive soils 'undisturbed' samples 100mm in diameter are taken by open drive sampler for laboratory testing of strength, permeability and consolidation characteristics.
  - 2.5 **STANDARD PENETRATION TESTS.** S.P.T tests are used in granular and cohesive materials and in soft or weathered rocks. Difficulties in obtaining true 'N' values mean they must only be used as a guide and not as an absolute value in foundation design.
  - 2.6 **ROTARY DRILLING.** Two main types of rotary drilling are carried out in rock. Rock coring using diamond or tungsten carbide tipped core bits provides samples and information on rock types, fissuring and weathering. Openhole drilling only produces small particles for identification purposes and the information gained is therefore limited. The latter is, however, useful as a quick method for detecting major strata changes and for the location of coal seams and old workings. Water, air, foam or drilling muds may be used as the flushing medium in either case.
  - 2.7 **PERMEABILITY TESTS.** These can be carried out in boreholes or trial pits and gives a good indication of in-situ permeability.
  - 2.8 **TRIAL PITTING.** This enables soil conditions to be closely examined at any specific point and samples taken. It also gives useful information on the stability of excavations and ingress of water.
  - 2.9 **WINDOW SAMPLING.** Window sampling consists of driving a series of 1m-long tubes into the ground using a dropping weight. On completion of each 1m run, the tube is withdrawn. The next tube is then inserted and the process repeated to provide a continuous profile of the ground. On each run the tube diameter is reduced in order to assist in its recovery.
  - 2.10 **GAS MONITORING.** This is routinely carried out in trial pits or probe holes to check for elevated levels of methane and carbon dioxide or oxygen deficiency, particularly since risks can exist from natural gases, landfill sites and rising groundwater levels in mine workings below ground. Longer term monitoring is carried out with gas monitoring standpipes.
3. **SOIL DESCRIPTION.** Samples from borings or trial pits are described as specified in the standard procedure outlined in the British Standards. The description includes colour, consistency, structure, weathering, lithological type, inclusions and origin. All descriptions are based on visual and manual identification.

**Fire Soils (Cohesive Soils)**

The following field terms are used:

| Soil Type  | Description                                                                    |
|------------|--------------------------------------------------------------------------------|
| Very soft  | Exudes between fingers                                                         |
| Soft       | Moulded by light finger pressure                                               |
| Firm       | Cannot be moulded by the fingers but can be rolled in hand to 3mm threads.     |
| Stiff      | Crumbles and breaks when rolled to 3mm threads but can be remoulded to a lump. |
| Very stiff | No longer moulded but crumbles under pressure. Can be indented with thumbs.    |

The following terms are used in accordance with the results of laboratory and field tests.

| Description   | Undrained Shear Strength $c_u$<br>(kPa) |
|---------------|-----------------------------------------|
| Extremely Low | <10                                     |
| Very Low      | 10 - 20                                 |
| Low           | 20 - 40                                 |
| Medium        | 40 - 75                                 |
| High          | 75 - 150                                |
| Very High     | 150 - 300                               |

Fine soils can also be classified according to their sensitivity, which is the ratio between undisturbed and remoulded undrained shear strength.

| Sensitivity | Ratio  |
|-------------|--------|
| Low         | 8      |
| Medium      | 8 - 30 |
| High        | >30    |
| Quick       | >50    |

#### Granular Soils (Non-Cohesive)

The following descriptions are used for granular soils.

| Description | Normalised Blow Count ( $N_1$ ) 60 |
|-------------|------------------------------------|
| Very Loose  | 0 - 4                              |
| Loose       | 4 - 10                             |
| Medium      | 10 - 30                            |
| Dense       | 30 - 50                            |
| Very Dense  | >50                                |

- NATURAL OR IN-SITU MOISTURE CONTENT.** The natural or in-situ moisture content of a soil is defined as the weight of water contained in the pore space, expressed as a percentage of the dry weight of solid matter present in the soil. Soil properties are greatly affected by the moisture content and the test can help to give an indication of likely engineering behaviour.
- LIQUID AND PLASTIC LIMITS.** Two simple classification tests are known as the liquid and plastic limits. If a cohesive soil is remoulded with increasing amounts of water, a point will be reached at which it ceases to behave as a plastic material and becomes essentially a viscous fluid. The moisture content corresponding to this change is arbitrarily determined by the liquid limit test. 'Fat' clays, which have high contents of colloidal particles, have high liquid limits; 'lean' clays, having low colloidal particle contents have correspondingly low liquid limits. An increase in the organic content of a clay is reflected by an increase in the liquid and plastic limits.

If a cohesive soil is allowed to dry progressively, a point is reached at which it ceases to behave as a plastic material, which can be moulded in the fingers, and it becomes friable. The moisture content of the soil at this point is known as the 'plastic limit' of the soil.

The range of water content over which a cohesive soil behaves plastically, i.e. the range lying between the liquid and plastic limits, is defined as the plasticity index.

A cohesive soil with a natural water content towards its liquid limit will, in general, be an extremely soft material whereas a cohesive soil with a natural water content below its plastic limit will tend to be a stiff material.

- PARTICLE-SIZE DISTRIBUTION.** A knowledge of particle-size distribution is used to classify soils and to indicate likely engineering behaviour. British Standards define soils in relation to their particle-size as shown below:-

|               |             |             |          |    |          |
|---------------|-------------|-------------|----------|----|----------|
| Boulders      | >200mm      | Coarse Sand | 2.0      | to | 0.63mm   |
| Cobbles       | 200 to 63mm | Medium Sand | 0.63     | to | 0.2mm    |
|               |             | Fine Sand   | 0.2      | to | 0.063mm  |
| Coarse Gravel | 63 to 20mm  | Coarse Silt | 0.063    | to | 0.02mm   |
| Medium Gravel | 20 to 6.3mm | Medium Silt | 0.02     | to | 0.0063mm |
| Fine Gravel   | 6.3 to 2mm  | Fine Silt   | 0.0063   | to | 0.002mm  |
|               |             | Clay        | <0.002mm |    |          |

- BULK DENSITY.** The bulk density of a material is the weight of that material per unit volume and includes the effects of voids whether filled with air or water. The 'dry density' of a soil is defined as the weight of solids contained in a unit volume of the soil.

8. **PERMEABILITY.** The permeability of a material is defined as the rate at which water flows through it per unit area of soil under unit hydraulic gradient.
9. **CONSOLIDATION CHARACTERISTICS.** When subjected to pressure, a soil tends to consolidate as the air or water in the pore space is forced out and the grains assume a denser state of packing. The decrease in volume per unit of pressure is defined as the 'compressibility' of the soil, and a measure of the rate at which consolidation proceeds is given by the 'coefficient of consolidation' of the soil. These two characteristics  $M_v$  and  $C_v$  are determined in the consolidation test and the results are used to determine settlement of structures or earthworks.
10. **STRENGTH CHARACTERISTICS.** The strength of geological materials is generally expressed as the maximum resistance that they offer to deformation or fracture by applied shear or compressive stress. The strength characteristics of geological materials depend to an important degree on their previous history and on the conditions under which they will be stressed in practice. Consequently, it is necessary to simulate in the laboratory tests the conditions under which the material will be stressed in the field.

In general, the only test carried out on hard rocks is the determination of their compressive strength but consideration must be given to fissuring, jointing and bedding planes.

The tests at present in use for soils and soft rocks fall into two main categories. Firstly, those in which the material is stressed under conditions of no moisture content change, and secondly those in which full opportunity is permitted for moisture content changes under the applied stresses. Tests in the first category are known as undrained (immediate or quick) tests, while those in the second category are known as drained (slow or equilibrium) tests. The tests are normally carried out in the triaxial compression apparatus but granular materials may be tested in the shear box apparatus.

The undrained triaxial test gives the apparent cohesion  $C_u$  and the angle of shearing resistance  $\phi_u$ . In dry sands,  $C_u = 0$  and  $\phi_u$  is equal to the angle of internal friction whereas with saturated non-fissured clays  $\phi_u$  tends to 0 and the apparent cohesion  $C_u$  is equal to one-half the unconfined compression strength  $q_u$ . On site the vane test gives an approximate measure of shear strength.

For some stability problems use is made of a variant of the undrained triaxial test in which the specimen is allowed to consolidate fully under the hydrostatic pressure and is then tested to failure under conditions of no moisture content change. This is known as the consolidated undrained triaxial test. Pore water pressures may be measured during this test or a fully drained test may be carried out. In either case the effective shear strength parameters  $C'$  and  $\phi'$  can be obtained which can be used to calculate shear strength at any given pore water pressure.

11. **COMPACTION.** The density at which any soil can be placed in an earth dam, embankment or road depends on its moisture content and on the amount of work which is used in compaction. The influence of these two factors can be studied in compaction tests, which can determine the maximum dry density (MDD) achievable at a certain optimum moisture content (OMC).
12. **CALIFORNIA BEARING RATIO TEST.** In flexible pavement design a knowledge of the bearing capacity of the subgrade is necessary to enable the thickness of pavement for any particular combination of traffic and site conditions to be determined. The quality of the subgrade can be assessed by means of the California Bearing Ratio Test or approximately by the MEXE cone penetrometer.
13. **ROCK DESCRIPTION.** This is based on;

(i) Strength

| Term                                                                                          | Field Identification                                                                                                     | Unconfined Compressive Strength (MPa) |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Extremely Weak <sup>a</sup>                                                                   | Indented by thumbnail.                                                                                                   | Less than 1                           |
| Very Weak                                                                                     | Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife.                              | 1 to 5                                |
| Weak                                                                                          | Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer. | 5 to 25                               |
| Medium Strong                                                                                 | Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer.   | 25 to 50                              |
| Strong                                                                                        | Specimen required more than one blow of geological hammer to fracture it.                                                | 50 to 100                             |
| Very Strong                                                                                   | Specimen requires many blows of geological hammer to fracture it.                                                        | 100 to 250                            |
| Extremely Strong                                                                              | Specimen can only be chipped with geological hammer.                                                                     | Greater than 250                      |
| <sup>a</sup> Some extremely weak rocks will behave as soils and should be described as soils. |                                                                                                                          |                                       |

(ii) Structure

| Thickness Term                          | Spacing Term    | Thickness or spacing |
|-----------------------------------------|-----------------|----------------------|
| Very thickly                            | Extremely wide  | >6m                  |
| Very thickly                            | Very wide       | 2m – 6m              |
| Thickly                                 | Wide            | 600mm – 2m           |
| Medium                                  | Medium          | 200mm – 600mm        |
| Thinly                                  | Close           | 60mm – 200mm         |
| Very thinly                             | Very close      | 20mm – 60mm          |
| Thickly laminated (Sedimentary)         | Extremely close | 6mm – 20mm           |
| Narrowly (Metamorphic and Igneous)      |                 |                      |
| Thinly laminated (Sedimentary)          | Extremely close | <6mm                 |
| Very narrowly (Metamorphic and Igneous) |                 |                      |

- (iii) Colour
- (iv) Texture
- (v) Grain size

| Description      | Predominate Grain Size (mm) |
|------------------|-----------------------------|
| Conglomerate     | >2                          |
| Coarse - grained | 2 - 0.63                    |
| Medium - grained | 0.63 - 0.20                 |
| Fine - grained   | 0.20 - 0.063                |
| Siltstone        | 0.063 - 0.002               |
| Mudstone         | <0.002                      |

- (vi) Rock Name
- (vii) Stability
- (viii) Weathering

| Term                                      | Description                                                                                                                                                                            | Grades |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Fresh/unweathered                         | No visible sign of rock material weathering; perhaps slight discolouration on major discontinuity surfaces.                                                                            | 0      |
| Slightly weathered                        | Slight discolouration indicates weathering of rock material and discontinuity surfaces.                                                                                                | 1      |
| Moderately weathered/Distinctly weathered | Less than half of the rock material is decomposed or disintegrated. Fresh or discoloured rock is present either as a continuous framework or as core stones.                           | 2      |
| Highly weathered/Destructed               | More than half of the rock material is decomposed or disintegrated. Fresh or discoloured rock is present either as a continuous framework or as core stones.                           | 3      |
| Completely weathered                      | All rock material is decomposed and/or disintegrated to soil. The original mass structure is still apparent.                                                                           | 4      |
| Residual soil                             | All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soils has not been significantly transported. | 5      |

- (ix) Discontinuities
- (x) Weathered of Rock Mass

14. **CHEMICAL TESTS.** A knowledge of water soluble sulphate content and pH of soils and groundwater is important in determining the protection required for concrete or steel in contact with the ground. Other specialist tests may be carried out on sites suspected of being contaminated (see standard appendix B).

15. **REFERENCES**

BS5930: 2015+A1:2020 British Standard Code of Practice for Site Investigations  
BS10175: 2011+A1:2017 British Standard Code of Practice for the Investigation of Potentially Contaminated Sites  
BS EN ISO 14688-1: 2018 Geotechnical Investigation and Testing: Identification and Classification of Soil  
BS EN ISO 14688-2: 2018 Geotechnical Investigation and Testing: Identification and Classification of Soil