ARCUS

SHEPHERDS' RIG WIND FARM

PEAT SLIDE RISK ASSESSMENT

NOVEMBER 2018

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1 INTRODUCTION

1.1 Background

Arcus Consultancy Services were commissioned by Infinergy to carry out a Peat Slide Risk Assessment (PSRA) for the proposed Shepherds' Rig Wind Farm (the Development) located in Dumfries and Galloway. The Development is located on an area of undulating hillside, much of which is forested centred at National Grid Reference (NGR) NX625935.

The Proposed Development will consist of up to 19 turbines with a total generating capacity of up to 78.6 MW. The site layout plan is shown on Figure 1 appended with this report.

1.2 Summary of conditions

A desk study of the site based on available geological and soils mapping indicated that peat was possible along the western site boundary within localised areas of flatter ground, with deposits being thin or absent in all other areas.

Onsite intrusive investigations confirmed that deposits across the site were generally thin, but consistent with the desk-based assessment, deeper deposits existed within the western site area. Additionally, localised pockets were noted in the central site area. Due to the proximity to potentially sensitive receptors, the undertaking of a PSRA was considered necessary.

The following receptors were identified as part of the assessment and verified by site visit:

- Proposed infrastructure including, tracks, turbines, compounds and borrow pits;
- Existing tracks;
- Tributaries associated with Polshagg Burn;
- Goat Strand;
- Craigengillan Burn and associated tributaries;
- Hare Strand; and
- Black Burn and associated tributaries;

1.3 Assessment Approach

The PSRA has been carried out in accordance with the Energy Consents Unit, Scottish Government guidance of 2017 titled 'Peat Landslide Hazard and Risk Assessments - Best Practice Guide for Proposed Electricity Generation Developments'[1], Scottish Government.

In June 2014, the new 'Scottish Planning Policy'[2] (SPP) and 'National Planning Framework (NPF3)'[3] were published. In relation to peat and the assessment of effects on resource, NPF3 references Scottish Natural Heritage 'Scotland's National Peatland Plan'[4]. These policy, framework and guidance documents are therefore also considered in this PSRA.

The PSRA undertaken is based on:

- Desk based assessment;
- Site walkover;
- An initial Phase 1 peat probing scheme;
- A second phase of probing comprising infrastructure specific probing; and
- A hazard and risk ranking assessment.

[1] https://www.gov.scot/Publications/2017/04/8868

[2] http://www.scotland.gov.uk/Topics/Built-Environment/planning/Policy

[3] http://scotland.gov.uk/Resource/0045/00453683.pdf

[4] https://www.nature.scot/climate-change/taking-action/carbon-management/restoring-scotlands-peatlands/scotlands-national-peatland-plan

The area of the development subject to assessment was determined by the emerging development layout which considered both anticipated peat deposits as well as other physical and environmental constraints.

2 METHODOLOGY

2.1 Site Reconnaissance and Peat Probing

This PSRA has been undertaken in accordance with the SG guidance and in parallel with the development design process.

Geo-Environmental Consultants, Mason Evans Partnership, were appointed to carry out the Phase 1 and 2 peat probing for the development, undertaken over two distinct periods. Initial probing occurred in October 2013 before supplementary Phase 1 probing re-commenced in April 2018. These visits comprised probing on a 100 m grid where access allowed, recording at each location peat depths, NGR co-ordinates and the probe refusal conditions giving an indication of the underlying substrate.

Further probing was undertaken by Arcus and Mason Evans in August 2018 which focussed on the outline civil design layout and turbine freeze.

2.2 Development of Hazard Rank

The early stages of the PSRA including the desk study, site visit and peat probing were carried out in parallel with the assessment of wider constraints and the development of the windfarm layout. Following identification of peat depths within the site, the assessment was carried out to determine the potential effects on the peat resource of construction activities which would include:

- Construction of tracks;
- Excavation of turbine bases;
- Foundation construction;
- Construction of hardstanding;
- Temporary storage of peat and soils; and
- The formation of borrow pits.

An assessment of the peat probing data and a review against desk study information was undertaken and a hazard rank was calculated for different zones across the site reflecting risk of peat instability / constraint to construction.

Where practical, the development design was progressed to avoid areas of a risk score above 'low'Within the EIA relative mitigation measures are proposed to reduce to further reduce the risk of inducing instability.

3 GUIDANCE AND ASSESSMENT APPROACH

3.1 General Guidance on Peat Failure

The SG guidance divides peat instability into two categories, 'peat slides' and 'bog bursts'. The guidance states that peat slides have a greater risk of occurrence in areas where:

- Peat is encountered at or near to ground surface level;
- The thicknesses are recorded in the region of 2.0 m (above which, in general terms, peat instability would increase with peat thickness); and
- The slope gradients are steep (between 5° and 15°).

Bog bursts are considered to have a greater risk of occurrence in areas where:

- Peat depth is greater than 1.5 m; and
- Slope gradients are shallow (between 2° and 10°).

It should be noted however that peat instability events, although uncommon, can occur out with these limits. Reports of bog bursts are generally restricted to the Republic of Ireland and Northern Ireland.

Preparatory factors which effect the stability of peat slopes in the short to medium-term include:

- Loss of surface vegetation (deforestation);
- Changes in sub-surface hydrology;
- Increase in the mass of peat through accumulation, increase in water content and growth of tree planting or
- Reduction in shear strength of peat or substrate due to chemical or physical weathering, progressive creep and tension cracking.

Triggering factors which can have immediate effect on peat stability and act on susceptible slopes include:

- Intensive rainfall or snow melt causing pressures along existing or potential peat/substrate interfaces;
- Snow melt;
- Alterations to drainage patterns, both surface and sub-surface;
- Peat extraction at the toe of the slope reducing the support of the upslope material;
- Peat loading (commonly due to stockpiling) causing an increase in shear stress; and
- Earthquakes or rapid ground accelerations such as due to blasting or mechanical movement.

Consideration of peat stability should form an integral part of the design of a windfarm development. While peat does not wholly provide a development constraint, areas of deep peat or peat deposits on steep slopes should be either avoided through design and micro-siting; or mitigation measures should be designed to avoid instability and movement.

4 DESK STUDY AND SITE VISIT SURVEY

4.1 Methodology

The purpose of the desk study and site visit was to gain a thorough understanding of site conditions including topography, geology, existing peat instability and hydrology. The outcome of this stage of the study was the determination of the areas requiring detailed intrusive survey (by peat probing) and ultimately provide data for the assessment of peat slide hazard and risk.

4.2 Desk Study Approach

The following sources of information were used as part of the desk study investigations:

- Scottish Government (SG) - 'Peat Landslide Hazard and Risk Assessments' December 2017;
- Scottish Government, Scottish Natural Heritage, SEPA (2017) Peatland Survey, Guidance on
- Developments on Peatland;
- The Scottish Government - Scotland's Third National Planning Framework, 2014;
- The Scottish Government - Scottish Planning Policy, 2014;
- Soil Survey of Scotland - 'MacAulay Institute for Soil Research' 1984;
- Soil Survey of Scotland - 'Scottish Peat Surveys' 1964;
- British Geological Survey - Online GeoIndex;
- Ordnance Survey (OS) topographical information;
- Assessments by other EIA specialists (specifically hydrology and ecology for data on sensitive receptors); and
- Aerial and Satellite photography.

Following a review of these sources a site visit was undertaken, the purpose of which was to verify the outcomes of the desk study and identify:

- The general condition of peat deposits;
- Evidence of any previous peat instability;
- The presence of low lying wet/peat lands;
- Watercourses and potential other receptors; and
- Potential borrow pit locations.

4.3 Topography

The development was separated into two distinct sections, a northern part which layout within the proximity of Craignegillan Hill and a southern area which lay to the north-east and east of Marscalloch Hill.

The northern site area ranges from circa. 250 mAOD in the north-east to 401 mAOD at the peak of Craigengillan Hill. The immediate areas around Craigengillan and to the north were fairly steep. The southern area ranged from 180 mAOD at the site entrance to 381 mAOD at the peak of Marscalloch Hill.

4.3.1 Geology

4.3.1.1 Superficial Soils

Published geological mapping of superficial soils indicates the majority of the site to be vacant of superficial soil cover, primarily within the regions of Craigengillan Hill and Marscalloch Hill. Till deposits typically comprising clay, sand and gravel are shown across the eastern and southern site areas and within the north-western site area, peat deposits are shown.

4.3.1.2 Bedrock Geology

Published bedrock geology mapping indicates the site to be underlain by Caradoc aged rocks comprising Portpatrick Formation Wacke. A geological fault was recorded within the southern site area orientated south-west to north-east through Muirdochwood. No other faults were noted. Within the northern site area, dykes intruded, noted as North Britain Siluro-Devonian aged Calc-Alkaline Dyke Suite comprising Microdiorite and Porphyritic rocks. One of the major dykes is orientated south-west-north-east across the western face of Craigengillan Hill.

4.4 Hydrology and Hydrogeology

All turbines, crane pads, access tracks and compounds at the Development site lie within the primary catchment of the Water of Ken and the Water of Deugh (Carsphairn Lane to Water of ken) and within their sub-catchments.

The Water of Ken is classified by SEPA in two sections relevant to the Core Study Area. The River Ken upstream of High Bridge of Ken flows south adjacent to the eastern boundary and converges with the Water of Deugh 1.7 km south west of the southern boundary. Downstream of this confluence the watercourse is classified as the Water of Ken downstream of Kendoon.

Smaller water bodies located within the development are listed in section 1.2 of this report.

4.5 Peat Probing Methodology

Following the desk study, a peat probing exercise was undertaken within developable area. This involved probing with a McIntosh Peat Probe at 100m centres (as recommended in Scottish Peat Surveys, 1964[5] as included in the SG guidance) with depths of peat measured and locations recorded with a handheld GPS.

The peat depths were recorded across the study area in a 100m grid pattern. The probing was carried out to refusal, and the maximum depth recorded was 4.5m. It should be acknowledged that natural variations in peat depth/thickness could occur between probe positions, although areas of infrastructure has undergone intensely spaced probing and this would be less likely.

[5] http://www.scotland.gov.uk/Resource/Doc/917/0120459.pdf

4.6 Peat Probe Results

During the course of the peat probing investigations, a total of 1293 probes were progressed within the study area and the table below summarises the recorded thicknesses.

Table 12.5 summarises the recorded peat depths.

Table 1 – Peat Depth Summary

Peat Depth Range (m)	No of peat probes	Percentage of Total (%)
<0.5m	934	72.2
0.51m - 1.0m	142	11
1.01m - 1.5m	75	5.8
1.51m - 2.0m	51	4
2.01m - 2.5m	48	3.7
2.51m – 3.0m	28	2.2
>3.00m	15	1.1

The 'Peat Probe Locations' are shown on Figure 2 appended with this report, and details of the probe records are included in Appendix B.

Based on the peat depth data collected on site a 'Recorded Peat Depths' are shown on Figure 3.

It is apparent that from Table 1 and the 'Recorded Peat Depths' figure that over 70% of the study area returned peat depths less than 0.5 m. As anticipated from the desk study, the thickest peat deposits were generally recorded in flatter areas particularly across the western areas of the development where locally peat was surveyed at depths up to 4.5 m. A 'Peat Depth Interpolation Map' is illustrated on Figure 4.

To assess the relationship between peat thicknesses and slope gradient, Figure 5 has been prepared showing 'Indicative Slope Gradients'. This shows that where steeper slopes exist (i.e. steeper than 1:14 or 4°), peat thicknesses were found almost always less than 0.5 m and generally less than 0.3 m.

5 HAZARD AND EXPOSURE ASSESSMENT

5.1 Background

A 'Hazard Ranking' system has been applied across the site based on the analysis of risk of peat slide as outlined in the Scottish Government guidance. This is applied on the principle:

Hazard Ranking = Hazard x Exposure

Where 'Hazard' represents the likelihood of any peat slide event occurring and 'Exposure' being the impact or consequences that a peat slide may have on sensitive receptors that exist on and around the study area.

5.2 Methodology

The determination of Hazard and Exposure values is based on a number of variables which impact the likelihood of a peat slide (the Hazard), and the relative importance of these variables specific to the site.

Similarly, the consequences or Exposure to receptors is dependent on variables including the particular scale of a peat slide, the distance it will travel and the sensitivity of the receptor.

In the absence of a predefined system, the approach to determining and categorising Hazard and Exposure is determined on a site by site basis. The particular system adopted for the Proposed Development PSRA assessment is outlined in the following sub sections.

5.3 Hazard Assessment

The potential for a peat slide to occur during the construction of a windfarm depends on several factors, the importance of which can vary from site to site. The factors requiring considerations would typically include:

- Peat depth;
- Slope gradient;
- Substrate material;
- Peat strength;
- Relief;
- Evidence of instability or potential instability;
- Vegetation cover; and
- Hydrology.

Of these, peat depth and slope gradient are considered to be principal factors. Without a sufficient peat depth and a prevailing slope, peat slide hazard would be negligible. For the Development, the substrate material is also considered a relevant factor in relation to slide.

5.4 Hazard Rating

When several factors may impact on the Hazard potential, a relative ranking process is applied attributing different weighting to each factor as shown below.

Table 2: Coefficients for Slope Gradients

Slope Angle (degrees)	Slope Angle Coefficients
Slope < 2°	1
2° < Slope < 4°	2
4° < Slope < 8°	4
8° < Slope < 15°	6
Slope >15°	8

Table 3: Coefficients for Peat Thickness and ground conditions

Peat Thickness	Ground Conditions Coefficients
Peaty or organic soil (<0.5 m)	1
Thin Peat (0.5 – 1.5 m)	2
Thick Peat (>1.5 m)	3*
Slips /collapses / creep / flows	8

* - Note that thicker peat generally occurs in areas of shallow gradient and records indicate that thick peat does not generally occur on the steeper gradients.

Table 4: Coefficients for Substrate

Substrate Material	Substrate Coefficients
Sand/gravel	1
Rock	1.5
Clay	2
Not proven	3
Slip material (Existing materials)	5

The Hazard Rating Coefficient for a particular location is calculated using the following equation:

Hazard Rating Coefficient = Slope Gradient x Peat Thickness x Substrate

From the Hazard Rating Coefficient, the risk to stability can be ranked as set out in Table 5.

Table 5: Hazard Rating

Hazard Rating Co-efficient	Potential Stability Risk (Pre Mitigation)
<5	Negligible
5 to 15	Low
16 to 30	Medium
31 to 50	High
> 50	Very High

5.5 Exposure Assessment

The main exposure receptors identified within the site and surrounding area which could potentially be affected in the event of a peat slide were primarily watercourses and associated tributaries, existing tracks and paths and the proposed wind farm infrastructure.

The impact of a peat slide on receptors can be assessed on a relative scale based on the potential for loss of habitat, a historical feature or disruption/danger to the public. To effectively assess the impact, the assessment of exposure effect must also consider the distance between the hazard and the receptor, and the relative elevation between the two.

5.6 Exposure Rating

Similar to the Hazard Rating, the Exposure Ratings were determined using relative ranking process by attributing the different weighting systems to each factor as shown below:

Table 6: Coefficients for Impact Receptor

Receptor	Receptor Coefficients
Tracks/footpaths	2
Non critical infrastructure, minor/private roads	3
Minor watercourses and tributaries, critical infrastructure (pipelines, motorways, dwellings, business properties).	6
Residential Properties/Community, Watercourses/Lochs, important habitat	8

Table 7: Coefficients for Distance from Receptor

Distance from Receptor	Distance Coefficients
> 1 km	1
100 m to 1 km	2
10 m to 100 m	3
<10 m	4

Table 8: Coefficients for Receptor Elevation

Receptor Elevation	Elevation Coefficients
< 10 m	1
10 m to 50 m	2
50 m to 100 m	3
> 100 m	4

The Exposure Rating Coefficient for a particular location is calculated using the following equation:

Exposure Rating Coefficient = Impact Receptor x Distance x Elevation

From the Hazard Rating Coefficient, the risk to stability is can be ranked as set out in Table 9.

Table 9: Exposure Rating

Exposure Rating Co-efficient	Potential Stability Risk (Pre Mitigation)
<10	Very Low
11 to 20	Low
21 to 30	High
31 to 50	Very High
>50	Extremely High

5.7 Rating Normalisation

In order to achieve an overall Hazard Ranking in accordance with the Scottish Government Guidance, the Hazard and Exposure Rating Coefficient derived from the coefficient tables are normalised as shown in Table 10.

Table 10: Rating Normalisation

Hazard Rating		Exposure Rating	
Current Scale	Normalised Scale	Current Scale	Normalised Scale
< 5 Negligible	1	<10 Very Low	1
5 to 15 Low	2	11 to 20 Low	2
15 to 31 Medium	3	21 to 30 High	3
31 to 50 High	4	31 to 50 Very High	4
>50 Very high	5	>50 Extremely High	5

The record of the Hazard Rank Assessment is included in Appendix B of this report.

6 HAZARD RANKING

Having identified the rating coefficients as defined in Section 5 of this report, it is possible to categorise areas of the site with a Hazard Ranking by multiplying the Hazard and Exposure Rating. Hazard Ranking and associated suggested actions matrix are shown in Tables 12 and 13 below:

Table 12 - Hazard Ranking and Suggested Actions

Hazard Ranking		Action Suggested in the Scottish Executive Guidance
17-25	High	Avoid project development at these locations.
11-16	Medium	Project should not proceed unless hazard can be avoided or mitigated at these locations, without significant environmental impact, in order to reduce hazard ranking to low or less
5-10	Low	Project may proceed pending further investigation to refine assessment. Mitigation of hazards maybe required through micro-siting or re-design at these locations.
1-4	Negligible	Project should proceed with monitoring and mitigation of peat landslide hazards at these locations as appropriate.

Table 13 - Hazard Ranking Matrix

Hazard Rating						
	5	Low	Low	Medium	High	High
	4	Negligible	Low	Medium	Medium	High
	3	Negligible	Low	Low	Medium	Medium
	2	Negligible	Negligible	Low	Low	Low
	1	Negligible	Negligible	Negligible	Negligible	Low
		1	2	3	4	5
		Exposure Rating				

Receptor exposure was assessed for each of the four hazard zones using the approach in Section 5. A summary of the Hazard Ranking result for each identified area is summarised in Table 14 and is presented in Figure 6 'Hazard Ranking Zonation Plan'. The zonation is based on a combination of considerations, mainly peat depths, topography and existing land uses.

7 SLIDE RISK AND MITIGATION

7.1 General

The PSRA has shown the site to be of generally negligible with isolated low hazard ranking,. Following receipt of the finalised infrastructure layout it and development specific risk register has been prepared and is provided.

Where the hazard ranking has been lowered through mitigation measures, the original ranking will remain in the overall hazard zoning plan and this should be acknowledged should there be future amendments to the infrastructure layout.

While the specific recommended mitigation in the low ranked areas are proposed and are embedded in the design at EIA stage, it remains necessary for detailed design and construction of the development infrastructure to be undertaken in a competent and controlled manner.

The embedded mitigation and good practice measures are set out in Section 7.2. It should be noted that the mitigation measures defined are not exclusive and other forms of mitigation may well be required and should be developed by designers and implemented during construction of the scheme.

Table 14 - Risk Register

Hazard Area and Infrastructure		Unmitigated Hazard		Mitigated Hazard	
Hazard Area	Infrastructure Affected	Ranking	Key Aspects	Specific Actions	Ranking
H1, H11, H12	No Infrastructure proposed	Negligible.	-	-	Negligible
H2	T1, T2, T3, T5, BP1 and associated infrastructure	Generally Negligible risk across the proposed infrastructure. – Three isolated low risk areas where peat depths were between 0.5m and 2.2m on slopes between 4° and 8°. The wider area comprised of slope up to 15° but no infrastructure is proposed in that area.	Location and topography: South Western side of Craigengillan Hill - Generally sloping west, south-west. Hydrology: Isolated peat up to 2.2m in the vicinity of an unnamed tributary of Marbrack Burn. Peat Depth: (min) 0.0m - (max) 2.20m. Generally <0.50m Slope Gradient: 0° to 15° Exposure: Existing track/proposed infrastructure	No specific actions for this area. This area was probed during both phases of investigation works. No significant peat deposits were recorded in the vicinity of the proposed infrastructure	Negligible

H3	T4, T6, T8 and associated infrastructure	Generally Negligible risk across the proposed infrastructure. - Peat depths were recorded up to 3.0m, although generally 2.0m. Slope gradients ranged between 2° and 4°. The assessment recorded slide risk area of 'Negligible due to the shallow nature of the gradient.	Location and topography: South Western side of Craigengillan Hill – Gentle slope to the west. Hydrology: Peat up to 2.2m in the vicinity of an unnamed tributary of Polshag Burn in the extremities of the west and up to 3.0m in the vicinity of unnamed tributaries of the Craigengillan Burn. Peat Depth: (min) 0.2m - (max) 3.0m. Generally, 1.50m - 2.0m Slope Gradient: 0° to 4° Exposure: Proposed infrastructure	Micro-siting of turbines out of deep peat will reduce the risk further in this area.	Negligible
H4	T10, Substation compound and associated infrastructure	Generally Negligible risk across the proposed infrastructure - Peat depths were recorded up to 4.1m, although generally between 1.5m and 3.0m on mainly 2° but up to 4°. The assessment recorded slide risk area of 'Negligible due to the shallow nature of the gradient.	Location and topography: East of Furmiston Craig and south of Craigengillan Hill – Generally flat lying, but gently sloping east. Hydrology: Peat up to 3.0m in a topographically low area. No water courses in the immediate vicinity. Peat Depth: (min) 0m - (max) 3.0m. Generally, 1.50m - 2.0m Slope Gradient: 2° to 4° Exposure: Proposed infrastructure	Micro-siting of turbines out of deep peat will reduce the risk further in this area.	Negligible

H5	T9, T12 and associated infrastructure	Negligible – Generally negligible risk with isolated zones of low risk areas where thin peat and steep slopes exist and minor water features are in close proximity.	Location and topography: Central Site area – Slightly sloping east. Hydrology: Minor water features (Craigengillan Burn and Black Burn exist). No peat recorded within close proximity to the water features. Peat Depth: (min) 0.0m - (max) 3.00m. Generally, <0.5 – 1.0m Slope Gradient: 4° to 8° Exposure: Minor watercourses, proposed infrastructure. Water Feature – Craigengillan Burn and Black burn	Micro-siting of turbines out of deep peat will reduce the risk further in this area.	Negligible
H6	T11 and associated infrastructure	Negligible – Turbine situated in an area of no peat while locally up to 1.0m across other infrastructure.	Location and topography: Eastern/Central Site area – Slightly sloping east. Hydrology: Minor water features (Hare Strand and Black Burn exist). No peat recorded within close proximity to the water features. Peat Depth: (min) 0.0m - (max) 2.00m. Generally, <0.5 – 1.0m Slope Gradient: 4° to 8° Exposure: Minor watercourses, proposed infrastructure. Water Feature – Hare Strand and Black Burn		Negligible

H7	T13, T16 and associated infrastructure	Low – Isolated zones of low risk areas where topography in generally flat and peat is recorded as consistently deep, up to 4.5m. Proposed infrastructure is in close proximity.	Location and topography: Western Site area – Generally flat, slightly sloping west Hydrology: None Peat Depth: (min) 0.0m - (max) 4.50m. Generally, 2.00m – 2.50m Slope Gradient: <2° to 4° Exposure: Proposed infrastructure. Water Feature – None noted	Micro-siting of turbines out of deep peat will reduce the risk further in this area.	Negligible
H8	T7 and associated infrastructure	Negligible – Generally negligible risk with thin peat across the majority and areas of steep topography. Minor water features are in close proximity.	Location and topography: Western and Central Site area – Slightly sloping east. Hydrology: Minor water features (Craigengillan Burn crossing and tributaries of Black Burn exist). No peat recorded within close proximity to the water features. Peat Depth: <0.5 – 1.0m Slope Gradient:Generally 4° to 8°but up to 15° Exposure: Minor watercourses, proposed infrastructure. Water Feature – Craigengillan Burn and Black burn		Negligible

H9	T14, T15 and associated infrastructure	Negligible – risk with mainly thin or no peat under infrastructure. Generally shallow topography. Minor water features are in close proximity.	Location and topography: Southern/Central Site area – Generally flat, slightly sloping south-east. Hydrology: Minor water features (Black Burn). Thin peat <0.5m recorded within close proximity to the water features. Peat Depth: (min) 0.0m - (max) 2.00m. Generally, <0.5 – 1.0m Slope Gradient: <2° to 8° Exposure: Minor watercourses, proposed infrastructure. Water Feature –Black Burn		Negligible
H10	T17, T18, T19, Borrow Pit 2 and associated infrastructure	Negligible – risk with mainly thin or no peat under infrastructure. Thin peat 0.5m located north of T17. Varying topography. Minor water features are in close proximity.	Location and topography: Southern/Central Site area – Generally sloping south-east, localised steep areas and localised flat areas. Hydrology: Minor water features (Dry Burn). No peat recorded within close proximity to the water features. Peat Depth: (min) 0.0m - (max) 2.10m. Generally, <0.5m Slope Gradient: Varies from <2° to 15° Exposure: Minor watercourses, proposed infrastructure. Water Feature –Dry Burn		Negligible

7.2 Embedded Mitigation

Embedded mitigation includes measures taken during design of the Development to reduce the potential for peat slide risk. In summary the principal measures that have been taken are:

- Locating infrastructure on shallower slopes, where possible; and
- Locating infrastructure on areas of shallow peat (or no peat) where possible.

7.3 Peat Slide Mitigation Recommendations

The following mitigation measures should be adopted post consent stage to validate the PSRA and influence the detailed design of the Proposed Development:

- Verification peat probing on any micro-sited turbine locations undertaken as part of the ground investigation prior to detailed design;
- Identification of areas sensitive to changes in drainage regime prior to detailed design;
- Update the PSRA as necessary following detailed ground investigations;
- Development of a drainage strategy that will not create areas of concentrated flow and will not affect the current peatland hydrology;
- Design of a development drainage system for tracks and hardstanding that will require minimal ongoing maintenance during the operation of the windfarm;
- Inspection and maintenance of the drainage systems during construction and operation;
- Identification of suitable areas for stockpiling material during construction prior to commencement of works; and
- Consideration of specific construction methods appropriate for infrastructure in peat land (i.e. geogrids) as part of design development.

7.4 Pre-Construction Investigations Recommendations

Following completion of this PSRA, it is considered that there no significant benefit in undertaking further intrusive ground investigation to determine peat conditions prior to submission for consent.

Prior to commencement of construction, further confirmatory probing should be undertaken as part of a site wide construction phase intrusive ground investigation.

8 CONCLUSIONS

This PSRA has been undertaken for the proposed Shepherds' Rig Windfarm in accordance with the SEG. The early stages of the assessment included a desk study and site walkover followed by a Phase 1 intrusive investigation exercise with peat probes driven at 100m centres within the study area. This was then supplemented by infrastructure specific probing at the proposed development footprint. The information gathered during this investigation was used to develop a Hazard Ranking across the Proposed Development site.

Through the peat probe surveys, it has been demonstrated that a majority of the site is underlain by thin or negligible deposits of peat. The turbines and associated infrastructure affected by the deep peat are T4, T6, T8, T9, and T13 where peat was recorded up to 3.0 m depth, and at T16 where peat was recorded to 4.5m. However only two turbines lie within an area of low slide risk in relation to peat, these being T13 and T16.

It is proposed that prior to construction all turbines within areas of deep peat are micro-sited into areas of shallower peat to reduce the risk of both peat disturbance and any potential for peat stability issues.

Based on the scope of the study, the PSRA shows the site to be generally of negligible or locally low hazard.

Notwithstanding this, infrastructure should be checked on site and micrositing adopted if required in order to maintain the design objective of avoiding peat slide risk.

APPENDIX A - FIGURES

APPENDIX B - HAZARD RANK ASSESSMENT RECORDS

INFINERGY

ARCUS

- Site Boundary
- Turbine Location
- Met Mast Location
- Tracks and Hardstandings
- Substation
- Construction Compound
- Borrow Pit Search Areas

1:20,000 Scale @ A3

0 0.25 0.5 km

NORTH

Produced By: RL	Ref: 2966-REP-028
Checked By: SC	Date: 22/11/2018

Proposed Site Layout
Figure 1

Shepherds' Rig Wind Farm
Peat Slide Risk Assessment

P:\Projects\Engineering\Engineering EIA\2966 Shepherds' Rig.aprx\2966-REP-028 Fig01 Proposed Site Layout

INFINERGY

ARCUS

- Site Boundary
- Turbine Location
- Met Mast Location
- Tracks and Hardstandings
- Substation
- Construction Compound
- Borrow Pit Search Areas
- Peat Probe Locations

1:20,000 Scale @ A3

0 0.5 1 km NORTH

Produced By: RL	Ref: 2966-REP-025
Checked By: SC	Date: 22/11/2018

Peat Probe Locations
Figure 2

Shepherds' Rig Wind Farm
Peat Slide Risk Assessment

P:\Projects\Engineering\Engineering EIA\2966 Shepherds' Rig.aprx\2966-REP-025 Fig02 Peat Probe Locations