TALLADH A BHEITHE WIND FARM

BORROW PIT SEARCH REPORT (APPENDIX 4.1)

Report: 1038564

Author: Gavin Germaine

Issued: 17/06/2014

Natural Power Consultants Ltd
The Green House, Forrest Estate
Dalry, Castle Douglas
DG7 3XS
SCOTLAND UK

Tel +44 (0) 1644 430 008

Client:
Eventus BV
P/a Aaltenseweg 17
7255 PG Hengelo Gld
The Netherlands

Report: 1038564

Talladh-a-Bheithe Wind Farm: Borrow Pit Search Report

Author:	Gavin Germaine	13/07/2013
Checked By:	Ade Richards	15/07/2014
Approved By:	Gavin Germaine	17/06/2014

Classification: COMMERCIAL IN CONFIDENCE

Distribution: NPC Internal, Eventus BV

Revision Table

Issue:	Date:	Revision Details:
A1	August 2013	First Issue
B	June 2014	Final Issue

TABLE OF CONTENTS

1. INTRODUCTION

NPC has produced this summary document to advise on the potential location of borrow pit areas within the proposed development of Talladh-a-Bheithe Wind Farm (hereafter referred to as the Development).

The Development is located approximately 42km to the west of Pitlochry and approximately 25km south of Dalwhinnie, within the Perth & Kinross region of Scotland, UK. The proposed development comprises twenty five Wind Turbine Generators (WTG's), crane hard standing, access tracks, temporary construction compound and potential borrow pit areas. The indicative wind farm infrastructure is presented within the Environmental Statement.

A total of four borrow pit search areas have been identified within the Development. Search areas have been selected following a detailed ground condition walkover survey. This work was undertaken simultaneously with detailed peat survey and stability assessments. The Peat Stability Assessment Report for the Development is reported separately and appended to the Environmental Statement (Ref: 1035483).

1.1. Ground Condition Survey

In order to fully understand the ground conditions and geological setting of the site; an in-depth walkover survey was undertaken by a senior geotechnical engineer. This comprised a walkover ground condition survey of the proposed wind farm infrastructure locations, including turbine locations and access tracks. During this survey a variety of parameters were assessed using visual examination and non-intrusive survey methods at potential borrow pit search areas:

- Geomorphological Mapping – identification of terrain feature, slope morphology, hydrology and bedrock exposure;
- Slope analysis, including determination of slope angle and aspect using sighting compass and inclinometer;
- Inspection of rock mass exposure, geological hammer & index testing carried out to determine relative strength index;
- Recording of rock discontinuities (fractures & joints) where possible;

Four potential borrow pit areas were selected based on evidence for shallow bedrock profiles, areas of least hydrological significance and lower peat slide risk. Consideration for the logistics of constructing the wind farm are also factored into the assessment, with multiple locations of potentially smaller extent required across the proposed infrastructure versus one larger borrow pit location. It was assumed that the construction of the proposed wind farm would taken place in phases and built out from the pre-existing estate access track.

1.1.1. Geology

The 1:50,000 scale BGS data indicates the development to be underlain by the bedrock from the Grampian Group Psammite. This is a 'metamorphic bedrock sequence described by the BGS as locally arkosic, quartzofeldspathic psammite in units 100 – 1000m thick'. The rock mass may contain subsidiary semi-pelite to pelite units (mudrock derived meta-sediments). Quartzite units occur locally towards the top of the succession. Amphibolite and calc-silicate rocks are rare. There are also rare and linear outcrops of the 'Etive Dyke Swarm' which is a Siluro-Devonian age igneous intrusive rock of

porphyritic micro-diorite. Further small scale intrusions of the 'North Britain Siluro-Devonian Dyke Suite' also rarely predicted to sub-crop beneath the site. These are described as calc-alkaline lamprophyres (ultra-mafic rock). These amphibolites and calc-silicate rocks are described by the BGS as rare.

The potential borrow pit search areas are situated within the predominant geological terrain of the Grampian Group Psammite. A cursory examination of this rock unit at field outcrop scale has revealed a medium strong rock mass occasionally weak and moderately weathered which is intersected by closely to medium spaced sub-horizontal to sub-vertical discontinuities. These represent fractures and jointing within the rock mass. It may be possible to take advantage of such discontinuity sets in order to facilitate ripping and mechanical excavation of the rock mass.

A detailed site investigation should be carried out post consent to confirm the depth of the bedrock profile and rock mass quality across each proposed borrow pit search area. Specific geotechnical materials testing will be required to confirm the compressive strength of the rock mass and aggregate suitability. Additional testing should also be carried out to assess the suitability for use of the rock aggregate in concrete batching.

1.2. Required Rock Volumes

An initial estimate of required rock volumes has been prepared to provide an indication of the scale of rock extraction required as part of the Development. The following assumptions have been taken in order to calculate the indicative rock fill requirements:

- Construction of new cut and replace access tracks requires 4.5m^3 of rock fill per linear metre;
- Construction of new floating access track requires 10m^3 of rock fill per linear metre;
- Construction of upgraded cut access track sections requires 2m^3 of rock fill per linear metre;
- Rock fill requirements for crane hardstand areas is calculated by an assumed area of 1,500m^2 multiplied by the mean peat depth across each turbine location.
- Rock fill requirements for the temporary construction compound are based on a 20,000m^2 area multiplied by the mean peat depth across this proposed area.
- The calculated total volume of indicative rock fill is increased by a factor of 25% in order to provide a minimum yield volume for on-site borrow pits.

The indicative required rock volumes are detailed below in Table 1.2.1 below. Additionally the required working areas are estimated based on the rock fill requirement estimate.

Table 1.2.1: Indicative Rock Fill Volume Requirements – Talladh-a-Bheithe Wind Farm

Infrastructure Element	Total Volume of Rock Fill
New 'Cut' Access Tracks	52,300.00m^3
New Floating Access Tracks	50,000.00m^3
New Upgrade Access Tracks	TBC
Crane Hardstand Areas	30,000m^3
Temporary Construction Compound	14,000m^3
Total Rock Fill Requirements	146,300.00m^3
Indicative Minimum Yield	**183,000.00m^{3*}**

*The indicative minimum yield does not allow for rock materials won in the cut & fill operations of access track construction which may provide additional rock resource to borrow pits; nor does the

minimum yield allow for aggregate requirements of on-site concrete batching for foundations and sub-structures.

Table 1.2.2: Borrow Pit Estimated Factored Rock Aggregate Total Volume

Borrow Pit	Search Area (Ha)	Required Rock Yield)** (m^3)	Mean Peat Depth (m)	Indicative Working Area (Ha)*	% Indicative Working Area of Search Area
BPA	3.5 Ha	50,000m^3	0.4	1.3Ha	37%
BPB	8.1 Ha	50,000m^3	0.7	1.3Ha	16%
BPC	6.5 Ha	50,000m^3	0.6	1.3Ha	20%
BPD	8.9 Ha	50,000m^3	0.5	1.3Ha	15%

*assuming a maximum 1.5m of superficial overburden including glacial till acknowledging uncertainty here; also assumes 5m excavation depth into bedrock with borrow pit excavation sides benched with a projected batter angle of 45°.
**Assuming total rock fill requirements of 200,000m^3 based on the estimates calculated in Table 1.2.1

The potential borrow pit search areas are indicated on Figure 4.1 Site Layout, within the Environmental Statement. Table 1.2.3 below provides a geo-reference to the centre of each potential borrow pit location.

Table 1.2.3: Potential Borrow Pit Search Areas – Geo-reference

Borrow Pit	Easting (Centre of Location)	Northing (Centre of Location)
BPA	251827	763015
BPB	252189	762664
BPC	255386	763495
BPD	254341	762996

1.3. Example Borrow Pit Working Method

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.

The upper most vegetated peat layer shall be stripped from the excavation in a progressive movement up the slope as the excavation extends. The peat shall be placed in a bund of 0.5m 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 deeper than 0.5m. This should be reviewed by an experienced geotechnical engineer throughout the development of the borrow pit. The bund shall also provide screening to the area on the three sides whilst the excavation is taking place. The bund shall have side slopes not exceeding 1:25 and shall not exceed 2m in height. This shall require continued assessment. The placement area for the material shall need to be assessed and confirmed as suitable for loading by a suitably experience and qualified geotechnical engineer.

The underlying sub-soils shall be removed in strips ahead of the working face and placed a minimum of 3m back from the excavated face or if required shall 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 shall 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 shall 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 Development area. Full details shall be provided as part of the detailed Construction Method Statement.

1.4. Primary Fragmentation – Extraction of Pay Rock

This 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 possible 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 entrance 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 Scottish Environment Protection Agency (SEPA) codes of practices and guidelines. The site drainage should take into account any possible negative impacts on site tracks and surrounding infrastructure. The reinstatement profile should complement the surrounding area.

The observed rock at the site should allow a wall face of 70˚ angle with working face of maximum 10m in height. 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 contractors' 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.
Once the rock material has been excavated forming a working face the pit can be extended by continued advancing face excavation. This would usually be at approximately 70 degrees to the horizontal to maintain a stable working face whilst maximising rock recovery. This angle may need to be changed if unstable rock is encountered or alternatively if the rock is of good stability and the face can be made steeper.

Rainfall, surface and groundwater ingress shall be contained in a temporary sump situated in the lowest floor level of the excavation. A pit floor gradient not exceeding 1:100 shall be used to direct accumulated water to this point. At the sump, an oil interceptor shall be installed at the overflow. Excess water would require continuous pumping from the sump silt trap area into a settlement lagoon with a suitable sediment trap prior to discharging to an agreed location. A SEPA discharge consent should be sought with respect to this element of the borrow pit development. All on site

surface water discharges from excavations should be undertaken with a suitable SEPA discharge license and carried out in an environmentally compliant manner.

1.5. Processing, Load & Haul Operations

The rock is likely to require crushing for secondary fragmentation and screening to gain a suitable aggregate size and prevent weathered material from sterilizing the pay 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 impacts 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 & haul methodology shall then be used to transport the stone to the required point of use.

1.6. Reinstatement Proposal

The proposed borrow pit reinstatement would be to generate a rough vegetated slope profile grading into the existing ground level of the surrounding terrain. The borrow pit faces would be reinstated to blend with the existing topography. The re-instated profile shall be at an acceptable level with as minimal change as possible from the existing profile using materials produced from on-site excavations leaving no more than 2m “sub-vertical” exposed rock faces visible around the margins.

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 35^0. This angle shall become increasingly gentle towards the borrow pit entrance, typically achieving slopes of 10^0 - 15^0.

Peat and 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 vegetation. 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 more gentle transition with the borrow pit floor.

The reinstatement may not take place immediately following completion on the borrow pit but this should be completed within the construction period of the wind farm. All restoration works should be carried out to the approval of an appointed Ecological Clerk of Works (ECoW).

REFERENCES

The Institute of Quarrying http://www.quarrying.org/a.html

The Scottish Government. PAN 50 Annex D: Controlling the Environmental Effects of Surface Mineral Workings. February 2000.