Orsted Limited

Oatfield Wind Farm

Site Investigation & Peat Stability Risk Assessment

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RSK

RSK GENERAL NOTES

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CONTENTS

TABLES

FIGURES

APPENDICES

SITE INVESTIGATION & PEAT STABILITY RISK ASSESSMENT

1 Introduction

1.1 Background

RSK Ireland was commissioned by Orsted to assess the geological site characteristics in relation to the planning application for the Oatfield Wind Farm (the Development) in Co. Clare.

1.2 Purpose

Site Investigation for the purposes of assessing ground conditions at EIA design phase of a proposed wind farm development, Oatfield Wind Farm, Co. Clare. Assessing ground conditions in terms of peat and slope stability risk, subsoil and geological characterisation and classification.

1.3 Scope of Works – Tender

The scope of works was initially specified by the Client at tender phase. The scope of works for ground investigations at tender included the following works;

- Site Investigation
- Peat probing

In consultation with the Client the scope of works was adapted to the site based on observations made by desk study and initial site walk overs and assessments. The actual completed scope of works is detailed in **Section 2**.

This work has been carried out in unison with the EIAR for the proposed development. Therefore, this report will be appended to EIAR **Chapter 10 Soils and Geology** as part of the planning application for the proposed development. The EIAR tender scope includes for a stand-alone Peat Stability Report as well as standalone Site Investigation report, however the two will be merged in this Site Investigation report. This is done with a view streamlining the site geological assessment.

1.4 Statement of Authority

RSK (Ireland) Ltd. (RSK), part of RSK Group, is a consultancy providing environmental services in the hydrological, hydrogeological and other environmental disciplines. The company and group provide consultancy to clients in both the public & private sectors. More information can be found at www.rskgroup.com. The principal members of the RSK EIA team involved in this assessment include the following persons;

- Project Manager & Lead Author: Sven Klinkenbergh – B.Sc. (Environmental Science), P.G.Dip. (Environmental Protection). Current Role: Principal Environmental Consultant. Experience c. 10 years

- Project Scientist: Jayne Stephens - B.Sc. (Environmental Science), PhD (Environmental and Infection Microbiology). Current Role: Environmental Consultant. Experience c. 5 years
- Project Scientist: Deirdre Walsh – B.Sc. (Geology), M.Sc. (Geoscience), PhD (Geomodelling). Current Role: Environmental Consultant
- Project Scientist: Conor Campbell – B.Sc. Environmental Science (hons). Current Role: Environmental Consultant

2 Site Investigation Works & Methods

2.1 Scope of Works – Completed

The completed scope of works included;

- Peat depth probing, 876 no. sampling locations.

2.2 Peat & Slope Stability Risk Assessment Methods

2.2.1 Peat depth probing & topography assessments

Peat depth probing was undertaken at the site including at each proposed potential turbine location, and at proposed locations for other infrastructure.

Depth probing was conducted using a fibreglass depth probe and at each survey point the depth of peat, local incline (incline within a c. 5-25 m radius of the survey point) and grid reference (Irish Grid) were recorded. Notes on observations were also recorded including time of taking photographs, presence of drains etc.

2.2.2 Peat stability numerical assessment

This stability assessment has been undertaken using a relatively simple infinite slope stability approach (Boylan and Long, 2012[1]) (derived from Bromhead's formula (Scottish Gov., 2017[2])), as follows;

$$FoS = \frac{cu}{yz \sin \alpha \cos \alpha}$$

For the purpose of this assessment, the above formula will be referred to as the FoS Formula.

Qualifying peat stability at all peat survey points was done using the following parameters outlined below in **Table 1**.

[1] Boylan, N. and Long, M. (2012) Evaluation of peat strength for stability assessments. Geotechnical Engineering Volume 167 Issue GE5, Institution of Civil Engineers (ICE)

[2] Scottish Government (2017) Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments

Table 1 Formula parameters & symbols

Symbol	Description	Unit
FoS	Factor of Safety	FoS
c_u	Effective cohesion or Undrained Shear Strength	kPa
y	Bulk Unit Weight of Peat	kN/m^3
z	Depth to failure plain	m
α	Slope Angle	Degrees

The Factor of Safety (FoS) result will range from 0 to infinity, however the following ranges are described and classified in **Table 2**.

Table 2: Factor of Safety (FoS) Classifications (Scottish Gov., 2017)

Description	FoS Value Range	Classification
Stable	>1.3	Acceptable
Marginally Stable	1.0 > < 1.3	Acceptable
Unstable	<1.0	Unacceptable

As per the guidance listed in **Section 2** of this report, FoS values of 1.0 or greater are considered acceptable in terms of peat stability (Scottish Gov., 2017).

The assessment has been completed on the basis of 2 no. scenarios, which are as follows;

1. Scenario A – Peat stability in terms of the receiving environment as is, that is using the depth of peat observed and recorded during site surveys.
2. Scenario B – Peat stability in terms of the in-situ peat with 1m fill (presumed peat) placed on top, that is using the depth of peat observed and recorded during site surveys plus 1 metre fill (depth + 1.0m). This is the assessment worst case scenario, and this will be used to assess stability at proposed infrastructure locations.

Undrained shear strength (effective cohesion) (c_u) has been derived by means of assessing moisture content results, which is; there is a correlation between peat moisture content and shear strength (effective cohesion). Shear vane testing has been carried out on the site however, shear vane test, or in situ barrel shear tests are not considered representative of shear strength characteristics of the peat being assessed in terms of stability assessment given numerous flaws with the test itself, namely; the shear vane test evaluates the shear strength where by the force is exerted in a vertical and cylindrical plane, which is not indicative of forces at play with respect slope stability or mass movement; and fibres and roots within the peat will effect the test itself, potentially exaggerating, or giving misleading data. The following graph presents conceptual shear strength values for peat (Boylan et. al, 2008).

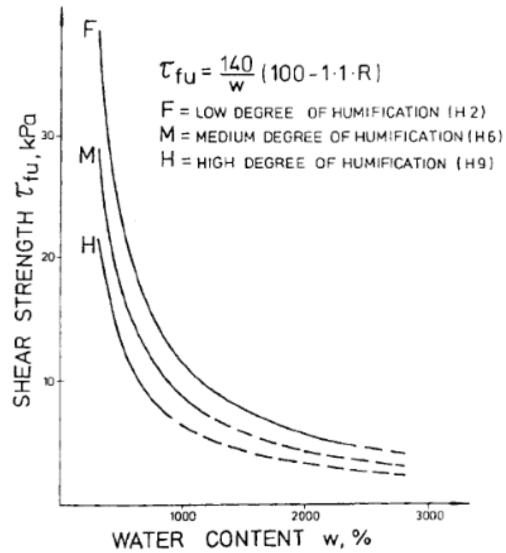

Figure 1: Correlation between moisture content and shear strength of peat (Boylan et al., 2008[3])

The following table presents the typical minimum, average and maximum moisture content which been used to determine indicative shear strength values for the Site.

Table 3: Peat moisture content range & indicative shear strength

Category	Moisture Content (%)	Indicative Shear Strength (kPa)
Minimum	200	>20
Average	750	10-20
Maximum	1500	<10

For the purpose of assessing peat stability for the Site a conservative undrained shear strength (effective cohesion) value will be used in numerical assessments, i.e. 3.5kPa.

In situ bulk density (kg/m3), or bulk unit weight (kN/m^3) of peat (y) is typically within the range of 900-1100kg/m3 (Munro, 2004[4]), or 8.8-10.8kN/m^3. For the purpose of assessing peat stability for the Site a conservative bulk unit weight value will be used in numerical assessments i.e., 11kN/m^3.

The depth to failure plane (z) is presumed to be thickness or depth of peat at any given sampling point being assessed, however it should be noted that the failure plane can potentially be within peat (peat on peat movement), or the substrate i.e., weathered rock or underlying soils.

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[3] Boylan N., Jennings P. and Long M. (2008) Peat slope failure in Ireland. Quarterly Journal of Engineering Geology and Hydrogeology.

[4] Munro R. (2004) Dealing with bearing capacity problems on low volume roads constructed on peat. Roadex, Northern Periphery.

Slope angle (α) is presumed to be topographical incline measured on site / evaluated using high resolution elevation data at any given sampling point being assessed, however it should be noted that the slope angle (α) relates to the failure plane angle, which is presumed to be the peat and substrate interface, and which is presumed to be parallel to the surface when using FoS Formula (Infinite Slope Formula). In reality the underlying substrate is unlikely to be parallel to the surface topology.

It should be noted that FoS Formula does not account for forces related to the toe and head of an area or mass of soil with the potential for mass movement, which is; in reality the Infinite Slope formula will likely exaggerate stability conditions negatively.

The following table lists parameter values, including inferred conservative parameter values used in numerical assessments.

Table 4: Formula parameters, symbols & inferred conservative values

Symbol	Description	Value	Unit
c_u	Effective cohesion	3.5	kPa
y	Bulk Unit Weight of Peat	11	kN/m^3
z	Depth to failure plain	Depth of Peat	m
α	Slope Angle	Surface Topography	Degrees

2.2.3 Risk Matrices & Ranking

In assessing the risk in relation to peat stability on site it is important to rate the risk in terms of the hazard, the likelihood and the consequences if any such issue should arise. Therefore, the slope stability risk assessment considers the following parameters, which are assessed by means of a series of risk matrices (Scottish Gov., 2017).

Table 5: Parameters included in risk matrices and assessed

Category	Description
Landslide History	Considers the likelihood of landslide events occurring based on the history of the site, including the current site use.
Factor of Safety	As described above, includes the following; • Peat depth • Peat quality / condition • Moisture content • Incline (surface topography) • Shear strength Bulk unit weight of peat
Substrate Topology	Identifying and qualifying variance in substrate topology and qualifying variance from theory underlining the stability formula used i.e., Infinite Slope (Parallel and no foot and head forces)
Significance of Receptor	Qualifying potential receptors in terms of significance.
Distance to Receptor	Qualifying localised proposed development areas in terms of distance to nearest receptor.

Considering the above parameters, the stability assessment follows the following steps;

1. FoS_{RAW} - Assess the site in terms of soil stability using the FoS Formula and calculate a Factor of Safety (FoS) using the *raw* data. This step is considered as preparation of the data obtained for the site i.e., translating the data to a value related to stability, and is not considered the final output of the stability assessment.
2. $FoS_{ADJUSTED}$ - Assess the FoS_{RAW} values in terms of suitability of the application of FoS Formula by considering the history of landslides in relation to the proposed site, and the topology of the substrate compared to the surface topology of the site. This is done by means of a risk matrix which qualifies the point, and also applies a coefficient for the next risk assessment step.
3. Risk Ranking RR_{SF} - The $FoS_{ADJUSTED}$ data is assessed in terms of significance of associated receptor. This is done by means of a risk matrix which qualifies the point, and also applies a coefficient for the next risk assessment step.
4. Risk Ranking RR_{D} – The RR_{SF} data is assessed in terms of distance to associated receptor. This is done by means of a risk matrix which qualifies the point.

Results and conclusions made by means of the above risk assessment are viewed as two tiered, that is;

1. The likelihood of a stability issue or landslide while considering the significance of the receptor (RR_{SF}).
2. The consequence of a stability issue or landslide while considering the distance to the receptor (RR_{D}).

For example, (1) The risk of a stability issues or landslide occurring at location X and impacting on receptor Y is negligible. (2) Considering the short distance from location X to receptor Y, in the unlikely event that an issue did arise the risk of adverse impacts effecting receptor Y is moderate.

Risk Matrices are presented in **App B (b)**.

2.2.4 Interpretation of Results

Results of the numerical stability risk assessment are modelled / mapped and interrogated in the context of site topography, site conditions, the proposed development and receptor sensitivity and susceptibility. Interpretation of results in the context of the development, activity and any potential consequences is an important step of the slope stability risk assessment. It is important to consider groups of data sets and site-specific dynamics at a particular location (for example; at a proposed turbine location) and to qualitatively risk assess stability in the context of all observed site characteristics, including; topography, substrate topology, geology, hydrogeology, and hydrology, etc. For example; data might indicate a single point of unacceptable FoS / stability, however this needs to be considered in context of neighbouring data and actual site conditions, such as the presence of deep peat within a localised basin confined by shallow bedrock at the surface at neighbouring points, that is; deep, "unstable" peat (by numerical model) observed to be confined by shallow bedrock does not equate to an elevated risk of a catastrophic landslide event occurring, but does equate to potential localised stability issues arising if excavating at that particular location with deep peat.

In turn, any potential stability hazard must be considered in risk assessments in terms of potential consequences to receptors, and not simply likelihood of a stability issues arising. For example; in an area with low risk in terms of stability or Factor of Safety (FoS), but immediately and directly upgradient of a sensitive receptor such as a surface water body, in the unlikely event (low risk = acceptable FoS) that a significant stability issue should arise, due to the proximity to the receiving receptor the consequences of such an event have the potential to be significant.

3 Baseline Conditions

3.1 Site Description & History

There are no recorded landslide events in close proximity to the Site (GSI, Accessed October 2023). There was no indications of stability issues or mass movement observed on the Site during site surveys.

The Geological Survey of Ireland (GSI) has developed a Landslide Susceptibility map[5] The Site is mapped as having areas ranging from of 'Low Risk' to 'Moderate Risk' in terms of landslide susceptibility. T6 and T10 are in areas which have been identified as 'moderately high' risk in terms of landslide susceptibility. There is potential of 'High Risk' to landslide susceptibility to the north of the proposed T1 location.

3.2 Site Geology

Consultation with Geological Survey Ireland Spatial Resources (GSI) indicates that the bedrock at 1:1,000,000 scale the Site is underlain by;

- Cornagnoe Formation (CE) - The formation contains two principal lithologies, grey mudstones and mottled siltstones/mudstones. Both lithologies include thin

[5] Geological Survey of Ireland (GSI) (ND) Geological Survey Ireland Spatial Resources [Online] - Available at: http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 [Accessed: October 2023]

beds of graptolitic mudstones from which graptolites of Llandovery age. Purple Grits (pg) are assigned here to the Cornagnoe Formation and underly T1 and T7.

- Broadford Formation (BF) - Dominated by grey banded mudstones but also contains abundant arenaceous horizons. This formation underlies T2 and T4.
- The Old Red Sandstone (ORS) - Red mudstones, siltstones and sandstones, and poorly sorted, polymict pebble conglomerates and breccias. This formation underlies T3, T4, T5, T6, T8, T9, T10, T11, both storage areas and the substation.

The Old Red Sandstone is the most dominant bedrock and unconformably overlies the older inliers of Lower Paleozoic mudstones and siltstones of the Broadford Formation and the Cornagnoe Formation. There are a number of faults present including east-west fault south of T1 proposed T1 hardstand and a north south orientated fault to the east side of T7.

3.3 Site Soils & Subsoils

Consultation with available maps (GSI, EPA accessed October 2023) indicate a number of soil types at the site location including Blanket peat (BktPt) and 'Acid Shallow, lithosolic or podzolic type soils potentially with peaty topsoil' (AminSRPT) in the Eastern Development Area (DA). The Western DA is a mix of 'Acid Deep Poorly Drained Mineral' (AminPD) soil covering large areas with smaller pockets of 'Acid Poorly Drained Mineral Soils with Peaty Topsoil' (AminPDPT), 'Acid Deep Well Drained Mineral' (AminDW), and 'Acid Shallow Well Drained Mineral' (AminSW) soil also mapped.

There is a variety of subsoil types across the site including peat (BktPt), TDSs sandstone till (Devonian) and TLPSsS, sandstone and shale till (Lower Paleozoic). **Table 6** summarises the soils and each infrastructure unit and the assumed subsoil depth.

Peat depths observed on the Site are generally 'Rock' to 'shallow' with isolated pockets of moderately deep peat. Depths at most sampling points are within the range of 0.01-0.5m and areas with deeper peat have been avoided in terms of the Development footprint. Peat depths are mapped, and the peat database presented in **Appendix 10.1 App A and App B(a)** respectively.

Table 6: Soils, subsoils and assumed subsoil depth summary for the main infrastructure units

DA	Turbine No. / Unit	Soil	Subsoil	Peat depth (m)	Assumed subsoil depth (m) (based on GW vulnerability)
W	T1	AminSW	Bedrock at or close to surface	0.01 - 1	0.9
W	T2	Amin PDPT	Till	0.01 - 1.5	2
W	T3	AminPD	Till	0.01 - 0.5	2
W	T4	AminPD	Till	0.01 - 0.5	2
W	T5	AminPD	Till	0.01 - 0.5	2
W	T6	Amin SRPT	Bedrock at or close to surface	0.01 - 1.5	0.9
W	T7	AminPD	Till	0.01 - 0.5	2
E	T8	BktPt	Peat	0.01 - 0.5	2
E	T9	BktPt	Peat	0.01 - 1.5	2
E	T10	Amin SRPT	Bedrock at or close to surface	0.01 - 1	0.9
E	T11	BktPt	Peat	0.01 - 4	2
W	Substation	AminDW	Till	0.01 - 1	2
W	Met Mast	AminPD	Till	0.01 - 2*	2
W	Compound/ Storage Area A	AminPD	Till	0.01 - 0.5	2
E	Compound/ Storage Area B	BktPt	Peat	0.01 - 2	2
GCR	Loopin area	AminSP AminDW AminSW	Bedrock at or close to surface / Till		0.9

*inferred from closest surveyed infrastructure unit (T2 track)

3.4 Topography & Substrate Topology

The topography at and in the immediate area surrounding the Site is variable. There is some elevation and incline variability. Including an increase in elevation to the northwest of the western area of the site. At lower elevations the topography is relatively flat or comprising of low magnitude inclines.

The substrate topology is observed to be moderately variable i.e. variable peat depth. Areas with generally shallower peat have less variance from the substrate however such areas are indicatively low risk in terms of stability given the peat is shallow.

3.5 Hydrology & Climate

Several mapped rivers run through and directly adjacent to the Site. Extensive constructed drainage channels associated with forestry and agriculture activities exist at the site.

3.6 Receptors

Receptors associated with the Proposed Development footprint are generally limited to non-critical infrastructure and water bodies.

Receptors associated with the Proposed Development footprint including streams, rivers, lakes and groundwater, are considered highly sensitive receptors considering;

- Water Framework Directive (WFD) status (2016-2021) generally ranging from Good to High, with some sections ranging to Poor. The principal objective of the WFD is to achieve good status or higher in all waters and to ensure that status does not deteriorate in any waters.
- The down-stream designations (sensitive protected areas e.g., SAC, SPA) associated with the catchment and the sensitive habitats and species associated with same.
- The designation of all waterbodies within the boundary of the Site and downstream surface water bodies and all groundwater bodies as sources of drinking water.
- There are no Salmonid River Regs or Nutrient sensitive Rivers in the vicinity of the development.
- Designated Shellfish areas in the Shannon Estuary catchment; downstream of the site in the Mouth of the Shannon (HAs 23;27) Code: IE_SH_060_0000
    1. West Shannon Ballylongford; Code: IE_SH_060_0000
    2. West Shannon Poulnasherry Bay; Code: IEPA2_0021
    3. West Shannon Carrigaholt; Code: IEPA2_0022
    4. West Shannon Rinevella; Code: IEPA2_0023

Ultimately, all surface water and groundwater associated with the Site is considered sensitive and must be protected.

Risk to receptors must consider both the hazard, and likelihood of adversely impacting on any given sensitive receptor, and therefore parameters such as distance from potential source of hazard to receptor, pathway directness and/or connectivity, and assimilative capacity of the receiving water body should also be considered.

Distance of proposed turbine and hard stand areas have been assessed in terms of distance to associates receptors (surface water features).

4 Site Investigation Data & Results

4.1 Peat Depth Data

Approximately 876 no. peat depth probe locations were assessed at the Site. Georeferenced and categorized peat depth locations are presented in **Appendix 10.1 - App A**. Peat depth data is presented in **Appendix 10.1 - App B(a)**. Number of probe locations by Depth Category are presented in **Table 7**.

Table 7: Peat depth probe points per depth category

Peat depth category	Number of probes	Percentage of probes
Rock (0.00-0.01 m)	157	17.9%
Very Shallow (0.01-0.5 m)	547	62.4%
Shallow (0.5-2.0 m)	148	16.9%
Moderately Deep (2.0-3.5m)	21	2.4%
Deep (3.5-5.0 m)	3	0.3%
Very Deep (>5.0 m)	0	0.0%
TOTAL	876	100%

4.2 Peat Stability Risk Assessment Results

Review of peat stability assessment result data and maps as presented in **Appendix 10.1 - App C** indicate that the factor of safety is generally acceptable and very low to low stability risk across the site with the exception of some minor isolated areas such as T1, T2, T5 and T10 where there are areas of steeper slopes (9°-15°) or northwest of T11 and along the track to T10 where there is a pocket of deeper peat (Moderately Deep to Deep).

Summary of risk at the site under varying conditions and scenarios is presented in in the following tables (**Table 8** and **Table 9**).

The two unstable points are at T2 where there is a strong slope (c. 14°) and along the track to T10 where there is Moderately Deep peat (c. 2m) recorded on a moderate slope (c. 6°). Both of these locations are isolated with surrounding 'Acceptable' locations.

Table 8: Factor of safety (adjusted) at peat probe locations

FoS (Adj.)	Acceptable	Marginally Stable	Unstable
Scenario A	876	0	0
Scenario B	850	24	2

The Risk ranking distance across the Site is generally very low. There are areas which are low to moderate where the peat probe locations are closer to sensitive surface water receptors (including T4, T7, T8 and the track between T6 and T7).

Table 9: Risk ranking (distance) at peat probe locations

RR (Dist.)	Very Low	Low	Moderate	High
Scenario A	690	160	26	0
Scenario B	666	180	30	0

Areas of elevated stability risk, even at a localised scale, are considered geo-hazards requiring mitigation.

4.3 Peat Stability Risk Assessment Interpretation

Table 10 presents the interpretation of stability risk assessment data in the context of stability, or factor of safety (FoS) (Adjusted, Scenario B) at each significant development infrastructure unit.

Table 10: Peat stability risk assessment – factor of safety (adjusted) (Scenario B) at main infrastructure units and portions of track.

DA	Turbine No. / Unit	Peat depth	Slope	FoS_{ADJ} (Factor of Safety (adjusted))	Geo-Hazard / Comment (To consider at detailed design / preconstruction planning)
W	T1	0 - 0.8	1.5 - 13.4	Acceptable	'High Risk' of landslide to the north of the turbine hardstand
W	T2	0 - 1.1	1.2 - 14.2	Acceptable	
W	T3	0.1 - 0.3	3.7 - 6.4	Acceptable	
W	T4	0 - 0	6.2 - 7.9	Acceptable	
W	T5	0 - 0.4	0.9 - 14.4	Acceptable	
W	T6	0 - 1.1	0.7 - 5.2	Acceptable	
W	T7	0 - 0.3	1 - 12.9	Acceptable	
E	T8	0 - 0.5	0.8 - 5.8	Acceptable	
E	T9	0.1 - 1.2	0.8 - 3.1	Acceptable	
E	T10	0 - 0.9	5.4 - 10.1	Acceptable	
E	T11	0 - 3.8	1.2 - 4.8	Acceptable	Some deeper peat to the north.

DA	Turbine No. / Unit	Peat depth	Slope	FoS_{ADJ} (Factor of Safety (adjusted)	Geo-Hazard / Comment (To consider at detailed design / preconstruction planning)
W	Substation	0 - 0.9	1.3 - 6.8	Acceptable	
W	Met Mast*	0.01 - 2	1 – 1.3	Acceptable	
W	Storage Area A	0 - 0.1	1.3 - 12.5	Acceptable	
E	Storage Area B	0 - 2	0.8 - 2.8	Acceptable	
W	Main track to T1*	0.01-0.5	2.4-6	Acceptable	
W	Main track to T2 and met mast	0 - 1.9	0.2 - 7.7	Acceptable	
W	Main track to T3*	0.01-0.5	1-3	Acceptable	
W	Main track to T5	0 - 0.6	0 - 7.5	Acceptable	
W	T5 to T6 track	0 - 0.9	0.9 - 4.5	Acceptable	
W	T6 track	0 - 1.2	0.9 - 3.9	Acceptable	
W	T6 to T7 track	0 - 0.4	0.8 - 8	Acceptable	
W	Main track to T4	0 - 0.4	0.7 - 12.2	Acceptable	
W	Main track to Substation	0 - 0.5	0.8 - 5.3	Acceptable	
E	East entrance to T9*	0 - 0	0.9 - 1.2	Acceptable	
E	T9 to Compound	0 - 0.4	0.6 - 4.9	Acceptable	
E	Compound to T10	0 - 2.1	0.6 - 7.9	Acceptable	A small pocket of deeper peat, surrounded by shallow peat midway up the track
E	Compound to T8	0.1 - 0.5	0.8 - 6.4	Acceptable	

DA	Turbine No. / Unit	Peat depth	Slope	FoS_{ADJ} (Factor of Safety (adjusted)	Geo-Hazard / Comment (To consider at detailed design / preconstruction planning)
E	Compound to T11	0 - 0.9	0.7 - 8.8	Acceptable	

*Inferred from nearby peat probe points

The following table (**Table 11**) presents the interpretation of stability risk assessment data in the context of stability (factor of safety (FoS)), receptor type (RR_{SF}) and distance to receptor (RR_D) at each significant development infrastructure unit and portion of new access track length.

Table 11: Peat stability risk assessment – risk ranking (distance) (Scenario B) at main infrastructure units and portions of track

DA	Turbine No. / Unit	RR_D (Ranked Risk considering Distance to Sensitive Receptors)	Receptor / Comment (Important to consider when carrying out detailed design and preconstruction planning)
W	T1	Very low	
W	T2	Very low	
W	T3	Very low	
W	T4	Low	Close proximity to a surface water feature
W	T5	Very low	
W	T6	Very low	
W	T7	Low	Close proximity to a surface water feature
E	T8	Low	Close proximity to a surface water feature
E	T9	Very low	
E	T10	Very low	
E	T11	Very low	
W	Substation	Very low	
W	Met Mast	Very low / low	Inferred from nearby data, close proximity to nearby surface water feature
W	Storage Area A	Low	Close proximity to a surface water feature

DA	Turbine No. / Unit	RR_D (Ranked Risk considering Distance to Sensitive Receptors)	Receptor / Comment (Important to consider when carrying out detailed design and preconstruction planning)
E	Storage Area B	Very low	
W	Main track to T1*	Very low	
W	Main track to T2 and met mast	Very low / low	Close proximity to a surface water feature
W	Main track to T3*	Very Low	
W	Main track to T5	Very Low	
W	T5 to T6 track	Very Low	
W	T6 track	Very Low	
W	T6 to T7 track	Very Low to Moderate	Close proximity to a surface water feature
W	Main track to T4*	Low / Moderate	Close proximity to a surface water feature
W	Main track to Substation	Very Low	
E	East entrance to T9*	Very Low	
E	T9 to Compound	Very Low	
E	Compound to T10	Very Low	
E	Compound to T8	Low	Close proximity to a surface water feature
E	Compound to T11	Very Low	

*Inferred from nearby peat probe points

5 Data Gap Analysis

Not all areas of the Site were peat probed and this is due to the superficial nature of the peat and low risk. The Western DA had very little peat present.

A few shear vane readings were taken which gave variable readings between 20 and 120kPa reflecting the shear strength differences between the peat and till subsoil.

No boreholes or trial pits, subsoil or sampling and analysis was undertaken during the site visits.

The Scenario B with a 1m surcharge used in this risk assessment gives indicative values only. A Geotechnical Clerk of Works will be employed during the construction phase in order to continuously monitor areas of peat. Ongoing physical stability checks and calculations will be undertaken in order to verify that safety standards are being met.

6 Conclusions

Peat stability

Peat depth across the site is generally very shallow with the exception of isolated pockets of deeper peat in the Western DA. There was no very deep peat observed at the site (**Appendix 10.1 - App A**).

The Factor of Safety (Adjusted) (Scenario B i.e., 1m surcharge) at peat probe locations is generally Acceptable with the exception of a few marginally stable / unstable point locations associated with deeper peat and/or steeper inclines (**Appendix 10.1 - App C(a)**).

The Risk Ranking (Distance) Scenario B i.e., 1m surcharge) at peat probe locations is generally Very Low to Low with the exception of a few moderate or risk point locations associated with deeper peat and/or steeper inclines and/or close proximity to sensitive receptors (**Appendix 10.1 - App C(b)**).

7 Caveats & Recommendations

The risk of landslides occurring on the proposed site under worst case scenario conditions (conservative values and Scenario B (+1m)) has been determined to be generally very low to low however, the following points should be noted;

- The low-risk classification is largely driven by shallow peat depths at sampling points associated with proposed infrastructure locations, and by the undulating nature of the substrate topology, however the potential for moderate to deeper areas of peat suggests that soil stability at a highly localized scale may give rise to some difficulty e.g. collapse of side walls in excavations, etc. Such potential issues give rise to the need for vigilance during and after the construction phase of the proposed development. All works are to be supervised and monitored by a competent person (Geotechnical Engineer) throughout the construction phase. The site is to be monitored at a reasonable frequency during the operational phase of the proposed development. The frequency of monitoring during the operational phase will be conducted at a high frequency (e.g. weekly) during the initial months, and will reduce gradually (e.g. monthly) over the following year minimum, or until site conditions are observed to be stable.

- The purpose of this report is to assess the proposed infrastructure units associated with the proposed development. The proposed site contains some existing infrastructure including roads and constructed drainage. Furthermore the site area, relative to the development footprint is large. The assessment/s reported here are limited to sampling point locations which have been executed to assess the proposed locations of new infrastructure units. The proposed site is mapped as having areas classified as low to moderate risk with some small areas of high risk in terms of landslide susceptibility the footprint of the existing and proposed development does not include these higher risk areas.
- Through EIA, constraint identification and design process, the development footprint avoids areas of unacceptable risk (i.e. high risk in terms of landslide susceptibility or to hydrogeological areas). Mitigation measures limiting all works to the development footprint as far as practical (vehicle movements, personnel movements, temporary storage, etc) and otherwise will avoid areas of elevated risk or close to sensitive receptors.
- Considering the variability of subsoil and bedrock depths further intrusive ground investigation must be carried out prior to construction in line with infrastructure manufacturer specification in order to assess the specific ground conditions at each of the infrastructure units. Geotechnical testing is required for turbine and substation foundations as well as anywhere engineering controls are being used as a mitigation measure such as the potential requirement for a retaining wall at T4.
- Should unfavourable ground conditions being encountered engineering controls such as piling can be utilised pending suitable site investigations.