# APPENDIX 11.2: BORROW PIT SEARCH REPORT

## Executive Summary

As part of the wider geological studies and peat assessments undertaken for the proposed development, four potential borrow pit areas have been identified for the site. The general findings of the original submission have not changed significantly, the siting of original borrow pit locations is considered in the wider assessments within this EIA Report. However central to the search for potential borrow pits are the hydrological, hydrogeological and are interconnected environmental sensitivities discussed in Chapter 11, to accommodate potential issues identified during scoping. Rock fill requirements have been indicated based on the proposed scale of construction, taking into account key assumptions on the design of the wind farm infrastructure (Chapter 5 of EIA Report). Finally, it is highlighted that the precise design, location and working areas of borrow pits across the site would be determined following detailed intrusive geotechnical site investigation carried out during the post consent phase.

## 1.1 Introduction

1.1.1 A total of four borrow pit workings have been identified within the proposed development. The working areas have been selected following a detailed engineering ground condition walkover survey. This work has been undertaken in conjunction with peat stability assessment and peat condition surveys. Full details are reported within Chapter 11 (Geology, Soils and Hydrogeology). The assessment has been further reviewed and updated to meet the requirements of the slightly modified layout.

## 1.1 Scope of Assessment

### *Study Area*

1.1.1 The proposed development is located in Argyll, approximately 8km north of Campbeltown. The site is located within an upland moorland terrain setting which transitions to commercial forestry plantation. The study area extends across the existing wind farm, extending into the commercial forestry plantation to the north. Chapter 5 (Description of Development) and Figure 11.5 depicts the location of borrow pit search and working areas in relation to the site. The solid bedrock geology is included for completeness (source BGS).

**Table 1 Geo-referenced borrow pit locations.**

| Borrow Pit ID | Easting | Northing |
|---|---|---|
| BPA | 168376 | 628342 |
| BPB | 167824 | 628102 |
| BPC | 167066 | 629148 |
| BPE | 168876 | 628658 |
| Note: Borrow Pit D was removed from the layout design during layout design optimisation | | |

## 1.2 Scoping and Consultation

1.2.1 The EIA scoping report for the proposed development states the "disturbance of hydrogeological conditions during excavation of borrow pits has the potential to affect habitats that depend on shallow groundwater." The assessment has therefore placed hydrogeology as a primary consideration.

1.2.2 Recent Scoping Opinion (October 2017) has reiterated that Borrow Pit C has the potential to impact upon a Private Water Supply (PWS). This has been addressed in Chapter 11 and further investigation will be required to mitigate risk.

### *Engineering Ground Condition Survey*

1.2.3 In order to fully understand the ground conditions and geological setting of the site; a comprehensive walkover survey has been undertaken by Natural Power. This survey comprised a walkover ground condition survey of the wind farm study, including proposed wind turbine locations and supporting infrastructure locations. During this survey a variety of parameters have been assessed through visual examination and the following non- intrusive survey techniques:

- Geomorphological mapping and terrain feature identification – terrain aspect, slope morphology, hydrology and bedrock geological conditions (rock exposures);
- slope analysis – including determination of slope angle and aspect through a sighting compass and inclinometer; and

rock mass assessment – where limited exposures are evident, undertaking inspection with geological hammer, performing index tests to assess relative strength (the notable absence of extensive rock outcrop on-site has limited this aspect of the survey).

1.2.4 In the absence of any extensive rock exposure, a total of four potential borrow pit areas have been selected. This is primarily based on the following rationale:

1.2.5 **Location BPA** as shown on Figure 11.9 is situated on the lower south slope of Cnocain Gean and would be adjacent to the proposed wind turbine T4. The location has been identified as representing a position into which steepening terrain can be utilised for the borrow pit excavation. This may allow for a smaller overall borrow pit excavation and impact compared to surrounding lower angle terrain. This area was used as the borrow pit during construction of the existing Tangy I and II wind farm. Figure 11.9 depicts the indicative working area and cross-sectional profile.

1.2.6 **Location BPB** is an area of agricultural pasture immediately south of proposed turbine T2. The location has been identified as representing a position into which steepening terrain can be utilised for the borrow pit excavation. This may allow for a smaller overall borrow pit excavation and impact compared to lower angle terrain surrounding this area. Figure 11.10 depicts the indicative working area and cross-sectional profile.

1.2.7 **Location BPC** is a forested area on the eastern perimeter of the site. The location has been identified as an area of probable shallow bedrock that can be used for borrow-pit excavation. There is a likely relatively thin layer of superficial geology which may allow for efficient access to the bedrock. This has been inferred from a shallow depth of peat recorded across this location. Figure 11.11 depicts the indicative working area and cross-sectional profile.

1.2.8 **Location BPE** is situated on the south-eastern edge of the commercial forestry plantation and across semi-improved grassland. This location would be immediately adjacent to the proposed wind turbine T1. The location has been identified as representing a position into which moderately steepening terrain can be utilised for the borrow pit excavation. This may allow for a smaller overall borrow pit excavation and impact compared to lower angle terrain. Figure 11.12 depicts the indicative working area and cross-sectional profile.

1.2.9 Consideration of the construction logistics have been factored into the location rationale. A strategy has been taken where multiple smaller scale borrow pit excavations are preferred over a single large location. The latter may have a greater environmental and visual impact.

1.2.10 It has been assumed that the construction of the proposed development will progress in phases, building out from the existing operational wind farm infrastructure. The final location and design of the proposed borrow pit working areas will need to be established following detailed intrusive site investigation. This phase of works is only generally undertaken post consent and as part of the pre-construction phase of works. It is therefore accepted that the initial indicated potential borrow-pit search areas depicted in Chapter 4 of the EIA Report represent larger areas than the likely final working areas which are included on the figure to indicate the staged process.

1.2.11 Volumetric analysis using Autocad Civil3D software has been undertaken for each potential location. Setting initial parameters, and, estimates for required rock volumes the indicative working areas and excavation profiles have been established for each location in Figures 11.9-11.12. These indicative designs are based on the following assumptions:

- Acknowledging some uncertainty as to the depth of superficial deposits, it has been assumed that the uppermost 1.5m of the ground profile will be stripped from each location and managed as part of the dedicated peat management and construction planning. This assumption will be refined, and final restoration profiles shall be determined following intrusive ground investigation;
- Rock cut faces do not exceed 80 degrees inclination;
- Rock cut faces do not exceed 10m height without horizontal bench of 5m;
- The floor of the borrow pit shall slope away from the working face at a grade of 1 in 100;
- The indicative restoration ground profile has been established based on an undulating slope of 10-15 degrees leaving no more than 2m exposed rock faces visible around the margins of the working area. The restoration profile is purely indicative and will be dictated by the encountered depth of superficial overburden soils and the geotechnical suitability of this material as backfill. The depth of sub-soil overburden will be determined as part of intrusive ground investigation;
- In line with the Peat Management Plan (Appendix 11.3); it is assumed that initial backfilling would be completed using superficial overburden glacial sub-soils. This material would be used to raise the base of the borrow pit to an adequate level and geometry onto which peat can be placed to achieve a final restoration profile; and
- Peat material used for restoration backfill purposes will be placed to ensure the retention of the two layered acrotelm and catotelm structure. Therefore, the vegetation supporting acrotelm will be used for the final restoration profiling at surface. Separated catotelm material where suitable may be used for deeper restoration backfill providing stability criteria are satisfied. Slope stability of the borrow pits will be verified by a suitable qualified geotechnical engineer.

## 1.3 Geological Setting

1.3.1 A detailed review of the geological conditions present beneath the site is presented within Chapter 11 (Geology, Soils and Hydrogeology). A summary of the salient bedrock geology units is provided below.

*1.3.2* The bedrock geology is understood to be comprised of the Stonefield Schist Formation on the western area of the site. According to the British Geological Society (BGS) this is a *"metamorphic bedrock formed approximately 542 to 1000 million years ago in the period. Originally sedimentary rocks. Later altered by low-grade metamorphism."*

1.3.3 The eastern area of the site consists of the Glen Sluan Schist Formation. The BGS describes this formation as "metamorphic bedrock approximately 542 to 1000 million years ago in the period. Originally sedimentary rocks formed in deep seas. Later altered by low-grade metamorphism."

*1.3.4* The central region of the site has two bedrock formations running in bands in a north- west/south-east direction. The eastern band is the Loch Tay Limestone Formation. The BGS describe this formation as a *"metamorphic bedrock formed approximately 542 to 1000 million years ago in shallow carbonate seas. Later altered by low-grade metamorphism."*

The western band is the Neoproterozoic Basic Minor Intrusion Suite. The BGS describes this formation as a *"metamorphic bedrock formed approximately 542 to 1000 million years ago in the period."*

Table 2 below reviews the anticipated bedrock units beneath each potential borrow pit location.

**Table 2: Anticipated Bedrock Units at Potential Borrow Pit Locations**[1]

| Borrow Pit ID | Geological Unit | Indicative Lithological Description |
|---|---|---|
| BPA | Loch Tay Limestone Formation (western limit of BP area).<br><br>Amphibolite & Hornblende Schist (eastern and central parts of BP area). | Schistose calcareous psammite and semipelite with units of blue-grey crystalline meta-carbonate rock up to 10m thick.<br>Basic crystalline schistose bedrock units of amphibolite and hornblende schist. Amphibolite is crystalloblastic and commonly foliated metamorphic rock. Its grain size may be variable and protolith (parent rock) may be undefined. 35- 90% mafic minerals, hornblende and plagioclase dominant with assemblages of garnet, biotite and quartz. |
| BPB | Amphibolite & Hornblende Schist (eastern and central parts of BP area.) | Basic crystalline schistose bedrock units of amphibolite and hornblende schist. Amphibolite is crystalloblastic and commonly foliated metamorphic rock. Its grain size may be variable and protolith (parent rock) may be undefined. 35- 90% mafic minerals, hornblende and plagioclase dominant with assemblages of garnet, biotite and quartz. |
| BPC | Stonefield Schist Formation (Entire BP area). | Mineralogy undefined. Schistose rock units are commonly foliated metamorphic rock units.<br>Medium grade metamorphic rock understood to be derived from marine sedimentary rocks. Psammitic and pelitic compositions are common. |
| BPE | Glen Sluan Schist Formation. | Mineralogy undefined. Schistose rock units are commonly foliated metamorphic rock units.<br>Medium grade metamorphic rock understood to be derived from marine sedimentary rocks. Psammitic and pelitic compositions are common. |

1.3.5 A small number of bedrock outcrops were observed at discrete locations across the development. A small series of outcrops are visible along the banks of the Allt nan Creamh river in the northern areas of the proposed development. Other areas with bedrock outcrops are the steep slopes west of Tangy Loch on the eastern perimeter (T6 and BPE). These rock outcrops reveal a weak to medium strong rock mass.

1.3.6 No obvious bedrock exposures have been identified within the centre of the site. It is postulated that there is likely to be an increased thickness of superficial deposits across this central area. A selection of photos depicting borrow pit areas and mode of bedrock exposure encountered at discrete points are included below:

**Photo: Borrow Pit A – Hornblende Schist Derived Boulder at Surface:**

**Photo: View North within BPC Area (Inferred Shallow Bedrock Profile):**

**Photo: Rock Exposure at Surface Identified Within BPD**

**Photo: BPE View West of Slope Geometry**

**Photo: Limited Exposure of Bedrock (Glen Sluan Schist) BPE**

## 1.4 Required Rock Volumes

1.4.1 An initial estimate of required rock volumes has been prepared in order to provide an overall indication of the scale of on-site rock extraction required as part of the proposed development. Table 3 below summarises the assumptions and calculations.

**Table 3: Indicative Rock Fill Volumes**

| Infrastructure | | Material Requirements<br>Note: red = imported material, black = won on-site | |
|---|---|---|---|
| | | Volume Calc Assumptions | Indicative Required Rock Volume to nearest 50m$^3$ |
| Hard standing | Dimensions vary considerably and depend on turbine manufacturer specification. Allowance is for assumed 1,750m$^2$ area per turbine Figure 5.3. | Hard standings designed to provide a cut / fill balance to avoid hauling materials. A maximum of 0.8m of fill has therefore been assumed. | 22,400m$^3$ |
| | | Capping material required across base (estimated 370m$^3$ necessary per turbine / hard standing – obtained from borrow pit). | 5,900m$^3$ |
| Turbine Foundations 16No. | Each concrete turbine base (circular) assumed 20m diameter. | Each base needs 550m$^3$ of concrete. This requires: 176 tonnes of cement (16 turbines =2,816)<br>660 tonnes of gravel (16 turbines =10,560)<br>330 tonnes of sand (16 turbines = 5,280). | 8,800m$^3$ concrete or 18,656 tonnes of components |
| | | 70 tonnes of steel reinforcing per turbine. | 1,120 tonnes |
| New 'Cut' Access Tracks | Assumed 8.6m permanent width (6.0m running surface and 0.5m verges, 1.6m drain) Figure 5.4.<br>5,474m total length | 0.5m assumed track fill depth construction approximated to trapezoid cross-section with 1:1 slopes). | 30,100m$^3$ |
| | | 0.2m depth capping material over 6m running surface (track fill construction approximated trapezoid cross-section with 1:1 slopes). | 10,000m$^3$ |
| New 'Float' Track | Assumed 7.7m permanent width (6.0m running surface, 0.5m verges, 0.7m drain) Figure 5.4.<br>1,985m total length | Assume 0.6m depth of track fill approximated to trapezoid cross section with 1:1 slopes). | 13,200m$^3$ |
| | | 0.2m depth capping material over 6m running surface (track fill construction approximated trapezoid cross-section with 1:1 slopes). | 3,650m$^3$ |
| Existing tracks to be upgraded and retained | Assume existing approximately 3.0m wide.<br>Final construction assumed permanent 8.6m width (6.0m running surface and 0.5m verges, 1.6m drain) Figure 5.4.<br>3,565m total length | Site wider 0.7m mean peat depth (track fill construction approximated to trapezoid cross-section with 1:1 slopes). | 16,700m$^3$ |
| | | 0.2m depth capping material (track fill construction approximated over the full 6m running surface). | 4,400m$^3$ |

| **Infrastructure** | | **Material Requirements**<br>**Note: red = imported material, black = won on-site** | |
|---|---|---|---|
| | | **Volume Calc Assumptions** | **Indicative Required Rock Volume to nearest 50$m^3$** |
| Existing Forestry Track to be upgraded | Assume existing approximately 3.0m wide.<br>Final construction assumed permanent 8.6m width (6.0m running surface and 0.5m verges, 1.6m drain) Figure 5.4.<br>492m total length | Site wide 0.7m mean peat depth (track fill construction approximated to trapezoid cross-section with 1:1 slopes). | 2,300$m^3$ |
| | | 0.2m depth capping material (track fill construction approximated over the full 6m running surface). | 600$m^3$ |
| 4x4 Passing Places | 4x4 passing places every 200m over track length of 11,024m (55 passing places) at 15m x 3m plus 60$m^2$ splay at each location as per Chapter 5. | Assumed track fill equal to site wide mean peat depth of 0.7m rock fill volume determined for total passing place area. | 4,050$m^3$ |
| | | 0.2m depth capping material, volume determined for total passing place area. | 1,150$m^3$ |
| Turbine Transport Passing Places | Assumed 3 turbine passing places on whole site at 50 x 4m plus 220$m^2$ splay for each location as per Chapter 5. | Assumed track fill equal to site wide mean peat depth of 0.7m rock fill volume determined for total passing place area. | 900$m^3$ |
| | | 0.2m depth capping material, volume determined for total passing place area. | 150$m^3$ |
| New Substation | 1 new substation assumed at 40 x 65m as per Figure 5.5 | 0.50m mean peat depth - 0.2m depth of capping material. | 1,750$m^3$ |
| x1 Compounds | Assumed 100 x 100m as per EIA Report Chapter 5 | 0.25m mean peat depth – 0.2m depth of capping material. | 4,500$m^3$ |
| x1 Laydown Area | Assumed 100 x 100m as per Chapter 5 | 0.55m mean peat depth – 0.2m depth of capping material. | 7,500$m^3$ |
| x1 Operations Building | Assumed compound dimensions 26x36m as per Figure 5.10c | 0.4m mean peat depth – 0.2m depth of capping material. | 550$m^3$ |
| X 3 Met Masts | 10x10m base plus 600$m^2$ crane hard stand at each location. | 0.3m mean peat depth – 0.2m depth of capping material. | 1,050$m^3$ |
| x4 Borrow Pits | Areas calculated using AutoCAD Civil 3D.<br>Borrow pit A- 11,900$m^2$.<br>Borrow pit B-19,150$m^2$.<br>Borrow pit C-$m^2$. 20,000$m^2$<br>Borrow pit E-$m^2$. 19,550$m^2$ | NA | NA |

<table>
<tr><th colspan="2" rowspan="2">Infrastructure</th><th colspan="2">Material Requirements<br>Note: red = imported material, black = won on-site</th></tr>
<tr><th>Volume Calc Assumptions</th><th>Indicative Required Rock Volume to nearest 50m³</th></tr>
<tr><td>23 Existing Hard standings</td><td colspan="2">Approximately 800m² per hard standing assuming 0.4m depth of fill present for re-use.<br>Approximately 2,135m of existing access tracks, assuming 3m width and 0.4m depth of fill present for re-use.</td><td>9,900m³</td></tr>
<tr><td colspan="4">Total Available Rock Fill Reclaimed from Reinstatement Areas: 9,900m³</td></tr>
<tr><td colspan="4">Total Required Rock Volume from On Site Borrow Pit Locations: 130,850m³</td></tr>
<tr><td colspan="4">Minimum Rock Volume Yield: 151,000m³</td></tr>
<tr><td colspan="4">Imported Construction Components: 18,656 tonnes (concrete components), 1,120 tonnes (reinforcing steel)</td></tr>
</table>

*The indicative minimum yield does not account for rock materials won in the cut & fill operations of access tracks and hard-standing construction. This may provide additional rock resource above that which is required from the potential borrow pit locations. The minimum yield is a 25% increase on the indicative requirement of stone to be won on site to the nearest 1000m$^3$. This provides an estimate of losses through fragmentation and unsuitable materials which may be worked from borrow pit locations.

1.4.2 Table 4 below provides a summary of the possible working areas which will be required within each potential borrow pit area in order to meet the indicative minimum yield of rock materials to be won on -site. Figures 11.9 – 11.12 provide further detail on the geometry of the indicative working areas at each location.

**Table 4: Indicative Borrow Pit Working Areas**

| Borrow Pit ID | Search Area (Ha) | Required Rock Yield** (m$^3$) | Predicted Rock Extraction (Figures 11.9-11.12) | Mean Peat Depth (m) | Indicative Working Area (Ha)* | % Indicative Working Area of Search Area |
|---|---|---|---|---|---|---|
| BPA | 2.4 | 37,750 | 44,800m$^3$ | 0.1 | 1.19 | 50% |
| BPB | 1.9 | 37,750 | 49,550m$^3$ | 0.0 | 1.91 | 100% |
| BPC | 4.3 | 37,750 | 41,940m$^3$ | 0.2 | 2.00 | 47% |
| BPE | 3.3 | 37,750 | 57,354m$^3$ | 0.1 | 1.95 | 59% |

*Assuming a maximum 1.5m depth of superficial overburden including peat and glacial till and acknowledging some uncertainty here and based upon volumetric analysis presented in Figures 11.9 - 11.12.

**Assuming a total rock yield of 151,000m$^3$ equally divided between the four potential borrow pit locations

The indicated borrow pit working areas have been devised based on the required rock yield and acceptable geometries for establishing a safe working borrow pit areas. It is acknowledged that if each location was worked to their full potential there would be a predicted surplus of rock fill available (~200,000m3) to supply the construction phase. At each indicated borrow pit working area only enough stone will be extracted to supply the construction works. The exact behaviour and geotechnical properties of the encountered materials will dictate the final excavated rock volumes from each borrow pit. These will be determined following detailed intrusive site investigation (post-consent). However, the final worked areas are not predicted to exceed the areas shown on Figures 11.9 – 11.12

1.4.3 The approach in estimating the likely size of potential borrow pit areas across the proposed development was to initially provide search areas based on the field survey observations. It is highlighted that 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 required to meet the minimum yield rock fill requirements. The working areas are smaller than the initially defined search areas. Therefore, there is likely going to be an optimisation of the borrow pit design within the confines of the identified search area.

### *Imported Aggregates*

1.4.4 It is highlighted that borrow pit A has been identified on the periphery of the existing and operational wind farm. This location was utilised as a borrow pit in the construction of the existing wind farm. It is therefore assumed that the required plant machinery would be able to access this location without any major construction of new access infrastructure. Build- out of the proposed development would then advance using a phased approach with access into the new borrow pit areas incrementally achieved throughout the construction phase. Through this approach the importing of aggregates onto site will be avoided.

1.4.5 It would be the aim to utilise site won rock-fill materials for base and capping layers of access and hardstand infrastructure. However, the final determination on this would be taken post consent, once detailed site investigation and geotechnical testing of aggregate sources has been undertaken.

## 1.5 Example Borrow Pit Working Methodology

### *Access*

1.5.1 Access to the borrow pit locations during construction would be from within the wider wind farm development site and existing forestry tracks. Therefore, no public roads are to be used during the proposed borrow pit development.

### *Vegetation*

1.5.2 Where the borrow pit locations are within areas of commercial forestry plantation, to allow further site investigation and to advance the working faces, both the hillside and laterally during excavation, felling would first have to take place.

### *Borrow Pit Design*

1.5.3 A detailed borrow pit design will be required to be completed by the appointed contractor prior to commencing operations. The final geometry of the borrow pit will be dictated by the bedrock geological conditions, with benching and rock cuttings designed to ensure adequate stability. However, general recommendations for borrow pit design would specify a maximum single lift face height of 10m with a maximum face angle of 80 degrees. This would be subject to inspection by a suitably experienced geotechnical engineer.

1.5.4 The borrow pit floor will be designed for a shallow gradient to allow adequate drainage away from the working area. A perimeter fence and/or adequate edge protection will be erected around each borrow pit working area, and a cut-off drain also installed. This shall reduce the surface water accumulation within the borrow pit excavation and safeguard against sediment loaded run-off.

### *Overburden Stripping, Removal and Storage*

1.5.5 The upper most vegetated peat layer will be stripped from the borrow pit excavation in a progressive movement up the slope as the excavation extends. As the excavation becomes larger and expands laterally into the terrain, the peat and overburden shall be stripped and stored to build up the peripheral bunds. These bunds will also 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 bunds shall be limited in their height and side slope angle such that they are stable for the duration of the operations, typically 2m height and 1in3 side slopes. The stability of peat bunds should be monitored with no storage of peat onto in-situ peat deposits deeper than 0.5m or on terrain where failure could be triggered. This should be reviewed by an experienced geotechnical engineer throughout the construction of the borrow pit. The bund will also provide screening to the area on the three sides whilst the excavation is taking place. 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 stockpiles and bunds should not be in the vicinity of any watercourses peripheral drains or wet flushes, to prevent peat erosion and instability.

1.5.6 The underlying sub-soils will be removed in strips ahead of the working face and placed a minimum of 3m 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.

1.5.7 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. Overburden shall only be removed over the area necessary for safe removal of the rock to prevent affecting land out- with the extraction area. It should be noted that overburden volumes can only be estimated following intrusive site investigation works.

1.5.8 A suitable fence and or protection barrier will be installed around the proposed borrow pit excavation areas 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. Full details will be provided as part of the detailed Construction Method Statement.

### *Extraction of Pay Rock*

1.5.9 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 single large 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 entrances towards the rock face created. Blasting operations where required will be specified by an appointed specialist contractor.

1.5.10 All workings should conform to the CEMP and relevant legislations including PAN 50, 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 effects on site tracks and surrounding infrastructure.

1.5.11 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 appointed 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.

1.5.12 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.

1.5.13 Once the rock material has been excavated forming a working face the borrow 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.

1.5.14 Rainfall, surface and groundwater ingress shall be contained by drainage installed around the borrow pit as described in the CEMP (Appendix 5.1). The contractor will incorporate interceptor (cut-off) drains to prevent water ingress to the area of works from the surrounding topography and a toe drain to control water ingress and flow around the base of the excavation. The contractor will channel borrow pit drainage to settlement ponds located a minimum of 50m from any watercourse and will construct all necessary drainage prior to commencing excavation of the borrow pit.

### *Processing (Load and Haulage Operations)*

1.5.15 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 effects of a processing plant may be minimised.

1.5.16 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.

### *Reinstatement*

1.5.17 The proposed borrow pits 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. Figures 11.9 – 11.12 provide indicative cross-sectional restoration profiles at each potential borrow pit location.

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

1.5.19 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. A response from SEPA noting best practice to borrow pit restoration with respect of re-using excavated peat is provided in Appendix 11.1 (Peat Stability Risk Assessment). 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. With regards to the re-use of excavated peat, the borrow pit restoration will take into account the “Guidance on the Assessment of Peat Volumes, Re-use of Excavated Peat and the Minimisation of Waste” (2012) publication.

1.5.20 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).

### *Plant and Machinery Considerations*

1.5.21 To win the rock a large excavator with a ripping tooth and rock breaker attachment is anticipated to be required across each location. This is likely to be supported by a fleet of articulated dumper trucks to load out the rock to the construction areas. A bulldozer may be required for grading and levelling, and an articulated loading shovel may also be used to feed dumper trucks and crushers from stockpiles.

1.5.22 Dependent on the material excavated a mobile crushing plant is likely to be required and will be located within or adjacent to each borrow pit working area, close to the point of extraction for processing and grading as necessary.

1.5.23 The plant and labour will be provided by the chosen construction contractor who would also be responsible for the safe operation and maintenance of machinery. The construction contractor may re-deploy these resources across the wind farm site and varying borrow pit locations as required.

The contractor will provide full method statements to personnel with respect to safe methods of working and emergency procedures.

### *Drainage Considerations*

1.5.24 Surface drainage shall be diverted around the working area wherever possible to prevent contamination of natural runoff by suspended solids. Temporary low bunding and/or catch ditches shall be created as required. The peat storage bunds shall provide a source of particulates from which runoff may temporarily pick up sediment and catch ditches should be created as necessary with the drainage feeding into the existing forestry drains that are present along the existing access track. Detailed mitigation measures to prevent siltation shall be included in the final design. Borrow Pit working area B has been optimised to exclude the westerly adjacent watercourse. Where required appropriate diversion and containment measures will be used to ensure this hydrological feature does not interact or become impacted by the borrow pit working. Borrow Pit working area E has been optimised to avoid a small watercourse to the south-west.

1.5.25 Rainfall, surface and groundwater entering the borrow pit shall be contained within the excavation. The borrow pit floor should be graded appropriately to aid drainage. Excess water should be pumped out of the pit and discharged to local drainage channels with appropriate silt removal measures prior to discharge.

1.5.26 All drainage shall be in accordance with The Water Environment (Controlled Activities) (Scotland) Regulations 2011 which provides best practice guidelines for a number of activities to prevent pollution of groundwater sources. If authorisations are required for process plant operation or consents to discharge, then applications will be made by the principal contractor to the Scottish Environment Protection Agency (SEPA).

### *Waste Management Strategy*

1.5.27 It is anticipated that there will be very little in the way of waste materials produced by the borrow pit development. Any un-useable rock and superficial deposits shall be temporarily stockpiled during construction and utilised as part of the borrow pit restoration scheme.

1.5.28 Any solid waste items associated with the development e.g. those materials associated with plant maintenance and operation or blasting (if required), shall be removed from the site and disposed of at a licensed waste disposal facility. The principal contractor shall be responsible for all waste generation and procedures in response to ground contamination from the construction project. Construction method statements shall be issued by the principal contractor detailing procedures in the event of a fuel or oil spillage.

1.5.29 Where appropriate, given the remote nature of the site, Planning Advice Note 50: Controlling the Environmental Effects of Surface Mineral Workings will be adhered to. There are to be no movements of material away from the wind farm area as all material is solely for use in the wind farm construction.

1.5.30 Operational impacts form noise and dust should be controlled by the specification of appropriate extraction methods and processing plant. Best Practice Guidance – The Control of Dust and Emissions from Construction and Demolition Sites (2006) shall be considered as part of the CEMP.

## 1.6 References

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

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

[1]: http://www.bgs.ac.uk/lexicon