

Mynydd y Gwrhyd Wind Farm

Coal Mining Risk Assessment

29 April 2014

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Planning & Development | Ecology & Hydrology | Technical
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1. Introduction

Awel Aman Tawe has submitted a planning application for the proposed development of a two turbine wind farm at Mynydd y Gwrhyd.

Natural Power has been commissioned to prepare a Coal Mining Risk Assessment Report of the proposed development site, in order to provide the Local Planning Authority with information on coal mining and an assessment of its impact on land stability.

1.1. Site Location and Description

The site is situated in Neath Port Talbot, South Wales, approximately 6.5km north of Pontardawe and 3km south west of Cwmllynfell, centred at approximate national grid reference 273119E, 210852N.

The site is located within an area of upland moorland, typical of the south Wales valleys. There are areas of uneven topography within the vicinity of the site which are indicative of past mining activity. An area of ground to the east of the turbine site had previously been exploited as an opencast coal site but ceased extraction in the early 1990's. Many of the spoil heaps have been cover by natural vegetation growth.

The general site location is show on Awel Aman Tawe Land Ownership Site Plan figure AAT-MyG-JC-Site Plan-180713.

1.2. Description and Layout of Proposed Development

It is proposed to construct a total of 2 wind turbines and associated infrastructure including a sub-station and temporary construction compound, crane pad, borrow pit and access track leading from the A474 road.

It is understood that the turbines will have an overall height of 100m (a hub height of 60m and 40m blades).

The consented turbine locations are understood to be as follows:

- T1: 273119E, 210852N.
- T2: 272739E, 210719N.

The substation is understood to be centred at NGR 272625E, 210679N.

The site layout is show on Awel Aman Tawe Land Ownership Site Plan figure AAT-MyG-JC-Site Plan-180713.

1.3. 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 necessary remedial works and/or demonstrate how coal mining issues have influenced the proposed development; 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.

2. Sources of Information

The following sources of information have been used in the formation of this report:

- Geotechnical Desk Study Assessment undertaken by Earth Science Partnership in 2002 for Awel Aman Tawe. **This desk study included a Coal Authority Coal Mining Report.** A copy of the Desk Study is appended to this report.
- Geological information obtained from the British Geological Survey (1:10,560 Geological Map of Sheets SN71SW and SN70NW, 1973).
- Coal Authority Mine Abandonment Plans: No.1 Rhondda 16719/1; No.2 Rhondda 16623, 16626/2 and 16809; Opencast SW 176 and SW 261.
- RCAHMW archive Aerial Photos.
- Coal Authority Permission to Enter or Disturb Coal Authority Mining Interests, 2013. **Including new Coal Authority Mining Report for drilling at main infrastructure area.** A copy of the new Coal Authority Mining Report is appended to this report.
- Subsequent to the initial risk assessment, site investigation works undertaken by Natural Power for Awel Aman Tawe, 2013. A copy of the relevant borehole logs are appended to this report.

3. Summary of Site Geology

The published geological records (1:10,560 scale, SN71SW and SN70NW) indicate that the site is situated on the Llynfi and Rhondda Beds of the Upper Coal Measures. These beds consist of a sandstone, mudstone and siltstone succession, with some interbedded coals and associated seatearths. The geological map indicates that the strata are predominantly sandstones around the eastern site infrastructure (turbines/substation), while the SW of the site is dominated by mudstone/shale. The succession tends to dip to the southeast at 10-18°, although a few localities document dips closer to 25°.

The majority of the site is located within a large fault block between the major north-south orientated Cwmllynfell Fault (east) and the Cwmteg Fault (west). The Cwmteg Fault primarily downthrows the strata to the east, and splits into a series of sub-parallel faults that underlie the access track to the southwest of the substation. These minor faults have a typical throws between 2.1m and 16m, and are likely to be inactive.

A number of coal seams are known in the vicinity of the site (namely the No.1 Rhondda, Penrhiw and Penrhiw Rider, No.2 Rhondda, Upper Pinchin Rider, Upper Pinchin). The No.1 Rhondda (also known as Duke Seam), Penrhiw and Penrhiw Rider all crop out to the south/ south east of the site therefore due to the dip of the beds do not extend below the site infrastructure.

The main coal seam underlying the site infrastructure is the No.2 Rhondda (also known as 'Ynisarwed Seam'). The Coal Authority plans document this seam as around 0.78m thick, with outcrops occurring north of the access track in an east-west direction. The Upper Pinchin and Pinchin seams occur deeper in the succession below the No.2 Rhondda therefore are likely to occur at significant depth beneath the site.

The Coal Authority plans indicate known workings in the No.1 Rhondda and No.2 Rhondda seams in the vicinity of the site. Natural Power map reference 10395UKC_M_001_A9 provides a generalised overview of the extent of workings as depicted by the Coal Authority mine abandonment plans that are listed in Section 2.

3.1. Turbine 1

Based on the available published information, T1 was identified as being possibly affected by known longwall mine workings from the New Penrhiw Colliery in the No.2 Rhondda seam, at around 48m to 52m below ground level. This area was worked by the New Penrhiw Colliery until 1993. Longwall mining removes the entire seam and allows the unsupported roof to collapse, which can result in disturbed ground above and cause subsidence at the ground surface. We have assessed the extent of the area that is likely to have been affected by these mine workings, based on methods as prescribed in CIRIA SP32 (Construction Over Abandoned Mine Workings) and the NCB Subsidence Engineers Handbook. This area is shown on the attached map ref: 10395UKC_M_002_A11, and indicates T1 could be at risk from the influences of past mining.

3.2. Turbine 2 and substation

The mining records indicated no recorded mine workings in the area of T2 or the substation, with the nearest known workings about 120m east. However, based on the available published information, T2 and the substation were identified as being possibly at risk of having been undermined by suspected historical unrecorded mine workings in the No.2 Rhondda seam, from a known mine entry located on the crop of the seam (approximately 70m north of T2 at Penwaun-uchaf). The seam has been calculated to be around 30m below ground level at T2, and would be sufficiently thick locally to be economic to mine. There is a likelihood any workings in this location would have been post and stall type, due to the age, but it is important to note this is not confirmed. Subsidence associated with post and stall workings is usually confined to localised rather than widespread areas. Roof collapse is the main subsidence mechanism, whereby the roof continues to fail until bulking of the collapsed material fills the voids, or until a stratum is reached which has a tensile strength large enough to allow the roof to span the void, e.g. a massive sandstone unit.

4. Identification and Assessment of Site Specific Coal Mining Risks

Table 4.1 summarises the potential risks associated with coal mining legacy for the proposed development site, identified from the desk study sources of information identified in Section 2.

Coal Mining Issue	Yes	No	Risk Assessment
Underground coal mining (recorded at shallow depths)	X		Recorded workings are known to be present in the vicinity of T1, as described in Section 3.1. Based on this assessment, T1 was confirmed as possibly being within the zone of influence of the abovementioned workings. Due to the age of the workings, subsidence associated with this type of mining will likely have ceased, but disturbed ground conditions could be present below T1, and there is a risk that increasing the loadings and stresses within the ground during foundation construction could disturb the equilibrium and instigate further subsidence during or post construction. The nature and condition of the bedrock below T1 will have the main influence on this. Subsequent to this initial risk assessment, further action was considered necessary and site investigation works were undertaken by Natural Power to investigate the desk based assumptions. This is reported in Section 5.
Underground coal mining (probable at shallow depths)	X		Possible unrecorded workings were suspected in the vicinity of T2 and the substation, as Described in Section 3.2. Our assessment suggested that if post and stall mining has been undertaken in this area, the associated voids could typically migrate vertically to up to ca 20mbgl, or potentially nearer the surface if poor bedrock conditions were present. There is a risk that increasing the loadings and stresses within the ground during foundation construction might instigate further unpredictable subsidence below T2 and substation and affect the integrity of the foundations. Again the nature and condition of the bedrock below the turbine location will have the main influence on this. Subsequent to this initial risk assessment, further action was considered necessary and site investigation works were undertaken by Natural Power to investigate the desk based assumptions. This is reported in Section 5.
Mine entries (shafts and adits)	X		Mine entries are known to be present within the area generally; however no known shafts or adit entries were located within 50m of the main infrastructure locations (T1, T2 and substation). The potential for any shafts and adits affecting the development was considered low, however this was assessed as part of the site investigation works undertaken by Natural Power in relation to the underground coal mining (identified above).
Record of past mine gas emissions or potential		X	The Coal Authority records indicate no known past mine gas emissions on site. In addition, the coal seams on site are not known as being potential gas bearing seams. Risk considered negligible.
Recorded coal mining surface hazard		X	None known. Risk considered negligible.
Surface mining (opencast workings)		X	Although opencasts are known locally, the property is not within the boundary of an opencast site from which coal has been removed by opencast methods. Risk considered negligible.

Table 4.1: Coal Mining Issues

5. Mitigation Works

The above desk based risk assessment identified potential risks to the development associated with past underground coal mining. Natural Power considered these issues required further assessment and validation. A site investigation was undertaken by Natural Power including boreholes drilled to target the known seams. A copy of the relevant borehole logs are appended to this report.

Prior written permission from The Coal Authority was obtained for the intrusive works (Permit Reference Number 8139 & 8141).

5.1. Turbine 1

At T1, we assessed the potential zone of disturbance could potentially extend to about 50mbgl. It was considered any holes drilled here should extend to around 55m to penetrate the base of the No.2 Rhondda seam to firstly prove the accuracy of the mine plans (i.e. the seam has not been worked below T1), and secondly to assess the nature and condition of the bedrock and whether any potentially disturbed ground was present below T1.

Two boreholes were drilled in the vicinity of T1:

The deepest borehole BHT1A was located at 273,109E, 201,840N and was drilled to a depth of 53mbgl to try to intercept the No.2 Rhondda seam. The borehole proved a thin layer of superficial deposits overlying a succession of undisturbed sandstone and mudstone layers, and the No.2 Rhondda seam was encountered intact from 48.9m to 49.7mbgl.

A supplementary borehole BHT1B was located at 273,117E, 201,855N and was drilled to a depth of 35mbgl to confirm that the rock within the depth of the zone of influence of the T1 turbine foundation was undisturbed. The borehole proved a thin layer of superficial deposits overlying a succession of undisturbed sandstone and mudstone layers.

None of the boreholes encountered any evidence of coal workings, voids, flush loss or highly fractured/ disturbed ground.

5.2. Turbine 2 and substation

At T2 and the substation, we assessed the potential for workings at about 30m depth. It was considered any holes drilled here should extend to around 35m to penetrate the base of the No.2 Rhondda seam to prove whether any historical unrecorded mine workings are present, and to assess whether any potentially disturbed ground was present.

Two boreholes were drilled in the vicinity of T2 and the substation:

Borehole BHT2A was located at 272,733E, 201,725N and was drilled to a depth of 35.2mbgl to try to intercept the No.2 Rhondda seam. The borehole proved a thin layer of superficial deposits overlying a succession of undisturbed mainly sandstone layers, and the No.2 Rhondda seam was encountered intact from 33.3m to 33.9mbgl. Below this a seat earth and mudstone was proven to 35.2mbgl.

Borehole BHT2B was located at 272,744E, 201,713N and was drilled to a depth of 41.3mbgl to try to intercept the No.2 Rhondda seam. The borehole proved a thin layer of superficial deposits overlying a succession of undisturbed mainly sandstone layers, and the No.2 Rhondda seam was encountered intact from 36.8m to 37.7mbgl. Below this a mudstone was proven to 41.3mbgl.

None of the boreholes encountered any evidence of coal workings, voids, flush loss or highly fractured/ disturbed ground.

6. Conclusions

Natural Power has undertaken a Coal Mining Risk Assessment for the Mynydd y Gwrhyd Wind Farm on behalf of Awel Aman Tawe.

The desk based risk assessment flagged possible coal mining issues and potential risks to the wind farm development associated with (a) known recent underground coal mining within the No.2 Rhondda seam in the vicinity of T1, and (b) potential for historical unrecorded workings, also in the No.2 Rhondda seam, in the vicinity of T2 and the substation.

Natural Power considered these issues required further assessment and validation. A site investigation was undertaken by Natural Power including boreholes drilled to target the No.2 Rhondda seam and overlying strata.

The boreholes undertaken all proved a thin layer of superficial deposits overlying a succession of undisturbed sandstone and mudstone layers. The No.2 Rhondda seam was encountered intact in three of the boreholes. In addition, none of the boreholes encountered any evidence of coal workings, voids, flush loss or highly fractured/ disturbed ground.

Based on the evidence gathered to date, Natural Power considers it is highly unlikely that there are any workings or disturbed ground present within the No.2 Rhondda seam in the vicinity of the proposed T1, T2 or substation locations, that would have an adverse effect on the proposed development, and the risk is assessed as extremely low.

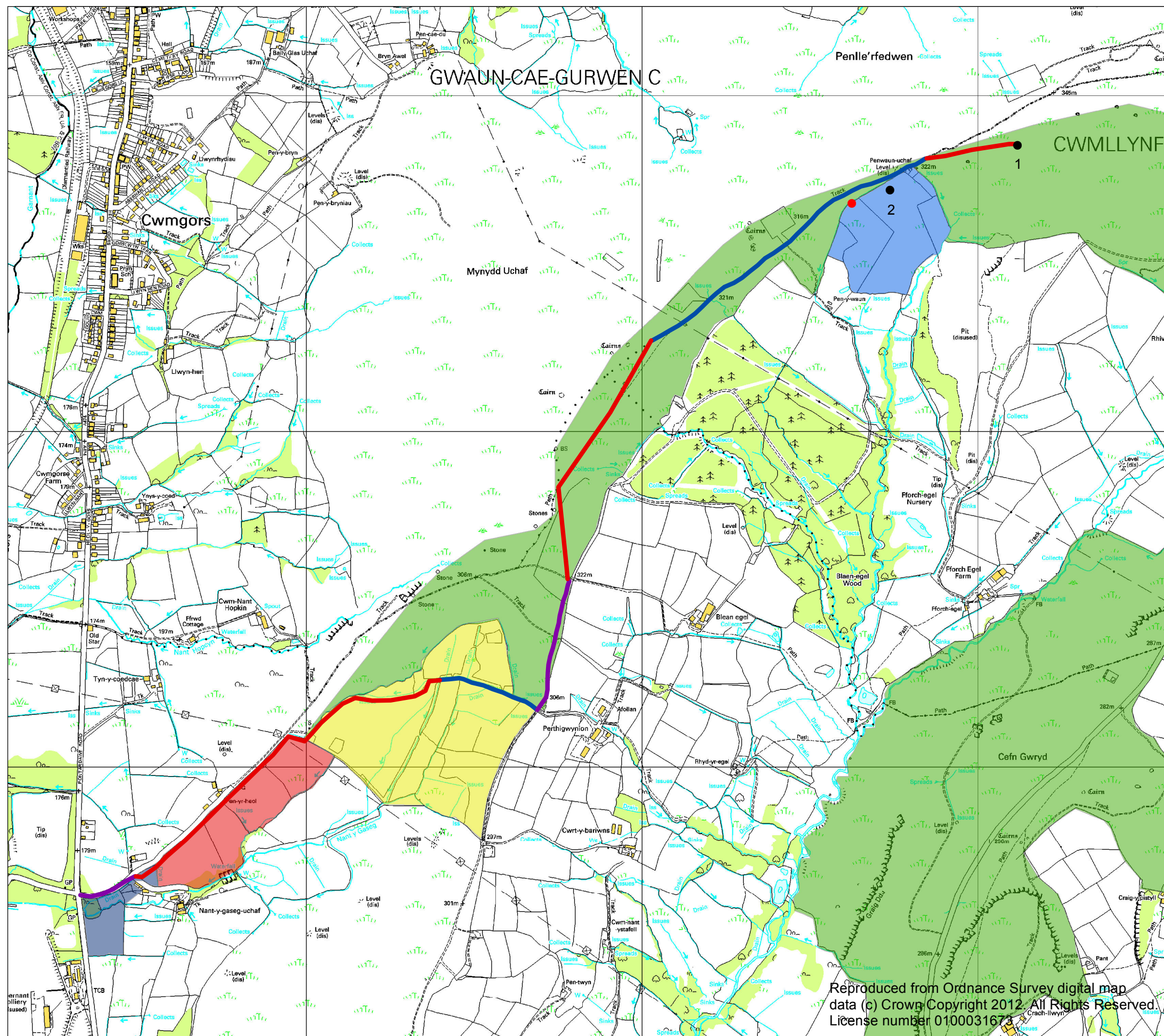
In the context of planning policy, it is considered the application site is likely to be safe and stable for the purposes of the proposed development.

6.1. Important Notes

1. The factual geotechnical data and associated interpretations given in this report are based on the strata observed in the exploratory holes and information obtained as part of the background reports. The ground investigation data naturally represents only a small proportion of the total volume of the ground at each turbine location. Whilst every effort has been made to interpret the conditions between exploratory hole locations, subsequent additional information revealed in any future investigations or during construction may affect the conclusions of this report. Natural Power can accept no responsibility for unforeseen conditions that have not been revealed by the exploratory holes, or which occur between them.
2. The detailed design of the key site structures will be undertaken by the appointed principal BOP contractor and their designers. Natural Power would note that differing designers have a wide spectrum of design solutions and therefore would consider that it is at the discretion of the designer/ contractor to verify that they have sufficient information for their chosen design, including in respect of coal mining risk.

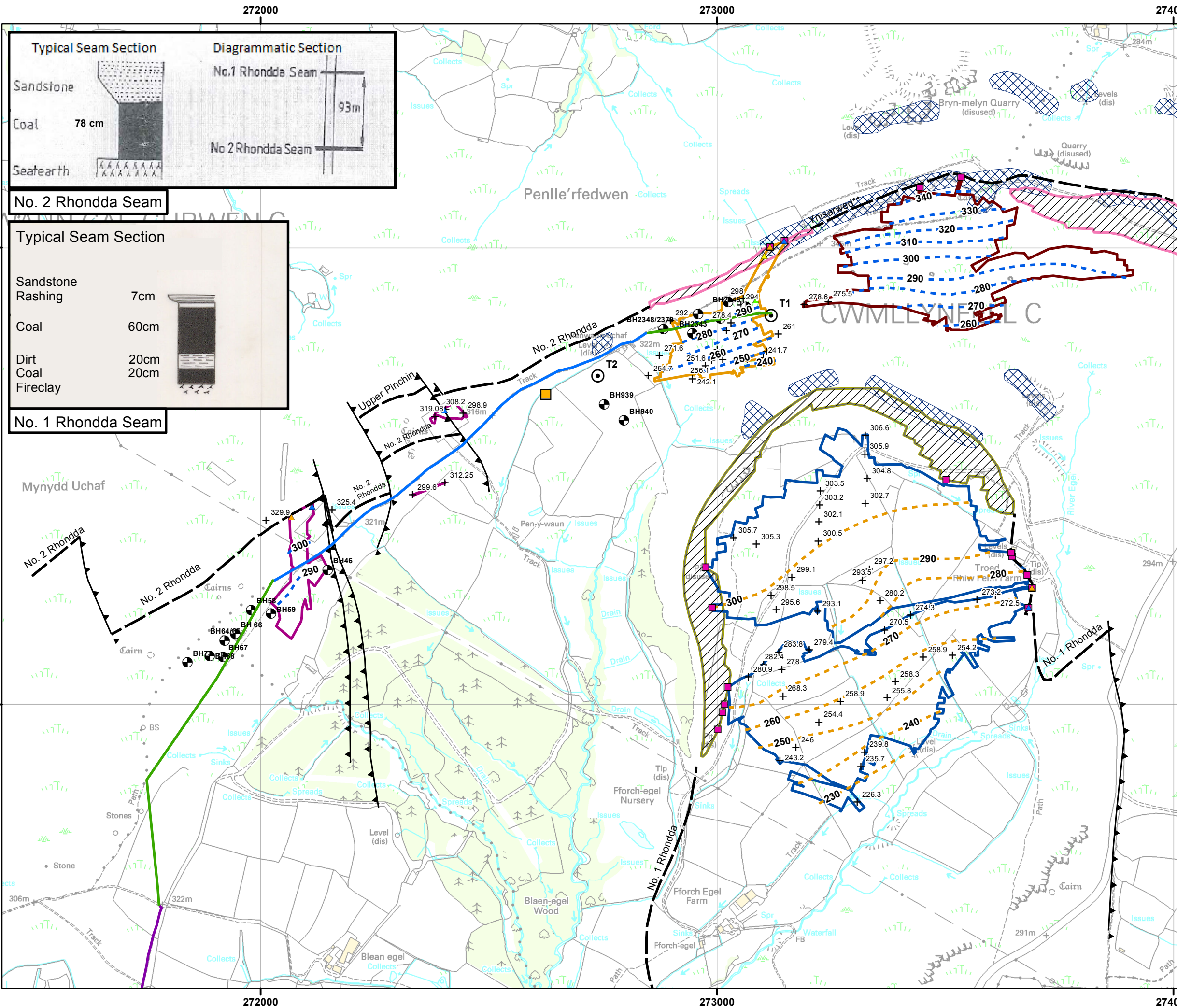
Appendices

A. Maps



Title: Land Ownership Site Plan	
Project: Awel Aman Tawe Community Wind Farm	
Key ● Turbine 1: 273119 210852 ● Turbine 2: 272739 210719 ● Sub Station: 272625 210679 — New track — Existing Road — Existing stone track to be upgraded - Andrew & Ruth Jones - Plas Newydd: Lindsey & Peggy Gittus - Perthgwynion: Hywel Davies - Penwaun Uchaf: Eifion Williams - Cefn Gwrhyd Common: Somerset Trust	
Approximate Map Scale @ A3: 1:12,000	
Original Map Scale: 1:10,000	
Date: July 2013	
Prepared By: Awel Aman Tawe	
Figure: AAT-MyG-JC-Site Plan- 180713	

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Project:
**Mynydd Y Gwrhyd,
Wales**

Title:
**Coal Authority- Abandoned
Mine Plans (Site Overview)**

- Key**
- Turbine location
 - Substation location
 - Boreholes
 - Base of coal seam spot heights (mAOD)*
 - Mine adits
- Ventilation Type**
- Air Shaft
 - Intake
 - Pump
 - Return
 - Coal outcrop
 - Base of No.1 Rhondda coal seam contour (mAOD)*
 - Base of No.2 Rhondda coal seam contour (mAOD)*
 - Fault lines (tab indicates downthrown block)
- Coal mine areas**
- Park Level Colliery (No. 1 Rhondda)
 - Brynmelyn (No. 1 Rhondda)
 - Bryngorof (No. 2 Rhondda)
 - Nant Gwrhyd (No. 2 Rhondda)
 - New Penrhiw Colliery (No. 2 Rhondda)
 - Pen Rhiw Fawr (No. 2 Rhondda)
 - Open cast working
 - Zone of unrecorded mine adit
 - Proposed track
 - Existing road
 - Existing stone track to be upgraded
- * Meters above ordnance datum.
** Alternative name for No. 2 Rhondda
- Notes:**
- Information on this map is directly reproduced from digital and other material from different sources. Minor discrepancies may therefore occur. Where further clarification is considered necessary, this is noted through the use of text boxes on the map itself.
 - For the avoidance of doubt and unless otherwise stated:
 - where a line recorded in the key demarcates a boundary on this plan, the boundary edge is the outside edge of the line.
 - where a line or feature recorded in the key of this plan is also shown as a line or feature by the Ordnance Survey, and that line or feature is located in a different position on the ground than shown by the Ordnance Survey, then the line or feature shall be deemed to follow the position as existing on the ground.
 - this plan should be used for identification purposes only, unless specifically stated above or in accompanying documentation.
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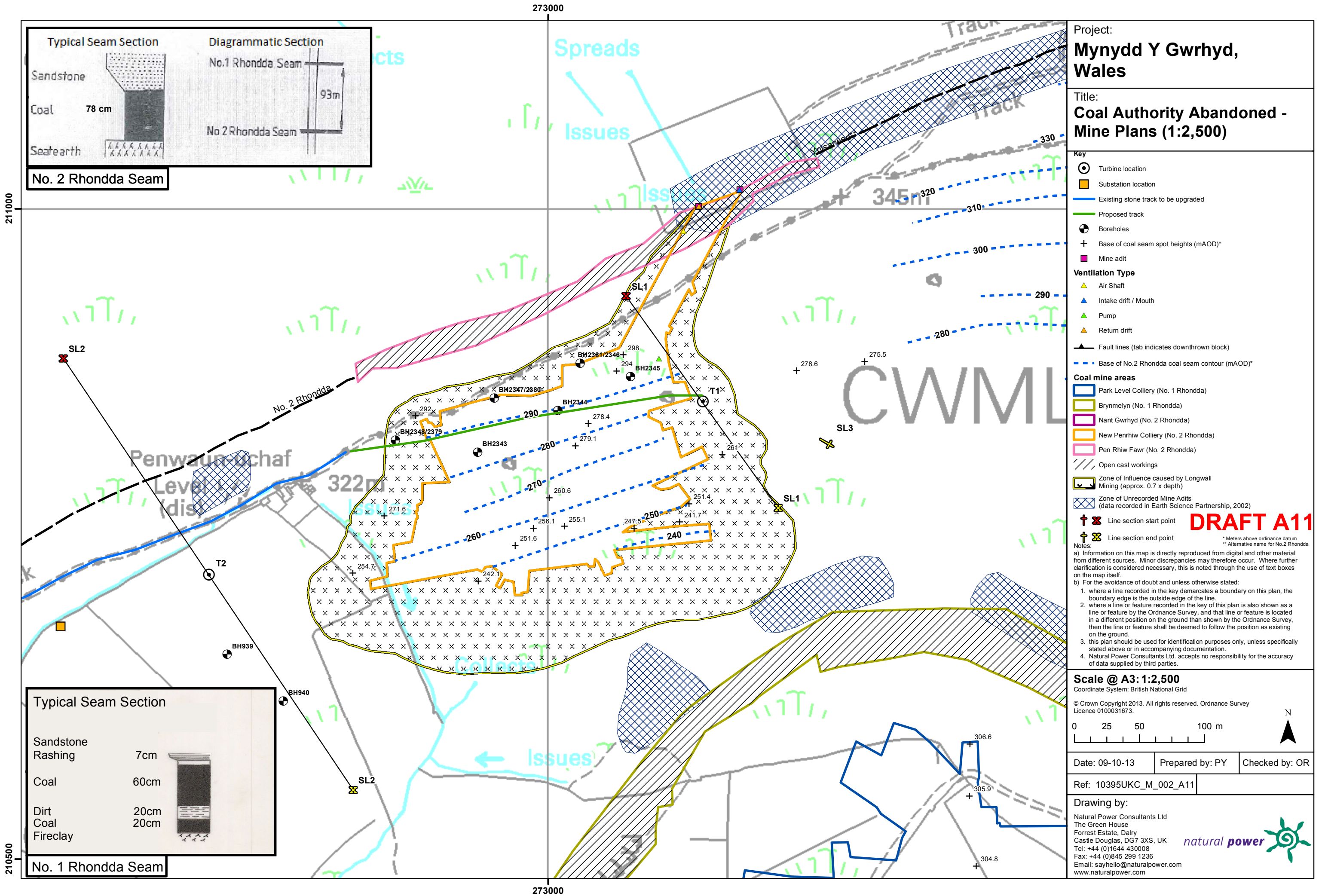
Scale @ A3: 1:8,000
Coordinate System: British National Grid
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Licence 0100031673.
0 100 200 400 m

Date: 01-10-13 Prepared by: PY Checked by: OR

Ref: 10395UKC_M_001_A9

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B. ESP Geotechnical Desk Study Assessment

**PROPOSED WIND FARM, MYNYDD UCHAF
GWAUN CAE GURWEN**

AWEL AMAN Tawe

**GEOTECHNICAL
DESK STUDY ASSESSMENT**

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Date: December 2002

Status: Final Report

Revision: 0

**PROPOSED WIND FARM, MYNYDD UCHAF
GWAUN CAE GURWEN**

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GWAUN CAE GURWEN**

ENCLOSURES

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GENERAL NOTES

1.0 INTRODUCTION

The Earth Science Partnership Ltd (ESP), Consulting Engineers, Geologists and Environmental Scientists, were instructed by Project Management Support Services Ltd (PMSS) on behalf of Awel Aman Tawe (hereafter known as 'the Client'), to undertake a geotechnical desk study assessment for a proposed wind farm on Mynydd Uchaf, to the south east of Gwaun cae Gurwen, north of Swansea. The site is presently occupied by open moorland.

The assessment was conducted to obtain preliminary geotechnical and geo-environmental information with regard to the nature and thickness of the underlying strata to allow a preliminary design of the proposed wind farm development.

The contract was awarded on the basis of a competitive tender quotation. The terms of reference for the assessment were mutually developed with the Client within the agreed budget and are as laid down in the Earth Science Partnership proposal of 20th November 2002. The assessment involved a review of historical Ordnance Survey maps and aerial photographs, geological maps and memoirs, mining records, and a site reconnaissance walkover.

This report represents the findings of the brief relating to the proposed end use as detailed in the text. The brief did not require an assessment of the implications for any other end use, nor is the report a comprehensive site characterisation and should not be construed as such. Should an alternative end use be considered, the findings of the assessment should be re-examined relating to this use.

This report represents the findings and opinions of experienced geo-environmental and geotechnical specialists, working within a brief agreed with the client. Earth Science Partnership does not provide legal advice and the advice of lawyers may also be required.

2.0 THE SITE

2.1 Site Location and Description

The site is located on the north eastern slopes of Mynydd Uchaf, between the valleys of the Upper Clydach (to the west), the River Amman (to the north) and the Afon Twrch (to the east). The villages of Gwaun cae Gurwen and Cwmllynfell/Ystradowen are located around 2.2km and 1.8km to the north west and north east respectively. The National Grid Reference of the centre of the site is SN 7300 1100 and a Site Location Plan is presented as Figure 1.

The site boundary is not marked by physical features and has been provided by the Client. The site under consideration is large and of irregular shape, between 800m and 1,800m in length (east-west) and 400m and 800m in width (north-south). The site area is around 84ha. The western area is labelled on recent maps as Penlle'rfedwen.

A site reconnaissance visit was made on 11 December 2002, by an experienced engineering geologist and a preliminary geomorphological assessment made of the site and its environs. Figure 2 shows a sketch site plan, showing the broad geomorphological features.

The site is accessed via a track from the Gwrhyd Road to the south east, which then runs east to west across the approximate central area to a turn off to Pen-y-waun Farm to the south west. This track is hereafter known as the 'central track' in this report. The central track splits to the east of a cairn near the eastern boundary, which forms the highest point on the site (see Section 2.2), with a second track running some 100m to the north of and approximately parallel to the main track (hereafter known as the 'northern track'). However the northern track finishes as a dead end some 400m west of the cairn. A third track runs between these two tracks. All the tracks are roughly surfaced with gravel and stone, and generally in poor condition. There are no other roads or easily accessible tracks on the site.

Away from the above tracks the site is typical South Wales valleys uplands open moorland, surfaced with grasses, reeds and rough stoney ground. A series of old quarries are located on the north eastern boundary, one of which having had abandoned cars dumped within the quarry floor. The ground around the quarries is uneven, probably representing the quarry waste tips. An old approximately north-south orientated tramway is evident running north from these quarries (outside the site boundary). An old adit is located on the north western side of the quarries, and is still open. Between the central and northern tracks there is an area of rough ground, which also appear to be remnants of old adits.

A ruined farmhouse, Penwaun-uchaf, is located alongside the central track in the south west of the site. No other buildings are present within the site boundary. The farms of Penhow, Blaenant and Brynmelyn are located to the west, north east and south of the site respectively. There are some fenced enclosures around Penwaun-uchaf, and further fenced enclosures are located along the northern boundary. The only other fenced area is located to the west of the northern track.

The area to the south, east and west of the site also comprises open moorland, however the areas to the east and south are very uneven, probably indicating disturbance by past mining operations. The farm of Blaen-nant-hir and a more wooded area is located to the north. There are few trees on the site itself,

however some trees are present on the northern boundary. No animals were seen on the site during the reconnaissance visit, but it is presumed that the site is used mainly for sheep grazing.

Overhead electricity lines on wooden poles cross the access road and the central track leading to an end point in the centre of the site (for the former colliery – see Section 3.2).

2.2 Topography

The site is located on the north eastern slopes of Mynydd Uchaf and the general topography in the vicinity slopes towards the north. The track across the centre of the site forms an approximate central spine, with the ground to the north, generally sloping to the north and that to the south generally sloping to the south.

The highest point on the site is at the cairn near the eastern boundary at 352m OD. Recent Ordnance Survey maps show the summit of Mynydd Uchaf, some 900m to the west is only 5m higher than this level. These maps show the central track to run between 340m OD near the cairn to 316m OD in the south western corner of the site. To the south, the land falls to elevations around 310m OD in both the south eastern and south western corners, before falling away further to the south.

A slight ridge runs east-west to the south of the central track, the top of which has many boulders. A further ridge runs to the south of the access road in the extreme east of the site (this is probably a remnant of an opencast site – see Section 3.2).

To the north of the central track the ground falls to between 260m and 280m OD along the northern boundary. The natural slope angles across the site are generally low (10° or less), however in this northern area, they steepen to of the order of $10-15^{\circ}$. These changes are indicated by two pronounced breaks in slope (see Figure 2).

The eastern area of the site is unevenly surfaced, with areas of probable waste tips from both past quarrying and mining operations. The land to the west of the site between it and Penhow, rises to around 322m OD, forming a small hill.

2.3 Surface Water

Surface water is present as a series of streams running north from the central area of the site towards the northern boundary. In the central area, these streams generally arise as issues at around 330m OD, whilst in the western area, a stream near the site boundary rises at around 315m OD. These streams flow generally in a slightly incised channel (around 0.5m to 1m deep), and areas of reeds and wet ground are present near their sources.

A pond is present between the quarries and the northern track. In the south of the site, issues near Penwaun-uchaf (also at around 330m OD) run along the central track and then down towards Pen y

waun, and to the south alongside the ruined farm. The River Egel rises in the south eastern corner of the site (at around 330m OD), flowing south past Brynmelyn.

2.4 History

The site history has been determined from a review of the historical Ordnance Survey County Series and National Grid maps, and aerial photographs (from 1947). Relevant extracts of the maps are presented in Appendix A.

The first available edition of the County Series map for the area (The Second Edition of 1907) indicates the site to be open moorland as today. The quarries are shown on the north eastern boundary and labelled the 'Bryn-melyn Quarry', and the tramway is shown to be active to the north. Penwaun-uchaf is shown and appears to be an active farm. The site is criss-crossed by a series of tracks, many of which are no longer evident. The central track is not shown to the south of the cairn. A series of 'old coal drifts' are shown between the northern and central tracks (see Figure 2) and to the south of the access track in the east of the site. Further 'old drifts' are indicated on the southern side of the elevated ground by the cairn, to the north of Penwaun-uchaf, and on the south eastern boundary. A series of drifts are also shown outside the boundary, immediately to the south of the site and to the east of the quarry.

The Third Edition of 1918 shows a similar layout, however a 'stone level' is shown immediately to the west of the quarries (still visible on site – see Section 2.1).

The site shows a similar layout on historical maps of 1948, 1962 and 1965, however by 1948 the quarry is shown to be disused and the latter maps show fewer coal drifts.

Aerial photographs from the 1980s and early 1990s show small scale excavations (opencast mining) in the area between the northern and central tracks. Mine records from the Coal Authority indicate opencast operations in this central area were completed in 1991 (see Section 3.2.3).

2.5 Previous Investigations and Assessments

We are not aware of any previous geotechnical investigations or assessments at the site.

2.6 Proposed Development

The proposed development comprises a wind farm of a maximum of 5 no. turbines founded on 13m square foundations at nominal depths of 2m, a 6m square sub station building and meteorological mast, the upgrading/ construction of around 2km of track to access the turbine and substation locations, construction of crane turning heads and hardstandings, and associated underground cables.

We are advised that the turbines must be spaced at least 250m apart, and the prevailing wind is anticipated to be from the south west.

3.0 ANTICIPATED GROUND MODEL

3.1 Geology

The published geological map for the area of the site (1:10,560 scale, SN 71 SW) indicates the site to be underlain by the Llynfi and Rhondda Beds of the Upper Coal Measures. These beds comprise interbedded bands of sandstone, mudstone and siltstone, with some coal seams and associated seat earths. The geological map indicates the succession in the area to be predominantly sandstones with some mudstone and coal seams. The dip of the strata is towards the south at around 10° to 18°, although some dip angles of 25° are shown (in the south west).

The site is located in a fault block between the major north-south orientated Cwmllynfell Fault (to the east) and the Cwmteg Fault (to the west) – see Figure 3. The Cwmllynfell Fault downthrows strata to the west and coincides with the extreme eastern boundary. The Cwmteg Fault downthrows the strata to the east, and splits into a series of sub-parallel faults to the west of the site. A north east- south west orientated fault is shown along the northern boundary, and records from coal seams at depth beneath the site, show this fault to be a normal fault dipping towards the south east, with a downthrow of between 7ft and 24ft (2.1m and 7.3m).

The following coal seams are indicated in the succession in the immediate vicinity of the site.

Seam Name	Alternative Names	Approximate Thickness
No 1 Rhondda		0.85m in two partings.
Penrhiw Rider	Two coals	Not known
thin coal		Thin
No 2 Rhondda		0.9m
Upper Pinchin Rider		Thin
Upper Pinchin		0.6m
thin coal		Thin
Upper Welsh		Thin
thin coal		Thin
Lower Pinchin		Thin – two coals
thin coal		Thin
Lower Welsh		Thin – two coals
Red	Ynysarwed	0.9m to 1.5m

A series of these seams are shown to crop out across the site in an approximate east-west direction – see Figure 3. The outcrops of the No 2 Rhondda, Upper Pinchin and Upper Pinchin Rider seams are shown across the centre of the site, whilst the Lower Pinchin crops out along the northern boundary, with the Lower Welsh, and Red seams further north. The No. 1 Rhondda seam crops out to the south of the site.

As the dip of the strata is to the south, the No 1 Rhondda seam is not anticipated to underlie the site, whilst the Two Coals and the thin coal beneath underlie only the extreme southern area. The seams between the Lower Pinchin and the Red underlie all the site, and are underlain by a further series of seams at greater depth including the Rock, Four Feet, Stanllyd and Peacock.

The remaining seams all underlie a varying proportion of the site to the south of their outcrop location (see Figure 3), i.e. the No 2 Rhondda underlies the area to the south of the northern track, whilst the Upper Pinchin underlie the area to the south of the quarry.

The geological plan indicates an absence of superficial deposits across the site. However our experience in the areas suggests that there is likely to be a thin veneer of glacial soils (probably gravelly clays), and in low lying areas, where the soils are waterlogged, there may be deposits of peat and soft clays. On the lower slopes, there may be deposits of head, caused by solifluction (natural downslope movements of soils).

3.2 Mining

There is evidence from the site history, the geological map and from the site reconnaissance that there has been considerable mining at the site, particularly in the eastern and southern areas.

A mining report has been obtained from the Coal Authority which indicates that the site is *within the likely zone of influence on the surface from workings in 7 seams of coal at shallow to 580m depth, the last date of working being 1993.*

The mining report also indicates there are 63 no. mine entries within 20m of the site boundary. It should be noted that the mining report provides information on mine entries and workings for which the Coal Authority have records. Further unrecorded mine workings may also be present.

3.2.1 Mine Entries

There are a large number of mine entries within the site boundaries – the Coal Authority indicate 63 no. recorded entries. All known or suspected entries are shown on Figure 4. These are all drifts or adits and generally grouped together on the outcrops of the seams, with the exception of 2 no. mine shafts.

The main group of adits (and the shafts) is located immediately to the south of the northern track, where a large number of adits extend over around 650m along the outcrop of the No. 2 Rhondda seam. One old adit is also shown just to the south of the cairn (A on Figure 4). This is likely to access the same workings as those discussed above. A further group of adits is present on this outcrop on the eastern boundary. The Coal Authority indicate that they have no treatment details for most of these mine entries. An inspection was undertaken in January 1971, but those that had been treated are reported to have been filed to an 'unknown specification'.

One isolated probable nineteenth century adit is shown on historical maps just to the north of Penwaun-uchaf. This adit (B on Figure 4) is indicated by the Coal Authority to be orientated to the north, however as it is located on the outcrop of the No. 2 Rhondda seam and the seam is located to the south, this orientation may not be correct. The adit may lead to the western edge of the workings to the east of Penwaun-uchaf – see Section 3.2.2. This adit was inspected in March 1971 and again reported to be

'filled to an unknown specification'. An examination of aerial photographs has indicated a feature in this area, which may also be an abandoned adit to the east of Penwaun-uchaf – see Figure 4.

One adit is shown, and is clearly evident on site, just to the west of the quarry near the eastern boundary (C on Figure 4). This adit is indicated on historical maps to have been for stone, however it is located close to the outcrop of the Upper Pinchin seam (which has been worked in the area) and therefore may have accessed unrecorded workings in this seam. Further adits are shown amongst the quarries and to the east of the site on the outcrop of the Upper Pinchin.

Adits are also shown on the No. 1 Rhondda to the south of the site, and on the Penrhiw Rider seam immediately outside the southern boundary. Similar adits within the site boundary cannot be ruled out in the south eastern corner of the site.

3.2.2 Abandoned Underground Workings

Further mining records have been obtained from the Coal Authority. Abandonment plans of the workings at the time of cessation of the operations, indicate past underground workings in the No 1 Rhondda, Penrhiw Rider, No. 2 Rhondda, Upper Welsh and Red seams. Workings at greater depth are indicated in the Peacock, Stanllyd, Big Vein, Upper and Lower Gellideg, Black, Upper Nine Feet and Penny Pieces coal seams and the Bute ironstone vein. These latter seams are at considerable depth and are unlikely to impact on the development. Therefore they have not been considered further.

In addition the above, opencast workings are indicated along the seam outcrops (see Section 3.2.3).

The broad outlines of the underground workings are shown on Figure 4. Workings in the No 2 Rhondda seam underlie much of the area to the south east of the northern track. These workings were accessed from the line of adits immediately to the south of the northern track, and are likely to have been worked initially in the nineteenth century before being abandoned (as shown on the historical map of 1907). Abandonment plans suggest that these workings were opened again in recent years as the Nant Gwrhyd No 2 Colliery and the plans show a date of abandonment of March 1991. This colliery is named the Bryn Gorof Colliery on the geological map.

Further workings are shown to the west between the above workings and Penwaun-uchaf. These again are in the No 2 Rhondda, and were accessed from 2 no. adits at the western end of the northern track. The overhead electricity lines are indicated to have serviced this colliery, known as the Penrhiw Colliery. The Coal Authority also indicate a date of abandonment of March 1991 for this colliery.

Workings are shown in the Upper Welsh seam immediately to the east of the quarry and the site boundary, and in the Penrhiw Rider seam immediately to the south east of the site. These workings are indicated to have been abandoned in February 1964 and December 1967 respectively.

3.2.3 Opencast Workings:

Relatively recent opencast workings are indicated along the outcrops of the No 1 Rhondda, the Penrhiw Rider, the No 2 Rhondda, and the Upper Pinchin/Upper Pinchin Rider. These recent opencast workings may have obscured former mine entries.

The Bryn Melyn Site was located on the outcrop of the No 1 Rhondda (to the south of the site) but is likely to be located almost completely outside the site boundary.

The Penrhiw Fawr Site is located on the No 2 Rhondda seam in two locations. It is shown between Penwaun-uchaf and the main group of adits on the outcrop in the central area of the site, and to the east of the cairn extending to outside the site boundary – the ridges to the south of the northern track and the eastern access road indicate the southern extension of the opencast workings. The Coal Authority indicate a date of abandonment of March 1991 for this site.

The Penllerfedwen Site (or Brynmelyn Colliery on the geological map) was mainly located to the east of the quarry on the eastern site boundary. Some of this opencast encroached within the site, in the vicinity of the quarry. The opencast is indicated to have been abandoned in 1963.

A fourth small area of opencast is shown on abandonment plans associated with the workings in the Penrhiw Rider seam to the south east of the site, and were reportedly abandoned in 1967.

The Coal Authority indicate the site is within 800m of the Pwll Bach and East Pit East prospective opencast sites. Provided that these are wholly outside the site boundaries they should not have a physical impact on the proposed wind farm development. However depending on their size, height and location, the creation of spoil heaps may impact on wind movements. We recommend that further enquiries are made to the Coal Authority and Planning departments to confirm any proposals.

3.3 Site Evidence of Contamination

There has been no specific contaminative use in the site history, however waste materials from particularly collieries can contain elevated levels of some contaminants, including sulphates and polyaromatic hydrocarbons (PAH). No visual or olfactory evidence of contamination was observed at during the site visits, although some fly tipping was evident in places.

3.3 Geomorphology

The existing topography and geomorphology at the site has evolved over a period of many, perhaps sixty to seventy millions of years under a number of different erosional regimes. However, the original geomorphology of the area has altered by man's activities, e.g. the mining and quarrying activities, and in particular, the opencast operations and placement of waste materials around the old works. The original geomorphology is however still important, as it will control amongst other things the stability of the area.

3.4 Hydrogeology

The underlying geology at the site comprises a series of aquifers and aquicludes/aquitards. The sandstones within the Coal Measures will comprise the main aquifers. The Environment Agency classify these as minor aquifers, with groundwater movement controlled by fracture flow.

The issues at around 330m OD are probably the surface expressions of perched water bodies above coal seams and impermeable mudstones. However there are likely to be a number of groundwater bodies, above each of the impermeable mudstones/seal earths, connected by fractures and past mine workings – old abandoned roadways and workings will provide super efficient flowpaths for groundwater flow. The groundwater conditions may still be changing in response to reduction in pumping from the mines.

3.5 Site Stability

Reference to geological maps and published records has not identified any available evidence to indicate that the site is affected by natural post glacial landslipping. There are a number of landslips in the near vicinity, and 2 no. within 1km of the site. The landslides are generally within superficial deposits, however one (some 2km to the south west) is within the strata below the No 2 Rhondda, and is postulated to have been caused by either mining subsidence or stream action, and one located some 300m to the north west is within the strata between the Lower and Upper Pinchin seams where it is faulted against the Middle Coal Measures.

4.0 PRELIMINARY ENGINEERING COMMENTS

4.1 Site Hazards

4.1.1 Mining

Shallow Mining:

The known shallow mining hazards are shown on Figure 4. From this the main area of hazard is the south eastern section of the site, particularly to the south of the outcrop of the No 2 Rhondda coal seam. In this area there are extensive underground workings, mine entries and abandoned opencast sites. A further area of opencast mining is shown on the eastern boundary in the vicinity of the quarry.

A further adit is located on the outcrop of the No 2 Rhondda seam just to the north of Penwaun-uchaf. This entry may have accessed unrecorded workings in the seam in the south western corner of the site and therefore it is possible that a mining hazard may also exist in this area.

The workings in the vicinity of the quarry won coal from the Upper Pinchin and Upper Pinchin Rider seams. These seams extend across the central part of the site and a further adit is shown immediately to the west of the quarry. This may have been to quarry stone, however its presence on the outcrop of a known worked seam may indicate workings in the seam. There is no evidence on historical, geological and mining records, or on aerial photographs to indicate there are any mine entries to the west of this adit, and therefore it is unlikely that there are abandoned workings in this area. However unrecorded workings may be present immediately to the west of the quarry.

The risk posed to the development by the abandoned mine workings will depend on a number of factors including the depth to the seam, the height and nature of the workings (i.e. backfilled, open, collapsed), the thickness and nature of the bedrock between the workings and the ground surface, and the depth of superficial deposits. The proposed wind farm development will be sensitive to settlement and hence the risk of subsidence, which can lead to considerable ground movements, is an important consideration.

Based on the above, the western and northern parts of the site, north of the outcrop of the No 2 Rhondda seam, are unlikely to be underlain by shallow mining.

Deeper Mining:

The whole site is underlain by extensive mine workings at greater depths in a number of seams. The shallowest of these is the Red seam which crops out some 400m to the north. A conceptual ground model drawn up for the site (Figure 5) indicates that this seam is likely to be present at a depth of between 110m and 220m in the north of the site and 300m and 340m in the south. At these depths these seams are unlikely to pose a risk to the development. However there are two faulted blocks in the north west of the site (see Figure 5), in which there is little information on the depth to the seams. It is possible that the seams may be at a higher elevation within these blocks and possibly pose a risk to the development.

4.1.2 Stability

There is no evidence of instability at the site away from the areas of past mining and quarrying. However an assessment should be made of the proposed individual turbine locations to confirm the ground beneath is stable.

4.1.3 Contamination

There is no evidence of any contamination or ground gas hazards away from the areas of past mining and quarrying.

4.1.4 Poor Ground

There are areas of waterlogged ground and reeds, particularly around the streams in the western and northern parts of the site. Soft ground may be encountered in these areas, however it is likely to be of limited thickness and underlain by more competent soils.

4.2 Hazard Zones

The available information has been used to zone the site in terms of the potential ground hazard, and this is presented on Figure 6.

Zone A1: the south eastern portion of the site, to the south of the No. 2 Rhondda coal seam, and underlain by shallow mining. There are likely to be east-west orientated bands where the seams are at sufficient depth that the subsidence risk posed is low. However these zones would require extensive investigations to confirm the risk, and therefore the area should only be considered if insufficient space is available elsewhere on the site. As the access road will be heavily loaded and an important transport route, we recommend further investigation to assess the risk from mining along the line of access roads in Zone A.

Zone A2: geologically similar to Zone A1, but located in the south west of the site and with no recorded mine workings. However the presence of the old adit to the north of Penwaun-uchaf (B on Figure 4) may indicate underground workings in this area, and hence a subsidence risk. Significant further investigation would be required to assess the potential for such workings and the risk posed.

Zone B: the eastern boundary in the vicinity of the quarry. This area is underlain by tipped quarry and possibly mine waste, mine entries (e.g. C on Figure 4), and potentially is underlain by shallow mine workings in the Upper Pinchin seam. Again parts of this area may be at low risk, however significant investigation is likely to be required to confirm this, and therefore it should only be considered should insufficient space be available elsewhere on the site.

Zone C1: the western and central portions of the site. Based on the available information, there is considered to be a low potential for mine workings in this area (no evidence has been found), and hence the risk from subsidence is likely to be low. Further investigation would be required at the turbine locations to confirm this. The ground conditions are likely to be generally favourable, however some peat or soft soils may be encountered in the near surface – further investigation would confirm this. The western part of this zone is also partly hidden from the residences of Gwaun cae Gurwen and Tairgwaith by the small hill to the west, thus reducing the visual impact of the turbines.

Zone C2: the northern part of the site. This zone is also considered to be at low risk from shallow mining, although the Lower Pinchin seam is present at shallow depth beneath part of the area, and a faulted block is located in the western area (Figure 5), within the which the depths of the seams are not clear. Further investigation would be required at the turbine locations to confirm the risk. The zone is located on the steepest natural slopes on the site, is the lowest area, and may be in a slight wind shadow. Hence turbines may need to be higher to collect the prevailing wind. As for Zone C1, areas of soft ground may be present, and the risk of inherent instability may be greater.

We recommend that the optimum location for the turbines is within Zone C1, particularly in the western area. However this zone is linear and orientated south west to north east, and therefore may not be the ideal shape and orientation for a prevailing wind from the south west. It is also unlikely to be large enough to accommodate 5 no. wind turbines at 250m separations. Therefore, some turbines may be constructed within the southern (more elevated) part of Zone C2, or within Zone A2 (subject to further investigation). Alternatively, the site boundary may be extended some 100m to the west to the Cwmteg Fault. The ground conditions in this area are anticipated to be similar to Zone C1.

Further geological assessment should be made once the preferred layout of turbines has been decided.

4.3 Sources of Aggregate

The old quarry at the site is within sandstone. This is likely to be the most accessible source of aggregate within the site boundary.

The Gwrhyd Quarry is located some 2km south of the site on the Gwrhyd Road. However preliminary enquiries indicate that the quarry only supplies decorative walling stone.

The nearest quarry capable of supplying road stone is likely to be the Cwmnantlleichi Quarry, operated by Bardon Aggregates, on the A4067 in the Tawe Valley at Ystalyfera. Preliminary enquiries indicate that this quarry only supplies small quantities of stone. They may be able to supply sufficient aggregate depending on the programming of the works. Further enquiries should be made once the precise quantities and programme are known.

4.4 Recommended Investigation

We recommend the following investigation:

- Rotary openhole drilling to a nominal depth of 40m, to confirm the depth to bedrock and the risk from shallow mine workings. Provided the turbines are to be constructed within Zone C1 or the northern part of C2, these may be limited to 2 no. per turbine base.
- Trial pits to a nominal depth of 4m, to confirm the nature of the near surface deposits and the thickness of soft ground (if any). We consider 3 no. pits should be excavated at each turbine location, at the locations of the substation and the meteorological mast and at 50m centres along the proposed access route.
- Aggregates testing if the old quarry is to be considered as a source of road stone.
- Geotechnical laboratory testing to confirm the class of concrete required for foundations.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The site of the proposed wind farm comprises open moorland on the northern slopes of Mynydd Uchaf. A review of the site history has indicated that it has been rural, however mining operations have taken place, particularly in the southern and eastern areas.

Abandonment plans obtained from the Coal Authority indicate past underground workings in the No 1 Rhondda, Penrhiw Rider, No. 2 Rhondda, Upper Welsh and Red seams at relatively shallow depth (less than 100m), and in the Peacock, Stanllyd, Big Vein, Upper and Lower Gellideg, Black, Upper Nine Feet and Penny Pieces coal seams and the Bute ironstone vein at greater depth. The outcrops of the No 2 Rhondda, Upper Pinchin and Upper Pinchin Rider seams are shown across the centre of the site, whilst the Lower Pinchin crops out along the northern boundary. The seams underlie the site to the south of their outcrops.

The main area of mining hazard is the south eastern section of the site, particularly to the south of the outcrop of the No 2 Rhondda coal seam. In this area there are extensive underground workings, mine entries and abandoned opencast sites. A further area of opencast mining is shown on the eastern boundary in the vicinity of the quarry. An adit is located on the outcrop of the No 2 Rhondda seam just to the north of Penwaun-uchaf. This entry may have accessed unrecorded workings in the seam in the south western corner of the site and therefore it is possible that a mining hazard may also exist in this area.

The available information has been used to zone the site in terms of the potential ground hazard, and this is presented on Figure 6:

Zone A1: the south eastern portion of the site underlain by shallow mining. We recommend that this area should only be considered if insufficient space is available elsewhere on the site. Further investigation will be required to assess the risk from mining along the line of access roads in Zone A.

Zone A2: geologically similar to Zone A1, but located in the south west of the site and with no recorded mine workings. However the presence of the old adit to the north of Penwaun-uchaf (B on Figure 4) may indicate underground workings in this area, and hence a subsidence risk.

Zone B: the eastern boundary in the vicinity of the quarry, underlain by tipped quarry and possibly mine waste, mine entries, and potentially underlain by shallow mine workings. Again this area should only be considered should insufficient space be available elsewhere on the site.

Zone C1: the western and central portions of the site. Based on the available information, there is considered to be a low potential for mine workings in this area (no evidence has been found), and hence the risk from subsidence is likely to be low. Further investigation would be required at the turbine locations to confirm this.

Zone C2: the northern part of the site, and also considered to be at probable low risk from shallow mining. Further investigation would be required at the turbine locations to confirm the risk. Turbines in this area may need to be higher to collect the prevailing wind. As for Zone C1, areas of soft ground may be present, and the risk of inherent instability may be greater.

We recommend that the optimum location for the turbines is within Zone C1, particularly in the western area. The site boundary may be extended some 100m, where the ground conditions in this area are anticipated to be similar to Zone C1.

6.0 REFERENCES

BARDON AGGREGATES, December 2002, Mr Les Vile, pers com.

**PROPOSED WIND FARM, MYNYDD UCHAF
GWAUN CAE GERWEN**

Table 1 Sources of Information

British Geological Survey Maps:

1:50,000 scale. Sheet 265, solid and drift edition.

Historical Ordnance Survey maps.

County Series: 1:2,500 scale, Glamorganshire 11.12, edition of 1918.

1:10,560 scale. Glamorganshire 11 SE, editions of 1907 and 1948.

National Grid: 1:10,560 scale, SN 71 SW, edition of 1969.

1:2,500 scale, SN 7210-7310 and SN 7211-7311, editions of 1962.

1:10,000 scale, SN 71 SW, edition of 1989.

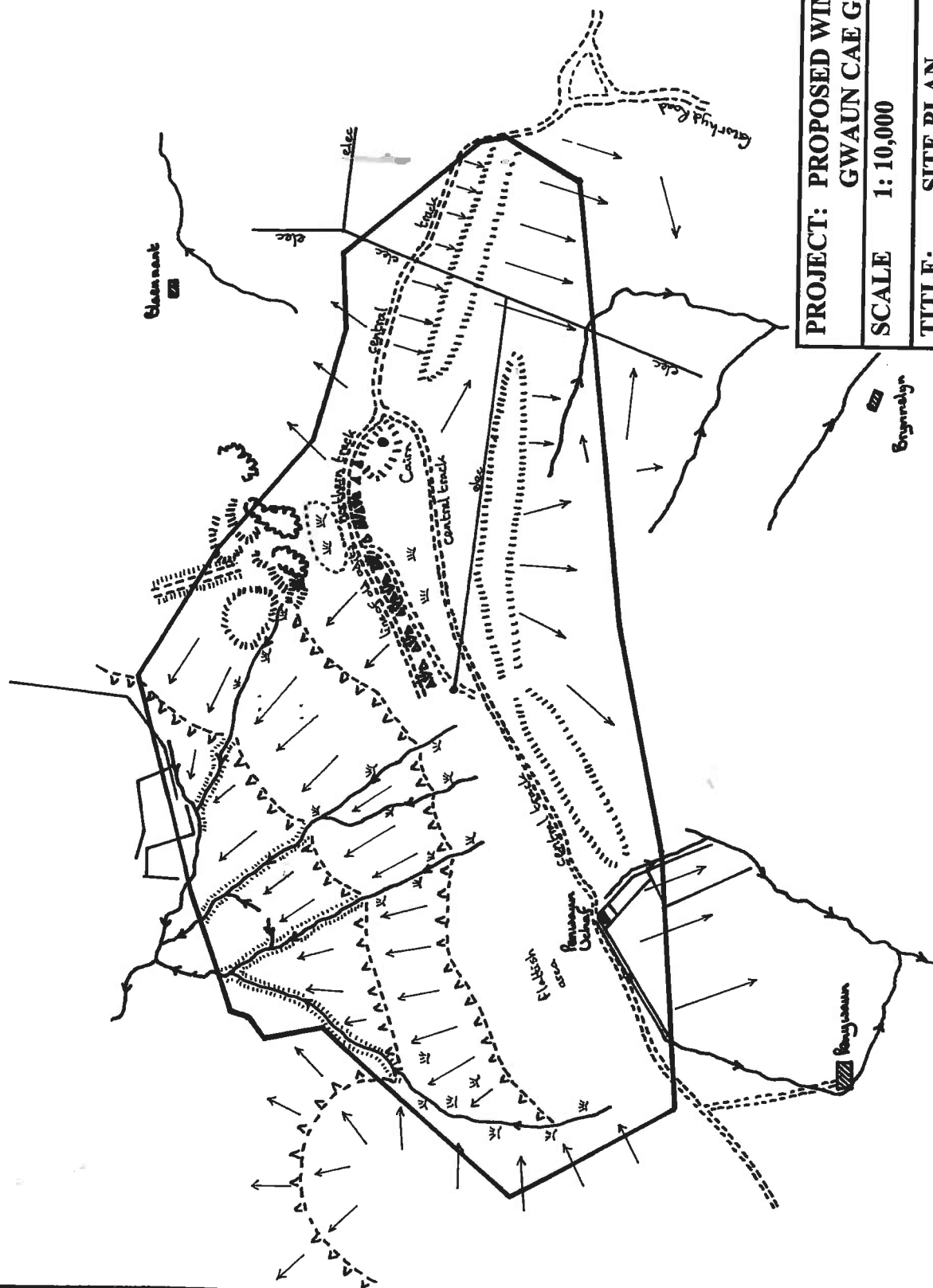
Modern Ordnance Survey maps

1:25,000 Explorer Series, Sheet Outdoor Leisure 12, Brecon Beacons National Park.

Aerial Photographs

Coal Authority Abandonment Mine Plans

FIGURES



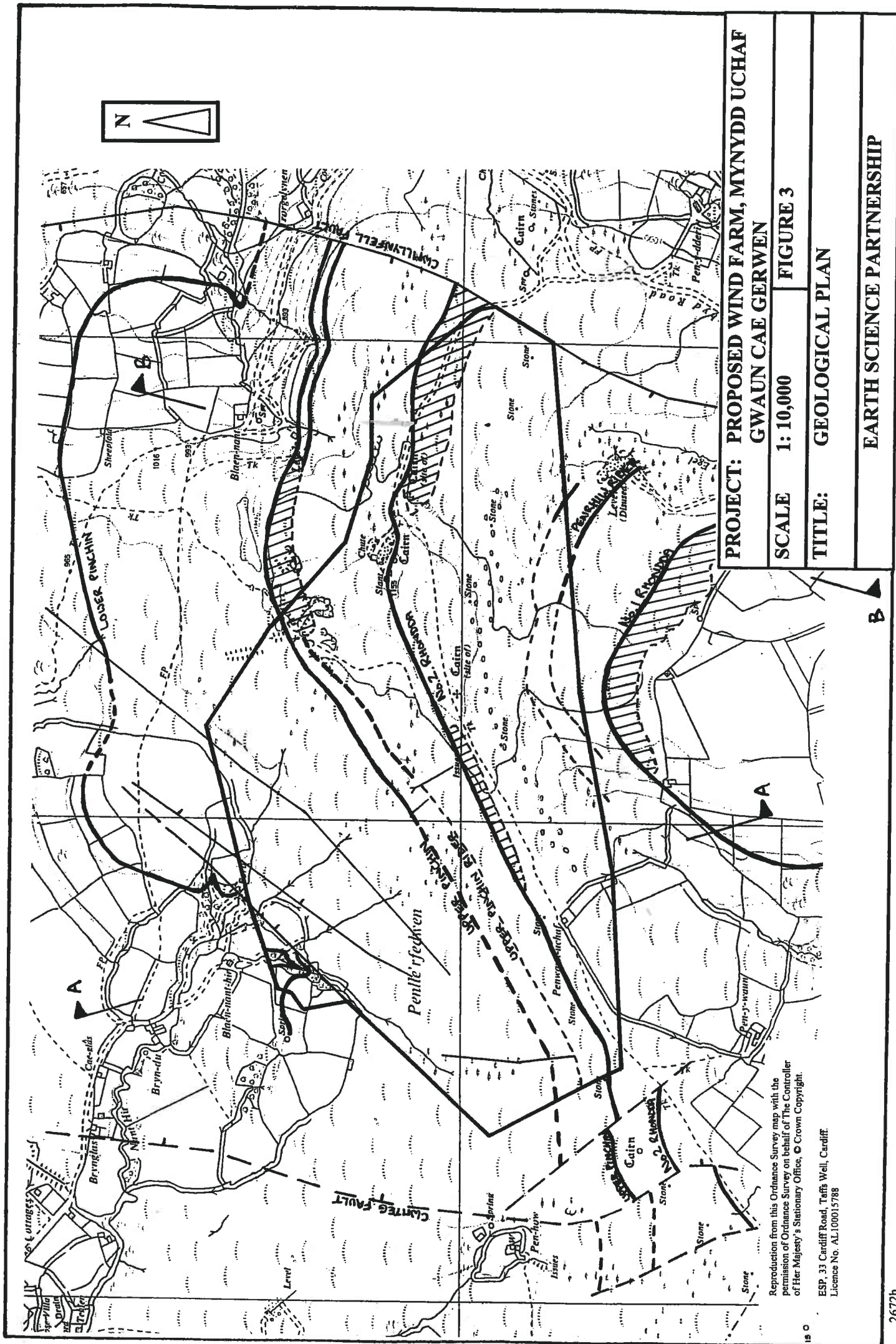
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GWAUN CAE GERWEN

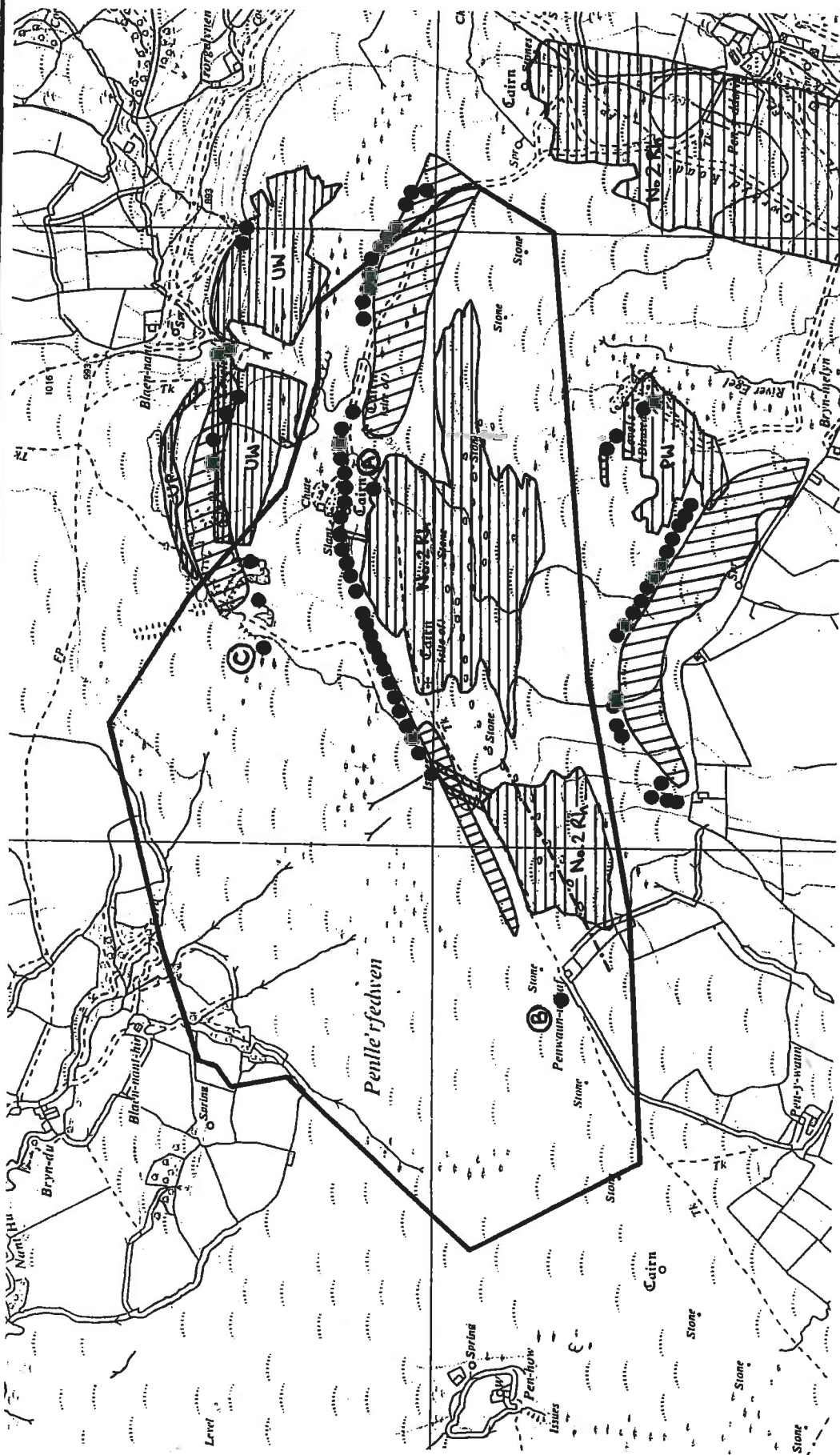
SCALE 1:10,000

FIGURE 2

TITLE: SITE PLAN

EARTH SCIENCE PARTNERSHIP





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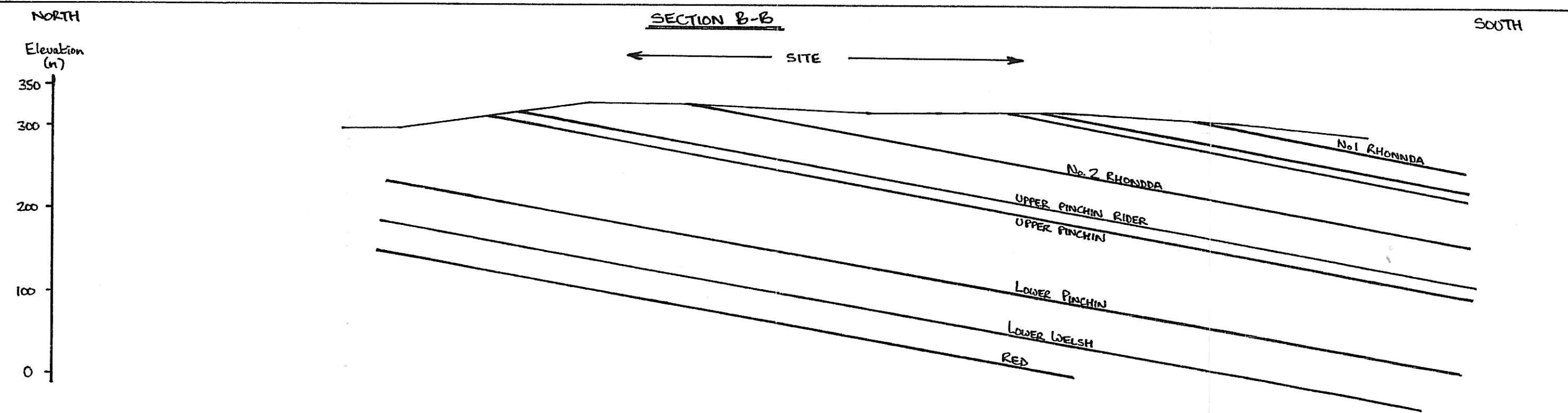
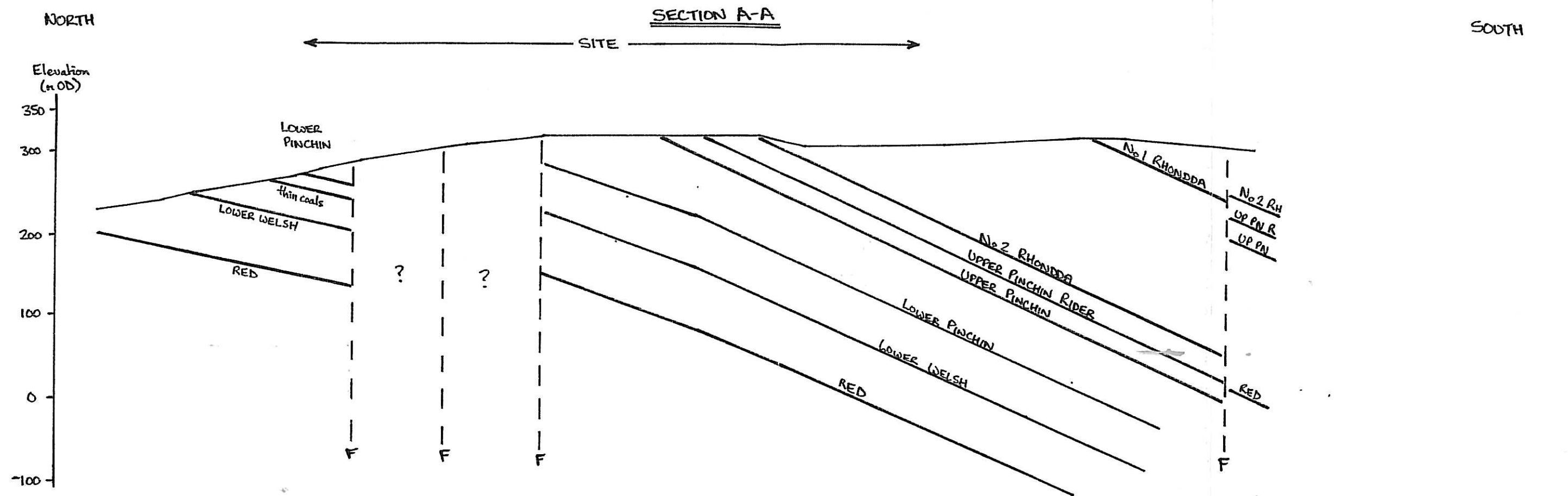
GWAUN CAE GERWEN

SCALE: 1:10,000

FIGURE 4

TITLE: MINING HAZARD PLAN

EARTH SCIENCE PARTNERSHIP

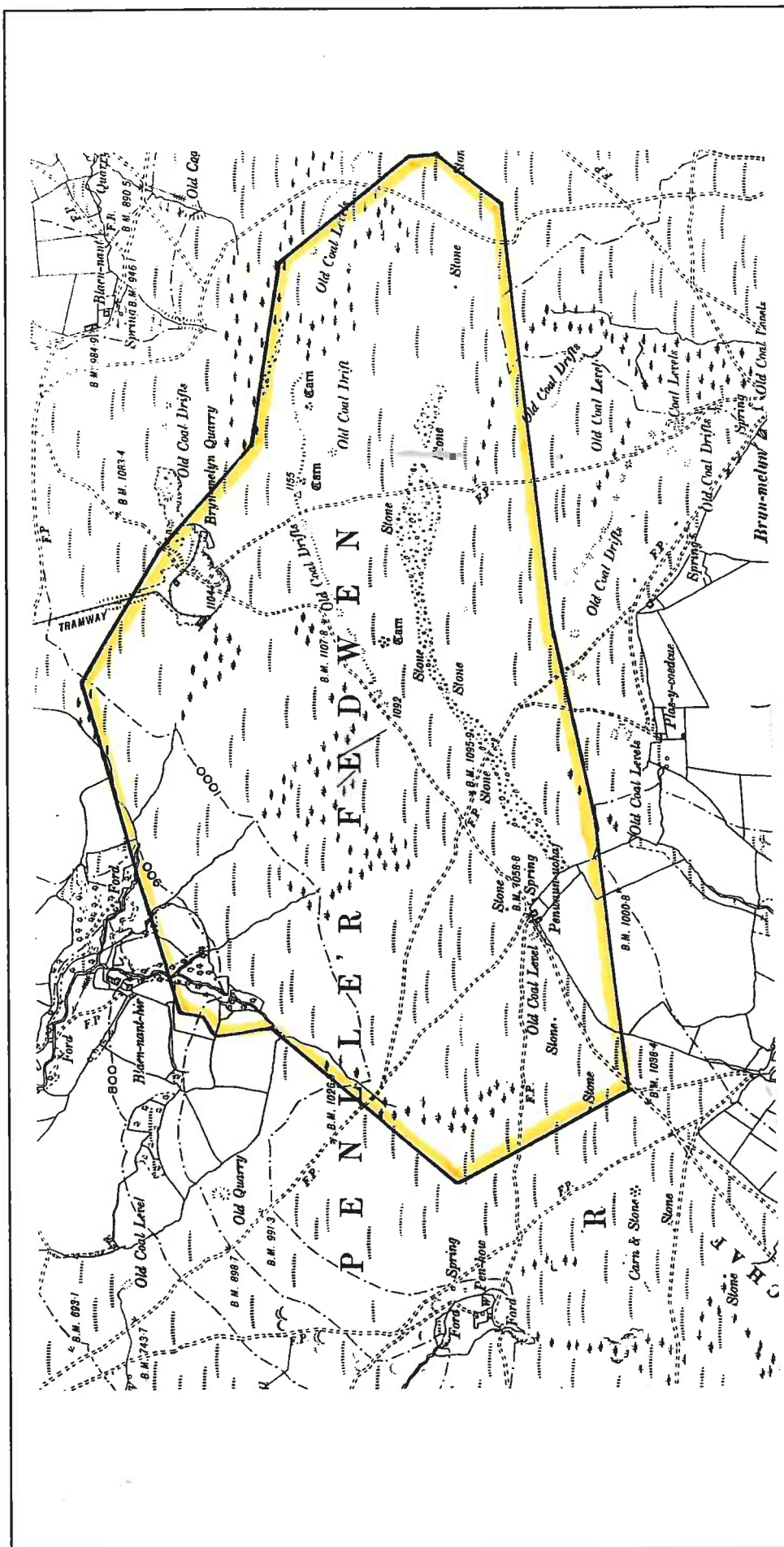


Lines & Section shown on Figure 4.

PROJECT: PROPOSED WIND FARM, MYNYDD UCHAF GWAUN CAE GERWEN		
SCALE	1:500	FIGURE 5
TITLE:	CONCEPTUAL GROUND MODEL	
EARTH SCIENCE PARTNERSHIP		

APPENDIX A

Extracts from Historical Maps



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PROJECT: PROPOSED WIND FARM, MYNYDD UCHAF

GWAUN CAE GERWEN

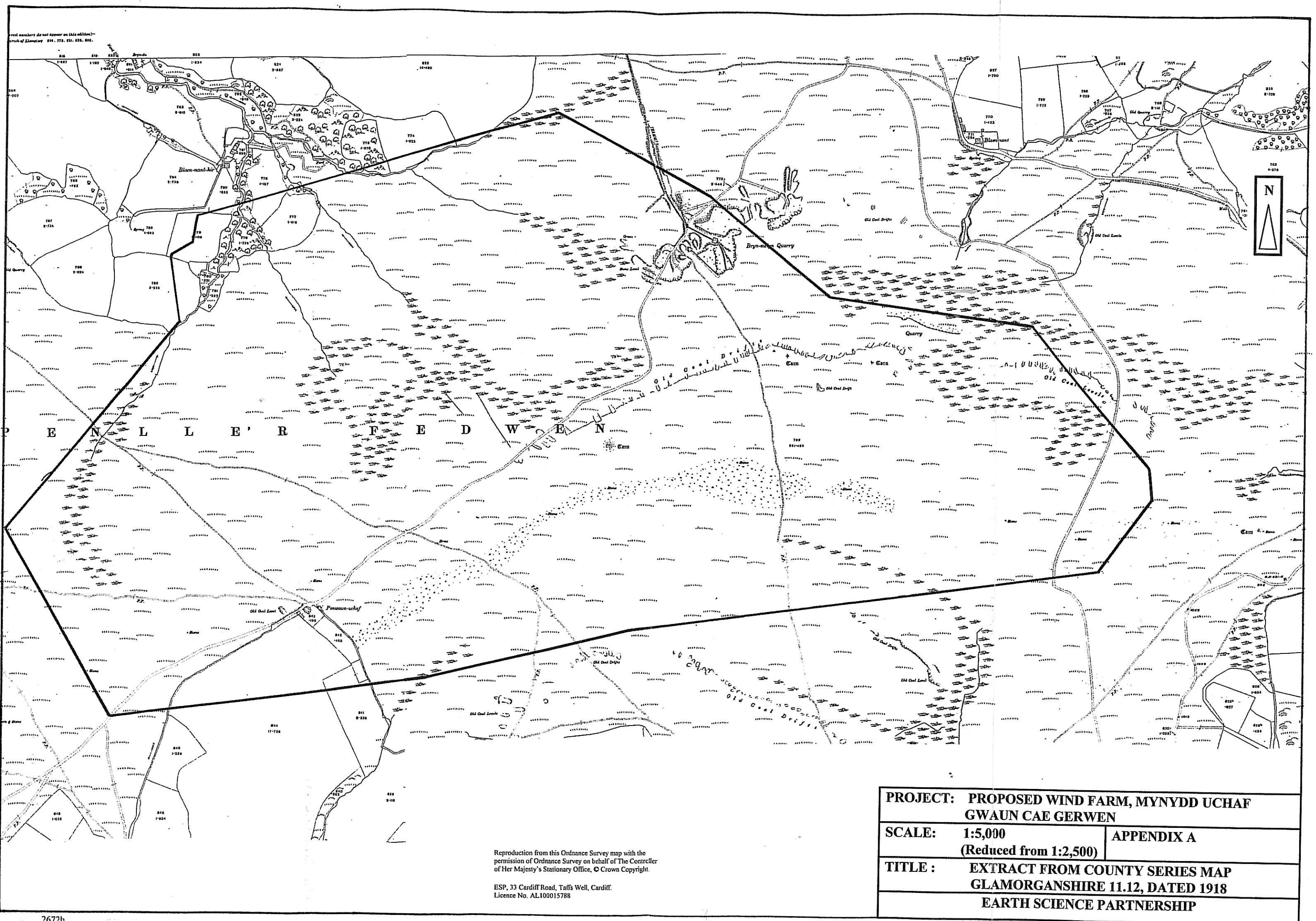
SCALE: 1:10,560

APPENDIX A

**TITLE: EXTRACT FROM COUNTY SERIES MAP
GLAMORGANSHIRE 11SE, DATED 1907**

EARTH SCIENCE PARTNERSHIP

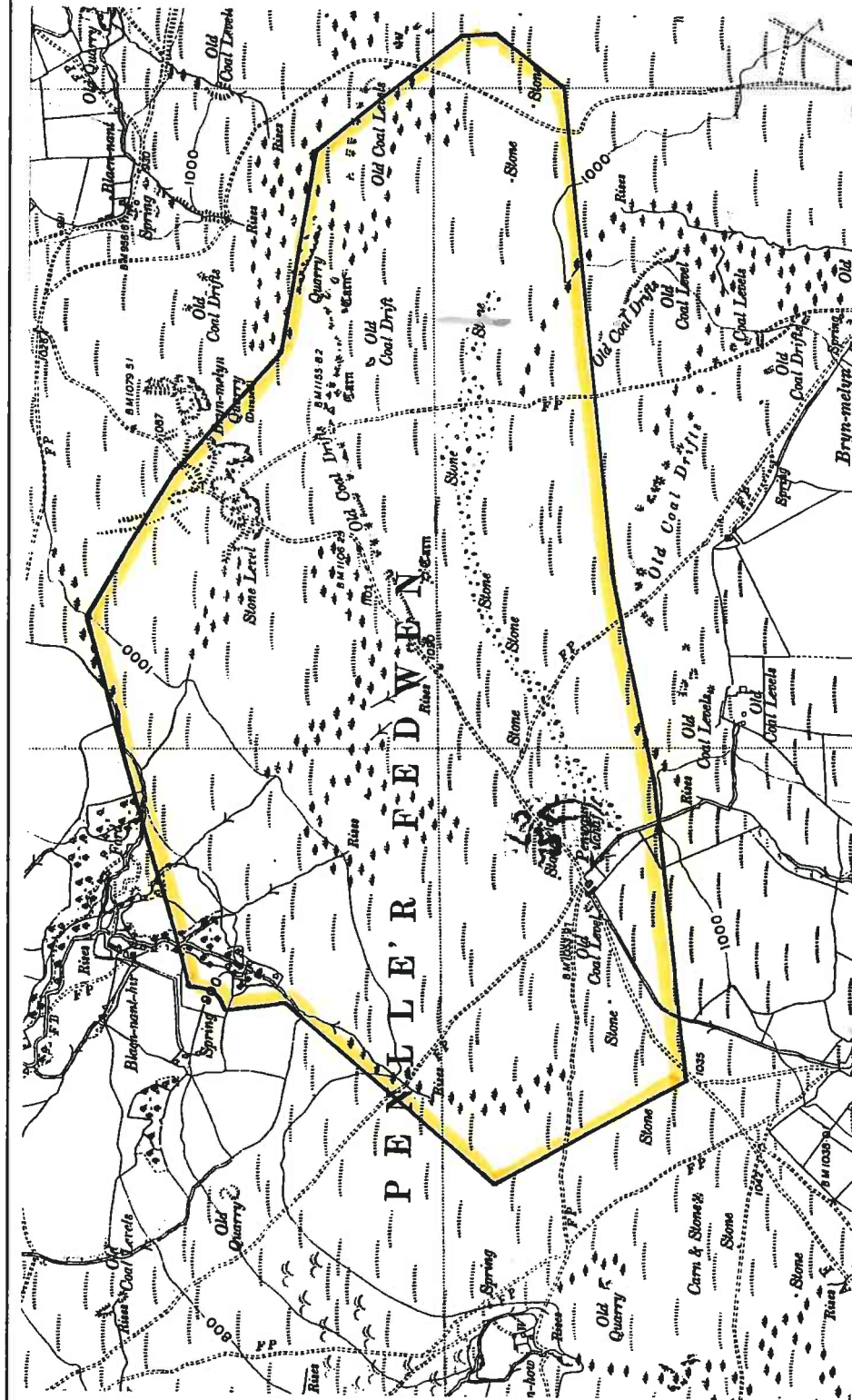




Grid numbers do not appear on this edition.
Scale of Elevations 810, 770, 730, 690, 650.

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PROJECT: PROPOSED WIND FARM, MYNYDD UCHAF GWAUN CAE GERWEN	
SCALE: 1:5,000 (Reduced from 1:2,500)	APPENDIX A
TITLE : EXTRACT FROM COUNTY SERIES MAP GLAMORGANSHIRE 11.12, DATED 1918	
EARTH SCIENCE PARTNERSHIP	



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PROJECT: PROPOSED WIND FARM, MYNYDD UCHAF

GWAUN CAE GERWEN

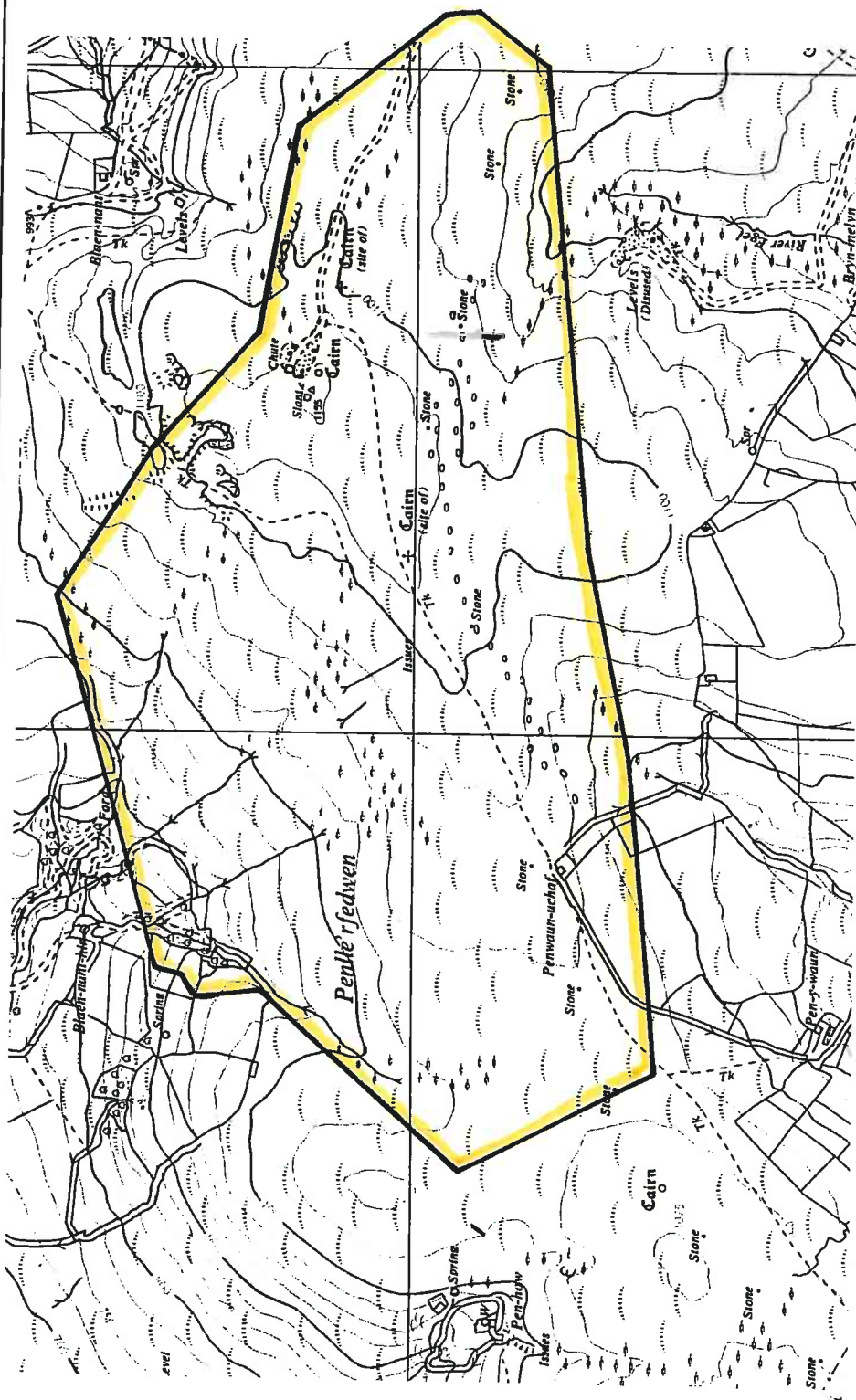
SCALE: 1:10,560

APPENDIX A

TITLE: EXTRACT FROM COUNTY SERIES MAP

GLAMORGANSHIRE 11SE, DATED 1948

EARTH SCIENCE PARTNERSHIP



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**PROJECT: PROPOSED WIND FARM, MYNYDD UCHAF
GWAUN CAE GERWEN**

SCALE: 1:10,560

APPENDIX A

**TITLE: EXTRACT FROM NATIONAL GRID SHEET
SN 17 SW, DATED 1969**

EARTH SCIENCE PARTNERSHIP



APPENDIX B

Coal Authority Mining Report

RECEIVED 2 DEC 2002

COAL AUTHORITY

The Coal Authority	
Cost:	£114.90
Plus V.A.T.	£20.10
Total Received:	£135.00
V.A.T. Reg Number	598 5850 6

EARTH SCIENCE PARTNERSHIP LTD,
33 CARDIFF ROAD,
TAFFS WELL,
CARDIFF,
SOUTH GLAMORGAN,
CF15 7RB

This matter is being dealt with by The Area Surveyor

Our Ref: **519544-02**

Your Ref: 2672H

Electronic Ref:

Date: 19 December 2002

Dear Sir,

Coal Mining Report LAND AT, MYNACH UCHAF, GWAUN CAE GERWEN, SWANSEA

I refer to the enquiry dated 04th December 2002, received 06th December 2002, in connection with the above.

This report is based on and limited to the records in the possession of The Coal Authority at the time the search is answered.

Ordnance Survey (O.S.) is undertaking a Positional Accuracy Improvement Programme of its mapping data. The Coal Authority (CA) has no control over the timing of issue of Positionally Improved mapping data by O.S. or over users of that data. In some instances the relative position between surface features and coal mining features may alter as a consequence of this programme. The CA will ensure that the integrity of its database is maintained by replotting some mining information to sustain the relationship between that mining information and the improved O.S. surface positions, some of which are now being released. However, mining reports are currently being produced against pre improved O.S. mapping whilst the Authority updates its database in line with the O.S. changes.

Past Underground Mining

The property is within the likely zone of influence on the surface from workings in 7 seams of coal at shallow to 580m depth, the last date of working being 1993.

Present Underground Mining

The property is not within the zone of likely physical influence on the surface from any present underground coal workings.

Future Underground Mining

The property is not within a geographical area for which a licence to extract coal by underground methods is awaiting determination by the Coal Authority.

The property is not within a geographical area for which a licence to extract coal by underground methods has been granted.

The property is not within the zone of likely physical influence at the surface from plans of future workings in our possession.

However reserves of coal exist in the locality which could be worked at some time in the future subject to feasibility, licences, and planning consents.

We have no record of any notice of the risk of the land being affected by subsidence being given under S.46 of the Coal Mining Subsidence Act 1991.

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Shafts and Adits

Within or within 20 metres of the property there are 63 mine entries, the approximate positions of which are shown on the attached plan. Your attention is drawn to the statements made on that plan.

Our records disclose the following information:

- 273211-063. No treatment details.
- 273211-071. No treatment details.
- 273211-074. No treatment details. - shaft
- 273211-042. No treatment details.
- 273211-075. This adit was inspected in January 1971 and was found to be filled to an unknown specification .
- 273211-043. No treatment details.
- 273211-027. This adit was inspected in January 1971 and was found to be filled to an unknown specification .
- 273211-028. No treatment details.
- 273211-030. No treatment details.
- 273211-029. This adit was inspected in January 1971 and was found to be filled to an unknown specification .
- 273211-020. No treatment details.
- 273211-011. No treatment details.
- 273210-054. No treatment details.
- 273211-010. No treatment details.
- (6) 272210-001. This adit was inspected in March 1971 and was found to be filled to an unknown specification .
- 273211-052. No treatment details.
- 273211-050. No treatment details.
- 273211-051. No treatment details.
- 273211-044. No treatment details.
- 273211-045. No treatment details.
- 273211-032. No treatment details.
- 273211-031. This adit was inspected in January 1971 and was found to be filled to an unknown specification .
- 273211-048. No treatment details.
- 273211-049. No treatment details.
- 273211-062. No treatment details.
- 273211-065. No treatment details.
- 273211-002. This adit was inspected in January 1971 and was found to be filled to an unknown specification .
- 273211-003. No treatment details.
- 273211-004. This adit was inspected in January 1971 and was found to be filled to an unknown specification .
- 273211-005. No treatment details.
- 273211-033. No treatment details.
- 273211-034. No treatment details.
- 273211-026. No treatment details.
- 273211-036. No treatment details.
- 273211-037. No treatment details.
- 273211-047. No treatment details.
- 273211-046. No treatment details.
- 273211-059. No treatment details.
- 273211-058. This adit was inspected in January 1971 and was found to be filled to an unknown specification .
- 273211-060. No treatment details.
- 273211-061. No treatment details. - shaft
- 273211-035. This adit was inspected in January 1971 and was found to be filled to an unknown specification .

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273211-007. No treatment details.

273211-006. No treatment details.

273211-009. No treatment details.

273210-061. No treatment details.

273211-001. No treatment details.

273211-057. This adit was inspected in January 1971 and was found to be filled to an unknown specification .

273211-008. This adit was inspected in January 1971 and was found to be filled to an unknown specification .

273211-056. No treatment details.

273211-054. No treatment details.

(A) 273211-023. This adit was inspected in January 1971 and was found to be filled to an unknown specification .

273211-012. No treatment details.

273211-025. No treatment details.

273211-024. No treatment details.

273211-038. No treatment details.

273211-039. No treatment details.

273211-040. This adit was inspected in January 1971 and was found to be filled to an unknown specification .

273211-041. No treatment details.

273211-021. No treatment details.

273211-022. No treatment details.

273211-055. This adit was inspected in January 1971 and was found to be filled to an unknown specification .

273211-053. This adit was inspected in January 1971 and was found to be filled to an unknown specification .

The records held by the Coal Authority may be incomplete. Consequently, there may exist in this locality mine entries of which we have no knowledge.

Surface Geology

Records in our possession do not disclose any fault or other line of weakness at the surface as having affected the stability of the property.

Past Opencast Mining

The property is located within the geographical boundary of an opencast site from which coal has been extracted by opencast methods.

Present Opencast Mining

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

Future Opencast Mining

The property is not within 800 metres of the geographical boundary of an opencast site for which a licence to extract coal by opencast methods is awaiting determination.

The property is within 800 metres of the geographical site boundary of the Pwll Bach Colliery prospective opencast site for which a licence to extract coal by opencast methods was granted in October 1994. The grant of this licence is conditional on the applicant securing any other rights, permissions (including planning permissions) and consents to enable him to carry out his operations.

The property is within 800 metres of the geographical site boundary of the East Pit East prospective opencast site for which a licence to extract coal by opencast methods was granted in October 1994. The grant of this licence is conditional on the applicant securing any other rights, permissions (including planning permissions) and consents to enable him to carry out his operations.

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Subsidence

The records in our possession do not disclose any damage notice or claim having been given, made or pursued in respect of the property since 1 January 1984.

The records in our possession do not disclose any current "Stop Notice" affecting the property.

The records in our possession do not show any request having been made to execute preventative works under S.33 of the Coal Mining Subsidence Act 1991.

Withdrawal of Support

The property lies within a geographical area in respect of which notices of entitlement to withdraw support were published in 1960, 1952, 1959.

The property does not lie within a geographical area in respect of which a notice has been given under S.41 of the Coal Industry Act 1994, revoking the entitlement to withdraw support.

Working Facilities Orders

The property is not within a geographical area that is the subject of an Order 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 within an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Additional Remarks

In view of the mining circumstances a prudent developer would seek appropriate technical advice before works are undertaken on site. All proposals should have regard to good engineering practice in mining areas as identified in authoritative publications on mining stability problems. In any event, no activities should be undertaken that intersect, disturb, or interfere with any coal or mines of coal without permission of the Coal Authority.

These replies are prepared in accordance with the Law Society's Guidance Notes 1998.

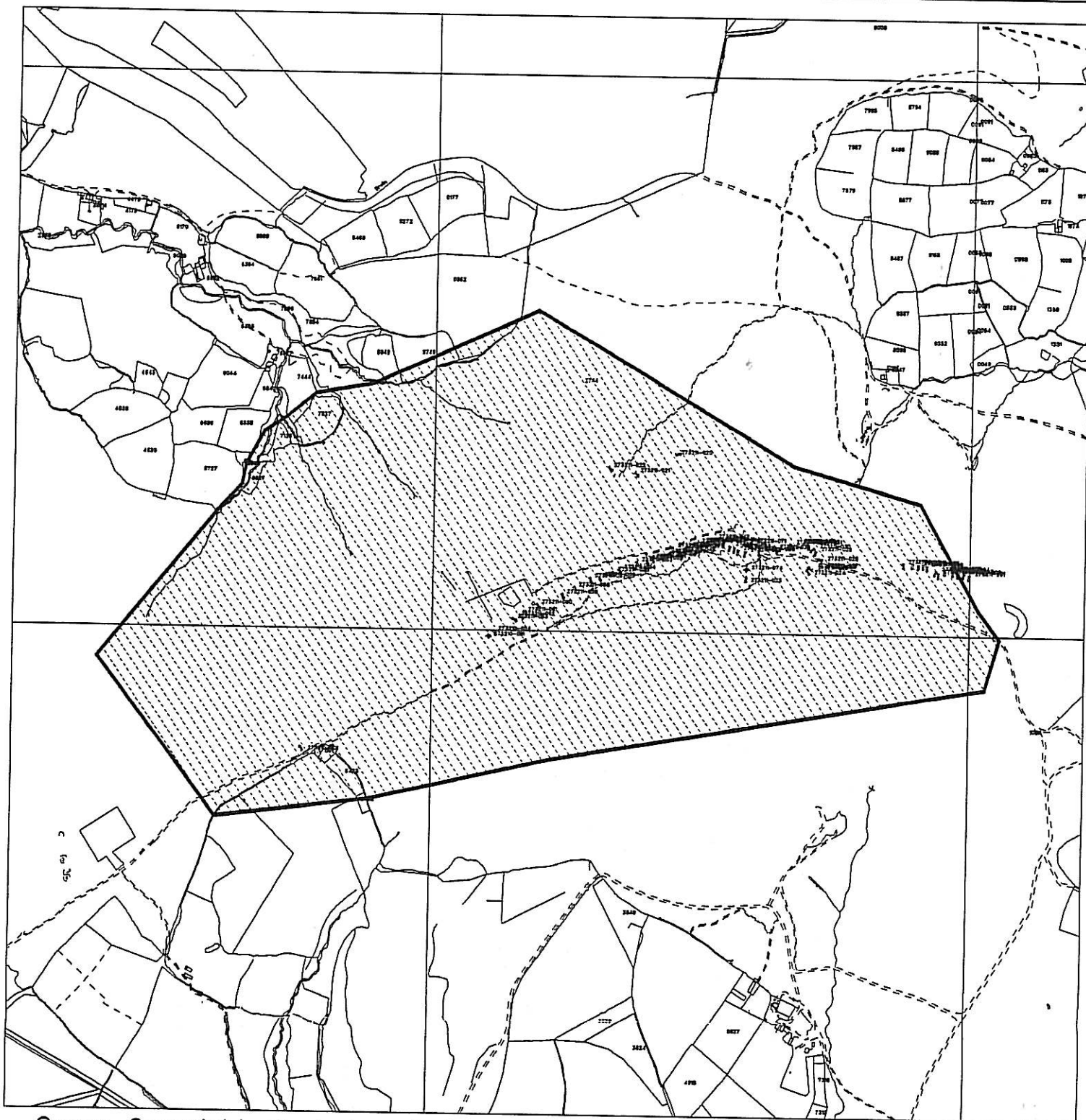
Yours faithfully



Albert Schofield

Director of Mining Records and Services

— —
— —



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SCALE: 1:10000

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This is a plan of the boundaries of the property in respect of which this report has been prepared. It is the responsibility of the user to ensure that the boundaries shown correspond with those of the property.

APPROXIMATE POSITION OF ENQUIRY BOUNDARY SHOWN



APPROXIMATE POSITION OF DISUSED MINE SHAFTS SHOWN



APPROXIMATE POSITION OF DISUSED MINE ADITS SHOWN



This plan shows the approximate location of the disused mine entry/entries referred to in the attached mining report. For reasons of clarity, mine entry symbols may not be drawn to the same scale as the plan. Property owners have the benefit of statutory protection (under the Coal Mining Subsidence Act 1991). This contains provision for the making good, to the reasonable satisfaction of the owner, of physical damage from disused coal mine workings including disused coal mine entries. A DTI leaflet setting out the rights and the obligations of either the Coal Authority or other responsible persons under the 1991 Act can be obtained by telephoning 0845 762 6848. If you wish to discuss the relevance of any of the information contained in the attached report you should seek the advice of a qualified mining engineer or surveyor. If you or your adviser wish to examine the source plans from which the information has been taken these are available at our Mansfield office, free of charge, by prior appointment, telephone 01623 638233. Should you or your adviser wish to carry out any physical investigations that may enter, disturb or interfere with any disused mine entry the prior permission of the owner must be sought. For coal mine entries the owner will normally be the Coal Authority. The Coal Authority, regardless of responsibility and in conjunction with other public bodies, provide an emergency call out facility in coalfield areas to assess the public safety implications of mining features (including disused mine entries). Our emergency telephone number at all times is 01623 646333.

GENERAL NOTES

1. Earth Science Partnership (ESP) believes that providing information about limitations is essential to help clients identify and therefore manage their risks. These risks can be mitigated through further investigation or research, but they cannot be eliminated,.
2. This report includes available factual data for the site as obtained only from the sources described in the text. The data are related to the site on the basis of the site location and boundary information provided by the client. The findings and opinions conveyed in this assessment are based on the information obtained from a variety of sources as detailed in the report, which ESP believe are reliable. Nevertheless, ESP cannot and does not guarantee the authenticity or reliability of the information it has relied on. It is possible that the assessment failed to indicate the existence of further sources of information on the site. Assuming such sources do exist, their information could not have been considered in the formulation of the opinions and findings in this report. It should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.
3. In preparing this report it has been assumed that all past and present occupants of the site have provided all relevant and other information, especially relating to known or potential hazards. This report is not required to identify insufficiencies or mistakes in the information provided by the user/owner or from any other source, but has sought to compensate for these where obvious in the light of other information.
4. Reports are normally prepared and written in the context of a stated purpose, and should not, therefore be used in a different context. Furthermore, new information, improved practices and legislation may necessitate an alteration to the report in whole or in part after its submission.
5. The opinions presented in this report are based on the findings derived from a site inspection, investigations and a review of historical and other records. The report details any indicators that may suggest that hazardous substances exist at the site at levels likely to warrant mitigation. Not finding such indicators does not mean that hazardous substances do not exist at the site. The most recent site inspection was undertaken as detailed in Section 3.1. Circumstances on sites are subject to change and certain indicators of the presence of hazardous substances that may have been latent at the time of this inspection may subsequently have become observable.
6. The work carried out for the assessment can only investigate a small portion of the subsurface conditions. Certain indicators or evidence of hazardous substances may have been outside the limited portion of the subsurface investigated, latent at the time of the work or only partially intercepted by the works, and thus their full significance could not be appreciated. In this regard, groundwater levels are particularly susceptible to variation. Accordingly, it is possible that the assessment failed to indicate the presence or significance of hazardous substances. Assuming such substances exist, their presence could not have been considered in the formulation of the report's findings and opinions.
7. The assessment was prepared for the sole internal use and reliance of the Client. The report shall not be relied upon by or transferred to other parties without the express written authorisation of the Earth Science Partnership. If an unauthorised party comes into possession of the report, they rely on it at their peril and the authors owe them no duty of care and skill.
8. The copyright in this report and other plans and documents prepared by the ESP is owned by them and no such report, plan or document may be reproduced, published or adapted without their consent. Complete copies of this report may, however, be made and distributed by the Client as an expedient in dealing with matters related to its commission.

**PROPOSED WIND FARM, MYNYDD UCHAF
GWAUN CAE GURWEN**

AWEL AMAN TAWE

**GEOTECHNICAL
DESK STUDY ASSESSMENT**

Document Ref. 2672h.671

December 2002

Written by:



J.P. Hucker BSc. CGeol FGS

Checked by:



**J.K.C. Campbell BSc, MSc, C Eng, C Geol,
Eur Geol, FGS, FIMM**

C. 2013 Coal Authority Mining Report

THE COAL AUTHORITY
200 LICHFIELD LANE
MANSFIELD
NOTTINGHAMSHIRE
NG18 4RG

Our reference: **71000480600002**
Your reference: **8139**
Date of your enquiry: **15 July 2013**
Date we received your enquiry: **15 July 2013**
Date of issue: **15 July 2013**

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

Non-Residential Coal Authority Mining Report

SITE AT , MYNDD Y GWERHYD WIND FARM (TURBINES), NEATH PORT TALBOT,

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 3 seams of coal at 40m to 600m depth, and last worked in 1990.

Any ground movement from these coal workings should have stopped by now.

In addition the property is in an area where the Coal Authority believe there is coal at or close to the surface. This coal may have been worked at some time in the past.

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 in an area for which a notice of entitlement to withdraw support was published in 1959.

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.

Location map



Approximate position of property

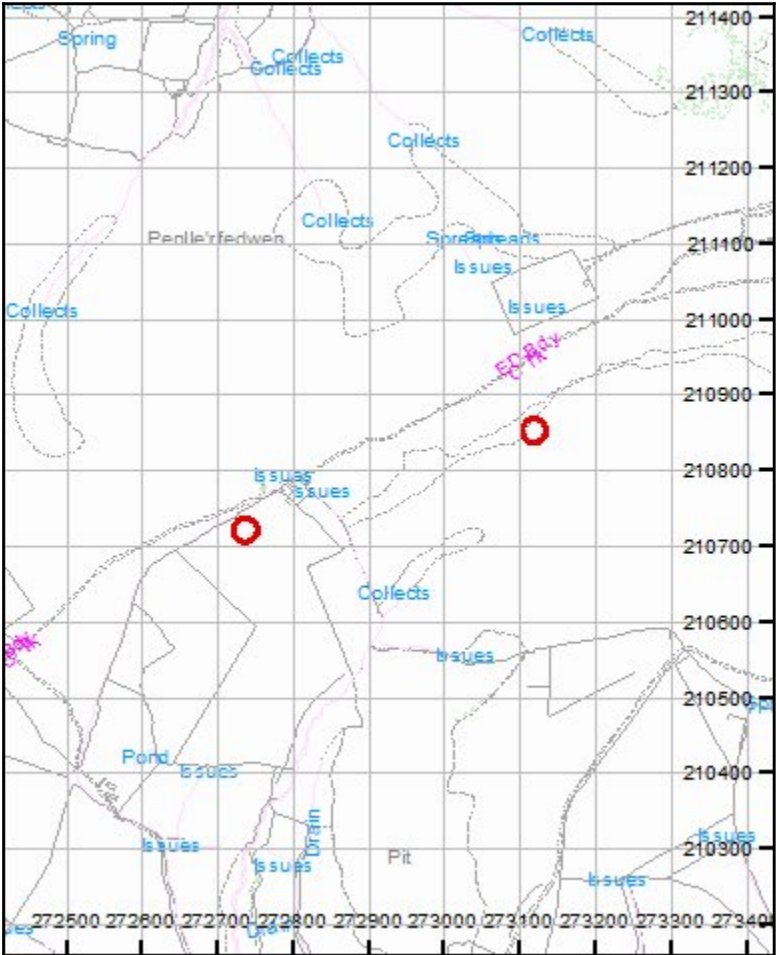


Enquiry boundary

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Key

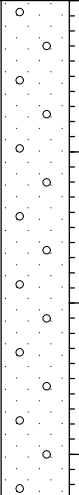
Approximate position of enquiry boundary shown



D. Natural Power Borehole Logs

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1A	
Job No 10395UKC	Date 05-12-13 11-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,109.0 N 201,840.0		
Contractor Natural Power				Sheet 1 of 7	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date	RQD					Discontinuities	Sample	Main		
3.30					(3.30) 					

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
							0	35.2	Air/Mist	100	Core from 0.00m-35.20m. Open hole drilling from 35.20m-53.00m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
--	--------------------------	--	-------------------

10395UKC MYNDY Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1A	
Job No 10395UKC	Date 05-12-13 11-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,109.0 N 201,840.0		
Contractor Natural Power				Sheet 2 of 7	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
9.55	100% (53)% 37%				(7.22)			Strong SANDSTONE (continued)		
12.20	100% (60)% 40%				12.02 12.20			Weak MUDSTONE		
15.20	100% (64)% 50%				(5.55)			Medium-Strong MUDSTONE		

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-35.20m. Open hole drilling from 35.20m-53.00m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1A	
Job No 10395UKC	Date 05-12-13 11-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,109.0 N 201,840.0		
Contractor Natural Power				Sheet 3 of 7	

RUN DETAILS					STRATA				Geology	Instrument/ Backfill
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date	RQD					Discontinuities	Sample	Main		
18.15	100% (68)% 53%				17.75			Medium-Strong MUDSTONE <i>(continued)</i>		
				(0.40) 18.15	Weak MUDSTONE					
20.95	100% (68)% 60%				(3.95)			Strong MUDSTONE		
23.90	100% (85)% 67%				22.10					
			(2.37)							

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-35.20m. Open hole drilling from 35.20m-53.00m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY Y GWRHYD G.P.J. GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1A
Job No 10395UKC	Date 05-12-13 11-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,109.0 N 201,840.0	
Contractor Natural Power				Sheet 4 of 7

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
26.95	98% (68)% 60%				24.47			Strong SANDSTONE <i>(continued)</i>		
					24.73			Weak MUDSTONE		
								Strong SANDSTONE		
29.67	100% (68)% 66%				(9.29)					
	100% (72)% 66%									

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-35.20m. Open hole drilling from 35.20m-53.00m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1A	
Job No 10395UKC	Date 05-12-13 11-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,109.0 N 201,840.0		
Contractor Natural Power				Sheet 5 of 7	

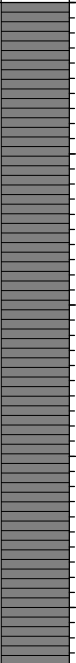
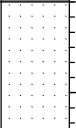
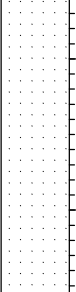
RUN DETAILS						STRATA			Geology	Instrument/ Backfill		
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION						
Date	RQD					Discontinuities	Sample	Main				
32.50								Strong SANDSTONE <i>(continued)</i>				
	100% (93)% 61%				34.02						Weak MUDSTONE	
					(0.38) 34.40						SANDSTONE	
					(0.80)							
35.20								35.20			MUDSTONE	
												

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
							35.2	53	Air	100	Core from 0.00m-35.20m. Open hole drilling from 35.20m-53.00m
All dimensions in metres Scale 1:50			Client Awel Aman Tawe			Method/ Plant Used Commachio Geo 205			Logged By AMcC		

10395UKC MYNDY GWRHYD G.P.J. GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1A	
Job No 10395UKC	Date 05-12-13 11-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,109.0 N 201,840.0		
Contractor Natural Power				Sheet 6 of 7	

RUN DETAILS					STRATA				Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
					44.40			MUDSTONE <i>(continued)</i>		
					(0.85) 45.25			SANDSTONE		
					45.60			SANDSTONE broken		
					(2.10) 47.70			SANDSTONE		
								MUDSTONE		

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-35.20m. Open hole drilling from 35.20m-53.00m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1A	
Job No 10395UKC	Date 05-12-13 11-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,109.0 N 201,840.0		
Contractor Natural Power				Sheet 7 of 7	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
Complete at: 53m					(0.70) 48.40		MUDSTONE <i>(continued)</i>			
					(0.50) 48.90		MUDSTONE			
				(0.80) 49.70	COAL (Rhondda 2 seam)					
					(3.20) 52.90 53.00		MUDSTONE			
			SANDSTONE							

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-35.20m. Open hole drilling from 35.20m-53.00m
All dimensions in metres Scale 1:50			Client Awel Aman Tawe			Method/ Plant Used Commachio Geo 205			Logged By AMcC		

10395UKC MYNDY Y GWRHYD G.P.J. GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1B	
Job No 10395UKC	Date 12-12-13 13-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,117.0 N 201,855.0		
Contractor Natural Power				Sheet 1 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date	RQD					Discontinuities	Sample	Main		
2.00				</						

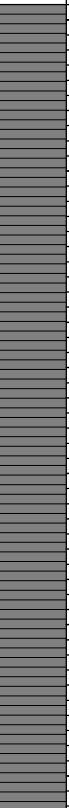
Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
							0	20.25	Air/Mist	100	Core from 0.00m-20.25m. Open hole drilling from 20.25m-35.00m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1B	
Job No 10395UKC	Date 12-12-13 13-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,117.0 N 201,855.0		
Contractor Natural Power				Sheet 2 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date	RQD					Discontinuities	Sample	Main		
	96% (52)% 31%				8.40			Strong SANDSTONE (<i>continued</i>)		
					8.53			Very weak MUDSTONE		
					8.90			Strong SANDSTONE		
					(10.85)			Medium-Strong MUDSTONE		
10.80										
13.20	100% (71)% 52%									
	100% (76)% 76%									

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-20.25m. Open hole drilling from 20.25m-35.00m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1B	
Job No 10395UKC	Date 12-12-13 13-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,117.0 N 201,855.0		
Contractor Natural Power				Sheet 3 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date	RQD					Discontinuities	Sample	Main		
16.10								Medium-Strong MUDSTONE <i>(continued)</i>		
	100% (85)% 85%									
18.75										
	100% (98)% 79%				19.75					
				xxxxxx				Medium-Strong SILTSTONE		
20.25				xxxxxx	(0.50) 20.25					
								MUDSTONE		

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
							20.25	35	Air	100	Core from 0.00m-20.25m. Open hole drilling from 20.25m-35.00m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1B	
Job No 10395UKC	Date 12-12-13 13-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,117.0 N 201,855.0		
Contractor Natural Power				Sheet 4 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
								SANDSTONE with coal traces <i>(continued)</i>		
					(7.90)					
					31.60			Strong SANDSTONE		

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-20.25m. Open hole drilling from 20.25m-35.00m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYND Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT1B	
Job No 10395UKC	Date 12-12-13 13-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 273,117.0 N 201,855.0		
Contractor Natural Power				Sheet 5 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
Complete at: 35m					(3.40)			Strong SANDSTONE <i>(continued)</i>		
					35.00					

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-20.25m. Open hole drilling from 20.25m-35.00m
All dimensions in metres Scale 1:50			Client Awel Aman Tawe			Method/ Plant Used Commachio Geo 205			Logged By AMcC		

10395UKC MYND Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2A	
Job No 10395UKC	Date 26-11-13 29-11-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 272,733.0 N 201,725.0		
Contractor Natural Power				Sheet 1 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill	
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION					
Date	RQD					Discontinuities	Sample	Main			
2.60					(2.60)			Drift deposits over highly weathered SANDSTONE			
3.00	75% (68)% 0%								Strong SANDSTONE		
4.50	100% (69)% 29%										
5.00	100% (100)% 24%										
5.45	89% (78)% 27%										
	100% (94)% 29%										
6.95						(0.48)			Medium-Strong CONGLOMERATE		
						7.12			Strong SANDSTONE		
	100%					(0.50)			Medium-Strong CONGLOMERATE		
					7.62			Medium-Strong SANDSTONE			
								Strong SANDSTONE			

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
							0	35.20	Air/Mist	100	Core from 0.00m-35.20m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYND Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2A	
Job No 10395UKC	Date 26-11-13 29-11-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 272,733.0 N 201,725.0		
Contractor Natural Power				Sheet 2 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date	RQD					Discontinuities	Sample	Main		
9.00	(74)% 36%				(0.73)			Strong SANDSTONE <i>(continued)</i>		
	8.35									
	8.46				Medium-Strong CONGLOMERATE Strong SANDSTONE					
10.10	91% (91)% 50%									
10.60	100% (100)% 100%									
13.20	100% (100)% 76%									
15.90	94% (92)% 55%				(13.04)					

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-35.20m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2A	
Job No 10395UKC	Date 26-11-13 29-11-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 272,733.0 N 201,725.0		
Contractor Natural Power				Sheet 3 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date	RQD					Discontinuities	Sample	Main		
18.90	97% (100)% 89%							Strong SANDSTONE <i>(continued)</i>		
19.70	88% (100)% 73%									
20.70	100% (87)% 14%									
					21.50					
	97% (73)% 58%				(2.20)			Strong SANDSTONE with coal traces and occasional coal laminae		
23.70					23.70					
								Strong SANDSTONE		

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-35.20m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2A	
Job No 10395UKC	Date 26-11-13 29-11-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 272,733.0 N 201,725.0		
Contractor Natural Power				Sheet 4 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill					
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION									
Date	RQD					Discontinuities	Sample	Main							
26.50	100% (87)% 79%				 (3.80)			Strong SANDSTONE (<i>continued</i>)							
	100% (69)% 48%														Strong SANDSTONE with coal traces
29.40															Strong SANDSTONE
	100% (27)% 25%				 (4.30)										

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-35.20m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2A	
Job No 10395UKC	Date 26-11-13 29-11-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 272,733.0 N 201,725.0		
Contractor Natural Power				Sheet 5 of 5	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
32.23		97% (41)% 20%						Strong SANDSTONE (<i>continued</i>)		
					33.30					
					(0.60) 33.90			COAL(Rhondda 2 Seam)		
					(0.80) 34.70			SEAT EARTH		
					(0.50) 35.20			Medium-Strong MUDSTONE		
35.20										
Complete at: 35.2m										

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-35.20m
All dimensions in metres Scale 1:50			Client Awel Aman Tawe			Method/ Plant Used Commachio Geo 205				Logged By AMcC	

10395UKC MYNDY GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2B
Job No 10395UKC	Date 02-12-13 04-12-13	Ground Level (m OS Datum) E 272,744.0	Co-Ordinates (BNG) N 201,713.0	
Contractor Natural Power				Sheet 1 of 6

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
2.00				<						

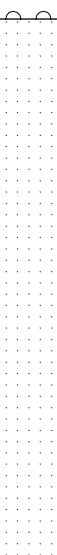
Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
							0	19.95	Air/Mist	100	Core from 0.00m-19.95m. Open hole drilling from 19.95m-41.30m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYND Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2B	
Job No 10395UKC	Date 02-12-13 04-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 272,744.0 N 201,713.0		
Contractor Natural Power				Sheet 2 of 6	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill	
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION					
Date	RQD					Discontinuities	Sample	Main			
8.45								Strong to medium strong SANDSTONE <i>(continued)</i>			
	100% (100)% 75%					10.24					
					(0.50)	10.74			Medium-Strong CONGLOMERATE		
											
11.30									Medium-Strong to Strong SANDSTONE		
	100% (90)% 67%					(3.72)					
14.10											
						14.46					
						14.55			Medium-Strong MUDSTONE		
	99% (89)% 77%					(1.93)			Strong SANDSTONE		

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-19.95m. Open hole drilling from 19.95m-41.30m
All dimensions in metres Scale 1:50			Client Awel Aman Tawe			Method/ Plant Used Commachio Geo 205			Logged By AMcC		

10395UKC MYNDY GWRHYD G.P.J. GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2B	
Job No 10395UKC	Date 02-12-13 04-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 272,744.0 N 201,713.0		
Contractor Natural Power				Sheet 3 of 6	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
17.03	100% (76)% 71%				16.48			Strong SANDSTONE (<i>continued</i>)		
				○ ○	16.70			Medium-Strong CONGLOMERATE		
								Strong SANDSTONE		
19.95					19.95					
								SANDSTONE		

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
							19.95	41.3	Air	100	Core from 0.00m-19.95m. Open hole drilling from 19.95m-41.30m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYND Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2B	
Job No 10395UKC	Date 02-12-13 04-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 272,744.0 N 201,713.0		
Contractor Natural Power				Sheet 4 of 6	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
Date						Discontinuities	Sample	Main		
								SANDSTONE <i>(continued)</i>		

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-19.95m. Open hole drilling from 19.95m-41.30m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYND Y GWRHYD GPJ GINT STD AGS 3.1.GDT 30/4/14

RUN DETAILS						STRATA		Geology	Instrument/ Backfill
Depth	TCR (SCR)	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION			
Date	RQD					Discontinuities	Sample Main		
							SANDSTONE <i>(continued)</i>		
					36.80 (0.90) 37.70		COAL (Rhondda 2 seam)		
					(3.60)		MUDSTONE		

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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0395UKC MYNDD Y GWRHYD.GPJ GINT STD AGS 3 1.GDT 30/4/14

DRILLHOLE LOG

Project Myndd y Gwrhyd				DRILLHOLE No BHT2B	
Job No 10395UKC	Date 02-12-13 04-12-13	Ground Level (m OS Datum)	Co-Ordinates (BNG) E 272,744.0 N 201,713.0		
Contractor Natural Power				Sheet 6 of 6	

RUN DETAILS					STRATA			Geology	Instrument/ Backfill
Depth	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION			
Date						Discontinuities	Sample		
Complete at: 41.3m				<					

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing	Core Dia mm	Strike	Water Standing	From	To	Type	Returns	
											Core from 0.00m-19.95m. Open hole drilling from 19.95m-41.30m

All dimensions in metres Scale 1:50	Client Awel Aman Tawe	Method/ Plant Used Commachio Geo 205	Logged By AMcC
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10395UKC MYNDY GWRHYD G.P.J. GINT STD AGS 3.1.GDT 30/4/14

What We Do



Natural Power is a leading independent renewable energy consultancy and products provider. We offer proactive and integrated consultancy, management & due diligence services, backed by an innovative product range, across the onshore wind, offshore wind, wave, tidal, solar and bioenergy sectors, whilst maintaining a strong outlook on other new and emerging renewable energy sectors. Established in the mid-1990s, Natural Power has been at the heart of many ground-breaking projects, products and portfolios for close to two decades, assisting project developers, investors, manufacturers, finance houses and other consulting companies.

With its iconic Scottish headquarters, The Green House, Natural Power has expanded internationally employing 300 renewable energy experts across Europe and the Americas and operating globally. Providing Planning & Development, Ecology & Hydrology, Technical, Construction & Geotechnical, Asset Management and Due Diligence services, Natural Power is uniquely a full lifecycle consultancy – from feasibility to finance to repowering, and every project phase in between. We are a truly trailblazing consulting organisation; Natural Power has consistently invested in product development and technical research in order to progress certain key areas within the industry such as the operational management of wind farms, the design and assessment of wind farms in complex flow and the use of remote sensing for wind measurement. From award-winning consultancy and management services, through a string of technology world-firsts, Natural Power has a successful track record and the breadth of services and deep-rooted experience that provides a wealth of added value for our diverse client base.

Natural Power – delivering your local renewable energy projects, globally.

Our Global Expertise

Natural Power delivers services and operates assets globally for our clients, with twelve offices across Europe and North America and agencies active in South America and AsiaPac.

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