



# **Y Bryn Wind Farm Borrow Pit Assessment Appendix 10.3**

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# 1. Borrow Pit Appraisal Background

## 1.1. Introduction

This report considers the following configuration of borrow pit search areas:

### Northern Wind Farm Sector

- Expansion to existing borrow pits workings 'N1'.

### Southern Wind Farm Sector:

- x 4 new Borrow pit search areas 'S2, S3, S4 & S5'; and
- Expansion to existing borrow pit workings 'S1'.

Locations proposed are based on several key factors driven by the developer in their consideration for key stakeholders and the requirement to ensure optimal construction logistics and minimal impact. Figure 2.1 provides regional context for the assessment.

The proposed borrow pit locations are selected based on access to existing borrow pit excavations and proximity to existing and proposed infrastructure. Initial estimates of available rock volume was performed using 3D terrain models. This search assessment has taken account of hydrological, hydrogeological, and wider environmental constraint.

The size of borrow pit search areas remains indicative. The final borrow pit design and working area considerations shall be confirmed following detailed intrusive ground investigation typically undertaken during the post consent phase of the development.

## 1.2. Scope

Borrow pit search locations were agreed with Y Bryn Wind Farm Ltd and presented to development stakeholders during February 2022. Search areas have been reviewed against contemporaneous geological desk study materials and aerial imagery. In order to infer ground conditions and geological setting; comprehensive walkover surveys have been undertaken by Natural Power Consultants Ltd (Natural Power). Surveys (undertaken across x2 visits) comprised walkover of the site including examination of bedrock exposures. Site walkover surveys were conducted by an experienced Geotechnical Engineer. A variety of parameters have been assessed through visual examination and the following non-intrusive survey techniques:

- Geomorphological mapping and terrain feature identification including; terrain aspect, slope, hydrology and bedrock conditions (rock exposures);
- Slope analysis including; determination of slope angle and aspect through a sighting compass and inclinometer;
- Rock mass assessment, where limited exposures are evident, undertaking inspection, index testing to assess relative strength; and
- Photographic record survey.

Relevant findings are compiled into this report, which is aimed at confirming borrow pit search areas, predicted extents, and estimates for the available volume of construction aggregate.

## 2. Site Information

### 2.1. Location

The proposed Y Bryn Wind Farm development is located approximately 5 km east of Port Talbot in South Wales and is formed of two discrete arrays separated by a minor road (B4282). The development is located within productive forestry, managed by Natural Resources Wales (NRW). Access is currently possible from the B4282 road running north of the site at BNG 283708, 191870. Figure 2.1 depicts the regional context.

*Source: Natural Power, Bing Maps.*



Figure 2.1: Regional Context & Site Location

### 2.2. Proposed development

The development will comprise of up to x18 wind turbine generators (WTGs), a sub-station, construction compound and associated infrastructure in the form of external wind turbine transformer housings, wind monitoring equipment, crane hardstand areas, underground electricity cables between the turbines, associated access tracks, temporary borrow pits, water crossings and drainage measures as necessary. On-site borrow pit locations are proposed in order to access

construction aggregates and avoid importation of material across the public road network. Figure 2.2 overleaf depicts the proposed wind farm layout and borrow pit search areas.

Source: Natural Power, OS 1:50k Colour

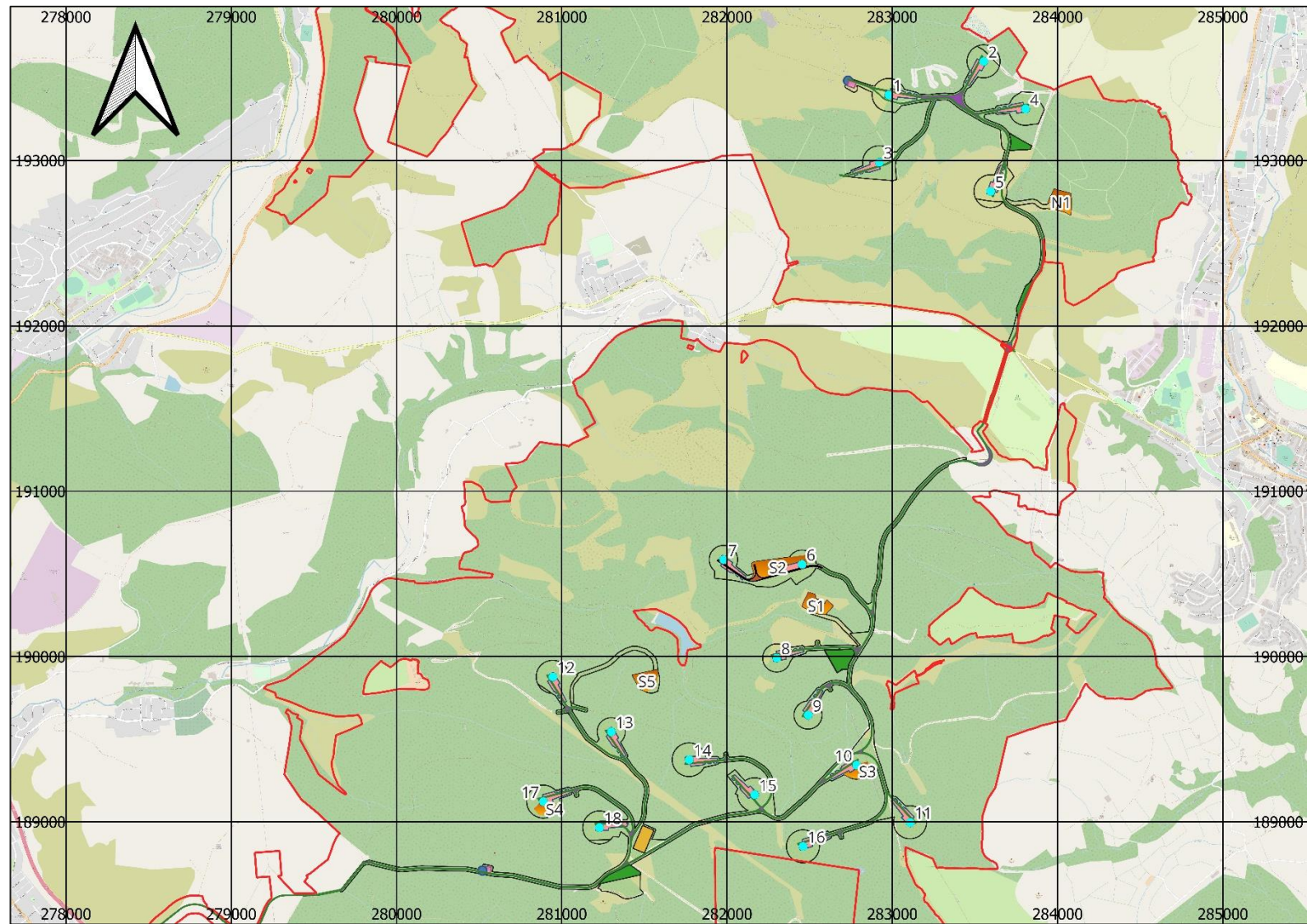


Figure 2.2: Site Layout & BP Search Areas

### 3. Borrow Pits

Six borrow pit locations (N1, S1, S2, S3, S4 & S5) have been assessed as part of this study. The location and example configuration of the proposed borrow pits is shown in Figures 3.1-3.6. All borrow pit search areas are proposed across productive forestry with good access from existing infrastructure. Relevant photographs, taken during the site visits are provided in Appendix A.

#### **Borrow Pit N1**

This location is a large existing/active borrow pit location with plentiful reserves of extracted and processed material. The borrow pit is located close to the site entrance of the northern area of the development. The outcropping rock is good quality sandstone, slightly weathered. The back face of the existing borrow pit is approximately 8.0 m high and this backwall can be extended north if greater quantities of material are required. Bedrock is visible at the surface suggesting thin overburden thickness.

*Source: Natural Power, Google Earth Aerial Imagery, British Geological Survey © NERC 2022*



**Figure 3.1: Proposed Borrow Pit N1 Location**

Bedrock is anticipated to comprise the: The Llynfi Member Sandstone with Mudstone and Siltstone indicated sub-cropping the northern limits of this search area.

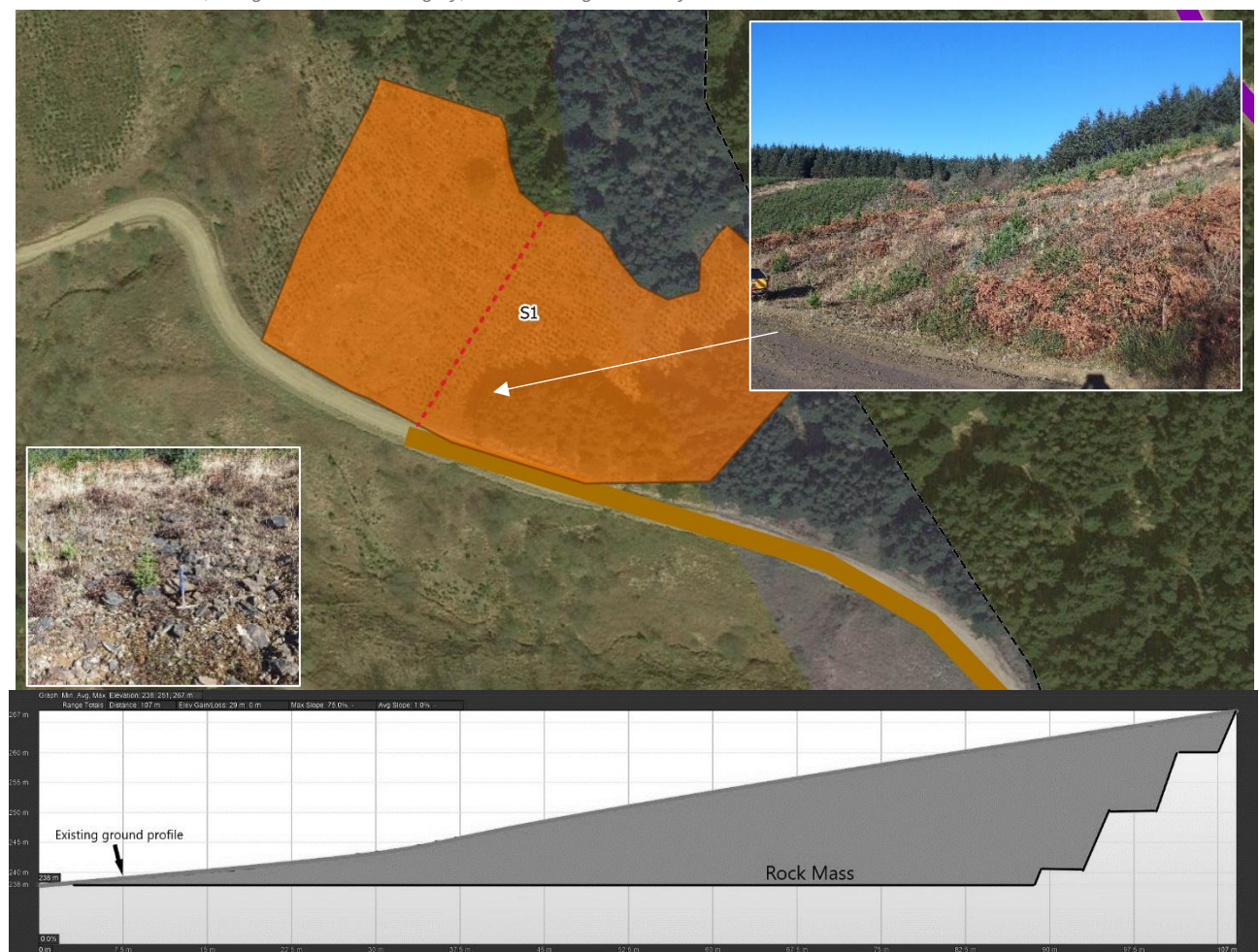
## **Borrow Pit S1**

Open, gently battered historic working immediately surrounded by very young trees approximately 1 m tall. 25 m -50 m to the north and east are mature forestry trees. Watercourse approximately 50m steeply downhill to the south on the opposite side of the existing track. Probable high sand and fines content of exposed material will require active management to prevent siltation of run-off. This watercourse runs flows to the west into Cwmwernderi Reservoir.

Possible that historic works finished by backfilling with superficial soils.

Visible material likely to excavate as brown to light brown subangular very (~30-40%) fine to coarse sandy COBBLES with fine to coarse subangular gravel and boulders of medium strong light brown medium sandstone. Possible high fines.

*Source: Natural Power, Google Earth Aerial Imagery, British Geological Survey © NERC 2022*



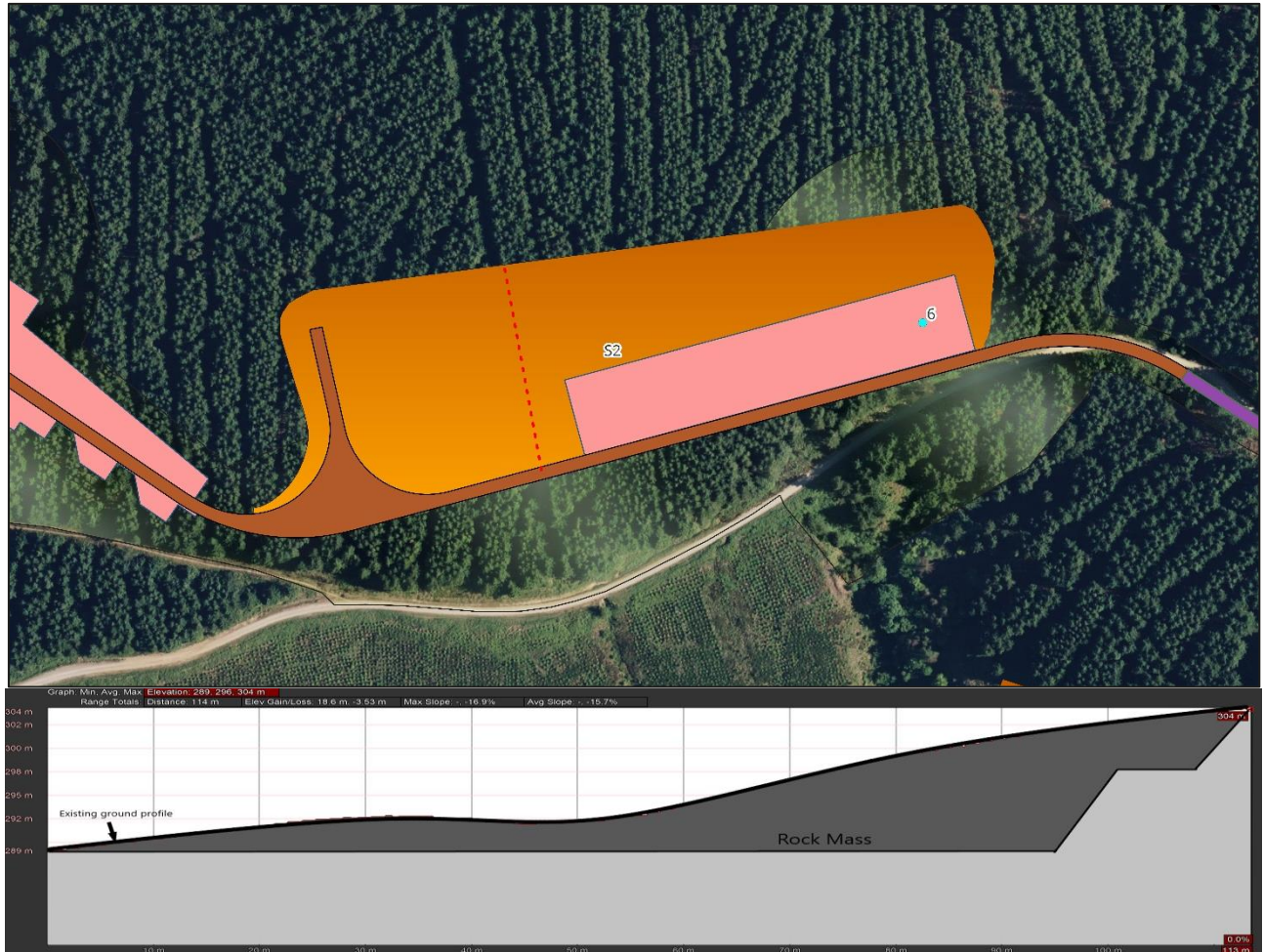
**Figure 3.2: Proposed Borrow Pit 'S1' Location**

Bedrock is anticipated to comprise the: Rhondda Member Sandstone with Mudstone and Siltstone. A coal seam is indicated to sub-crop the extreme north-eastern limits of this search area.

## **Borrow Pit S2**

Located within productive forestry no rock outcrops are visible on the aerial photography. The developer has sought to position this borrow pit to optimise rock extraction which will be required as part of the construction of Turbine 6. Expanding areas of cut north to form this borrow pit will require a robust design to ensure long term stability of any remaining rock cut slopes.

Source: Natural Power, Google Earth Aerial Imagery, British Geological Survey © NERC 2022



**Figure 3.3: Proposed Borrow Pit 'S2' with indicative working profile**

Bedrock is anticipated to comprise the: Brithdir Member Sandstone.

### **Borrow Pit S3**

Located within productive forestry no rock outcrops are visible on the aerial photography. Turbine 10 and associated hardstanding is directly down-slope of the proposed borrow pit search area. The developer is seeking to optimise earthworks at Turbine 10 and extend excavations south to create BP S3. Expanding areas of cut south to form this borrow pit will require a robust design to ensure long term stability of any remaining rock cut slopes.

Source: Natural Power, Google Earth Aerial Imagery, British Geological Survey © NERC 2022



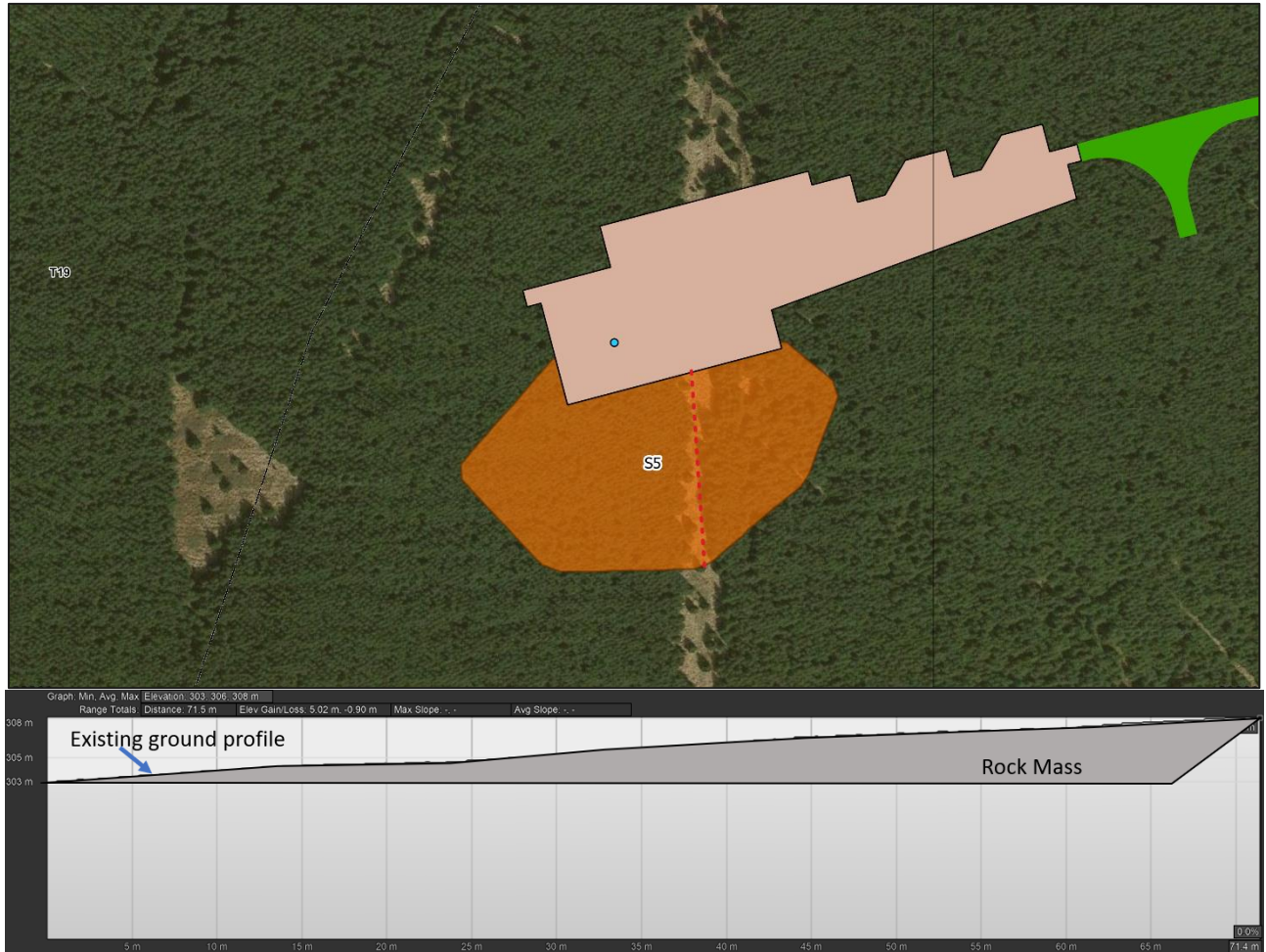
**Figure 3.4: Proposed Borrow Pit 'S3' with indicative working profile**

Bedrock is anticipated to comprise the: Brithdir Member Sandstone.

## **Borrow Pit S4**

Located within productive forestry no rock outcrops are visible on the aerial photography. The developer is seeking to optimise earthworks at Turbine 17 and extend excavations southwards to create BP S5. Expanding areas of rock cut to form this borrow pit will require a robust design to ensure long term stability of any remaining rock cut slopes.

Source: Natural Power, Bing Aerial Imagery, British Geological Survey © NERC 2022



**Figure 3.5: Proposed Borrow Pit 'S4' with indicative working profile**

Bedrock is anticipated to comprise the: Brithdir Member Sandstone.

## **Borrow Pit S5**

The existing borrow in front of search area 'S5' has numerous mechanically exposed faces of sandstone of variable quality. The rock is generally moderately strong to strong with x4 different joint sets. Occasionally silty with slight weathering but predominantly fresh. On visual inspection it appears the borrow pit may be extended south into the back wall. Bedrock exposure at the surface is indicative of reduced overburden thickness.

*Source: Natural Power, Google Aerial Imagery, British Geological Survey © NERC 2022*



**Figure 3.6: Proposed Borrow Pit 'S5' Location**

Bedrock is anticipated to comprise the: The Brithdir Member Sandstone. A shallow dipping coal seam should be anticipated beneath the southern half of the borrow pit search area.

The following assumptions and criteria would be applied to the proposed borrow pit developments:

- Stripped overburden soils would be stored in peripheral bunds at a safe distance from the working area. Bunds shall be no more than 1m in height with 1 in 1.5 slope batters. The final location and geometry of temporary storage bunds shall be confirmed by a qualified geotechnical engineer during construction;
- Cut rock faces shall not exceed 70 degrees and further may need to be shallower where weathered material or unfavourable discontinuity orientations are encountered;
- Cut rock faces shall not exceed 10 m height without a horizontal bench 5 m wide;
- The slope stability of borrow pit workings (cut faces, storage bunds and backfilled materials) would be verified and monitored by a qualified geotechnical engineer during opening, working and restoration phases;
- The perimeter of the borrow pit shall incorporate appropriate edge protection suitable personnel and vehicles when adjacent or downslope from access tracks;
- The floor of the borrow pit shall slope away from the working face at a grade of 1 in 100; and
- Suitable drainage controls would be established to prevent siltation run-off.

Consideration of the construction logistics have been factored into the location rationale:

- A number of smaller borrow pit excavations are in preference over a larger single extraction location; and
- The final location and design of the borrow pit working areas will need to be established following detailed intrusive ground investigation.

### 3.1. Rock Volumes

An initial estimate for the potential volume of rock excavatable from the proposed on-site borrow pits has been calculated. The results from this are shown in Table 3.1.

Table 3.1: Borrow Pit Volumes

| Borrow Pit | Maximum Search Area (ha) | Longest Dimensions (m) | Estimated Maximum Indicative rock yield (m <sup>3</sup> ) |
|------------|--------------------------|------------------------|-----------------------------------------------------------|
| S1         | 0.7                      | 50x75                  | 26,500*                                                   |
| S2         | 3.0                      | 330 x 100              | 200,000*                                                  |
| S3         | 0.8                      | 130 x 60               | 34,000*                                                   |
| S4         | 0.7                      | 124 x 65               | 24,500*                                                   |
| S5         | 1.1                      | 115x150                | 54,000*                                                   |
| N1         | 1.5                      | 125*115                | 49,000*                                                   |

*\*Estimated maximum yield has been calculated by the ESH engineer with an assumed 1m of unusable overburden at each borrow pit location.*

*Source: Natural Power*

At this stage the size of potential borrow pit extents has been estimated. The exact size and geometry of the final excavation will be defined post consent with a comprehensive intrusive geotechnical site investigation.

The approximate working area (%) represents the scale of borrow pit excavation that is required to exceed the minimum yield rock fill requirements. It is assumed there would be optimisation of the borrow pit design within the confines of the identified area.

The potential excavatable volume of rock is sufficient to meet the turbines, access tracks and associated infrastructure on the site. Following further investigation, the highest rock quality locations should be taken forward pre-construction. Pending results of the intrusive investigation it is likely that the full extent or not all borrow pit locations would need to be developed in full to meet construction requirements.

### 3.2. Geological Setting

Borrow pit locations were visually inspected and selected based on an absence of deep superficial soil cover or evidence for shallow bedrock conditions. These visual assessments were made during site walkover such that locations are targeted away from areas of peatland. The depth and coverage of superficial overburden soils shall be investigated fully as part of post consent and pre-construction site investigations.

The salient bedrock geology information is provided below:

At Borrow Pit N1 The dominant bedrock geology is identified from the British Geological Survey BGS online database<sup>1</sup> to comprise the Llynfi Member Sandstone. Described as: green-grey and blue-grey, feldspathic, micaceous, lithic arenite of southerly provenance, with thin mudstone/siltstone and seatearth interbeds and mainly thin coals; the lithologies are commonly arranged in fining upwards channel-fill sequences. South from N1; the bedrock is indicated to comprise of the South Wales Upper Coal Measures Formation described as a grey (productive) coal-bearing mudstones/siltstones with seatearths and minor grey, quartz-rich sandstones, coals and ironstones. Beyond this, further south, the South Wales Middle Coal Measures Formation is seen to dominate, described as a grey, (productive) coal-bearing mudstones/siltstones, with seatearths and minor sandstones. Figures 3.7 & 3.8 depict the geological units present across the borrow pit search areas.

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<sup>1</sup> British Geological Survey (BGS) online database. Available at: <https://www.bgs.ac.uk/map-viewers/geoindex-onshore/>  
[Accessed 18/12/2023]

Source: British Geological Survey, 1:50,000 Solid Geology, © NERC 2022

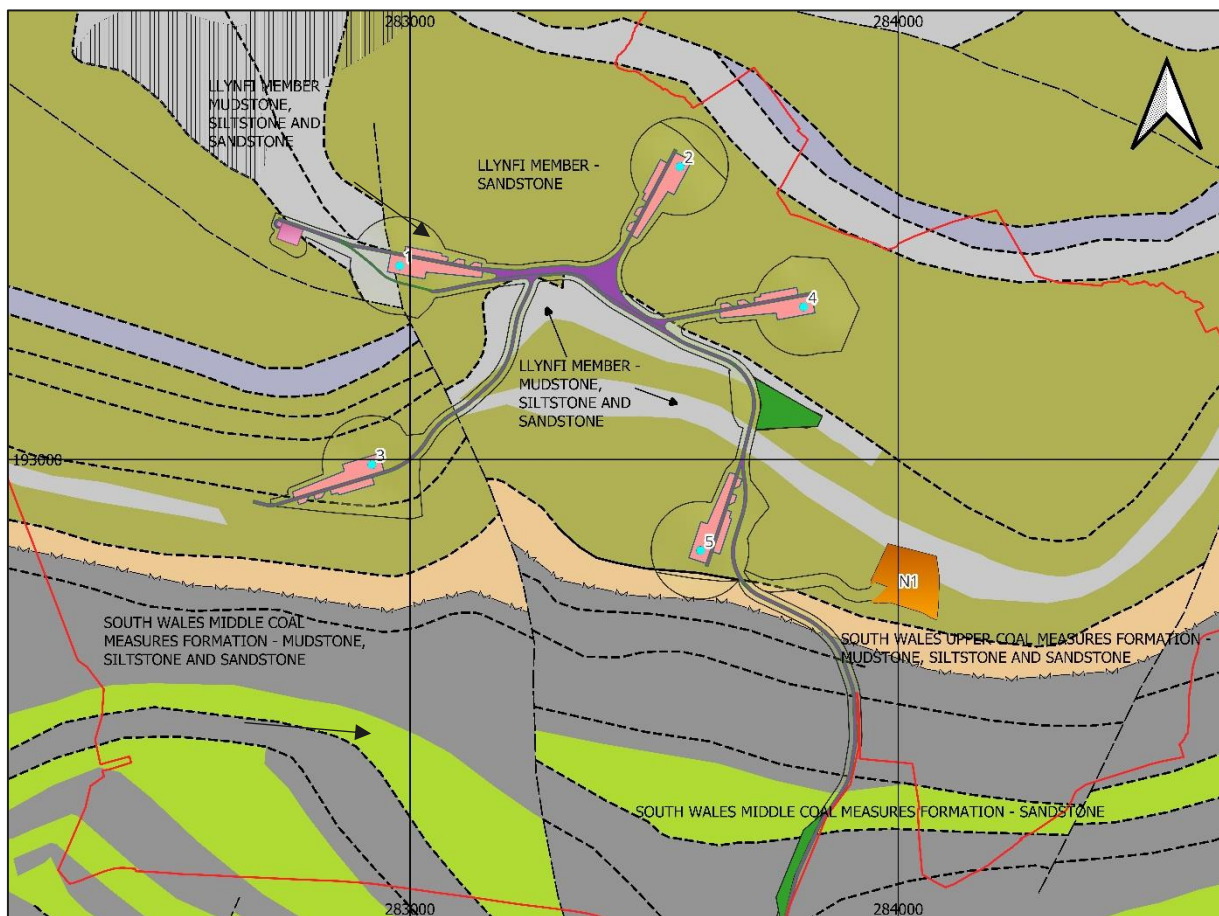


Figure 3.7: Solid Geology Map - North

Source: British Geological Survey, 1:50,000 Solid Geology

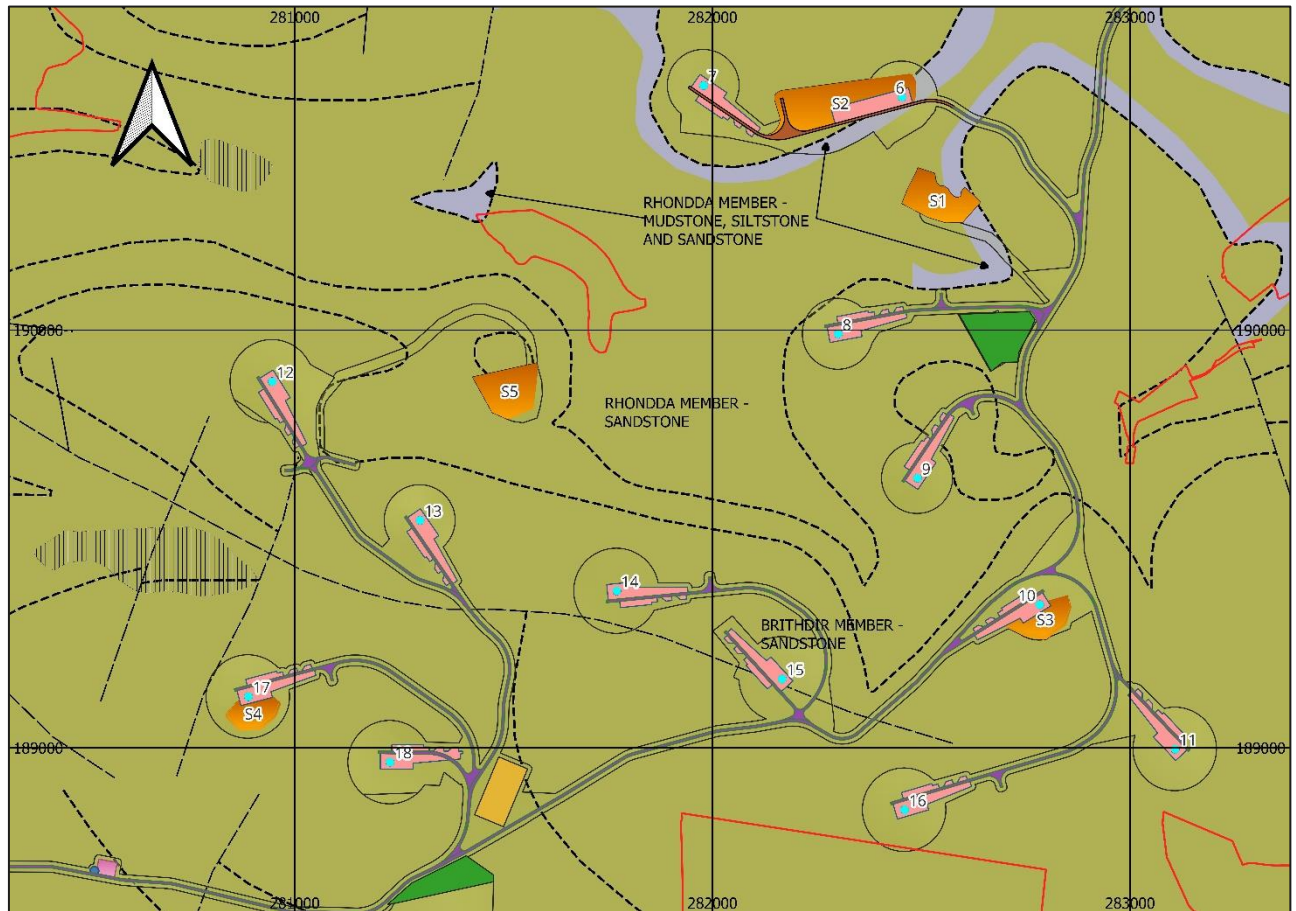


Figure 3.8: Solid Geology Map – South

A review of the engineering properties of this rock mass yields the following information: the bedrock is Mudstone and strong Sandstone (Coal Bearing) at all borrow pit locations. The Llynfi Sandstone member has been visually confirmed at N1, and is described as:

*'Medium strong to extremely strong medium to widely jointed thinly to thickly bedded fine to coarse-grained SANDSTONE; may contain slate or mudstone and siltstone beds. Weathers to a loose to very dense sand, gravel or silty/clayey sand. Low to high permeability; flow is through matrix and discontinuities. Includes GREYWACKES.'*

For the southern sector of the site the dominant Rhondda Sandstone Member (BGS indicates: S1, S2) is described by the BGS as:

*'Green-grey, lithic arenites ("Pennant sandstones") with thin mudstone/siltstone and seatearth interbeds and mainly thin coals.'*

The sub-dominant Brithdir Sandstone Member in the southern sector (BGS indicates: S3, S4, S5) is described by the BGS as:

*'Green-grey, lithic arenites ("Pennant sandstones") with conglomerate lenses at bases of units; thin mudstone/siltstone and seatearth interbeds and mainly thin coals. Age Asturian.'*

The onshore Geoindex provides a number of historic borehole logs drilled for colliery exploration, these describe the above units generally as '*Sandstone with thin conglomerates of ironstone and coal pebbles*'.

Highly weathered rock may be excavatable by hard digging. In fresher material ripping or blasting is required depending on the joint/bedding spacing and orientation. Where fresh to slightly weathered excavated slopes may maintain long-term stability.

These geological formations are considered to be suitable granular fill provided care is taken in selection and abstraction.

It would be of critical importance for any future ground investigation, to determine spacing, orientation and nature of discontinuities, and the depth and properties of weathered zone materials. From visual inspection the site wide mean overburden thickness is estimated at 0.50 m - 1.0 m.

The above geological bedrock units are classified as 'High Vulnerability, Secondary A Aquifers'. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The Cwmwernderi Reservoir is located within the south area of the site, particular care must be taken to avoid any contamination of this water supply.

From the aerial photography and site visit there was no evidence of slope instability at Borrow Pit Locations, however the onshore Geoindex shows multiple historic landslides located within the site boundary northwest of the proposed wind farm. Assessment of soil and rock slope stability will be of critical importance during future ground investigations including storage locations of overburden material.

## 4. Borrow Pit Working Methodology

A perimeter cut off drain shall be excavated 10m away from the proposed working face prior to overburden stripping. This shall reduce the surface water accumulation within the borrow pit excavation and safeguard against sediment loaded run-off.

In the event of a borrow pit extension, the upper most vegetated peat layer will be stripped from the excavation in a progressive movement up the slope as the excavation extends. Excavated soils will be placed in a bund of 0.5 m high around the site to provide a cut off for water coming down the slope to be diverted to ensure no ingress of additional water into the excavation area. The stability of peat bunds should be monitored with no storage of peat onto in-situ peat deposits. This should be reviewed by an experienced geotechnical engineer throughout the extension of the borrow pit. The bund will also provide screening to the area on the three sides whilst the excavation is taking place. The bund will have side slopes not exceeding 1:2.5 and will not exceed 0.5 m in height. This will require continued assessment. The placement area for the material will need to be assessed and confirmed as suitable for loading by a suitably experienced and qualified geotechnical engineer.

The underlying sub-soils will be removed in strips ahead of the working face and placed a minimum of 3 m back from the excavated face or if required will be stripped and stored separately in a secure area until the excavation is complete and the overburden soils can be utilised for the restoration of the borrow pit area. Any peat excavated will be stored separately from overburden.

Where possible stockpiled overburden materials would be used in re-instating the site borrow pits and tracks. It is also highlighted that spoil from other working areas such as turbine bases may also be used to achieve the restoration profile.

A suitable fence and or protection barrier will be installed around the proposed borrow pit excavation area on the slope to ensure the safety of both people working within the excavation area and anyone who may be within the proposed development area.

Where coal measures are present gas monitoring is recommended to record levels of natural ground gas. Accumulations of gas in excavations could be a potential health and safety risk where not effectively monitored and controlled. Coal Authority Permissions will be required for any extraction of shallow incidental coal seams.

#### 4.1. Extraction of Rock

The potential borrow pit locations are distributed across the proposed development to allow for phased build out of the proposed infrastructure and in order to reduce the impact of adopting one larger borrow pit excavation.

Due to the nature of the rock the excavation is likely to be achieved through ripping, hydraulic breaking and blasting. An assessment of blasting times should be undertaken to allow adequate notice of on-site vibrations. Typical pattern of blasting includes the use of drilled holes on a grid layout. A progressive system of blasting could be adopted from the borrow pit proposed entrances towards the rock face created.

All workings should conform to relevant legislations including PAN 50, the principles of The Quarries Regulations 1999, the Groundwater Regulations 1998, HSE and Environment Agency codes of practices and guidelines. The site drainage should consider any possible negative effects on site tracks and surrounding infrastructure. The reinstatement profile should complement the surrounding area.

Prior to restoration a mid-face bench may be required to ensure long term slope stability due to the horizontal and occasional sub-vertical rock mass discontinuities which may daylight the working face. The final contractor's design may require stability assessment by a geotechnical engineer as the excavation progresses. If the excavation is assessed as stable the bench widths and wall face angle can be amended to the most optimum design whilst ensuring the area is safe and stable.

Where appropriate temporary interception bunds and drainage ditches shall be constructed upslope of the borrow pit to minimise surface run-off ingress. These cut off ditches shall be of minimal length, depth and gradient, and silt traps and buffer strips shall be utilised to minimise erosion, sedimentation and peak flows. Interception bunds and drainage ditches will be monitored regularly throughout the construction works by an appointed Ecological/Environmental Clerk of Works (ECOW).

#### 4.2. Processing Loading and Haulage Operations

The rock is likely to require crushing for secondary fragmentation and screening to gain a suitable aggregate size and prevent weathered material from contaminating the site won rock. Primary

fragmentation shall be used to achieve a suitable material size. This would be utilised for direct truck loading straight to the point of use. In this way the effects of a processing plant may be minimised.

Where processing is required a mobile in borrow pit plant setup should be positioned close to the working face to allow direct loading. Load and haul methodology shall then be used to transport the stone to the required point of use.

Restoration blasting could be implemented. This includes inclined blasting at the borrow pit face edges to achieve a shallower restoration rock face profile to a maximum top slope angle of 35°. This angle shall become increasingly gentle towards the borrow pit entrance, achieving slopes of 10° – 15° typically.

Topsoil overburden from the relevant borrow pit locations would then be used to reinstate the final surface of the excavation to allow natural re-vegetation with local species. Loosened rock from the restoration blasts shall be used to partially buttress against the lower few metres of the resultant rock face to form a gentler transition with the borrow pit floor.

The reinstatement would take place immediately following completion on the borrow pit. All restoration works should be carried out to the approval of an appointed ECoW.

The geological interest of potential bedrock exposures should not be discounted. Where possible opportunities for local and national bodies with interest in the geological setting of the site should be provided with access to study and document any significant features uncovered by the borrow pit workings.

## Appendix A: Site Walkover Photographs

Source: Natural Power



Figure 4.1: Photos of Borrow Pit 'S5'

Source: Natural Power



Figure 4.2: Photos of Borrow Pit 'N1'

Source: Natural Power



Figure 4.3: Photos of Borrow Pit 'N1' Vicinity

Source: Natural Power



Figure 4.4: Steep terrain of 'N1' Vicinity with blocky scree evident at surface

Source: Natural Power



Figure 4.5: Detailed view of surface material at Borrow Pit 'N1' Vicinity

Source: Natural Power



Figure 4.6: Borrow Pit BP 'S1'



**Figure 4.7: Surface material at Borrow Pit BP 'S1'**



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