Technical Appendix 8.4 Borrow Pit Appraisal

Breezy Hill Energy Project

Brockwell Energy Limited

Prepared by:

SLR Consulting Limited

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Basis of Report

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1.0 Introduction

SLR Consulting Ltd (SLR) was commissioned by Brockwell Energy Limited, on behalf of Breezy Hill Energy Limited (the 'Applicant'), to undertake a Borrow Pit Appraisal (BPA) for the proposed Breezy Hill Energy Project (the 'Proposed Development'). The Proposed Development is located approximately 13 km south-east of Ayr, 8.5 km south-west of Cumnock and 4.5 km north of Dalmellington, within the North Kyle Forest Estate (NKF) managed by Forestry and Land Scotland (FLS).

The Proposed Development is located adjacent to the North Kyle Wind Farm. The Site falls within the East Ayrshire Council (EAC) administrative area, Site centre at British National Grid (BNG) coordinates 248092 612583, as shown on **Figure 8.4.1**.

The Applicant is proposing to submit a Section 36 application to construct a renewable energy development comprising of up to 20 wind turbines, and an on-site Battery Energy Storage System (BESS). The Proposed Development is detailed in **Environmental Impact Assessment Report (EIAR) Chapter 2 Proposed Development** and presented in **Figure 8.4.2**.

There has been substantial work undertaken to date at the Proposed Development to inform the proposed borrow pits, including site reconnaissance visits and several phases of peat probing which are detailed within **Technical Appendix TA 8.1: Peat Probing and Coring Survey Report, TA 8.2 Peat Management Plan (PMP)** and **TA 8.3: Peat Landslide and Hazard Risk Assessment (PLHRA).**

The principal objective of this report is to provide an initial assessment of the aggregate requirements for the Proposed Development and identify potential borrow pits suitable for providing this aggregate.

There are three potential search areas for borrow pits that have been identified. The proposed borrow pit search areas have been predominantly selected due to their location, where mapping indicates bedrock is likely to occur close to surface. Other factors included environmental impacts such as bedrock type, sensitive habitats and peat depth, morphology, and orientation. Limited superficial soils are expected at these locations. The borrow pit locations are located a minimum of 50 m from watercourses.

The work has been undertaken by a team of Geotechnical Engineers and Geologists, with over 17 years' consultancy experience specialising in the assessment of soils, geology and water for renewable power projects in Scotland.

2.0 Desk Based Review

This assessment has been completed through a largely desk-based review of soil and geological maps and OS contour data with Site reconnaissance undertaken by a geologist and geotechnical engineer, to cross-check the geological desk-based review.

2.1 Land Use and Topography

The Proposed Development site comprises a total area of c.1,012 hectares (ha), and is situated within the NKF, which spans around 4000 ha.

The NKF primarily features Sitka spruce and has experienced extensive opencast coal mining in recent decades. Many of the coal mines within the NKF have been abandoned, with the result that the land is scarred, derelict and unsafe in some locations.

Most of the Site is currently under forestry, some of which has been recently felled (2024). The Site is underlain by historical underground coal mine workings; consequently, there is residual mining infrastructure on the surface including a mine water reservoir or void which has become somewhat naturalised over time, referred to as the Coyle Water, and there are several mining access tracks that are used to access the Site.

The elevation of the Site varies from 245 m Above Ordnance Datum (AOD) in the north-west of the Site to 410 m AOD in the south of the Site.

2.2 Superficial Geology

BGS Onshore GeoIndex[1] 1:50,000 scale mapping indicates that much of the site is underlain by peat, and glacial till deposits, with superficial deposits absent where bedrock is expected near surface on several of the hill tops.

Figure 8.4.3 shows the superficial geology mapping and the Proposed Development.

2.3 Bedrock Geology

BGS Onshore GeoIndex Mapping indicates that the Site is predominantly underlain by a sequence of sedimentary rocks of the Scottish Coal Measures Groups and intrusive igneous rocks of the Midland Valley Carboniferous to Early Permian Alkaline Basic Sill Suite, as shown on **Figure 8.4.4**.

The Site is underlain in the centre and north by the Scottish Lower Coal Measures Formation, with a band of Scottish Middle Coal Measures Formation indicated in the south-west extent of the Site. A Carboniferous to Permian age olivine microgabbro sill is mapped in the south-west, with a small area also in the north. An analcime gabbro sill extends across the centre of the Site. There are small, isolated areas of Ayrshire Basanitic and Foidiitic Plugs and Vents present in the east. The area is also transversed by three faults with a north-west to south-east bearing.

2.4 Mining

According to The Remediation Authority (formerly Coal Authority) Interactive Map, the Site is located within a Coal Mining Reporting Area, with parts of the Site within a Development High Risk Area. There are mining features which have subsequently infilled and are shown as waterbodies within the Site. Both surface mining and probable shallow coal mine workings are identified on-site, with mine adits identified in the south.

1 BGS Online Viewer, available at: https://mapapps2.bgs.ac.uk/geoindex/home.html?

2.5 Hydrogeology

The hydrogeology of the Site comprises low productivity aquifers associated with intrusions of Western Midland Valley Sills in the centre and southern extent of the Site and moderate productivity aquifers in the north of the Site associated with Scottish Coal Measures Group, as shown on Figure 8.7. The low productivity aquifer present has small amounts of groundwater with flow through fractures and discontinuities. The moderately productive Scottish Coal Measures Group aquifer is defined by BGS as a 'Regional, cyclic multi-layered aquifer with low yields from sandstones. Higher yields where mined but poor quality water, including high iron and fluoride.'

The site is underlain by the Cumnock groundwater body (ID 150646) which is part of the Clyde sub basin district and has an overall classification of 'Poor'.

3.0 Borrow Pit Assessment

This section of the report provides an assessment of the three potential borrow pit search area locations with an evaluation of their potential to meet the Proposed Development's aggregate requirements.

The assessment has been completed through a desk-based review of geological maps and memoirs and is supported by several site visits from SLR geologists and a geotechnical engineer. Where accessible, potential borrow pit locations were inspected visually with a view to assess ground conditions and help determine the borrow pit's suitability for use during construction of the Proposed Development.

In exploring the three potential borrow pit search area locations, consideration has been given to the practical aspects of each borrow pit. The main aspects to consider are as follows:

- ease of access;
- rock type;
- overburden thickness;
- topography;
- current and historical uses;
- proximity to construction activities;
- visual impact; and
- impact on environmentally sensitive areas.

Steeper topography is preferable for quarrying, where peat and soils coverage will be limited. Careful consideration was given to landscape and visual impacts, and other considerations included proximity to watercourses and places interest. The proposed borrow pits are in areas where the peat cover is typically thinner or vacant and aggregate reserves are expected to occur near the surface.

3.1 Aggregate Requirements

The proposed turbine locations and their subsequent maintenance would require the construction of a purpose-built network of access tracks and upgrade of existing tracks where necessary. These tracks would be single track with occasional passing places, un-metalled and would be constructed to the turbine suppliers' specifications conforming to the Specification for Highway Works (SHW)[2].

The indicative volumes of aggregate required for site infrastructure are summarised in Table A and based on the materials calculator provided by the project engineers.

Table A: Aggregate Requirement Summary

Infrastructure Element	Volume of Aggregate Required (m^3)
Excavated Track	73,917
Floated Track	11,972
Turbine Foundations	7,403

2 Highways Agency, Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works, Series 600 Earthworks, Published February 2017.

Infrastructure Element	Volume of Aggregate Required (m^3)
Substation (Inc Temp, Perm, SPEN and BESS)	27,264
Hardstandings	48,580
Construction Compounds	19,500
Ancillary Aggregate	740
Contingency Aggregate	17,178
Total	**205,814**

It has been estimated that approximately 205,814 m^3 of suitable quality rock would be required to construct the Proposed Development. This includes SHW2 classes 6F2, 6N/6P and concrete aggregate. If rock quality is not suitable for each of these engineered materials, then there may be a requirement for imported materials.

No account has been taken in the calculations for the fortuitous 'winning' of rock during the construction phase for example during infrastructure excavations. If such rock was available, the amount extracted from the borrow pits could be reduced.

3.2 Borrow Pit Assessment

This section of the report provides an assessment of the three borrow pit search areas together with an evaluation of their potential to meet the Proposed Development's aggregate requirements. The Borrow pit design within each search area is detailed within **Figure 8.4.5, 8.4.6** and **8.4.7**.

All borrow pits could be extended or reduced in size depending on review of aggregate requirements and/or ground investigation data.

The geology encountered within the Proposed Development is supported by BGS geological maps for the Proposed Development. Dimensions of the borrow pits, volume of superficial material to be removed and volumes of site won rock for each borrow pit have been estimated based on cross-sections developed through a digital terrain model. These are required to be confirmed by future intrusive ground investigation works.

The calculations provided in this report assume a worst-case scenario and where no other rock or materials would be found on site during construction. In the event such rock was available the amount extracted from the borrow pits could be reduced.

3.2.1 Borrow Pit 01

Borrow Pit 01 is located in the centre of the Proposed Development, southeast of T11, at approximate BNG coordinates 248109,612760.

No suitable photographs are available due to dense forestry.

Table B: Borrow Pit 01

Borrow Pit 01	
Superficial Geology	Glacial Till – Diamicton, Sand and Gravel
Bedrock Geology	Western Midland Valley Westphalian to Early Permian Sills – Analcime-Gabbro
Inferred Design Parameters	Overall slope angle 60° Maximum face height 15 m
Gradient	Slope increasing steeply towards the north-east
Details of Extraction	Combination of digging, drilling and blasting
Estimated Excavation Area	14,500 m^2
Estimated Excavation Volume	76,500 m^3

3.2.2 Borrow Pit 02

Borrow Pit 02 is located in the centre of the Proposed Development, southwest of the BESS at approximate BNG coordinates 248514,612302.

No suitable photographs are available due to dense forestry.

Table C: Borrow Pit 02

Borrow Pit 02	
Superficial Geology	Where present, Glacial Till – Diamicton, Sand and Gravel
Bedrock Geology	Western Midland Valley Westphalian to Early Permian Sills – Analcime-Gabbro
Inferred Design Parameters	Overall slope angle 60° Maximum face height 15 m
Gradient	Slope increasing steeply towards the northeast
Details of Extraction	Combination of digging, drilling and blasting
Estimated Excavation Area	11,300 m^2
Estimated Excavation Volume	62,000 m^3

3.2.3 Borrow Pit 03

Borrow Pit 03 is located in the south-west of the Proposed Development, south of an existing forestry track at approximate BNG coordinates 246640, 611513.

Photo 1: BP03 facing south-west (02/12/2024)

Table D: Borrow Pit 03

Borrow Pit 03	
Superficial Geology	Largely absent, with glacial till on the northern extent and peat deposits to the south (within search area but outside excavation footprint)
Bedrock Geology	Western Midland Valley Westphalian to Early Permian Sills – Olivine Microgabbro
Inferred Design Parameters	Overall slope angle 60° Maximum face height 15 m
Gradient	Slope increasing steeply towards the south
Details of Extraction	Combination of digging, drilling and blasting
Estimated Excavation Area	12,200 m^2
Estimated Excavation Volume	74,000 m^3

4.0 Indicative Borrow Pit Design

The indicative borrow pit volumes are presented in Table B to Table D. The design of the borrow pits anticipates extracting a net stone volume suitable for the requirements of the Proposed Development, excluding imported top surface dressing which would require importing. This target capacity has been determined based on the estimated requirements for construction materials together with additional allowances for overburden material. It is envisaged that overburden/soils together with processed materials would be carefully stored adjacent to the excavation void for eventual use in the restoration process.

4.1 Marking Out and Overburden Stripping

The permitted extents of the borrow pit would be marked out with pegs, and overburden, including topsoil, subsoil and weathered rock horizons, would be stripped from within this delineated area.

The overburden and weathered rock horizons would be stripped using a combination of crawler tractor dozers and backtrackers with the material loaded by loading shovels. The overburden (including surface vegetation turves) would be carefully stripped and stored as a series of separate turves, topsoil, subsoil and weathered rock storage mounds to be used for reinstatement purposes.

4.2 Excavations within Rock

Once overburden and weathered rock horizons have been stripped, and stored, a suitably qualified geotechnical engineer/blasting engineer would assess the nature of the underlying solid rock strata. The engineer would provide advice on suitable extraction techniques including; extraction method, bench and cut face design parameters, and blasting design (if required).

If blasting is required, blasting would be undertaken in accordance with the Quarries Regulations 1999[3] and Annex D PAN 50[4].

A combination of digging, ripping and blasting would be utilised to excavate rock (subject to the nature of the material encountered, depth of weathering and level of fracturing) which would be processed using a mobile crushing and screening plant, which would be sited within the base of the working borrow pit.

4.3 Stockpiling of Materials

The initial overburden strip would be stored within temporary screening mounds around the perimeter of the borrow pit. The screening mounds would be at least 1.5 m in height.

The remaining unsuitable materials (weathered/unsuitable rock horizons) would be stockpiled within the base of the working borrow pit. The stockpiles would have a maximum height of 5 m, with maximum side-slope gradients of 1(Vertical (V)) in 2.5(Horizontal (H)) and be in full compliance with the Quarries Regulations 1999[3] and Quarries National Joint Advisory Committee (QNJAC) Guidelines[5]. This material would be used as part of the restoration profiling on the cut faces.

3 Health and Safety Executive (2014), Health and Safety at Quarries, Quarries Regulations 1999, Approved Code of Practice and Guidance (Second Edition).

4 Scottish Government (2000), PAN 50 Annex D: Controlling the Environmental Effects of Surface Mineral Works.

5 Quarries National Joint Advisory Committee (2020), Available at: http://qnjac.co.uk/what-is-qnjac/. Last accessed April 2020.

4.4 Access Tracks/Haulage Routes

The proposed access tracks to the borrow pit(s) would include suitable roadside drainage ditches, with soakaways located, where appropriate.

The tracks (haulage routes) within the borrow pit(s) would have a gradient of no steeper than 1(V) in 10(H).

4.5 Water Management/Drainage

The borrow pit(s) would feature a perimeter surface drain, which would aim to prevent water in-flow into the borrow pit. The water collected within the surface drains would be discharged either into the surrounding vegetation, or into suitably located settlement lagoons.

Where necessary, surface settlement lagoons would be constructed within the borrow pit. These would be constructed with the aim of containing any surface water collection within the excavation voids, and from collection of water from the perimeter surface drains. The lagoons would be contained within a bunded area at the base of the borrow pit, with suitable pumping systems installed allowing water to be pumped to soakaways as required.

4.6 Restoration

When considering the borrow pit excavations the principles of the relevant guidance[6,7] of the re-use of excavated peat and the minimisation of waste have been consulted. This guidance states that across the borrow pit areas, peaty soils may be used at depths of up to 0.5 m as part of the borrow pits' reinstatement works. The final configuration of the borrow pits shall allow retention of rainfall and promote the infiltration of this to the peat and peaty soils used to restore the borrow pits which will prevent peat drying out. Surface vegetation and acrotelmic peat layers, safeguarded from parts of the site where peaty soils and peat are excavated will be used to restore surface of the borrow pits and prevent erosion.

The formulation of a detailed construction method statement undertaken pre-construction shall incorporate construction design and sequencing for the proposed restoration of borrow pit areas. These plans shall draw on detailed site investigation information gathered as part of the preconstruction phase of works. The final design of borrow pit floor levels and restoration profiles shall depend on the depth of superficial deposits and the quality of rock recorded across the proposed borrow pit locations.

The aim of the restoration of borrow pits is to achieve a self-sustaining hydrological system that retains the carbon stored within the peat deposits. The geometry of the borrow pit shall be such that retention of shallow groundwater once restored will prevent the peat drying out. This could be achieved by the excavation and/or formation of impervious bunds or by combining the two approaches. Bunds should be constructed with stone as peat cannot stick to mineral to retain basal peat. Bunds should be approximately 30 m cells or smaller to increase residence times of water within the borrow pit. A further key requirement will be to maintain a source of water to the restoration area to allow for suitable hydrological conditions to develop. The existing peatland within the area is largely fed by ombrotrophic (rain-fed) from rainfall rather than ground-water sources and this should be sufficient to keep the reinstated peat wet.

An assessment of the water level/depth to saturated peat in the borrow pit will be recorded quarterly and reported annually for a period of five years, following placement of peat. This

6 NatureScot (July 2024), Good Practice During Wind Farm Construction.

7 Scottish Renewables, Scottish Environment Protection Agency. 2012. Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste

could be recorded by inserting a peat probe at a number of locations across the restoration surface or by establishing a small network of hand driven dip wells where it is safe to do so. In addition, annually for a period of five years, following placement of peat:

- the edge of the peat would be inspected to assess for potential loss of water; and
- evidence of drying (e.g. surface cracking and /or erosion) would be assessed and reported.

Should the monitoring data suggest the peat is drying, mitigation measures would be agreed with SEPA and NatureScot.

Full details of restoration would be determined following pre-construction ground investigation work and detailed borrow pit design.

5.0 Conclusion

In summary, three borrow pit search areas have been assessed as being capable of supplying all the aggregate required for the Proposed Development. The locations and methods of working would be managed to cause minimal impact to the ground conditions and water environment. The borrow pit design and recommended methods of operation are in line with the Quarries Regulations, Approved Code of Practice, 1999 (as amended)[8] to provide a safe working environment and minimise risk of instability.

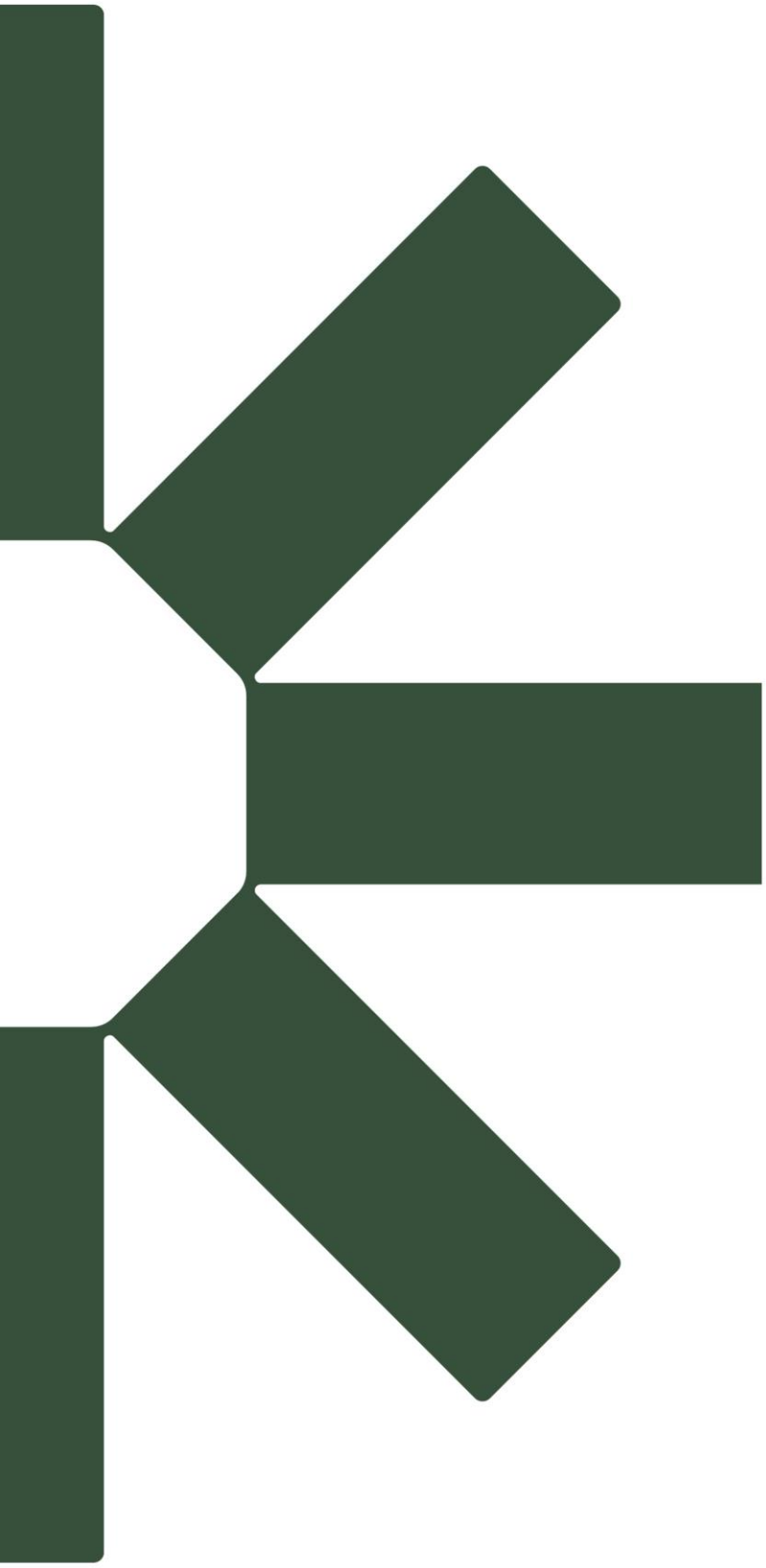
An approximate volume of excavated materials has been calculated for each of the proposed borrow pit locations within the borrow pit search areas, these volumes are based on initial calculations based on assumptions for the Proposed Development. These calculations would be verified by detailed intrusive investigation at the proposed locations, post-consent. Calculations do not take into consideration the 'winning' of materials along the route. Each of the proposed borrow pits selected could be increased or decreased in size, depending on the aggregate requirements or following an assessment of the suitability of aggregate materials following detailed ground investigation.

The quality of rock anticipated on-site is inferred from a visual assessment of rock outcrops and published information. An intrusive ground investigation, sampling and material laboratory testing will be required to confirm ground condition and suitability.

Prior to the construction of the Proposed Development, design and best practices, and any required mitigation measures, will be set out in full within a Construction Environmental Management Plan (CEMP) and can be secured by an appropriately worded pre-development planning condition.

8 Health and Safety Executive (2014), Health and Safety at Quarries, Quarries Regulations 1999, Approved Code of Practice and Guidance (Second Edition).

Figures



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