

ROGERS **GEOTECHNICAL SERVICES LTD**

The **Ground Investigation** Specialists



Unit 12 Emley Business Park
Leys Lane
Emley
Huddersfield
HD8 9QY

Tel: 01924 849 621 **Fax:** 01924 849 185



www.citation.co.uk

MINING RISK ASSESSMENT

at

HUNGER HILL FARM, HAIGH HEAD ROAD, HOYLANDSWAINE

for

DC21 LTD.

Report No J2166/12/E

May 2012

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1. INTRODUCTION

It is understood that as part of the planning application for a wind turbine at the site, a mining risk assessment has been requested by the planning authority. Indeed, the client has provided conjectural information that there is a suspected mine shaft approximately 100m to the south of the turbine location. Consequently, a desktop study has been commissioned in order to assess the risk to the development from mining.

The proposed turbine is to comprise the construction of a 6m by 6m reinforced concrete foundation from which the turbine and mast can be erected. It is understood that the design bearing pressure at the underside of the foundation is 100kN/m^2 . The location for the turbine is to the south of Hunger Hill Farm at the edge of an agricultural field at grid coordinates $53^{\circ}32'22.52''\text{N } 1^{\circ}36'57.89''\text{W}$ (OSGB36 425867, 404435), which is indicated on the attached site plan presented as Appendix 1 of this report.

The proposed turbine is located near the top of a point of high ground and is at approximately 260m above sea level. The top of the high ground is at about 270m above sea level and is roughly 500m to the south east of the turbine location, the ground to the north through to the west, then south of the turbine being downslope.

2. **DESK STUDY**

The geological desk study has been undertaken using the following sources of information.

- British Geological Survey data.
- British Geological Survey borehole records.
- Coal Authority mines report.
- Coal Authority coal abandonment plans

2.1 **Geological Survey Data**

The available published geological data for the site has been examined and the following table presents the anticipated geology.

Table 1: Geological Data for the Site

Strata Type	Strata Name ¹	Previous Name ²	Description ²
Superficial Geology	-	-	None indicated
Solid Geology	Pennine Lower Coal Measures Formation – Penistone Flags	Lower Coal Measures	Interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part.

The location of the turbine is shown to be underlain by the Pennine Lower Coal Measures Formation, specifically the Penistone Flags which is a member of the formation typically comprising leaves of mudstone and flaggy sandstone. Furthermore, it would appear that a northwest to southeast trending fault, which is downthrown to the southwest, is present at or very near the proposed location for the turbine. To the northeast of the fault the Top Whinmoor Coal is shown to outcrop in a semi-circular pattern, this coal seam lies, stratigraphically, immediately above the Penistone Flags.

There is a dip marker shown on the BGS map sheet approximately 800m to the south of the turbine location which indicates that the strata dips to the east. However, this indication of dip lies within a different faulted block to that of the turbine location and may not be accurate. Notwithstanding this, it may be noted that, in broad terms, the outcrop patterns of the strata local to the turbine, roughly follow the topographical contour lines, which generally indicates strata at or near horizontal dip.

¹ Sources: BGS Map sheet 86 – Glossop (Solid and Drift Edition) and the Geology of Britain Viewer

² Sources: BGS Lexicon of Named Rock Units

In view of the above, it should be appreciated that due to the faulted nature of the ground at the turbine location, it has not been possible to estimate the depth to any coal seams below turbine.

2.2 Geological Survey Borehole Records

The BGS keep borehole records from across Britain which are available for public viewing through their website³. As part of this study, the records in the area around the site have been reviewed in order to assist in establishing the geological conditions.

Unfortunately, there appear to be no stored borehole records close enough to the turbine location to be considered as pertinent evidence for the underlying geological conditions. Indeed, the closest boreholes are related to the construction of the A628, 650m to the south east of the turbine. These boreholes are located the other side of a fault and it therefore cannot be conclusively determined whether the ground conditions indicated on these logs correlate to those at the turbine.

2.3 Coal Authority Mines Report

A Non-residential Coal Authority Mining Report has been obtained as part of this assessment. The report is presented as Appendix 2 and for the purposes of discussion has been summarised below. Please note that due to the pro forma of the mining report, the turbine location has been referred to as the 'property'.

Underground Coal Mining

Past

The property is in the likely zone of influence from workings in 1 seam of coal at shallow depth, and last worked in 1870.

Present

The property is not in the likely zone of influence of any present underground coal workings.

Future

The property is not in an area for which the Coal Authority is determining whether to grant a licence to remove coal using underground or opencast methods.

The property is not in an area for which a licence has been granted to remove coal using underground or opencast methods.

The property is not in an area that is likely to be affected at the surface from any planned future workings.

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

No notice of the risk of the land being affected by subsidence has been given under section 46 of the Coal Mining Subsidence Act 1991.

³ BGS Borehole Records

Mine Entries

There are no known coal mine entries within, or within 20 metres of, the boundary of the property. Records may be incomplete. Consequently, there may exist in the local area mine entries of which the Coal Authority has no knowledge.

Coal Mining Geology

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

Opencast coal mining

Past

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

Present

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

Future

The property is not within 800 metres of the boundary of an opencast site for which the Coal Authority is determining whether to grant a licence to remove coal by opencast methods.

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

Coal mining subsidence

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

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

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

Mine gas

There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.

Hazards related to coal mining

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

Withdrawal of support

The property is not in an area for which a notice of entitlement to withdraw support has been published.

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

2.3.1 Comments

The Coal Authority Mining Report indicates that the site is in the likely zone of influence of a coal seam at shallow depth which has been worked. On the basis of the geological data for the site, it is considered that this is likely to be Top Whinmoor Coal.

2.4 Coal Authority Coal Abandonment Plans

On the basis of the information provided by the geological data and the Coal Authority mining report, it is considered that there is a worked coal seam at shallow depths below the proposed wind turbine location. In light of this, the Coal Authority records were queried to establish whether any abandonment plans were available for the site location.

The Coal Authority records indicated that there was an abandonment plan for workings below the turbine location and consequently, the abandonment plan was obtained and presented as Appendix 3.

The abandonment plan shows a hatched area of possible workings within the Whinmoor Coal associated with the Wellhouse Pit from 1919 to 1921. Two shaft markers are on the plan and state '*11m to Whinmoor, c 75cm*' and '*10m to Whinmoor, c 37cm*'. Furthermore, there are lines on the plan, which when compared to the BGS map sheet, appear to show the outcrops of the Top Whinmoor Coal. The plan is reference to Ordnance Survey grid lines, these grid lines have been used to overlay the plan on to a modern aerial view of the site, this work is also presented within Appendix 3, although it should be appreciated that there is a limited accuracy to this process.

The overlay of the mine abandonment plan clearly shows that the turbine location is located above the possible workings and in addition, the shaft marker on the plan shows a reasonable correlation with the location of the suspected shaft given by the client.

It should be appreciated that the height above sea level of the ground at the position of the mine shaft and the turbine are approximately the same, within say 1m. On this basis, it is considered that there are workings within the Whinmoor Coal seam at approximately 11m depth below the turbine position.

Typically, instability from mine workings is considered to be of low risk if there is a sufficient cover of competent rock between the base of a foundation and the top of the seam. A sufficient thickness is often considered to be 10 times the seam thickness, plus the thickness of the seam, although this is by no means definitive. Therefore, on the basis that the Top Whinmoor Coal is 0.75m thick, a sufficient cover of competent rock would be 8.25m (assuming a 0.75m worked seam at this location). In this case, the depth below ground level of competent rock is unknown.

It should be appreciated that the stress transmitted into the ground from a square foundation is likely to be significant to depths of up to 1.5 times the foundation breadth, which in this case could be as deep as 9m below the foundation level. This would suggest that the turbine foundation will be stressing the ground to the depth of the potentially worked Top Whinmoor Coal. Furthermore, in light of the shallow cover above the Top Whinmoor Coal, a collapse of the workings could migrate to the surface.

As a consequence of the above, it is concluded that there may be an insufficient thickness of competent rock above any workings within the Top Whinmoor Coal. Therefore, the risk of instability to the workings is considered to be moderate/high, particularly as the thickness of weaker overburden is not known and that the foundation is likely to stress the ground immediately above the workings.

3. **RISK ASSESSMENT**

The risk to the stability of the wind turbine has been evaluated from the data obtained and with reference to the following ratings and definitions:

Low - The possibility of instability is unlikely.

Moderate - The possibility of instability is likely and remedial action may be required.

High - The possibility of instability is highly likely and remedial action will be necessary.

Table 2: *Development specific risk assessment.*

Item	Risk of Instability	Comments	Risk Rating
1	Unstable geological conditions	The proposed turbine is located on or close to a geological fault	Moderate
2	Coal workings	The proposed turbine is located above a shallow coal seam which is considered to have been worked	High

4. **CONCLUSIONS**

Whilst the focus of this assessment has been to establish the risk to the proposed turbine from mine workings, the review of the geological survey data has indicated that the proposed turbine location is very close to or on the line of a fault. It should be appreciated that faults typically result in a vertical zone of broken and weak ground and should a foundation be located over a fault, instability may result from fault movement, although in the United Kingdom fault movements are likely to be limited.

It is therefore recommended that the ground below proposed turbine location be investigated for the presence of fault breccia. Should the fault be found below or in close proximity to the turbine foundation, it would need to be grouted to stabilise the weak material and the foundation base designed to cope with some movement.

In regard to the shallow potentially worked coal seams, the ground below the proposed turbine foundation would again need to be investigated to establish the nature of the underlying material and the presence of any voids. Any voids revealed may need to be stabilised, which is typically achieved by grouting. However, it should be noted that a single investigated position would not be sufficient as it may encounter a pillar within the workings and miss an adjacent void.

As an alternative to grouting, it may be possible to found the turbine base on drill and cased piles. In this scenario, the casing would need to be drilled to the underside of any voids and the piles formed below within competent rock. If this approach is considered further then the advice of a specialist contractors would be required. It is probable that the chosen contractor would require additional investigation in order to formulate a suitable design. Such an investigation should include a rotary cored borehole with core recovery. It cannot be recommended that driven piles be employed as this installation method may lead to destabilising any workings. Equally, uncased piles would not be appropriate as there is no method to form the piles in voided ground.

As a consequence of the conclusions in this report, consideration may be given to relocating the proposed turbine. In this event, careful consideration will need to be given to the mine abandonment plans and the area of workings below the site, as the same considerations will be required within these areas.

It may be noted that the vertical geological section provided on the BGS map sheet indicates that there are coal seams present at depths of 15m and 21m below the site. However, on the basis of the enquiry made with the Coal Authority, no mine abandonment plans were available for these seams and it can be inferred that it is unlikely that these seams have been worked.

For and on behalf of
Rogers Geotechnical Services Ltd,

J. Farnsworth BEng, FGS
Geotechnical Engineer

S.P. Rogers CEng, CGeol, MICE, MCIHT, FGS
Technical Director

APPENDIX 1

SITE PLAN



AREA 25 HA
SCALE: 1:2500
CENTRE COORDINATES: 425576 , 404911



Supplied by Streetwise Maps Ltd
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100047474



Google earth

feet
meters



APPENDIX 2

COAL AUTHORITY MINING REPORT

The COAL AUTHORITY

Issued by:

The Coal Authority, Property Search Services, 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire, NG18 4RG

Website: www.groundstability.com Phone: 0845 762 6848 DX 716176 MANSFIELD 5

**ROGERS GEOTECHNICAL SERVICES
UNIT 12
LEYS LANE
EMLEY
HUDDERSFIELD
HD8 9QY**

Our reference: **51000086107001**
Your reference: **J2166/12/E Hunger Hill**
Date of your enquiry: **28 May 2012**
Date we received your enquiry: **28 May 2012**
Date of issue: **28 May 2012**

This report is for the property described in the address below and the attached plan.

Non-Residential Coal Authority Mining Report

**HUNGER HILL FARM,, HAIGH HEAD ROAD, FIELD TO THE SOUTH OF FARM,
HOYLANDSWAINE, SOUTH YORKSHIRE, S36 7LY**

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

Coal mining	See comments below
Brine Compensation District	No

Information from the Coal Authority

Underground coal mining

Past

The property is in the likely zone of influence from workings in 1 seam of coal at shallow depth, and last worked in 1870.

Present

The property is not in the likely zone of influence of any present underground coal workings.

Future

The property is not in an area for which the Coal Authority is determining whether to grant a licence to remove coal using underground methods.

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

The property is not in an area that is likely to be affected at the surface from any planned future workings.

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

No notice of the risk of the land being affected by subsidence has been given under section 46 of the Coal Mining Subsidence Act 1991.

Mine entries

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

Records may be incomplete. Consequently, there may exist in the local area mine entries of which the Coal Authority has no knowledge.

Coal mining geology

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

Opencast coal mining

Past

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

Present

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

Future

The property is not within 800 metres of the boundary of an opencast site for which the Coal Authority is determining whether to grant a licence to remove coal by opencast methods.

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

Coal mining subsidence

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

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

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

Mine gas

There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.

Hazards related to coal mining

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

Withdrawal of support

The property is not in an area for which a notice of entitlement to withdraw support has been published.

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

Working facilities orders

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

Payments to owners of former copyhold land

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

Comments on Coal Authority information

In view of the mining circumstances a prudent developer would seek appropriate technical advice before any works are undertaken.

Therefore if development proposals are being considered, technical advice relating to both the investigation of coal and former coal mines and their treatment should be obtained before beginning work on site. All proposals should apply good engineering practice developed for mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or mines of coal without the permission of the Coal Authority. Developers should be aware that the investigation of coal seams/former mines of coal may have the potential to generate and/or displace underground gases and these risks both under and adjacent to the development should be fully considered in developing any proposals. The need for effective measures to prevent gases entering into public properties either during investigation or after development also needs to be assessed and properly addressed. This is necessary due to the public safety implications of any development in these circumstances.

Information from the Cheshire Brine Subsidence Compensation Board

The property lies outside the Cheshire Brine Compensation District.

Additional Remarks

This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority and Cheshire Brine Board's Terms and Conditions 2006. The Coal Authority owns the copyright in this report. The information we have used to write this report is protected by our database right. All rights are reserved and unauthorised use is prohibited. If we provide a report for you, this does not mean that copyright and any other rights will pass to you. However, you can use the report for your own purposes.

Issued by:	The Coal Authority, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG
Tax Point Date:	28 May 2012
Issued to:	ROGERS GEOTECHNICAL SERVICES UNIT 12 LEYS LANE EMLEY HUDDERSFIELD HD8 9QY
Property Search for:	HUNGER HILL FARM,, HAIGH HEAD ROAD, FIELD TO THE SOUTH OF FARM, HOYLANDSWAINE, SOUTH YORKSHIRE, S36 7LY
Reference Number:	51000086107001
Date of Issue:	28 May 2012
Cost:	£64.00
VAT @ 20%:	£12.80
Total Received:	£76.80
VAT Registration	598 5850 68

Location map



Approximate position
of property

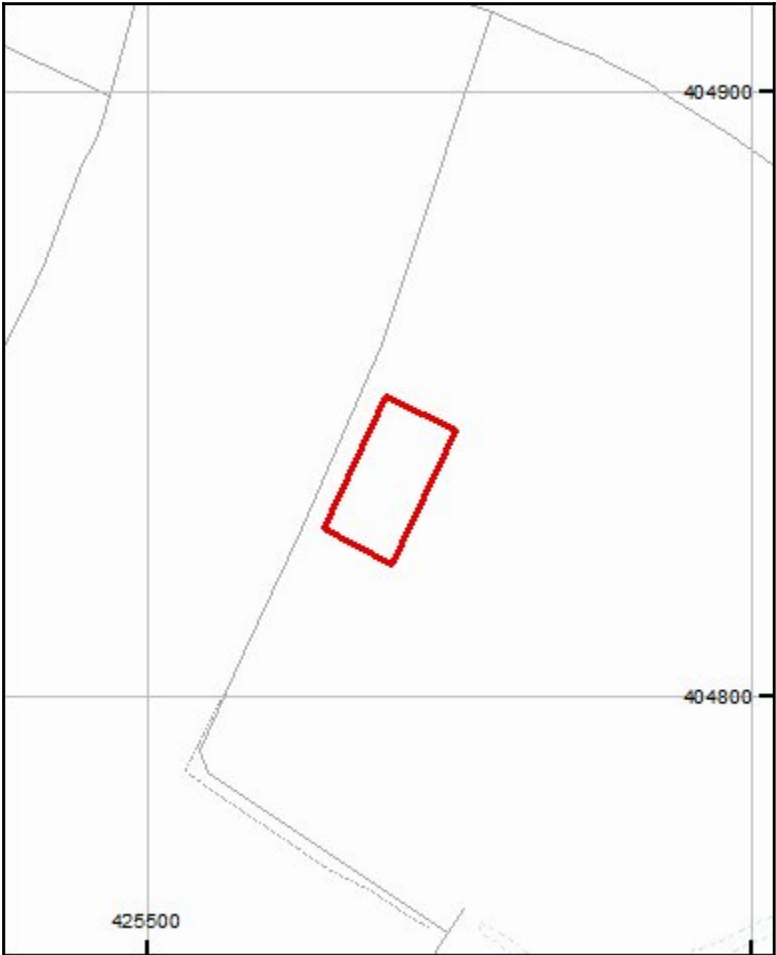


Enquiry boundary

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Key

Approximate position of enquiry
boundary shown



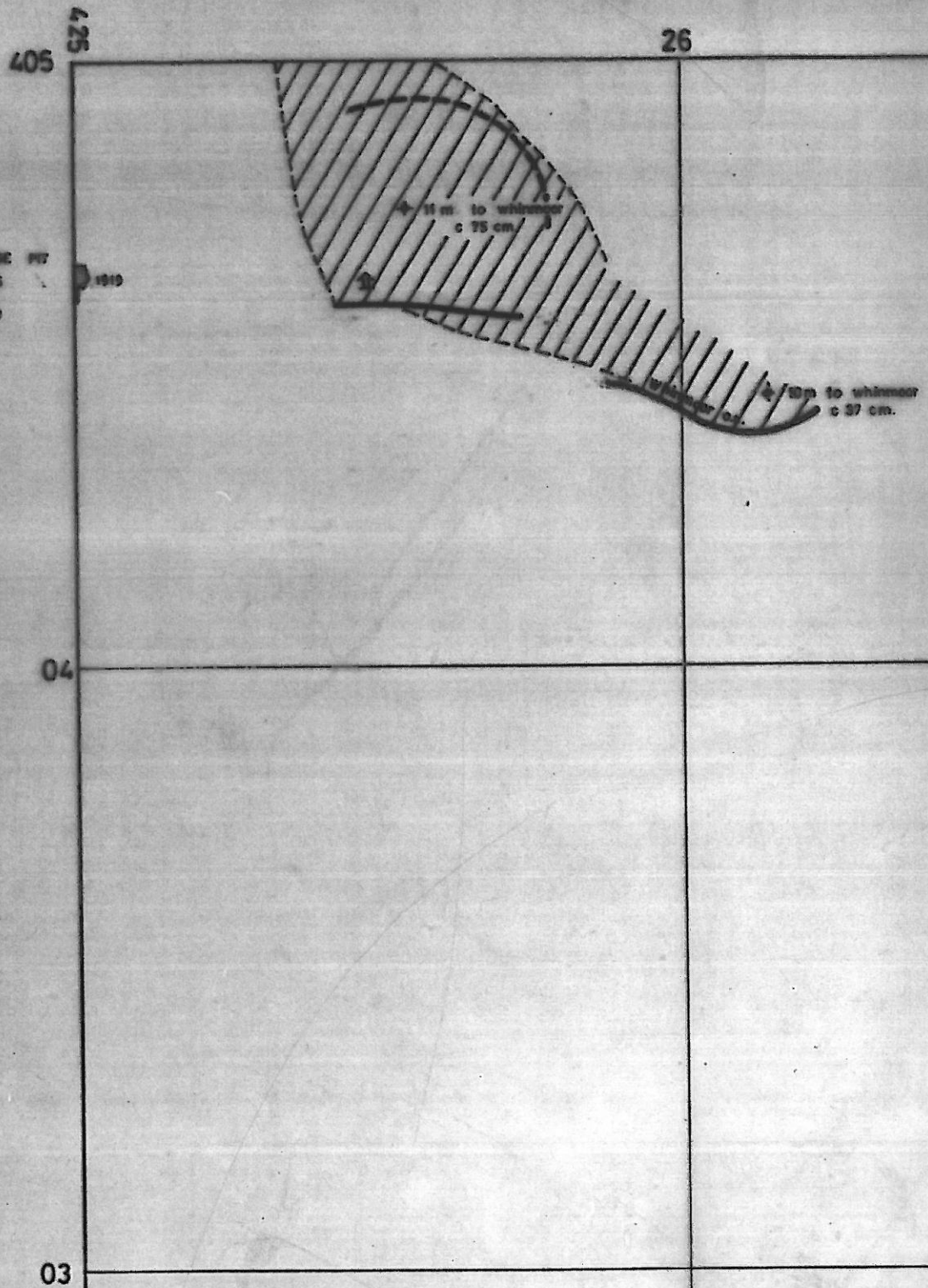
APPENDIX 3

MINE ABANDONMENT PLANS

SE.20 SE.

Hatched area indicates possible workings as shown
on Coal Commission plans - no accurate records
at M.R.O. Rammarah.

WELLHOUSE PT
WORKINGS
1919-21
CAT. No. 577





Title: **Coal Abandonment Plan Overlay**

 Rogers Geotechnical Services Ltd	Site Name: Hunger Hill Farm Hoylandswaine	Job No: J2166/12/E
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