SHEPHERDS' RIG WIND FARM
OUTLINE PEAT MANAGEMENT PLAN

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1 INTRODUCTION

1.1 Preparation of the Peat Management Plan

This outline Peat Management Plan (oPMP) for Shepherds' Rig Wind Farm (the Development) has been prepared initially to inform the Planning Authority and all statutory consultees of the proposed peat and soils management methodologies to be employed during construction.

The purpose of the oPMP is to:

- Define the materials that will be excavated as a result of the Development, focusing specifically on the excavation of peat;
- Report detailed investigations into peat depths within the site;
- Detail proposals for the management of excavated peat and other soils;
- Determine volumes of excavated arisings, the cut/fill balance of the Development and proposals for re-use or reinstatement using excavated materials; and
- Detail management techniques for handling, storing and depositing peat for reinstatement.

The oPMP has been produced in accordance with Scottish Renewables (SR) and the Scottish Environment Protection Agency (SEPA) Guidance on Peat Excavations and Management[1]. This PMP is intended to be a document that will evolve during the different phases of the project and as such will be subject to continued review to address:

- Requirements to discharge future Consent and Planning Conditions;
- Detailed ground investigations and design development;
- Unforeseen conditions encountered during construction;
- Changes in best practice during the life of the wind farm; and
- Changes resulting from the construction methods used by the contractor(s).

Whilst this oPMP provides a base standard for good practice, where avoidance or further minimisation of risks to the environment can be demonstrated through use of alternative methods or improvements to current practices, the Contractor will implement these wherever possible and will correspond with SEPA and Dumfries and Galloway Council.

1.2 The Development Site

The Development is located approximately 5 km to the east of Carsphairn and 10km north of St John's Town of Dalry, in northern Dumfries and Galloway.

The Development will comprise of 19 turbines with maximum tip height of 149.9 m and approximately 11 km of track. The 'Site Layout Plan' is included in **Figure 1**.

The superficial soil mapping indicates superficial soils across the majority of the site to be underlain predominantly by areas vacant of significant superficial soil cover, primarily within the regions of Craigengillan Hill and Marscalloch Hill. Till deposits typically comprising clay, sand and gravel were shown across the eastern and southern site areas. Within the north-western site area, peat deposits were shown.

Published bedrock geology mapping indicates the site to be underlain by Caradoc aged rocks comprising Portpatrick Formation Wacke. Localised faulting exists within the central site area at varying dip angles but generally to the south-east.

[1] SR and SEPA (2012). Guidance on the Assessment of Peat volumes, Reuse of Excavated Peat and the Minimisation of Waste [online] Available at: http://www.scottishrenewables.com/media/uploads/publications/a4_developments_on_peatland.pdf [Accessed 21/08/2014].

The proposed access tracks for the Development, along with details of upgrades to existing forestry tracks and the construction of hardstandings and other elements of infrastructure are defined in detail in **Chapter 4 Description of the Proposed Development**

1.3 Consultation

Peat management and the assessment of borrow pit potential within the site was considered throughout the Environmental Impact Assessment (EIA) for the Development and the outcomes of studies are reported in the EIA Report. The EIA Report formed part of the planning application and was made available to the Scottish Government, Dumfries and Galloway Council and its consultees including SEPA.

This oPMP considers assessments included in the EIA Report and responds to the consultees scoping responses.

2 OBJECTIVES

2.1 Introduction

2.1.1 Background

The preparation of an outline 'Peat Management Plan' responds both to the scoping responses from April 2018 and the intent to deliver a construction project that complies with good practice in accordance with SR and SEPA guidance.

By undertaking detailed peat survey work and carrying out assessments such as peat slide risk assessment (PSRA) and borrow pit assessment (BPA) for the EIA, a consistent approach to the management of peat across the site can be achieved.

In addition to the assessments, an outline civil design of the site layout has been undertaken. The overall objective of the outline design has been to minimise the excavation of peat where possible, and achieve as close as practicable an overall material balance within the site. This is considered to give the best opportunity to achieve reinstatement or restoration in accordance with good practice, and remove the need for waste management controls.

This objective is achieved through:

- Ensuring the characteristics of the site are understood through extensive peat probing and assessing the sites topography;
- Developing the outline design based on the access track requirements in 3D; and
- Modelling the peat depth profile based on probing and the topographical survey in 3D;

2.1.2 Approach to Minimising Peat Excavation

The following steps have been taken during the outline design stage of the Development to minimise the impact on peat:

- The development of an access track design which avoids deeper peat where practicable;
- The design and orientation of turbines and crane hardstandings considers local topographical and peat constraints; and
- Consideration of borrow pit locations in an area of shallow peat cover.

At detailed design and construction stage these steps will be further supplemented by taking the following measures to minimise disturbance:

- Maximisation of batter angles in cuttings
- Consideration of floating tracks; and
- The use of appropriate construction plant to avoid unnecessary disturbance of the ground surface.

The fundamental principle upon which this oPMP is based is that achieving a successful materials strategy is contingent on gaining a thorough understanding of the Development site through investigation and developing a design that achieves the materials management objectives. For this Development, this principle is achieved by undertaking significant peat investigation works prior to preparing this oPMP and developing the design in 3D based on the available information.

2.1.3 Objectives of the outline Peat Management Plan

The main objectives of the oPMP is to outline how any peat expected to be excavated will be managed and re-used during the construction of the Development.

This is achieved by responding to the following objectives;

- Providing a description of peat conditions on site and how this was determined;
- Estimation of peat volumes to be excavated and reused;
- Classification of excavated material;
- Consideration of the use of appropriate peat(s);
- Describing how excavated peat will be handled to ensure suitability for re-use;
- Determining if temporary storage of peat will be required during construction and how this will be done to ensure suitability for re-use; and
- Considering the potential volume of peat which may not be suitable for re-use and any requirement for a Waste Management Plan for the Development.

The response to these objectives is provided in the following sections.

3 PEAT MANAGEMENT

3.1 Investigations

The existing peat depths across the Development site have been determined through a peat probe survey undertaken during the EIA. The survey was initiated to inform the EIA and site design work while supporting the peat slide risk assessment.

Initial peat depth surveys were undertaken in October 2013 comprising 100m grid coverage across the site, where accessible. This rationale of probing is in accordance with the Phase 1 approach as detailed in the Scottish Government guidance for investigating peat.

Peat depths ranged from zero to 4.5 m thickness across the Development site and were shown as localised or isolated zones within the western site area. This was consistent with the British Geological Survey mapping.

Further peat depth surveys were undertaken in August and September 2018. The probe positions for these visits were determined by the design freeze layout and provided increased resolution along the access track alignments and in the vicinity of turbine hardstandings. Peat depths were measured at cross sections centred along the proposed access tracks at 50m centres with offsets of 25m on either side of the centre line.

Across turbine locations, additional peat probing was carried out at 10m centres for assessment and micro siting of turbines and hardstandings relative to prevailing conditions. The peat depths are illustrated in Figure 2 'Peat Depth Interpolation'.

3.2 Summary of Peat Depths

Throughout the peat surveys to date, a total of 1,293 probes were sunk. Over 70% of these recorded no peat or peat less than 0.5m while 11% of probes recorded peat between 0.5m and 1.0m. Thick peat (where the depth was greater than 1.0m) was recorded in 19% of locations..

Peat was found to be thicker along the western and north-western site area, close to the boundary with pockets of peat up to 4.5m recorded although only 1% of probes recorded peat greater than 3.0m depth.

The distribution of peat deposits along the proposed tracks and infrastructure are shown on Figure 2 'Peat Depth Interpolation' included in Appendix A.

It was found that peat was generally thinner or absent across the northern, central and eastern areas of the site, with exception of localised pockets in flatter areas. This is consistent with the steeper areas of the Development site.

Where peat is consistently over 1.0m thick and existing ground levels permit, the use of floating roads should be adopted. Prior to commencing works on site, the Contractor as part of any floating road design will undertake further ground investigation to establish peat characteristics and surcharging strategies. It should be noted that micro-siting of turbines T4, T6, T8, T9, T0, T13 and T16 within 75m radius to areas out with deep peat will be undertaken to reduce the impact on deep peat.

3.2.1 General Peat Classification

Acrotelmic peat is the upper layer of peat consisting of living and partially decayed material with a higher hydraulic conductivity and a variable water table. These deposits are generally found to exist in the upper 0.5m of peat deposits and is typically suitable for re-instatement because it contains viable plant life to assist in the regeneration of peatland vegetation and carbon sequestration.

Catotelmic peat is variable in characteristics, with decomposition of fibres generally increasing with depth. Water content can be highly variable and affects the structural strength of the material. Suitability for reuse generally depends on fibre and water content. The upper catotelm is commonly deemed as being appropriate for reuse in restoration due to its relatively high fibre content.

Generally excavated semi fibrous catotelmic peat from the site will have sufficient structural strength to be able to be used in the lower layers of verge restoration as it will not be 'fluid'.

The catotelmic peat would be capped with a surface layer of actrotelm to re-establish the peat vegetation. If any fluid like wet catotelmic peat is encountered then it would be placed in more appropriate locations such as low-lying section of the borrow pits or concave deposition areas.

The following assumptions have been made in classifying peat excavated during the construction work:

- Where the total peat depth was found to be less than 0.5m, this peat material is assumed to be 100% acrotelmic;
- Where the total peat depth is between 0.5m and 1.0m, the upper acrotelmic peat is at least 0.5m deep; and
- Where the total peat depth as found to be greater than 1.0m, acrotelmic peat is assumed to account for at least 30% of total depth but generally applying minimum of 0.5m thick.

Existing topography and permitted track gradients drive the design of the infrastructure with due consideration given to potential construction risk and effects on environmentally sensitive receptors including deep peat, watercourse buffers and any GWDTEs. Further micro-siting post-consent would take place in such a way as to avoid where possible the excavation of deep peat.

3.2.2 Excavation Calculation

To derive an accurate estimate of excavated volumes, the access tracks and turbine hardstandings have been developed to outline design stage in 3D based on Ordnance Survey digital Terrain 5 data. This design is overlaid on the 3D peat surface model which has been derived from the extensive peat probe surveying undertaken.

By analysing these models, it is possible to derive volumes of excavation and estimate what the excavated material comprise - be this non peat superficial soils, peat or other materials. Table 4.1 shows the construction activities that will generate excavated peat, and the expected volumes produced from each activity based on the 3D modelling exercise, and without the proposed mitigation of micro-siting.

Table 4.1 Peat excavation volumes based on construction activity

Development Component	Anticipated Volume of Excavated Peat (m^3)	Anticipated Volume of Acrotelmic Peat (m^3)	Anticipated Volume of Catotelmic Peat (m^3)
General earthworks associated with widening/upgrade of existing tracks, new access tracks and crane pads	88,390	16,736	71,654
Borrow pit	6,660	6,660	0
Construction compound/Substation	2,250	2,250	0
TOTAL	**97,300**	**25,646**	**71,654**

A detailed assessment of excavated volumes by location within the site is provided in Appendix 2 of this report.

3.2.3 Peat Re-use Requirements

The principles of re-instating peat and peat soils should be adhered to for all elements of the infrastructure, comprising the below;

- Peat and peaty soils will be reinstated on track and infrastructure verges with turves placed on the upper horizons encouraging re-vegetation.
- All peat, soil and turves excavated from beneath infrastructure (excluding any floating track section) will be re-instated in the vicinity of its original location.
- Any wet catotelmic peat will be placed at the bottom of any restoration profile, followed by semi fibrous catotelmic peat and then acrotelmic should be placed on top; and
- Restoration activities will be overseen by the Ecological Clerk of Works to ensure methods are properly adhered to.

Table 4.2 shows the opportunities for re-use of peat with the site including the demand for acrotelm and catotelm peat. Table 4.3 summarises the total peat balance estimated during construction of the Development.

Table 4.2 Peat Re-use volumes based on construction activity

Development Area	**Total Demand Estimate (m³)**	**Acrotelm Demand (m³)**	**Catotelm Demand (m³)**	**Estimated Reinstatement Thickness (max) where gradient permits (m)**	**Assumptions**
General earthworks associated with widening/ upgrade of existing tracks, new access tracks, crane Pads and turbine bases	92,300	20,441	71,859	0.060	Earthworks surface area of approximately 252,942m^2 – assume up to 0.63 m reinstatement on verge and earthwork banks, both side**s** of tracks. Dressing off and landscaping of 25 turbines bases.
Borrow Pits	4,440	4,440	0	0.50	Assumption made that peat reinstatement thicknesses will reflect the peat excavated prior to borrow pit workings, i.e up to 0.5m at borrow pits 1 and 2.
Construction Compounds/ Substation	1,124	1,124	0	0.50	Full reinstatement of compound and dressing off of side slopes at sub-station compound.
Total	**97,864**	**26,005**	**71,859**		

Table 4.2 is presented as a summary of the assessment of peat reinstatement volumes. A detailed assessment is provided in Appendix 2 of this report.

The following assumptions have been made in assessing peat re-use:

- New access track sections assume verges on both sides at widths of approximately 0.5m. As the access track edges will have graded slopes, peat depths will vary across the profile to tie into existing ground levels.
- Upgraded track sections assume a verge on the upgraded side 0.5m wide. As the access track edges will have graded slopes, peat depths will vary across the profile to tie into existing ground levels.
- Verges along the access tracks could consist of up to 0.6m thick peat. Where possible catotelmic peat will be reinstated along verges in flatter areas.
- No peat will be placed on access track verges where the local topography is steep and/or a watercourse is in close proximity. This has been reflected in the volumes generated for access track sections.

- Peat will be laid only to a thickness that maintains hydrological conditions and to avoid drying out. Peat will not be used as a thin layer or on steeper non-peat slopes. Low verges and landscaping will be formed to permit surface water to drain off the access tracks.
- Catotelmic soils will only be used if it is suitable for purpose.
- Borrow pit reinstatement assumes a maximum peat depth thickness of that which existed prior to borrow pits works, but anticipated not to exceed 0.5m. This will include the re-use of acrotelmic peat soils and turves.

Table 4.3 - Peat Balance Calculations

Peat Description	Total Peat Demand Estimate for Reinstatement (m^3)	Total Peat Supply from Excavation (m^3)	Surplus (+) or Deficit (-) (m^3)
Acrotelm	26,005	25,646	-359
Catotelm	71,859	71,654	-205
Total	**97,864**	**97,300**	**-564**

The results of the peat balance calculation shown in Table 4.3 demonstrates the total peat excavated during construction marginally exceeds the estimated demand for reinstatement based on the assumptions provided in this section.

The calculations indicate that there will be a small deficit of peat. These volumes should be considered in the context of the total excavated peat during construction.

Where required other suitable site won materials can be utilised in reinstatement works.

3.2.4 Handling and Storage of Peat

It will be necessary for the Contractor to prescribe methods and timing involved in excavating, handling and storing peat for use in reinstatement. The contractor will be responsible for appointing a chartered geotechnical engineer, as discussed in the CEMP, who will monitor any potential stability risks. Construction methods will be based on the following principles:

- The surface layer of peat (acrotelm) and vegetation will be stripped separately from the catotelmic peat. This will typically be an excavation depth of up to 0.5 m.
- Acrotelmic material will be stored separately from catotelmic material;
- Careful handling is essential to retain any existing structure and integrity of the excavated materials and thereby maximise the potential for excavated material to be reused;
- Less humified catotelmic peat which maintains its structure upon excavation should be kept separate from any highly humified amorphous or wet catotelmic peat;
- Acrotelmic material will be replaced as intact as possible once construction progresses / as it is complete;
- To minimise handling and transportation of peat, acrotelmic and catotelmic will be replaced, as far as is reasonably practicable, in the locality from which it was removed. Acrotelmic material is to be placed on the surface of reinstatement areas;
- Temporary storage of peat will be minimised, with restoration occurring in parallel with other works;
- Suitable areas should be sited in areas with lower ecological value, low stability risk and at a suitable distance from water courses;
- Reinstatement will, in all instances, be undertaken at the earliest opportunity to minimise storage of turves and other materials;
- Managing the construction work as much as possible to avoid periods when peat materials are likely to be wetter i.e. high rainfall events;

- Temporary storage and replacement of any peat excavated from the borrow pit should occur adjacent to and within the source pit; and
- Transport of peat on site from excavation to temporary storage and restoration site should be minimised.

Following consideration of all constraints and considering the above points, three suitable temporary storage areas have been identified on Figure 3 – Temporary Peat Storage Areas.

4 CONCLUSION

The following conclusions are drawn regarding the management of peat and excavated materials within the proposed Development site:

- As a result of the outline 3D modelling of the site layout and the 3D modelling of peat surfaces, the volume calculations demonstrate that all excavated peat can be reused on-site;
- Excavated peat will be used for the reinstatement of access track verges, cut and fill embankment slopes, reinstatement of turbine hardstandings, reinstatement of borrow pits and general landscape fill;
- The estimates of excavated peat provided in this report are likely to be higher than actually occur, as micro-siting during construction will allow for the avoidance of localised pockets of deeper peat;
- Sufficient methods have been defined to ensure that peat can be sensitively handled and stored onsite to allow for effective reuse; and
- No waste licence is required for the construction work.

APPENDIX 1 - FIGURES

INFINERGY

ARCUS

- Site Boundary
- Turbine Location
- Met Mast Location
- Borrow Pit
- Substation
- Construction Compound
- Proposed Infrastructure

1:20,000 Scale @ A3

0 0.5 1 km

NORTH

Produced By: RL	Ref: 2966-REP-029
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Proposed Site Layout
Figure 1

Shepherds' Rig Wind Farm
Peat Management Plan

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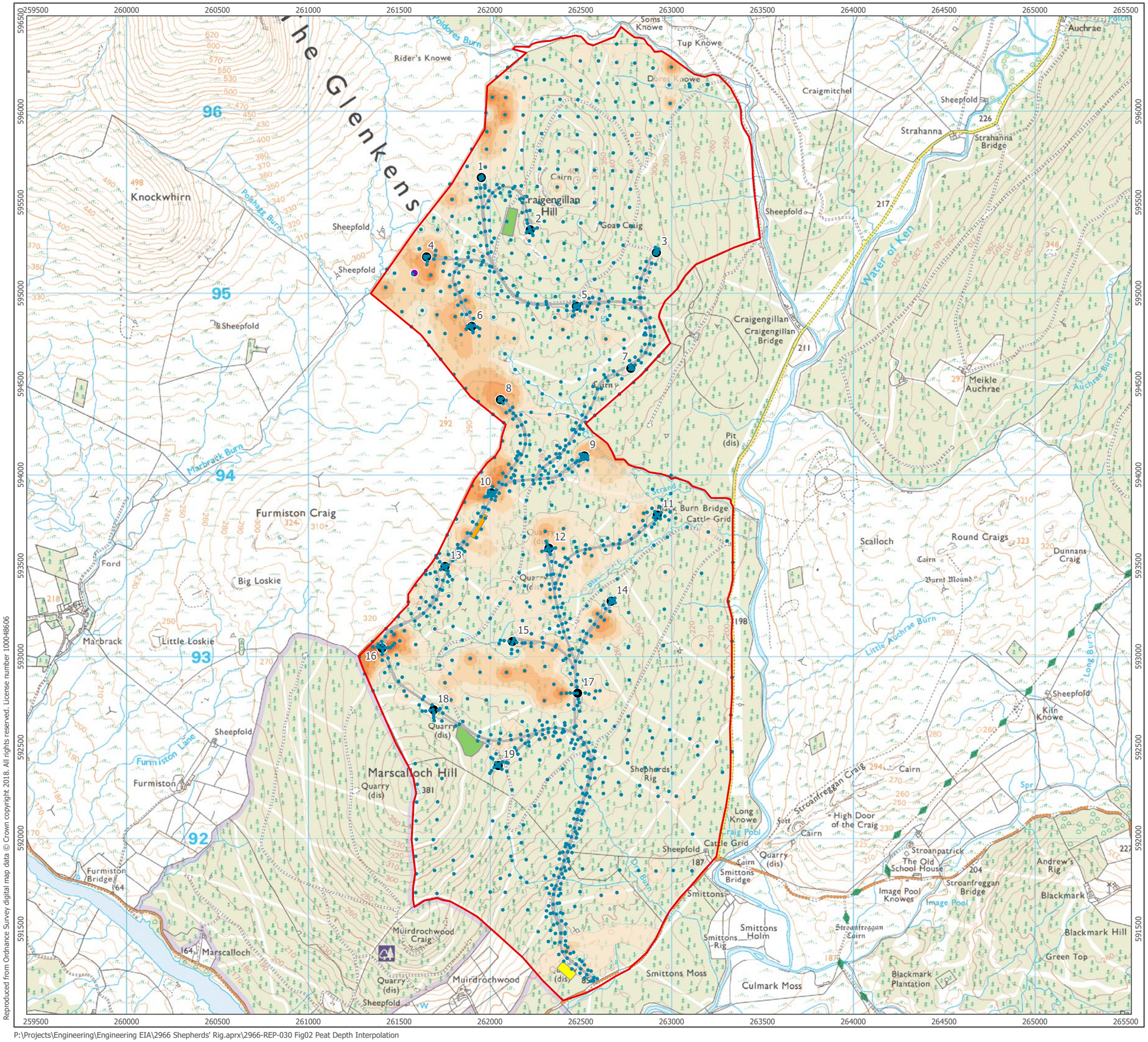

P:\Projects\Engineering\Engineering EIA\2966 Shepherds' Rig.aprx\2966-REP-030 Fig02 Peat Depth Interpolation

INFINERGY

ARCUS

- Site Boundary
- Turbine Location
- Met Mast Location
- Proposed Infrastructure
- Substation
- Borrow Pit
- Peat Probe Locations

Peat Depth Interpolation (m)

- 0.51 - 1.00
- 1.01 - 1.50
- 1.51 - 2.00
- 2.01 - 2.50
- 2.51 - 3.00
- 3.01 - 3.50
- 3.51 - 4.00
- 4.01 - 4.50
- Construction Compound

1:20,000 Scale @ A3

0 0.5 1 km

NORTH

Produced By: RL	Ref: 2966-REP-030
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Peat Depth Interpolation
Figure 2

Shepherds' Rig Wind Farm
Peat Management Plan

INFINERGY

ARCUS

- Site Boundary
- Turbine Location
- Met Mast Location
- Peat Storage Areas
- Proposed Infrastructure
- Substation
- Construction Compound
- Borrow Pit Search Areas

1:20,000 Scale @ A3

0 0.5 1 km

NORTH

Produced By: KB	Ref: 2966-REP-044
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Temporary Peat Storage Areas
Figure 3

Shepherds' Rig Wind Farm
Peat Management Plan

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APPENDIX 2 - EARTHWORKS VOLUMES AND CALCULATIONS

2966 - Shepherds' Rig, Peat Management Plan

EARTHWORKS AREA/VOL					NOTES
Total Cut/Fill Area m2				252942	
Total Cut Vol m3				134777	
PEAT / TOPSOIL				**m3**	
Peat/Topsoil				143936	Based on available peat probe information
Total Peat/Topsoil				**143936**	
Volume of Topsoil				**43036**	Assumed average acrotelm thickness is 300mm. Peat soils to be reused on site as detailed below
Volume of Peat				**100901**	Peat soils to be reused on site as detailed below
PEAT EXCAVATION BY INFRASTRUCTURE	**m2**	**Acrotelmic m3**	**Catotelmic m3**	**m3**	
Peat Volume - Tracks & Crane Pads	223240	16736	71654	88390	
Peat Volume - Borrow Pit	22202	6661		6661	
Peat Volume - Compound Area/Substation	7,500	2250		2250	
TOTAL Peat Volume		**25647**	**71654**	**97301**	
INFRASTRUCTURE AREAS -EW			**m/m2**	**m2 Total**	
Tracks			11000	66000	
Crane Hardstanding			1780	33820	
Borrow Pit				22202	
Compound Area/Substation			7,500	6000	
TOTAL AREA				**128022**	
REINSTATEMENT	m2	**Acrotelmic m3**	**Catotelmic m3**	**m3**	
Earthworks Tracks	157240	20441.2	71859	92300	Up to 590mm Peat reinstated. Catotelm is placed in the lower horizons, acrotelm will be placed over the top, encapsulating,
Borrow Pit Dressing/Reinstatement	22202	4440.4		4440	where appropriate gradients allow.
Construction Compound /Substation Reinstatement	5620	1124		1124	
TOTAL PEAT REINSTATED	**185062**	**26006**	**71859**	**97864**	
PEAT BALANCE					
Peat +Surplus/-Deficit		-359	-205	-564	