APPENDIX 8-1

GEOTECHNICAL AND PEAT STABILITY REPORT

FEHILY TIMONEY
30 YEARS

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

GEOTECHNICAL & PEAT STABILITY REPORT

COOLE WIND FARM

Prepared for: **MKO**

Date: **February 2021**

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GEOTECHNICAL & PEAT STABILITY ASSESSMENT REPORT
COOLE WIND FARM

User is responsible for Checking the Revision Status of this Document

Rev. No.	Description of Changes	Prepared by:	Checked by:	Approved by:	Date:
0	Draft for Comment	IH	PJ	BdH	29.10.20
1	Update following revisions to layout	IH	PJ	BdH	17.12.20
2	Update following revisions to layout	IH	PJ	BdH	13.01.21
3	Updates following Client comments	IH	PJ	BdH	16.02.21

Client: MKO Ltd

Keywords: Geotechnical, Peat Stability, Peat Failure, Ground Investigation, Risk Assessment

Abstract: Fehily Timoney and Company (FT) were engaged by MKO to undertake a geotechnical assessment of the proposed Coole Wind Farm site with respect to peat stability. As part of the geotechnical assessment of the proposed development, FT completed walkover surveys at the site. The findings of the geotechnical and peat stability assessment showed that the site has an acceptable margin of safety and is suitable for the proposed wind farm development.

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1. NON-TECHNCIAL SUMMARY

Fehily Timoney and Company (FT) was engaged by McCarthy Keville O'Sullivan (MKO) on behalf of Coole Wind Farm Ltd to undertake a geotechnical and peat stability assessment of the proposed Coole wind farm site. In accordance with planning guidelines compiled by the Department of the Environment, Heritage and Local Government (DoEHLG), where peat is present on a proposed wind farm development, a peat stability assessment is required.

A walkover including intrusive peat depth probing, desk study, stability analysis and risk assessment was carried out to assess the susceptibility of the site to peat failure following the principles in Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, 2017).

The findings, which involved analysis of over 200 locations, showed that the site generally has an acceptable margin of safety and is considered to be at low risk of peat failure/slide. A number of deeper peat areas are present on site which will require specific construction methods, but do not represent a peat slide/failure risk. The findings include recommendations and control measures for construction work in deep peat lands to ensure that all works adhere to an acceptable standard of safety.

The proposed wind farm comprises 15 no. wind turbines and associated infrastructure. A 1.2km section of the wind turbine delivery route to the south of the Proposed Wind Farm site which passes over an area of bogland is included in this assessment.

The site consists of a series of bogs which have formed in poorly drained topographical depressions which comprises intact deep peat and partially cutaway peat with an extensive drainage network. Prior to the growth of the bogs the area would have comprised water-logged and shallow lakes, which since the end of the last Ice Age have become silted, hence the formation of the blanket peat areas. The site has been harvested using mechanical harvesting equipment resulting in well drained and extensively trafficked peat.

Peat thicknesses recorded during the site walk-over and ground investigation ranged from 0 to 7.8m with an average of 3.0m. Depths of soft ground (including the thickness of the peat) of in excess of 12m were recorded on site.

Slope inclinations at the main infrastructure locations range from 0 to 3.0 degrees. The flat topography/nature of the terrain on site highlights the low risk of peat failure.

Ground conditions comprised mainly of peat overlying typically shell marl overlying lacustrine soil overlying localised glacial till.

In terms of likely construction techniques, with the exception of turbine T5 and T15 all turbines and their associated crane hardstands are likely to require a piled foundation as a result of the depth of peat and soft lacustrine deposits present. In addition, it is likely that a piled foundation will be required for the sub-station building. The sub-station platform and construction compound platform will likely be constructed using floating techniques. The proposed construction methods for the new proposed access roads are both floated and excavated techniques. This means that the volume of peat to be excavated and managed at the site is minimal.

A walk-over including intrusive peat depth probing, a ground investigation including trial pits and window sampling, desk study, stability analysis and risk assessment were carried out to assess the susceptibility of the site to peat failure following the principles in Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (Scottish Executive, 2017).

The purpose of the stability analysis is to determine the stability i.e. Factor of Safety (FoS), of the peat slopes. The FoS provides a direct measure of the degree of stability of a peat slope. A FoS of less than 1.0 indicates that a slope is unstable; a FoS of greater than 1.0 indicates a stable slope. An acceptable FoS for slopes is generally taken as a minimum of 1.3.

The stability analysis, which analysed the main infrastructure locations on site, generally showed results above the minimum acceptable FoS of 1.3 and hence have a satisfactory margin of safety except for 2 no. locations where FoS of 1.23 and 1.20 were calculated.

The locations where the lower FoS was calculated were at turbine T9 and a proposed section of access road south of turbine T12. The lower FoS corresponds to areas of deeper peat which are in topographical depressions and would not be at risk from a peat slide. There is a safety risk within the deeper peat areas during construction which can be overcome by adopting specific construction methods suitable for working in deep peat areas. Consequently, these areas have an elevated construction risk and will be subject to additional mitigation/control measures. In essence, excavations of peat at these locations will not occur and rather piled foundations and floating roads methodologies will be employed where possible.

Based on the findings of the peat stability assessment, the proposed Coole wind farm site and associated works has an acceptable margin of safety and is considered to be at low risk of peat failure/slide. A number of deeper peat areas are present on site which will require specific construction methods, but do not represent a peat slide/failure risk. The findings include recommendations and control measures for construction work in deep peat lands to ensure that all works adhere to an acceptable standard of safety.

In summary, the Coole wind farm site has an acceptable margin of safety and is considered to be at **low** risk of peat failure.

2. INTRODUCTION

2.1 Fehily Timoney and Company

Fehily Timoney and Company (FT) is an Irish engineering, environmental science and planning consultancy with offices in Cork, Dublin and Carlow. The practice was established in 1990 and currently has about 70 members of staff, including engineers, scientists, planners and technical support staff. FT deliver projects in Ireland and internationally in our core competency areas of Waste Management, Environment and Energy, Civils Infrastructure, Planning and GIS and Data Management.

2.2 Project Description

FT was engaged in September 2020 by MKO on behalf of Coole Wind Farm Ltd to undertake a geotechnical & peat stability assessment of the proposed Coole wind farm site.

The Coole wind farm site comprises a cut-away blanket peat area of approximately 4.1km^2. The site is located close to the eastern boundary of Co. Westmeath. The village of Coole is 3km southeast of the site. The surrounding landscape is predominately flat with land-use comprising forestry, agricultural land and both intact and cutaway peatland.

A 1.2km section of the wind turbine delivery route to the south of the wind farm which passes over an area of bogland has also being included in this assessment.

The development comprises of the following:

(1) up to 15 no. wind turbines with a tip height of up to 175 metres and all associated foundations and hardstanding areas,

(2) 1 no. onsite electrical substation including control building, associated electrical plant and equipment, welfare facilities and a wastewater holding tank,

(3) 1 no. temporary construction compound,

(4) provision of new site access roads, upgrading of existing access roads and hardstanding areas,

(5) excavation of 1 no. borrow pit,

(6) all associated underground electrical and communications cabling connecting the turbines to the proposed onsite substation,

(7) construction of 26 km of underground electricity cabling to facilitate the connection to the national grid from the proposed onsite substation located in the townland of Camagh to the existing 110kV Mullingar substation located in the townland of Irishtown,

(8) upgrade works to the existing 110kV Mullingar substation consisting of the construction of an additional dedicated bay to facilitate connection of the cable,

(9) construction of a link road between the R395 and R396 Regional Roads in the townland of Coole to facilitate turbine delivery,

(10) junction improvement works to facilitate turbine delivery, at the N4 junction with the L1927 in the townland of Joanstown, on land to the South East of railway line level crossing on the L1927 in the townland of Culvin, the L1927 and L5828 junction in the townland of Boherquill and the L5828 and R395 junction in the townland of Corralanna,

(11) drainage

(12) forestry felling

(13) signage, and

(14) all associated site development works.

The peat depth data recorded by AGEC during a site walk-over during December 2016, by HES in 2012 and 2016 and by FT in September 2020 have been used in the assessment of peat stability for the proposed wind farm site. A ground investigation in the form of trial pits and window sampling was also carried out by HES in 2016. An intrusive ground investigation was undertaken by GII during July 2020.

2.3 Peat Stability Assessment Methodology

FT undertook the assessment following the principles in Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, 2nd Edition (PLHRAG, 2017). The Peat Landslide Hazard and Risk Assessment Guide (PLHRAG) is used in this report as it provides best practice methods to identify, mitigate and manage peat slide hazards and associated risks in respect of consent applications for electricity generation projects.

The best practice guide was produced following peat failures in the Shetland Islands, Scotland in September 2003 but more pertinently following the peat failure in October 2003, during the construction of a wind farm at Derrybrien, County Galway, Ireland.

The geotechnical and peat stability assessment at the site included the following activities:

(1) Desk study

(2) Site reconnaissance including shear strength and peat depth measurements

(3) Peat stability assessment of the peat slopes on site using a deterministic and qualitative approach

(4) Peat contour depth plan – compiled based on the peat depth probes carried out across the site by FT, AGEC and HES

(5) Factor of safety plan – compiled for the short-term critical condition (undrained) for over 200 no. FoS points analysed along the proposed infrastructure envelope on site

(6) Construction buffer zone plan – identifies areas with an elevated or higher construction risk where mitigation/control measures will need to be implemented during construction to minimise the potential risks and ensure they are kept within an acceptable range

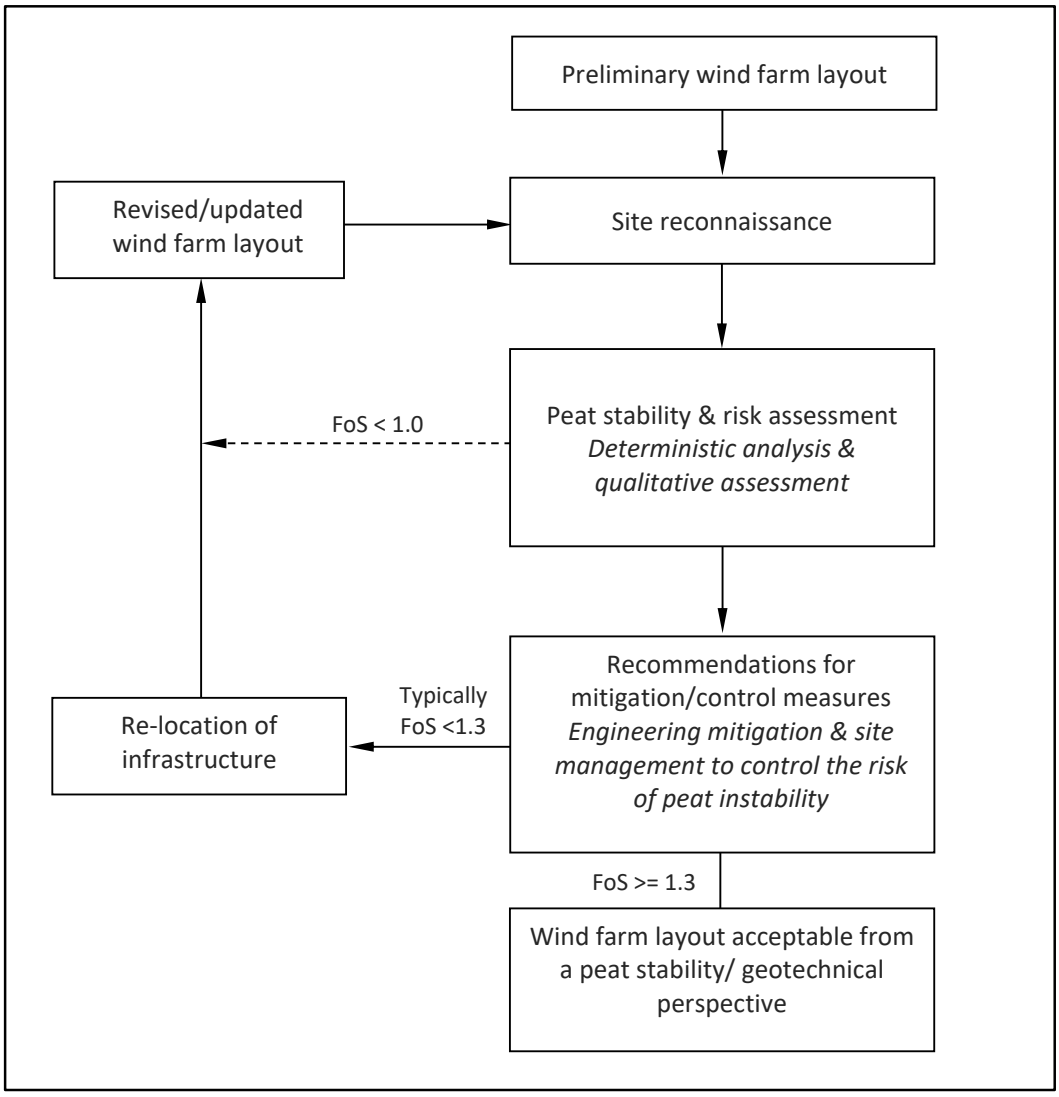
(7) A risk register was compiled to assess the potential design/construction risks at the infrastructure locations and determine adequate mitigation/control measures for each location to minimise the potential risks and ensure they are kept within an acceptable range, where necessary

(8) Preliminary assessment of foundation type for turbines

(9) Commentary of founding details for other infrastructure elements such as access roads, crane hardstands, substation & construction compound platforms and met mast foundation

A flow diagram showing the general methodology for peat stability assessment is shown in Figure 2.1. The methodology illustrates the optimisation of the wind farm layout based on the findings from the site reconnaissance and stability analysis and subsequent feedback.

Figure 2.1: Methodology for Peat Stability Assessment



2.4 Peat Failure Definition

Peat failure in this report refers to a significant mass movement of a body of peat that would have an adverse impact on the proposed wind farm development and the surrounding environment. Peat failure excludes localised movement of peat that would occur below an access road, creep movement or erosion type events.

The potential for peat failure at this site is examined with respect to wind farm construction and associated activity.

2.5 Main Approaches to Assessing Peat Stability

The main approaches for assessing peat stability for wind farm developments include the following:

(1) Geomorphological

(2) Qualitative (judgement)

(3) Index/Probabilistic (probability)

(4) Deterministic (factor of safety)

Approaches (1) to (3) listed above are considered subjective and do not provide a definitive indication of stability; in addition, a high level of judgement/experience is required which makes it difficult to relate the findings to real conditions. FT apply a more objective approach, the deterministic approach (as discussed in Section 2.6).

As part of FT's deterministic approach, a qualitative risk assessment is also carried out taking into account qualitative factors, which cannot necessarily be quantified, such as the presence of mechanically cut peat, quaking peat, bog pools, sub peat water flow, slope characteristics and numerous other factors. The qualitative factors used in the risk assessment are compiled based on FT's experience of assessments and construction in peat land sites and peat failures throughout Ireland and the UK. This approach follows the guidelines for geotechnical risk management as given in Clayton (2001), as referenced in the best practice for Peat Landslide Hazard and Risk Assessment Guide (PLHRAG, 2017), and takes into account the approach of MacCulloch (2005).

The risk assessment uses the results of the deterministic approach in combination with qualitative factors, which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability to assess the risk of instability on a peat land site.

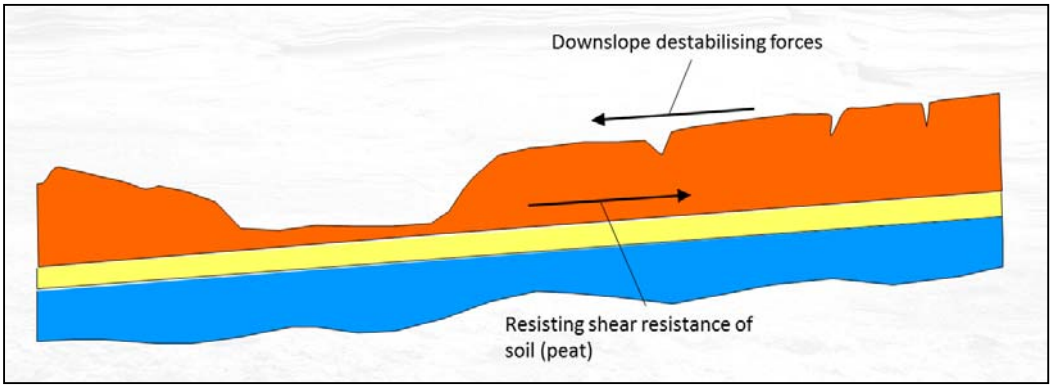
2.6 Peat Stability Assessment – Deterministic Approach

The peat stability assessment is carried out across a wide area of peatland to determine the stability of peat slopes and to identify areas of peatland that are suitable for development; this allows the layout of infrastructure on a particular wind farm site to be optimised. The assessment provides a numerical value (factor of safety) of the stability of individual parcels of peatland. The findings of the assessment discriminate between areas of stable and unstable peat, and areas of marginal stability where restrictions may apply. This allows for the identification of the most suitable locations for turbines, access roads and infrastructure.

A deterministic assessment requires geotechnical information and site characteristics which are obtained from desk study and site walkover, e.g. properties of peat/soil/rock, slope geometry, depth of peat, underlying strata, groundwater, etc. An adverse combination of the factors listed above could potentially result in instability. Using the information above, a factor of safety is calculated for the stability of individual parcels of peatland on a site (as discussed in Section 7).

The factor of safety is a measure of the stability of a particular slope. For any slope, the degree of stability depends on the balance of forces between the weight of the soil/peat working downslope (destabilising force) and the inherent strength of the peat/soil (shear resistance) to resist the downslope weight, see Figure 2.2.

Figure 2.2: Peat Slope Showing Balance of Forces to Maintain Stability



The factor of safety provides a direct measure of the degree of stability of a slope and is the ratio of the shear resistance over the downslope destabilising force. Provided the available shear resistance is greater than the downslope destabilising force then the factor of safety will be greater than 1.0 and the slope will remain stable. If the factor of safety is less than 1.0 the slope is unstable and liable to fail. The acceptable range for factor of safety is typically from 1.3 to 1.4.

2.7 Applicability of the Factor of Safety (Deterministic) Approach for Peat Slopes

The factor of safety approach is a standard engineering approach in assessing slopes which is applied to many engineering materials, such as peat, soil, rock, etc.

The factor of safety approach is included in the Peat Landslide Hazard and Risk Assessments Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, 2017); see Section 5.3.1 of the guide. This guide provides best practice methods to identify, mitigate and manage peat slide hazards and associated risks in respect of consent applications for electricity generation projects.

Furthermore, the best practice guide notes that the results from the factor of safety approach 'has provided the most informative results' with respect to analysing peat stability (Section 5.3.1 of the guide).

The factor of safety approach in this report includes undrained (short-term stability) and drained (long-term stability) analyses. The undrained condition is the critical condition for the development. The purpose of the drained analysis is to identify the relative susceptibility of rainfall-induced failures at the site.

Notwithstanding the above, the stability analysis used by FT in this report also includes qualitative factors to determine the potential for peat stability i.e. the analysis used does not solely rely on the factor of safety approach.

The deterministic analysis is considered an acceptable engineering design approach. This concurs with the best practice guide referenced above.

2.8 Assessment of Intense Rainfall and Extreme Dry Events on the Peat Slope

The deterministic approach carried out by FT examines intense rainfall and extreme dry events. The deterministic approach includes and undrained (short-term stability) and drained (long-term stability) analysis to assess the factor of safety for the peat slopes against a peat failure.

The drained loading condition applies in the long-term. This condition examines the effect of the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes. For the drained analysis the level of the water table above the failure surface is required to calculate the factor of safety for the peat slope.

In order to represent varying water levels within the peat slopes, a sensitivity analysis is carried out which assesses varying water level in the peat slopes i.e. water levels ranging from 0 to 100% of the peat depth is conducted, where 0% equates to the peat been completely dry and 100% equates to the peat being fully saturated.

By carrying out such a sensitivity analysis with varying water level in the peat slopes, the effects of intense rainfall and extreme dry events are considered and analysed. The results of which are presented in Section 7 of this report.

3. DESK STUDY

3.1 Desk Study

The main relevant sources of interest with respect to the site include:

- Geological plans and Geological Survey of Ireland database
- Ordnance survey plans
- Literature review of peat failures
- Review of ground investigation data

The geological plans on the Geological Survey of Ireland database (GSI, 2020) were used to verify the bedrock conditions.

The Ordnance Survey plans were reviewed to determine if any notable features or areas of particular interest (from a geotechnical point of view) are present on the site.

The desk study also includes a review of both published literature and GSI online dataset viewer (GSI, 2020) on peat failures/landslides in the vicinity of the site.

A review of the findings of a ground investigation carried out by HES (2016) and by GII (2020) was also carried out.

3.2 Soils, Subsoil & Bedrock

The bog at the Coole site was essentially formed in poorly drained topographical depressions within the north of the Midlands. Prior to the growth of the bog the area would have comprised water-logged and shallow lakes, which since the end of the last Ice Age have become silted hence the formation of a blanket peat area.

Based on the site walk-over, exposures present and ground investigation data for the site the superficial deposits were typically described as soft to firm dark brown to brown fibrous peat overlying shell marl (locally) overlying lacustrine soil overlying till (see Appendix A - Photo 5).

A review of the GSI subsoils maps indicate that the site is underlain by predominantly blanket peat with lacustrine soil and some localised till derived from limestone and shale rock.

The underlying bedrock was described by the Geological Survey of Ireland database (GSI, 2020). In the area of the Coole site, there is one dominant bedrock formation and one localised bedrock formation in the south of the site.

The dominant bedrock formation is from the Lucan formation and is generally described as dark limestone and shale (calp). A detailed description of the dominant bedrock formation is graded, intraclastic skeletal packstones interbedded with shales, laminated calcisiltites, argillaceous micrites and locally abundant chert representative of the basinal facies of the ‘Calp’. Basal part of the Calp dominated by dark grey, calcareous, bioturbated mudstones and wackestones also referred to at the Tober Colleen formation.

In a localised area in the south of the site Mudbank limestone which is typically described as massive grey micritic limestone. There are two mapped faults located in the south of the site with a southwest to northeast trend.
No karst features were identified within the site boundary following a review of the GSI database or during the site walk-over. A number of karst features are noted to the east of the site. The closest karst feature is located some 3km to the east of the site where a spring was noted.

3.3 Previous Failures

The investigation works carried out at the study area have been used in conjunction with a desk study review to assess the susceptibility of the study area to peat failure.

There are no recorded peat failures within the Coole wind farm site (GSI, 2020).

The nearest recorded peat failure is located some 20km west of the study area. The failure occurred in Rhine in Longford in 1809. The failure mechanism is described as a peat burst.

Other failures occurred some 25km west & 30km east of the study area in Newtownforbes in Longford and Chamberlainstown in Meath respectively. The failure in Newtownforbes occurred in 1883 in a raised peat bog. The triggering event of the peat failure is not specified. Minimal detail is available for the Chamberlainstown failure.

Based on the Geological Survey of Ireland's dataset viewer (GSI, 2016) no other peat or non-peat failures occurred within a 30km radius of the site.

The presence, or otherwise, of relict peat failures or clustering of relict failures within an area is an indicator that particular site conditions exist that pre-dispose a site to failure or not as the case may be. Hence based on the historical data reviewed and the terrain and ground conditions present on site it can be concluded that site conditions in the area of the Coole site have low potential of peat failure.

3.4 Ground Conditions along Grid Connection

The proposed wind farm will connect to the grid via:

- An underground cable (approximately 26 km in length) running from the onsite substation to the existing 110 kV Mullingar substation, located to the south of the proposed wind farm site. The proposed underground cable will be located on existing or proposed tracks and within the public road corridor.

No peat stability or geotechnical issues are envisaged as a result of the proposed grid connection works. Refer to Appendix 4.4 and 4.5 of the EIAR for further information.

4. FINDINGS OF SITE RECONNAISSANCE

4.1 Site Reconnaissance

As part of the assessment of potential peat failure at the proposed site, FT carried out a site reconnaissance in conjunction with the desk study review described in Section 3. This comprised walkover inspections of the site with recording of salient geomorphological features with respect to the wind farm development which included peat depth and preliminary assessment of peat strength. General photographs of the site are included at the end of the main text.

The following salient geomorphological features were considered:

- Active, incipient or relict instability (where present) within the peat deposits
- Presence of shallow valley or drainage line
- Wet areas
- Any change in vegetation
- Peat depth
- Slope inclination and break in slope

The survey covered the proposed locations for the turbine bases and associated infrastructure.

The method adopted for carrying out the site reconnaissance relied on experienced practitioners carrying out a visual assessment of the site supplemented with measurement of slope inclinations.

4.2 Findings of Site Reconnaissance

The site reconnaissance undertaken by AGEC comprised walk-over inspections of the site & associated works from 13th to 15th December 2016 and 31st May 2017. An additional walkover covering the areas of T14 and T15 was undertaken by FT during September 2020.

The findings from the site walkovers have been used to optimise the layout of the infrastructure on site.

The main findings of the site walkover of the wind farm site are as follows:

(1) The site consists of a series of bogs which have formed in poorly drained topographical depressions which comprises intact deep peat and partially cutaway peat with an extensive drainage network. Prior to the growth of the bogs the area would have comprised water-logged and shallow lakes, which since the end of the last Ice Age have become silted hence the formation of the blanket peat areas. The site has been harvested using mechanical harvesting equipment resulting in a well-drained and extensively trafficked peat (see Appendix A – Photos 1 to 3 for overview of site conditions).

(2) Peat depths recorded across the site ranged from 0 to 7.8m with an average of 3.2m (Figure 4.1). In excess of 250 no. peat depth probes were carried out on site. Depths of soft ground (including the thickness of the peat) of in excess of 12m were recorded on site.

(3) The peat depths recorded at the turbine locations varied from 0.3 to 7.5m with an average depth of 5.2m. The slope angle at the turbine locations range from 1.0 to 3.0 degrees which highlights the flat topography/nature of the site.

(4) The site is relatively flat-lying with drainage channels running typically north to south. Across the central portion of the site the drainage channels typically run from east to west.

(5) The access roads for the wind farm comprise construction of new proposed access roads, while utilising some of the localised existing access tracks present on site. The construction of new proposed access roads will be carried out using floated and excavated road construction techniques.

(6) Slope angles at the turbine locations range from 1 to 3 degrees. These slope angle readings were obtained during the site reconnaissance by FT using handheld equipment, such as the Silva Clino Master which has an accuracy of +/- 0.25 degrees. The slope angle quoted typically reflects the slope within the footprint of each infrastructure location.

(7) A number of deep peat areas were identified during the site walkover (Figure 4.1). Locally the peat in these areas was recorded as quaking (or buoyant) indicating highly saturated peat, which would be considered to have low strength. These areas are within typically flatter locations and do not represent a peat slide risk but a safety risk during construction. Consequently, these areas have an elevated construction risk and will be subject to additional mitigation/control measures.

(8) The peat has been harvested by surface stripping of the peat and excavation of drainage channels. The acrotelm layer (upper fibrous layer of peat) where most of the strength of the peat lies has been removed. Notwithstanding this, the stripped upper surface of the peat is relatively well drained.

(9) Localised areas of ponding water were recorded close to and around areas subject to tracked vehicle movements. This is not unexpected given the ground conditions and the flat terrain present on site (see Appendix A - Photo 3).

(10) No evidence of past failures or any significant signs of peat instability were noted on site.

(11) In relation to the 1.2km section of the wind turbine delivery route (TDR) to the south of the wind farm which passes over an area of bogland, the following comments are given:

- (a) A section of the proposed delivery route overlies part of a bog and an existing gravel track. The bog would have formed in a poorly drained topographical depression which comprises intact deep peat and partially cutaway peat with an extensive drainage network. There is a mature forested area on a section of the bog. The existing gravel track is used to access agricultural land.
- (b) The topography along the section of proposed TDR is relatively flat lying with drainage channels running typically north to south.
- (c) The peat depths recorded along the TDR varied from 0m (no peat, along the existing track) to 2.8m in the bog with an average depth of 1.8m. The slope angle along the access track range from 0.5 to 3.0 degrees which highlights the flat topography/nature of the area.
- (d) In the area of the bog, the peat has been harvested by surface stripping of the peat and excavation of drainage channels. The acrotelm layer (upper fibrous layer of peat) where most of the strength of the peat lies has been removed. Notwithstanding this, the stripped upper surface of the peat is relatively well drained.
- (e) The construction of the access tracks for this section of the wind turbine delivery route will be carried out using a floated road construction technique through the bog and upgrading the existing track where present.
- (f) No evidence of past failures or any significant signs of peat instability were noted along this section of the route.

(12) The findings of the site reconnaissance are as follows:

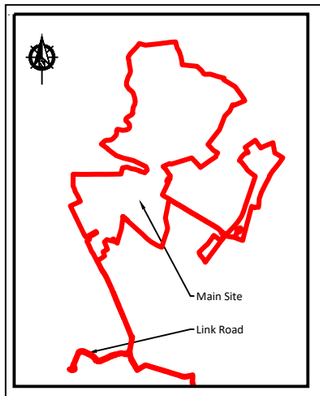
(a) The site consists of a series of bogs which have formed in poorly drained topographical depressions which comprises intact deep peat and partially cutaway peat with an extensive drainage network.

(b) Peat depths recorded across the site vary from 0 to 7.8m with an average of 3.2m.

(c) A construction buffer zone plan has been produced for the site (Figure 4.2). This Figure shows areas which have an elevated or higher construction risk due to the terrain and features encountered during the site reconnaissance e.g. deep peat, weak, quaking peat, etc.

(d) The results of the peat depth probing, shear strength testing of the peat and qualitative factors identified on site have been used in the stability and risk assessment; the findings of which are shown on the construction buffer zone plan and factor of safety plan for site (Figures 4.2 and 7.1).

(13) Based on the findings from the site reconnaissance, the proposed development footprint for the site would be considered to have a low risk of peat failure/slide. Notwithstanding the above, a number of deeper peat areas are present on site which will require specific construction methods, but do not represent a peat slide/failure risk



KEYPLAN

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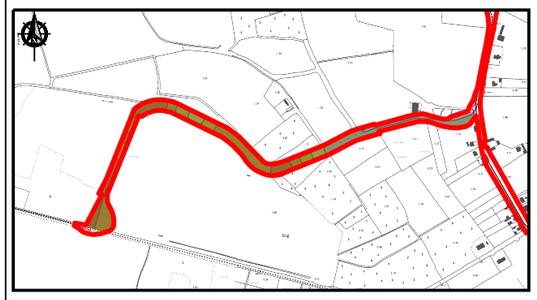

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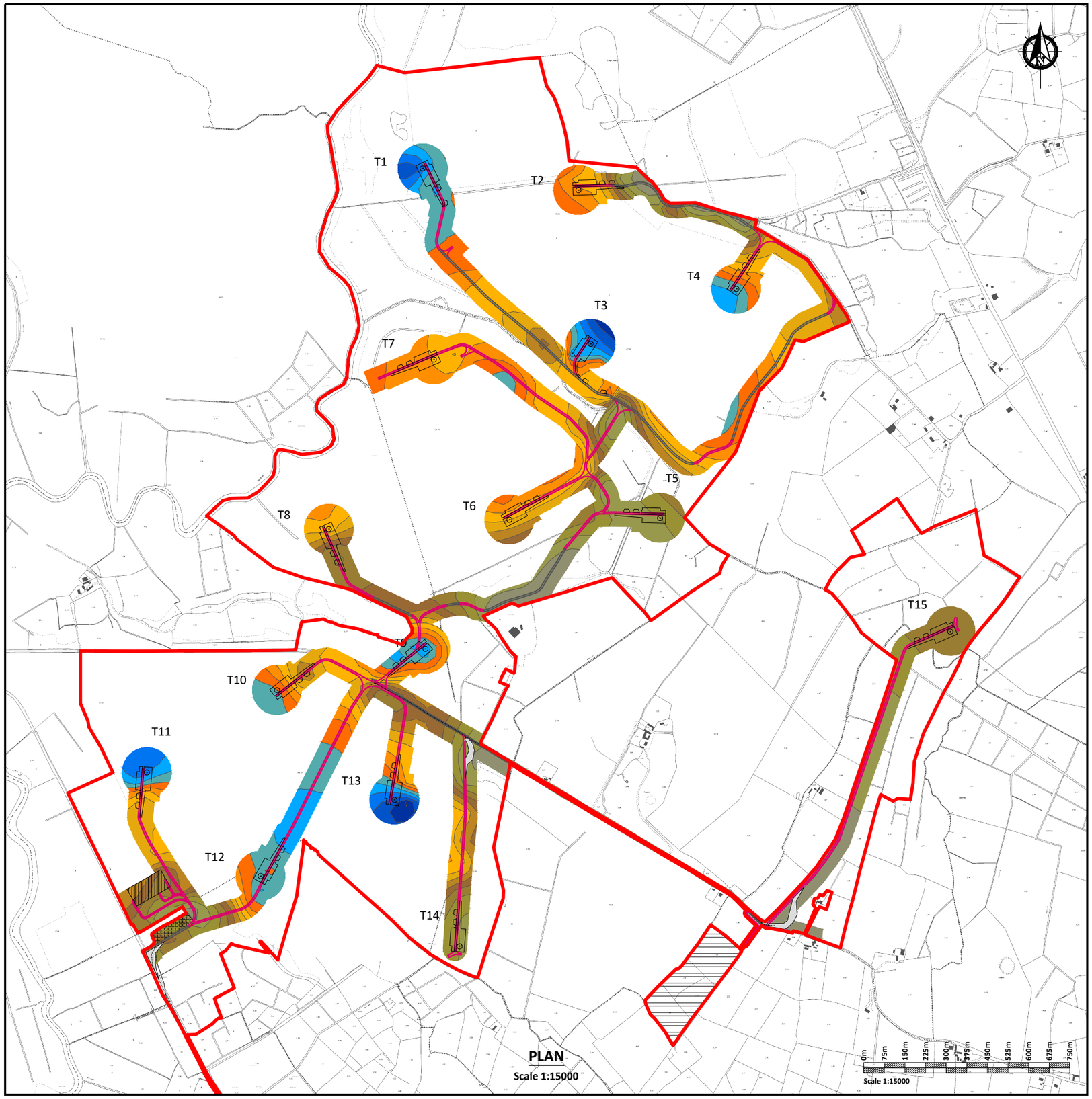

PLAN

Scale 1:15000

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Peat Depth Legend:

- ≥ 0 < 0.5
- ≥ 0.5 < 1
- ≥ 1 < 1.5
- ≥ 1.5 < 2
- ≥ 2 < 2.5
- ≥ 2.5 < 3
- ≥ 3 < 3.5
- ≥ 3.5 < 4
- ≥ 4 < 4.5
- ≥ 4.5 < 5
- ≥ 5 < 5.5
- ≥ 5.5 < 6
- ≥ 6 < 6.5
- ≥ 6.5 < 7
- ≥ 7 < 7.5
- ≥ 7.5 < 8

Legend:

- Turbine and Hardstand
- Construction Compound
- Borrow Pit
- Onsite Substation
- Existing Internal Roads to Upgrade
- New Internal Roads
- Turbine Delivery Route
- Site Boundary
- Temporary Hardcore Surfacing

Scale (@ A3)
1:15000

Date - 12.01.21

FIGURE 4.1 - PEAT DEPTH CONTOUR PLAN

Drawn - POR

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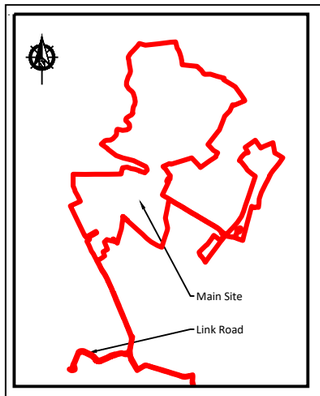

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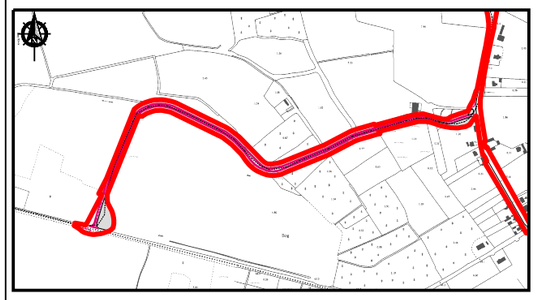

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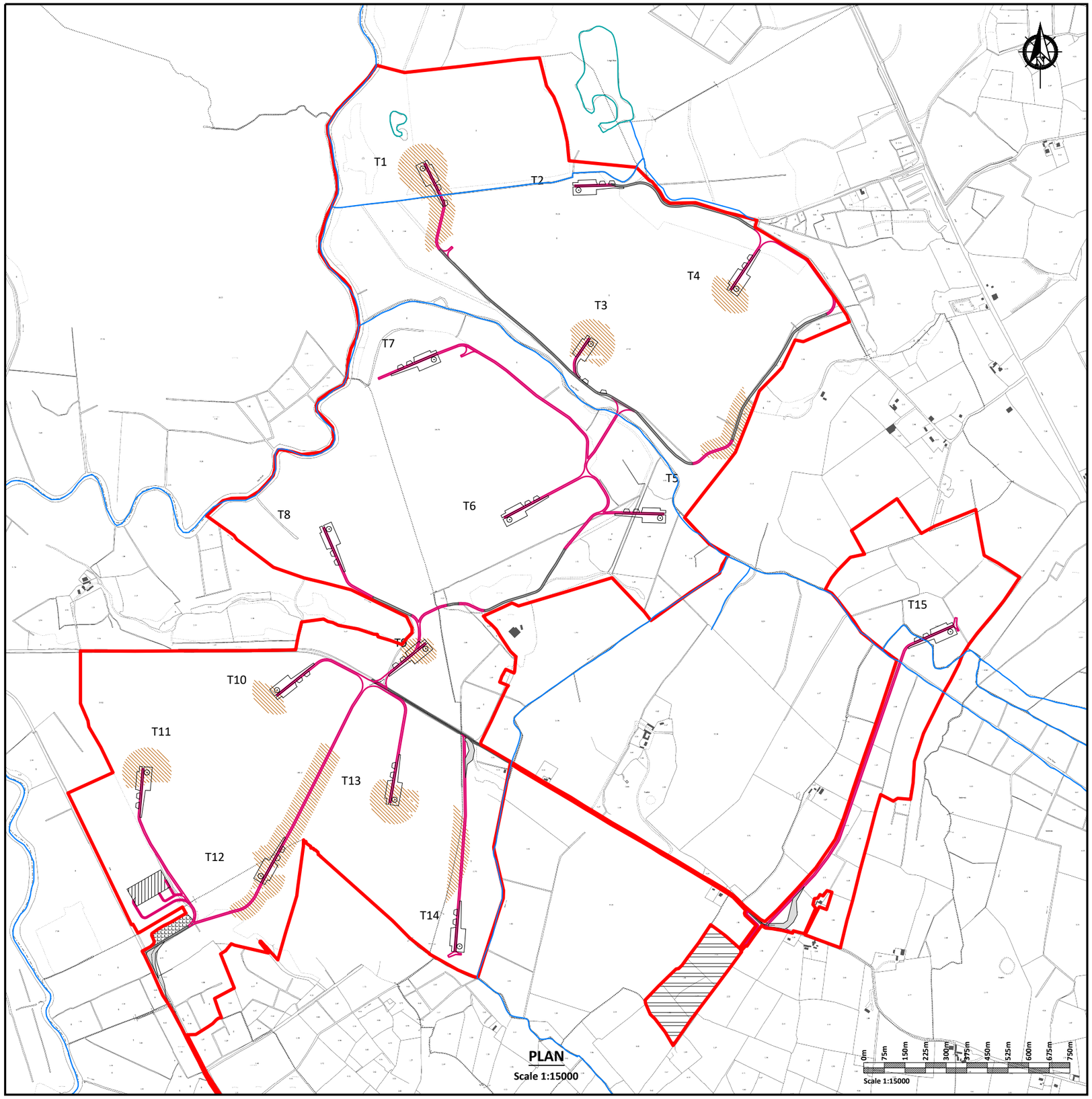

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Construction Buffer Zone Legend:

Areas which have an elevated or higher construction risk (areas with deep weak and occasionally quaking peat). Areas where additional control/mitigation measures are required.

Watercourse

Legend:

Turbine and Hardstand

Construction Compound

Borrow Pit

Onsite Substation

Existing Internal Roads to Upgrade

New Internal Roads

Turbine Delivery Route

Site Boundary

Temporary Hardcore Surfacing

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FIGURE 4.2 - CONSTRUCTION BUFFER ZONE PLAN

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5. GROUND INVESTIGATION

A ground investigation was carried out at the Coole site by HES in December 2016. An additional ground investigation was carried out by GII (Ground Investigations Ireland) in July 2020.

The HES ground investigation consisted of 11 no. window samples and 8 no. trial pits. The trial pits and window samples were carried out at various locations across the site. The GII ground investigation consisted of 13 no. rotary cored boreholes at turbine and substation locations across the site.

The purpose of the ground investigations was to assess the ground conditions across the site and to determine the ground conditions at the proposed borrow pit location. A ground investigation location plan is included as Figure 5.1 in this report.

The trial pit, window sample and borehole logs are included within Appendix E of this report.

Based on the ground investigations, underlying the peat is a significant depth of soft ground consisting of shell marl and lacustrine deposits. Depths of soft ground of up to 14.0m (includes thickness of peat) were recorded on site. Note, occasionally the window sampling did not encounter the base of the soft ground. In addition, and based on observations during the window sampling, confined water pressures may also be present towards the base of the soft ground.

Based on the ground investigation data, the ground conditions at the wind farm and borrow pit location are outlined separately in the text below.

5.1 Summary of Ground Conditions at proposed Wind Farm

The ground conditions at the site can be typically categorised into the following deposits:

Peat – Typically described as brown/dark brown fibrous and amorphous peat. The hand vanes carried out in the peat indicate undrained shear strengths in the range 13 to 96kPa, with an average value of about 36kPa. The relatively high strengths are as a result of the extensive drainage works which have taken place on site for the harvesting of the peat. Peat thicknesses from probing and the ground investigation ranged from 0 to 12m.

Calcareous Mud/Shell Marl – Soft cream coloured mud with local deposits of shell fragments. The thickness of the layer is variable across the site from 0.3 to 3.0m.

Lacustrine Soil – Locally grey to dark grey soft to firm clay. The marl is considered to be a lacustrine deposit. The thickness of the layer varies from 0.3 to 5.6m.

Glacial Granular Soils – Locally loose to dense wet grey sandy clayey silty gravel. This layer was locally encountered in a small number of the trial pits. The glacial granular soils are likely to have a mixed strength/density.

Weathered Bedrock – Possible weathered bedrock was only encountered in trial pit TP2-C. Arisings from the trial pit comprised of large angular cobbles and a matrix of sandy silt and angular gravel. Bedrock was recorded in all of the rotary cored boreholes at a depth of 6.05 to 16.9m bgl.

5.2 Summary of Ground Conditions at proposed Borrow Pit

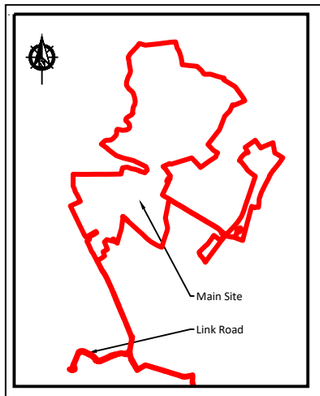
The ground conditions at the borrow pit can be typically categorised into the following deposits:

Topsoil – Typically described as sandy gravelly clay.

Glacial Till – Consisted of orange to brown slightly gravelly Clay. Deposits ranged from 0.3m to 1.1m in thickness.

Weathered Bedrock – Typically consisting of angular gravels, cobbles and boulders of weathered limestone in a clay matrix. Weathered bedrock was typically encountered between 0.2m and 1.3mbgl.

Bedrock – Bedrock comprises of strong intact limestone at typically 1.5mbgl.



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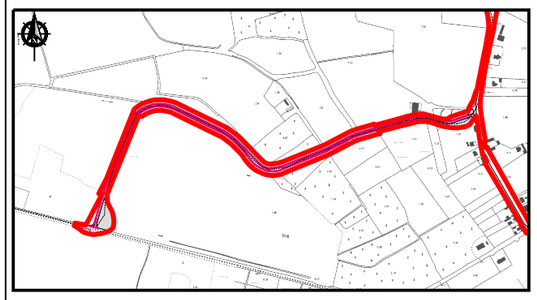

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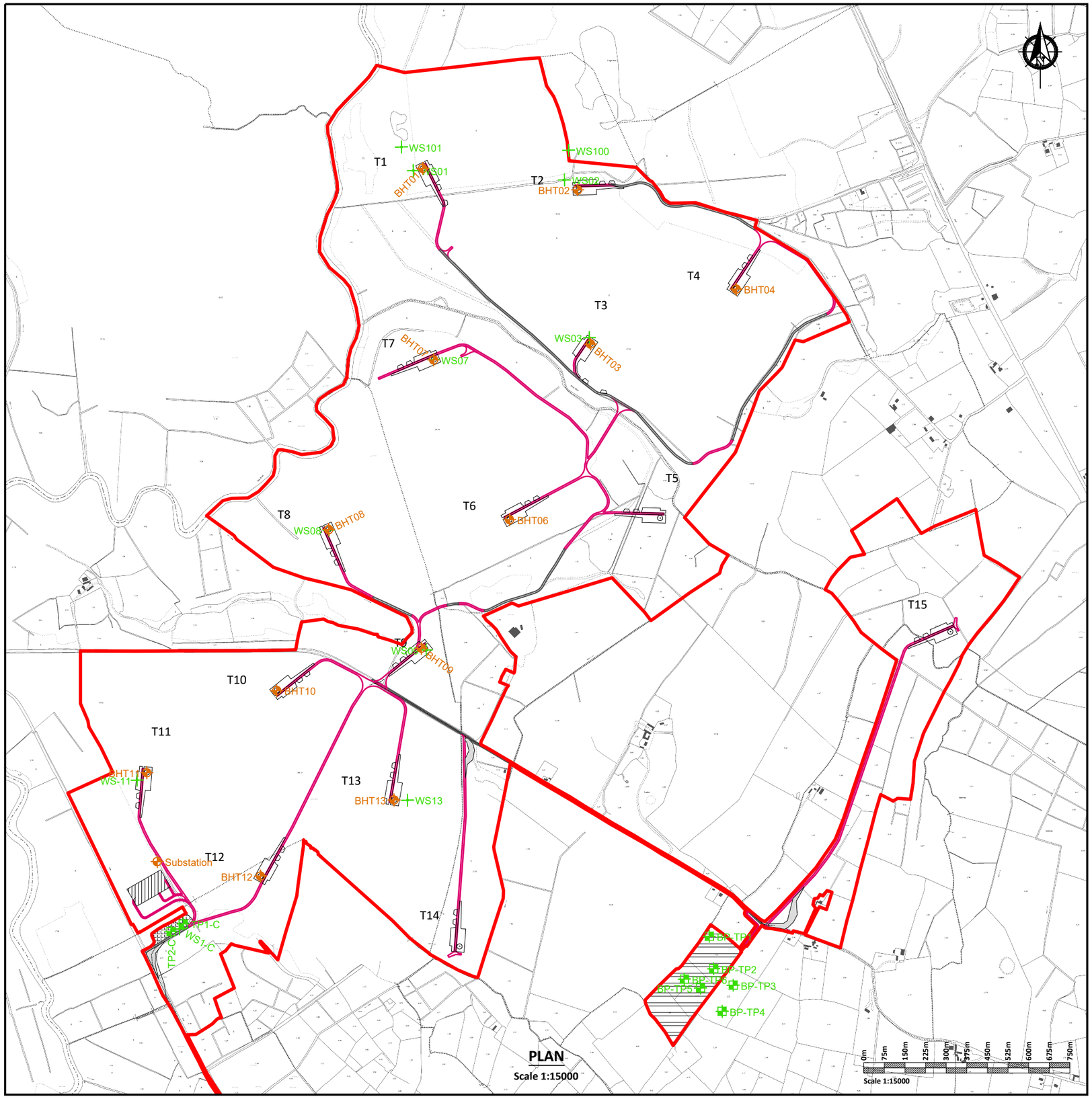

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Ground Investigation Legend:

BP-TPX TPX	Trial Pit Locations (HES 2016)
WSX	Window Sample Location (HES 2016)
	Borehole Location (2020)

Legend:

- Turbine and Hardstand
- Construction Compound
- Borrow Pit
- Onsite Substation
- Existing Internal Roads to Upgrade
- New Internal Roads
- Turbine Delivery Route
- Site Boundary
- Temporary Hardcore Surfacing

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FIGURE 5.1 - GROUND INVESTIGATION LOCATION PLAN

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6. SITE GROUND CONDITIONS

6.1 Soils & Subsoils

The bog at the Coole site was essentially formed in poorly drained topographical depressions within the north of the Midlands. Prior to the growth of the bog the area would have comprised water-logged and shallow lakes, which since the end of the last Ice Age have become silted hence the formation of a blanket peat area.

Based on the site walk-over, exposures present and ground investigation data for the site the superficial deposits were typically described as soft to firm dark brown to brown fibrous peat overlying shell marl (locally) overlying lacustrine soil overlying till (see Appendix A - Photo 5).

A review of the GSI subsoils maps indicate that the site is underlain by predominantly blanket peat with lacustrine soil and some localised till derived from limestone and shale rock.

6.2 Bedrock

The underlying bedrock was described by the Geological Survey of Ireland database (GSI, 2016). In the area of the Coole site, there is one dominant bedrock formation and one localised bedrock formation in the south of the site.

The dominant bedrock formation is from the Lucan formation and is generally described as dark limestone and shale (calp). A detailed description of the dominant bedrock formation is graded, intraclastic skeletal packstones interbedded with shales, laminated calcisiltites, argillaceous micrites and locally abundant chert representative of the basinal facies of the 'Calp'. Basal part of the Calp dominated by dark grey, calcareous, bioturbated mudstones and wackestones also referred to at the Tober Colleen formation.

In localised area in the south of the site Mudbank limestone which is typically described as massive grey micritic limestone.

There are two mapped faults located in the south of the site with a southwest to northeast trend.

No karst features were identified within the site boundary following a review of the GSI database or during the site walk-over. A number of karst features are noted to the east of the site. The closest karst feature is located some 3km to the east of the site where a spring was noted.

7. PEAT DEPTHS, STRENGTH & SLOPE AT PROPOSED INFRASTRUCTURE LOCATIONS

As part of the site walkovers, peat depth, in-situ peat strength and slope angles were recorded at various locations across the site.

7.1 Peat Depth

Peat depth probes were carried out at/near to proposed turbine locations and access roads and other main infrastructure elements. At turbine locations up to 5 probes were carried out around the turbine location, where accessible, and an average peat depth was calculated.

7.2 Peat Strength

The strength testing was carried out in-situ using a Geonor H-60 Hand-Field Vane Tester. From FT's experience hand vanes give indicative results for in-situ strength of peat and would be considered best practice for the field assessment of peat strength.

7.3 Slope Angle

The slope angles at each of the main infrastructure locations were obtained using a combination of readings taken during the site reconnaissance by FT using handheld equipment, such as the Silva Clino Master and from contour survey plans for site.

The slope angle quoted typically reflects the slope within the footprint of each infrastructure location. It should be noted that slope angles derived from contour survey plans would be considered approximate, as such surveys are dependent on the density of survey data and do not always reflect local variations in ground topography. Slope angles recorded during the site reconnaissance by FT using handheld equipment would generally be deemed more accurate and representative of local topography.

7.4 Summary of Findings

Based on the peat depths recorded across the site by FT, AGEC and HES, the peat varied in depth from 0 to 7.8m with an average of 3.2m. All peat depth probes carried out on site have been utilised to produce a peat depth contour plan for the site (Figure 3.1).

A summary of the peat depths at the proposed infrastructure locations is given in Table 6.1. The data presented in Table 6.1 is used in the peat stability assessment of the site; see Section 8 of this report.

Table 7.1: Peat Depth & Slope Angle at Proposed Infrastructure Locations

Turbine	Easting	Northing	Peat Depth Range (m) (1)	Average Peat Depth (m)	Slope Angle (°) (2)
T1	640852	777346	6.1 to 7.0	6.6	2.0
T2	641419	777267	3.5 to 4.4	4.0	2.0
T3	641463	776708	5.0 to 6.1	5.9	2.0
T4	641994	776908	4.8 to 5.6	5.3	1.0
T5	641716	776074	0.3 to 2.0	0.6	2.0
T6	641168	776069	4.3 to 4.8	4.6	2.0
T7	640893	776651	2.9 to 4.0	3.4	1.0
T8	640511	776034	3.1 to 3.9	3.6	2.0
T9	640862	775599	5.0 to 6.2	6.0	3.0
T10	640322	775448	4.2 to 6.5	4.6	2.0
T11	639849	775149	5.0 to 6.5	5.6	1.0
T12	640263	774772	4.5 to 12.5	4.9	3.0
T13	640750	775050	4.6 to 8.0	5.4	2.0
T14	640986	774517	1.0	1.0	1
T15	642732	775628	0.8 to 1.9	1.5	1
Substation	639914	774720	0.4 to 3.4	2.0	2.0
Construction Compound	639942	774580	0.4 to 3.1	1.6	1.0
Borrow Pit	641896	774383	0.0	0.0	Variable

Note (1) Based on probe results from the site walkovers and ground investigation results. The range of peat depths for the infrastructure locations are typically based on a 10m grid carried out around the infrastructure element, where accessible.

Note (2) The slope angles at each of the main infrastructure locations were obtained using a combination of readings taken during the site reconnaissance by FT using handheld equipment, such as the Silva Clino Master (which has an accuracy of +/- 0.25 degrees) and from contour survey plans for site. The slope angle quoted typically reflects the slope within the footprint of each infrastructure location.

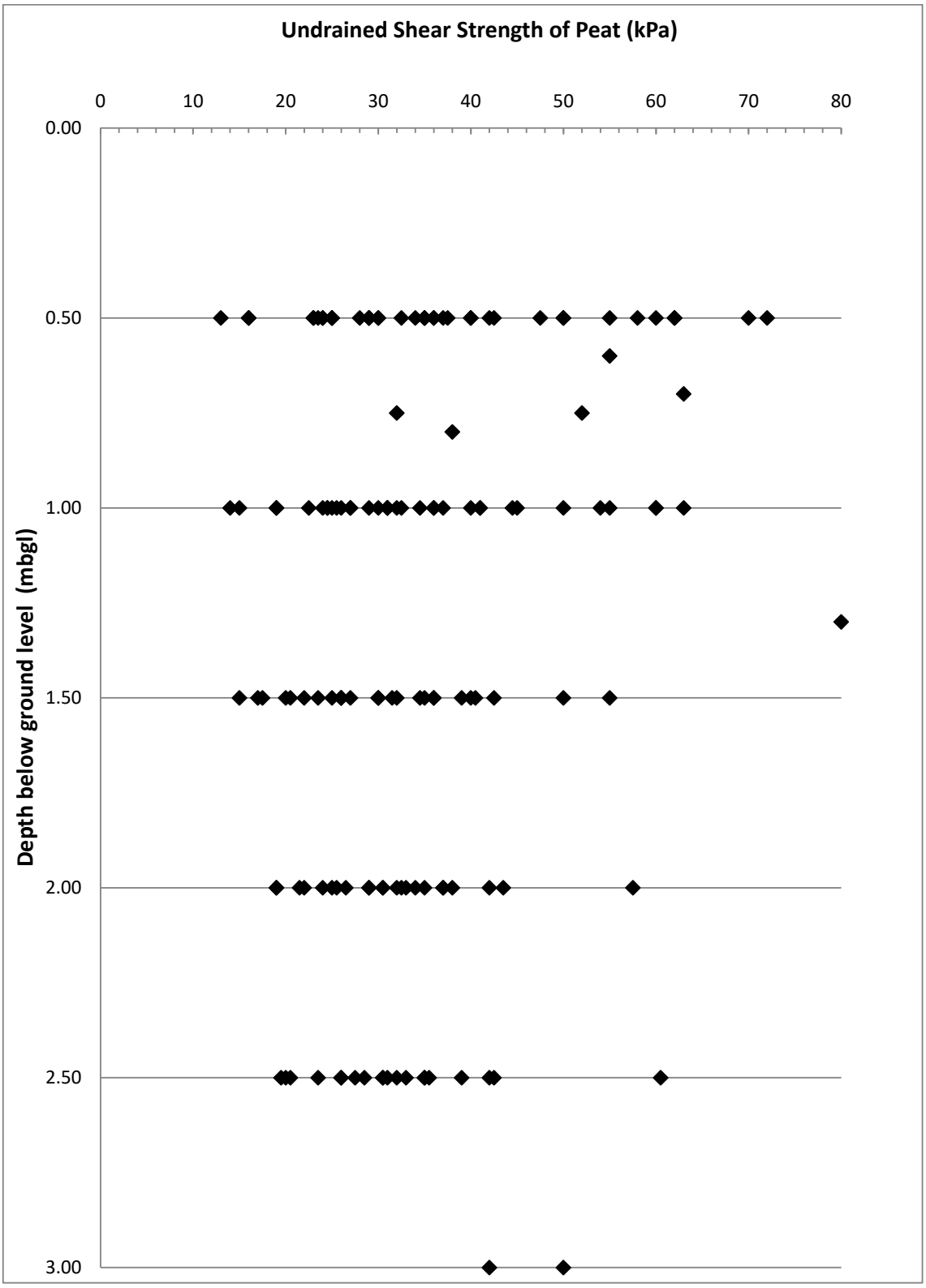
Note (3) The data presented in the Table above is used in the peat stability assessment of the site.

In addition to probing, in-situ shear vane testing was carried out as part of the ground investigation. Strength testing was carried out at selected locations across the site to provide representative coverage of indicative peat strengths. The results of the vane testing with depth are presented in Figure 6.1.

The hand vane results indicate undrained shear strengths in the range 13 to 98kPa, with an average value of about 36kPa. The strengths recorded would be typical of well drained peat as is present on the Coole site.

Peat strength at sites of known peat failures (assuming undrained loading failure) are generally very low, for example the undrained shear strength at the Derrybrien failure (AGEC, 2004) as derived from back-analysis, was estimated at 2.5kPa. The recorded undrained strength at Coole is significantly greater than the lower bound values for Derrybrien indicating that there is no close correlation to the peat conditions at the Derrybrien site and that there is significantly less likelihood of failure on the Coole site.

Figure 7.1: Undrained Shear Strength (c_u) Profile for Peat with Depth



8. PEAT STABILITY ASSESSMENTS

The peat stability assessment includes an assessment of the stability of the natural peat slopes for individual parcels across the site including at the turbine locations and along the proposed access roads. The assessment also analyses the stability of the natural peat slopes with a surcharge loading of 10kPa, equivalent to placing 1m of stockpiled peat on the surface of the peat slope.

8.1 Methodology for Peat Stability Assessment

Stability of a peat slope is dependent on several factors working in combination. The main factors that influence peat stability are slope angle, shear strength of peat, depth of peat, pore water pressure and loading conditions.

An adverse combination of factors could potentially result in peat sliding. An adverse condition of one of the above-mentioned factors alone is unlikely to result in peat failure. The infinite slope model (Skempton and DeLory, 1957) is used to combine these factors to determine a factor of safety for peat sliding. This model is based on a translational slide, which is a reasonable representation of the dominant mode of movement for peat failures.

To assess the factor of safety for a peat slide, an undrained (short-term stability) and drained (long-term stability) analysis has been undertaken to determine the stability of the peat slopes on site.

1. The undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

2. The drained loading condition applies in the long-term. The condition examines the effect of the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

Undrained shear strength values (c_u) for peat are used for the total stress analysis. Based on the findings of the 2003 Derrybrien failure and other failures in peat, undrained loading during construction was found to be the critical failure mechanism.

A drained analysis requires effective cohesion (c') and effective friction angle (ø') values for the calculations. These values can be difficult to obtain because of disturbance experienced when sampling peat and the difficulties in interpreting test results due to the excessive strain induced within the peat. To determine suitable drained strength values a review of published information on peat was carried out. Table 8.1 shows a summary of the published information on peat together with drained strength values.

From Table 8.1 the values for c' ranged from 1.1 to 8.74kPa and ø' ranged from 21.6 to 43°. The average c' and ø' values are 4.5kPa and 30° respectively. Based on the above, it was considered to adopt a conservative approach and to use design values below the averages. For design the following general drained strength values have been used for the site:

c' = 4kPa
$ø'$ = 25°

Table 8.1: List of Effective Cohesion and Friction Angle Values for Peat

Reference	Cohesion, c' (kPa)	Friction Angle, ø' (degs)	Testing Apparatus/ Comments
Hanrahan et al (1967)	5 to 7	36 to 43	From triaxial apparatus
Rowe and Mylleville (1996)	2.5	28	From simple shear apparatus
Landva (1980)	2 to 4	27.1 to 32.5	Mainly ring shear apparatus for normal stress greater than 13kPa
	5 to 6	-	At zero normal stress
Carling (1986)	6.5	0	-
Farrell and Hebib (1998)	0	38	From ring shear and shear box apparatus. Results are not considered representative.
	0.61	31	From direct simple shear (DSS) apparatus. Result considered too low therefore DSS not considered appropriate
Rowe, Maclean and Soderman (1984)	1.1	26	From simple shear apparatus
	3	27	From DSS apparatus
McGreever and Farrell (1988)	6	38	From triaxial apparatus using soil with 20% organic content
	6	31	From shear box apparatus using soil with 20% organic content
Hungr and Evans (1985)	3.3	-	Back-analysed from failure
Dykes and Kirk (2006)	3.2	30.4	Test within acrotelm
Dykes and Kirk (2006)	4	28.8	Test within catotelm
Warburton et al (2003)	5	23.9	Test in basal peat
Warburton et al (2003)	8.74	21.6	Test using fibrous peat
Hendry et al (2012)	0	31	Remoulded test specimen
Komatsu et al (2011)	8	34	Remoulded test specimen
Zwanenburg et al (2012)	2.3	32.3	From DSS apparatus
Den Haan & Grognet (2014)	-	37.4	From large DSS apparatus
O'Kelly & Zhang (2013)	0	28.9 to 30.3	Tests carried out on reconstituted, undisturbed and blended peat samples

8.2 Analysis to Determine Factor of Safety (Deterministic Approach)

The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes using infinite slope analysis. The analysis was carried out at the turbine locations, along the proposed access roads and at various locations across the site.

The FoS provides a direct measure of the degree of stability of the slope. A FoS of less than unity indicates that a slope is unstable, a FoS of greater than unity indicates a stable slope.

The acceptable safe range for FoS typically ranges from 1.3 to 1.4. The previous code of practice for earthworks BS 6031:1981 (BSI, 1981), provided advice on design of earthworks slopes. It stated that for a first-time failure with a good standard of site investigation the design FoS should be greater than 1.3.

As a general guide the FoS limits for peat slopes in this report are summarised in Table 8.2.

Table 8.2: Factor of Safety Limits for Slopes

Factor of Safety (FoS)	Degree of Stability
Less than 1.0	Unstable (red)
Between 1.0 and 1.3	Marginally stable (yellow)
1.3 or greater	Acceptable (green)

Eurocode 7 (EC7) (IS EN 1997-1:2005) now serves as the reference document and the basis for design geotechnical engineering works. The design philosophy used in EC7 applies partial factors to soil parameters, actions and resistances. Unlike the traditional approach, EC7 does not provide a direct measure of stability, since global Factors of Safety are not used.

As such, and in order to provide a direct measure of the level of safety on a site, EC7 partial factors have not been used in this stability assessment. The results are given in terms of FoS.

A lower bound undrained shear strength, c_u for the peat of 6kPa was selected for the assessment based on the c_u values recorded at the site. It should be noted that a c_u of 6kPa for the peat is considered a conservative value for the analysis and is not representative of all peat present across the site. In reality, the peat has a significantly higher undrained strength as a result of the extensive drainage & extraction works which have been carried out on site.

The formula used to determine the factor of safety for the undrained condition in the peat (Bromhead, 1986) is as follows:

$$F = \frac{c_u}{\gamma z \sin\alpha \cos\alpha}$$

Where:

F = Factor of Safety

c_u = Undrained strength
γ = Bulk unit weight of material
z = Depth to failure plane assumed as depth of peat
α = Slope angle

The formula used to determine the factor of safety for the drained condition in the peat (Bromhead, 1986) is as follows:

$$F = \frac{c' + (\gamma z - \gamma_w h_w)\cos^2 \alpha \tan \phi'}{\gamma z \sin \alpha \cos \alpha}$$

Where:

F = Factor of Safety
c' = Effective cohesion
γ = Bulk unit weight of material
z = Depth to failure plane assumed as depth of peat
γ_w = Unit weight of water
h_w = Height of water table above failure plane
α = Slope angle
ϕ' = Effective friction angle

For the drained analysis the level of the water table above the failure surface is required to calculate the factor of safety for the slope. Since the water level in blanket peat can be variable and can be recharged by rainfall, it is not feasible to establish its precise location throughout the site. Therefore, a sensitivity analysis using water level ranging between 0% and 100% of the peat depth was conducted, where 0% equates to the peat being completely dry and 100% equates to the peat been fully saturated.

The following general assumptions were used in the analysis of peat slopes at each location:

(1) Peat depths are based on the maximum peat depth recorded at each location from the walkover surveys.

(2) The slope angles used in the peat stability assessment were obtained using a combination of readings taken during the site reconnaissance by FT using handheld equipment and from contour survey plans for site. It should be noted that slope angles derived from contour survey plans would be considered approximate, as such surveys are dependent on the density of survey data and do not always reflect local variations in ground topography.

(3) Slope angle at base of sliding assumed to be parallel to ground surface.

(4) A lower bound undrained shear strength, c_u for the peat of 6kPa was selected for the assessment. The lowest recorded value on the Coole wind farm site during the walkovers was 13kPa. It should be noted that a c_u of 6kPa for the peat is considered a conservative value for the analysis and is not representative of all peat present across the site. In reality, the peat has a significantly higher undrained strength as a result of the extensive drainage & extraction works which have been carried out on site.

For the stability analysis two load conditions were examined, namely

Condition (1): no surcharge loading
Condition (2): surcharge of 10 kPa, equivalent to 1m of stockpiled peat assumed as a worst case.

8.3 Results of Analysis

8.3.1 Undrained Analysis for the Peat

The results of the undrained analysis for the natural peat slopes are presented in Appendix C and the results of the undrained analysis for the most critical load case (load condition 2) are shown on Figure 8.1. The undrained analysis for load condition 2 is considered the most critical load case as most peat failures occur in the short term upon loading of the peat surface. The results from the main infrastructure locations are summarised in Table 8.3.

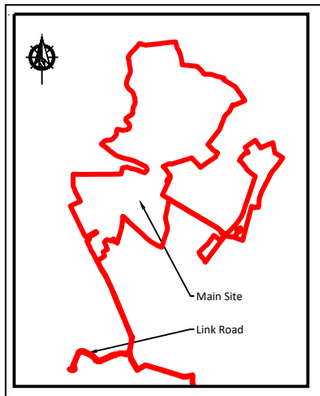
The calculated FoS for load condition (1) is in excess of 1.30 for each of the locations (220 no. locations) analysed with a range of FoS of 1.80 to in excess of 10, indicating a low risk of peat instability.

The calculated FoS for load condition (2) is in excess of 1.30 for each of the locations (220 no. locations) analysed with a range of FoS of 1.49 to in excess of 10, indicating a low risk of peat instability.

Table 8.3: Factor of Safety Results (Undrained Condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	640852	777346	**2.46**	**2.15**
T2	641419	777267	**3.91**	**3.19**
T3	641463	776708	**2.82**	**2.42**
T4	641994	776908	**6.14**	**5.21**
T5	641716	776074	**19.11**	**9.05**
T6	641168	776069	**3.58**	**2.97**
T7	640893	776651	**8.60**	**6.88**
T8	640511	776034	**4.41**	**3.51**
T9	640862	775599	**1.85**	**1.59**
T10	640322	775448	**3.31**	**2.77**
T11	639849	775149	**5.55**	**4.78**
T12	640263	774772	**2.17**	**1.82**
T13	640750	775050	**2.29**	**2.02**
T14	640986	774517	**34.38**	**17.19**

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T15	642732	775628	**18.10**	**11.86**
Substation	639914	774720	**5.38**	**4.10**
Construction Compound	639942	774580	**11.09**	**8.39**
Borrow Pit	641896	774383	No peat recorded	



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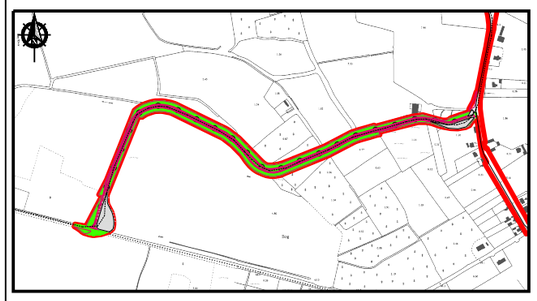

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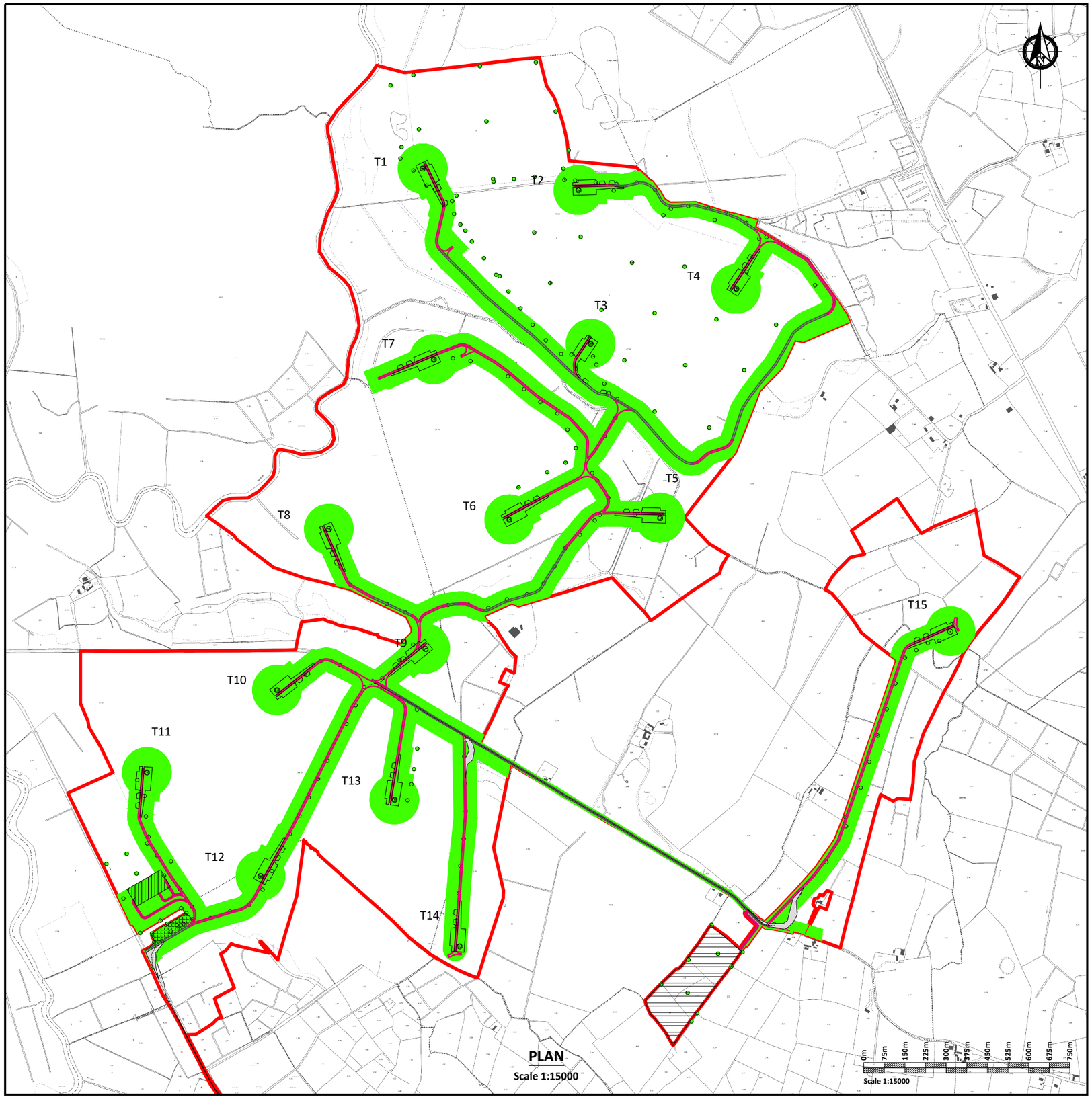

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Factor of Safety Legend:

0 < 1.0	
≥ 1.0 < 1.3	
≥ 1.3	

Increasing Stability

No Peat Recorded
At This Location

Legend:

- Turbine and Hardstand
- Construction Compound
- Borrow Pit
- Onsite Substation
- Existing Internal Roads to Upgrade
- New Internal Roads
- Turbine Delivery Route
- Site Boundary
- Temporary Hardcore Surfacing

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Date - 12.01.21

FIGURE 7.1 - FACTOR OF SAFETY PLAN - SHORT TERM CRITICAL CONDITION (UNDRAINED)

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8.3.2 Drained Analysis for the Peat

The results of the drained analysis for the peat are presented in Appendix C. The results from the main infrastructure locations are summarised in Table 8.4. As stated previously, the drained loading condition examines the effect of rainfall and water on the existing stability of the natural peat slopes.

The calculated FoS for load condition (1) is in excess of 1.30 for each of the locations (220 no. locations) analysed with a range of FoS of 1.30 to in excess of 10 except for 2 no. locations where FoS of 1.23 and 1.20 were calculated.

The locations where the lower FoS were calculated was at turbine T9 and a proposed section of access road south of turbine T12. The lower FoS correspond to areas of deeper peat which are located in topographical depressions and would not be at risk from a peat slide. The risk within the deeper peat areas relates to a safety risk during construction which can be overcome by adopting specific construction methods suitable for working in deep peat areas. Consequently, these areas have an elevated construction risk and will be subject to additional mitigation/control measures (see Appendix B). The remainder of the locations analysed had acceptable FoS of greater than 1.3, indicating a low risk of peat instability.

The calculated FoS for load condition (2) is in excess of 1.30 for each of the locations (220 no. locations) analysed with a range of FoS of 2.14 to in excess of 10, indicating a low risk of peat instability.

Table 8.4: Factor of Safety Results (Drained Conditions)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	640852	777346	1.64	3.10
T2	641419	777267	2.61	4.60
T3	641463	776708	1.88	3.50
T4	641994	776908	4.09	7.52
T5	641716	776074	12.74	13.06
T6	641168	776069	2.39	4.28
T7	640893	776651	5.73	9.93
T8	640511	776034	2.94	5.07
T9	640862	775599	1.23	2.30
T10	640322	775448	2.21	4.00
T11	639849	775149	3.70	6.89
T12	640263	774772	1.44	2.63
T13	640750	775050	1.53	2.92
T14	640986	774517	22.92	24.82
T15	642732	775628	12.06	17.12
Substation	639914	774720	3.58	5.91
Construction Compound	639942	774580	7.39	12.11

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Borrow Pit	641896	774383	No peat recorded	

9. PEAT STABILITY RISK ASSESSMENT

A peat stability risk assessment was carried out for the main infrastructure elements at the wind farm. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRAG (2017) and MacCulloch (2005).

The risk assessment uses the results of the stability analysis (deterministic approach) in combination with qualitative factors, which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability, to assess the risk for each infrastructure element.

For each of the main infrastructure elements, a risk rating (product of probability and impact) is calculated and rated as shown in Table 9.1. Where a subsection is rated 'Medium' or 'High', control measures are required to reduce the risk to at least a 'Low' risk rating. Where a subsection is rated 'Low' or 'Negligible', only routine control measures are required.

Table 9.1: Risk Rating Legend

17 to 25	High: avoid works in area or significant control measures required
11 to 16	Medium: notable control measures required
5 to 10	Low: only routine control measures required
1 to 4	Negligible: none or only routine control measures required

A full methodology for the peat stability risk assessment is given in Appendix D.

9.1 Summary of Risk Assessment Results

The results of the peat stability risk assessment for potential peat failure at the main infrastructure elements is presented as a Geotechnical Risk Register in Appendix B and summarised in Table 9.2.

The risk rating for each infrastructure element at the Coole wind farm is designated Negligible following some mitigation/control measures being implemented. Sections of access roads to the nearest infrastructure element will be subject to the same mitigation/control measures that apply to the nearest infrastructure element.

Details of the required mitigation/control measures can be found in the Geotechnical Risk Register for each infrastructure element (Appendix B).

Table 9.2: Summary of Peat Stability Risk Register

Infrastructure	Pre-Control Measure Implementation Risk Rating	Pre-Control Measure Implementation Risk Rating Category	Notable Control Measures Required	Post-Control Measure Implementation Risk Rating	Post-Control Measure Implementation Risk Rating Category
Coole Wind Farm Site					
Turbine T1	Low	5 to 10	Yes	Negligible	1 to 4
Turbine T2	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T3	Low	5 to 10	Yes	Negligible	1 to 4
Turbine T4	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T5	Negligible	1 to 4	No	Negligible	1 to 4
Turbine T6	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T7	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T8	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T9	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T10	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T11	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T12	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T13	Negligible	1 to 4	Yes	Negligible	1 to 4
Turbine T14	Low	5 to 10	No	Negligible	1 to 4
Turbine T15	Low	5 to 10	No	Negligible	1 to 4
Substation	Negligible	1 to 4	Yes	Negligible	1 to 4
Construction Compound	Negligible	1 to 4	No	Negligible	1 to 4
Borrow Pit	N/A – No peat recorded			N/A	
Section of Wind Turbine delivery route					
Access Track (Upgrade of existing track)	N/A – No peat recorded			N/A	
Access Track (New floated track)	Negligible	1 to 4	No	Negligible	1 to 4

10. SUMMARY AND RECOMMENDATIONS

10.1 Summary

The following summary is given.

FT was engaged by MKO on behalf of Coole Wind Farm Ltd. to undertake a geotechnical and peat stability assessment of the proposed wind farm site and associated works. An assessment of a 1.2km section of the wind turbine delivery route to the south of the wind farm which passes over an area of bogland is also included in this report.

The findings of the peat assessment showed that the site generally has an acceptable margin of safety and is considered to be at low risk of peat failure/slide. A number of deeper peat areas are present on site which will require specific construction methods, but do not represent a peat slide/failure risk. The findings include recommendations and control measures for construction work in deep peat lands to ensure that all works adhere to an acceptable standard of safety.

The area of the wind farm site and a section of the wind turbine delivery route assessed in this report consists of a series of bogs which have formed in poorly drained topographical depressions which comprises intact deep peat and partially cutaway peat with an extensive drainage network. Prior to the growth of the bogs the area would have comprised water-logged and shallow lakes, which since the end of the last Ice Age have become silted hence the formation of the blanket peat areas. The site has been harvested using mechanical harvesting equipment resulting in well-drained and extensively trafficked peat.

Peat thicknesses recorded during the site walk-overs from ranged from 0 to 7.8m with an average of 3.2m.

Slope inclinations at the main infrastructure locations range from 0 to 3 degrees. The flat topography/nature of the terrain on site highlights the low risk of peat failure.

An analysis of peat sliding was carried out at the main infrastructure locations across site for both the undrained and drained conditions. The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes.

An undrained analysis was carried out, which applies in the short-term during construction. For the undrained condition, the calculated FoS for load conditions (1) & (2) for the locations analysed, show that all locations have an acceptable FoS of greater than 1.3, indicating a low risk of peat failure. The undrained analysis would be considered the most critical condition for the peat slopes.

A drained analysis was carried out, which examines the effect of in particular, rainfall on the existing stability of the natural peat slopes on site. For the drained condition, the calculated FoS for load conditions (1) & (2) for the locations analysed, show that all locations have an acceptable FoS of greater than 1.3 except for 2 no. locations (at T9 and south of T12) where FoS of 1.20 and 1.23 were calculated.

The locations where the lower FoS were calculated was at turbine T9 and a proposed section of access road south of turbine T12. The lower FoS correspond to areas of deeper peat which are located in topographical depressions and would not be at risk from a peat slide. The risk within the deeper peat areas relates to a safety risk during construction which can be overcome by adopting specific construction methods suitable for working in deep peat areas. Consequently, these areas have an elevated construction risk and will be subject to additional mitigation/control measures (see Appendix B). In essence, excavations of peat at these locations will not occur and rather piled foundations and floating roads methodologies will be employed where possible. The

remainder of the locations analysed had acceptable FoS's of greater than 1.3, indicating a low risk of peat instability.

The risk assessment at each infrastructure location identified a number of mitigation/control measures to reduce the potential risk of peat failure. Sections of access roads to the nearest infrastructure element should be subject to the same mitigation/control measures that apply to the nearest infrastructure element. See Appendix B for details of the required mitigation/control measures for each infrastructure element.

In summary, the findings of the peat assessment showed that the proposed Coole wind farm site has an acceptable margin of safety, is suitable for the proposed wind farm development and is considered to be at **low** risk of peat failure. The findings include recommendations and control measures for construction work in peat lands to ensure that all works adhere to an acceptable standard of safety.

10.2 Recommendations

The following recommendations are given.

Notwithstanding that the site has an acceptable margin of safety a number of mitigation/control measures are given to ensure that all works adhere to an acceptable standard of safety for work in peatlands. Mitigation/control measures identified for each of the infrastructure elements in the risk assessment will be taken into account and implemented throughout design and construction works (Appendix B).

In terms of likely construction techniques, with the exception of turbine T5 all turbines and their associated crane hardstands are likely to require a piled foundation as a result of the depth of peat and soft lacustrine deposits encountered. In addition, it is likely that a piled foundation will be required for the sub-station building. The sub-station platform and construction compound platform will likely be constructed using floating techniques. The proposed construction methods for all the new proposed access roads are floated and excavated techniques. Existing access tracks will be upgraded as required on site and incorporated into the infrastructure on site. All the above outlined construction techniques are to be confirmed at detailed design stage.

Figure 4.1 shows areas with elevated or higher construction risk based on qualitative factors identified during the site walk-over e.g. relatively deep peat, quaking peat, etc. Figure 8.1 shows the results of the factor of safety (FoS) analysis for the peat slopes on site for the most critical load condition.

Recommendations and guidelines given in FT's report 'Peat Management Plan - Coole Wind Farm, County Westmeath' (FT 2020) should be taken into consideration during the design and construction stage of the wind farm development. To minimise the risk of construction activity causing potential peat instability it is recommended that the Construction Method Statements (CMSs) for the project take into account, but not be limited, to the recommendations above. This will ensure that best practice guidance regarding the management of peat stability will be inherent in the construction phase.

11. REFERENCES

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FEHILY TIMONEY
30 YEARS

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ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX A

Photos from Site Walkover

Photo 1 Overview of site conditions

Photo 2 Overview of site conditions

Photo 3 Overview of site conditions

Photo 4 Example of vegetated area within construction compound footprint

Photo 5 Example of ground conditions on site (peat overlying lacustrine deposits)

Photo 6 Existing bog pool to the south of turbine T12

Photo 7 Section of wind turbine delivery route (existing track)

Photo 8 Section of wind turbine delivery route (through peatland)

FEHILY TIMONEY
30 YEARS

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APPENDIX B

Peat Stability Risk Registers

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	**Turbine T1**

Grid Reference (Eastings, Northings):	**240910**	**277329**
Distance to Watercourse (m)	**100 - 150**	
Maximum Measured Peat Depth (m):	**7.0**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 2.25 (u), 1.64 (d)	1	2	2	Negligible	No	See Below	1	2	2	Negligible
2	Evidence of sub peat water flow	1	2	2	Negligible	No		1	2	2	Negligible
3	Evidence of surface water flow	1	2	2	Negligible	No		1	2	2	Negligible
4	Evidence of previous failures/slips	0	2	0	Not Applicable	No		0	2	0	Not Applicable
5	Type of vegetation	2	2	4	Negligible	No		2	2	4	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	2	2	Negligible	No		1	2	2	Negligible
7	Evidence of very soft/soft clay at base of peat	3	2	6	Low	Yes		1	2	2	Negligible
8	Evidence of mechanically cut peat	0	2	0	Not Applicable	No		0	2	0	Not Applicable
9	Evidence of quaking or buoyant peat	2	2	4	Negligible	No		1	2	2	Negligible
10	Evidence of bog pools	0	2	0	Not Applicable	No		0	2	0	Not Applicable
11	Deep peat	4	2	8	Low	Yes		1	2	2	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T1**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	**Turbine T2**

Grid Reference (Eastings, Northings):	**241477**	**277250**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**4.4**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 3.19 (u), 2.61 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	1	1	1	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	1	1	1	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	1	1	1	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Deep peat	3	1	3	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T2**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	Turbine T3

Grid Reference (Eastings, Northings):	**241521**	**276690**
Distance to Watercourse (m)	**100 - 150**	
Maximum Measured Peat Depth (m):	**6.1**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 2.42 (u), 1.88 (d)	1	2	2	Negligible	No		1	2	2	Negligible
2	Evidence of sub peat water flow	1	2	2	Negligible	No		1	2	2	Negligible
3	Evidence of surface water flow	2	2	4	Negligible	No		1	2	2	Negligible
4	Evidence of previous failures/slips	0	2	0	Not Applicable	No		0	2	0	Not Applicable
5	Type of vegetation	2	2	4	Negligible	No		2	2	4	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	2	2	Negligible	No	See Below	1	2	2	Negligible
7	Evidence of very soft/soft clay at base of peat	3	2	6	Low	No		1	2	2	Negligible
8	Evidence of mechanically cut peat	2	2	4	Negligible	No		1	2	2	Negligible
9	Evidence of quaking or buoyant peat	1	2	2	Negligible	No		1	2	2	Negligible
10	Evidence of bog pools	0	2	0	Not Applicable	No		0	2	0	Not Applicable
11	Deep peat	4	2	8	Low	Yes		1	2	2	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T3**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	Turbine T4

Grid Reference (Eastings, Northings):	**242051**	**276891**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**5.6**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 5.21 (u), 4.09 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	2	1	2	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	1	1	1	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Deep peat	4	1	4	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T4**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	**Turbine T5**

Grid Reference (Eastings, Northings):	**241774**	**276057**
Distance to Watercourse (m)	**50 - 100**	
Maximum Measured Peat Depth (m):	**0.9**	
Control Required:	**No**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 9.05 (u), 12.74 (d)	1	3	3	Negligible	No		1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	1	3	3	Negligible	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	1	3	3	Negligible	No		1	3	3	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	3	3	Negligible	No	See Below	1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	1	3	3	Negligible	No		1	3	3	Negligible
8	Evidence of mechanically cut peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Other	0	3	0	Not Applicable	No		0	3	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T5**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation at detailed design stage;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties;
v	Inspection & approval of turbine base sub-formation by a competent person where a gravity type foundation base is constructed.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	Turbine T6

Grid Reference (Eastings, Northings):	241226	276051
Distance to Watercourse (m)	> 150	
Maximum Measured Peat Depth (m):	4.80	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 2.97 (u), 2.39 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	1	1	1	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	1	1	1	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	1	1	1	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Deep peat	3	1	3	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T6**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	**Turbine T7**

Grid Reference (Eastings, Northings):	**240951**	**276634**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**4.0**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 6.88 (u), 5.73 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	1	1	1	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	1	1	1	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	1	1	1	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Deep peat	3	1	3	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T7**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	Turbine T8

Grid Reference (Eastings, Northings):	**240569**	**276017**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**3.9**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 3.51 (u), 2.94 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	0	1	0	Not Applicable	No		0	1	0	Not Applicable
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	1	1	1	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	1	1	1	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Deep peat	3	1	3	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T8**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	Turbine T9

Grid Reference (Eastings, Northings):	**240920**	**275581**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**6.2**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 1.59 (u), 1.23 (d)	2	1	2	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	1	1	1	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	2	1	2	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Deep peat	4	1	4	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T9**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	**Turbine T10**

Grid Reference (Eastings, Northings):	**240380**	**275431**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**5.2**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 2.77 (u), 2.21 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	1	1	1	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	2	1	2	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Deep peat	4	1	4	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T10**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	Turbine T11

Grid Reference (Eastings, Northings):	**239907**	**275132**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**6.2**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 4.78 (u), 3.70 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	1	1	1	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	1	1	1	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	2	1	2	Negligible	No		1	1	1	Negligible
11	Deep peat	4	1	4	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T11**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	**Turbine T12**

Grid Reference (Eastings, Northings):	**240321**	**274755**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**5.3**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 1.82 (u), 1.44 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	1	1	1	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	1	1	1	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	1	1	1	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Deep peat	4	1	4	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T12**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	Turbine T13

Grid Reference (Eastings, Northings):	**240808**	**275032**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**7.5**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 2.02 (u), 1.53 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	1	1	1	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	3	1	3	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	1	1	1	Negligible	No		1	1	1	Negligible
9	Evidence of quaking or buoyant peat	2	1	2	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Deep peat	4	1	4	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T13**
i	Due to deep peat at this turbine location, additional construction measures such as the following may be required: - access and working area possibly formed using bog mats with the addition of temporary working platform - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - detailed design of access platforms and temporary working platforms to be carried out in advance of construction works - construct using piled foundation due to depth of peat and soft underlying deposits - install piling/working platform required for the construction of turbine base foundation - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works - site trial of piling works and potential issues to be identified prior to commencing construction - testing of piles to be carried out in accordance with latest standards to ensure design assumptions are satisified
ii	Use of experienced geotechnical staff for construction supervision, monitoring works, etc.;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	**Turbine T14**

Grid Reference (Eastings, Northings):	**640985.5 774517**
Distance to Watercourse (m)	**50 - 100**
Maximum Measured Peat Depth (m):	**1.0**
Control Required:	**Yes**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 17.19 (u), 22.92 (d)	1	3	3	Negligible	No		1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	1	3	3	Negligible	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		2	3	6	Low
6	General slope characteristics upslope/downslope from infrastructure location	1	3	3	Negligible	No	See Below	1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	1	3	3	Negligible	No		1	3	3	Negligible
8	Evidence of mechanically cut peat	1	3	3	Negligible	No		1	3	3	Negligible
9	Evidence of quaking or buoyant peat	2	3	6	Low	No		1	3	3	Negligible
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Deep peat	1	3	3	Negligible	No		1	3	3	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T14**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation at detailed design stage;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties;
v	Inspection & approval of turbine base sub-formation by a competent person where a gravity type foundation base is constructed.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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Location:	**Turbine T15**

Grid Reference (Eastings, Northings):	**642732**	**775628**
Distance to Watercourse (m)	**50 - 100**	
Maximum Measured Peat Depth (m):	**1.9**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 11.86 (u), 12.06 (d)	1	3	3	Negligible	No	See Below	1	3	3	Negligible
2	Evidence of sub peat water flow	1	3	3	Negligible	No		1	3	3	Negligible
3	Evidence of surface water flow	1	3	3	Negligible	No		1	3	3	Negligible
4	Evidence of previous failures/slips	0	3	0	Not Applicable	No		0	3	0	Not Applicable
5	Type of vegetation	2	3	6	Low	No		2	3	6	Low
6	General slope characteristics upslope/downslope from infrastructure location	1	3	3	Negligible	No		1	3	3	Negligible
7	Evidence of very soft/soft clay at base of peat	1	3	3	Negligible	No		1	3	3	Negligible
8	Evidence of mechanically cut peat	1	3	3	Negligible	No		1	3	3	Negligible
9	Evidence of quaking or buoyant peat	1	3	3	Negligible	No		1	3	3	Negligible
10	Evidence of bog pools	0	3	0	Not Applicable	No		0	3	0	Not Applicable
11	Deep peat	1	3	3	Negligible	No		1	3	3	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T15**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation at detailed design stage;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties;
v	Inspection & approval of turbine base sub-formation by a competent person where a gravity type foundation base is constructed.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	Construction Compound

Grid Reference (Eastings, Northings):	**240015**	**274575**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**3.1**	
Control Required:	**No**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 8.39 (u), 7.39 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	2	1	2	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Relatively deep peat	3	1	3	Negligible	No		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Construction Compound**
i	Due to relatively deep peat at the construction compound, additional construction measures such as the following may be required: - access to area formed using bog mats, where required - compound to be constructed using floated techniques - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform
ii	Use of experienced geotechnical staff for site investigation at detailed design stage;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	Substation

Grid Reference (Eastings, Northings):	**239967**	**274699**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**3.4**	
Control Required:	**Yes**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 4.1 (u), 3.58 (d)	1	1	1	Negligible	No		1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	2	1	2	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No	See Below	1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	2	1	2	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Relatively deep peat	3	1	3	Negligible	Yes		1	1	1	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Substation**
i	Due to relatively deep peat at the substation, additional construction measures such as the following may be required: - access to area formed using bog mats, where required - compound platform to be constructed using floated techniques - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - install piling/working platform required for the construction of substation building - substation building to be constructed using piled foundation due to depth of peat and soft underlying deposits - monitoring (in the form of timber stakes as sightlines) to be installed in area of working platform and to be monitored regularly during the piling works
ii	Use of experienced geotechnical staff for site investigation at detailed design stage;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	**Borrow Pit**

Grid Reference (Eastings, Northings):	**241921**	**274347**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**No peat**	
Control Required:	**No**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = No Peat (u), No Peat (d)	0	1	0	Not Applicable	No	See Below	0	1	0	Not Applicable
2	Evidence of sub peat water flow	0	1	0	Not Applicable	No		0	1	0	Not Applicable
3	Evidence of surface water flow	0	1	0	Not Applicable	No		0	1	0	Not Applicable
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	0	1	0	Not Applicable	No		0	1	0	Not Applicable
6	General slope characteristics upslope/downslope from infrastructure location	0	1	0	Not Applicable	No		0	1	0	Not Applicable
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Borrow Pit**
	N/A - No peat present

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	Access Track

Includes the upgrade of a section of the existing track for the wind turbine delivery route south of the wind farm site

Grid Reference from/to (Eastings, Northings):	240579	272665
	240245	272592
Distance to Watercourse (m)	> 150	
Maximum Measured Peat Depth (m):	No peat	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = No Peat (u), No Peat (d)	0	1	0	Not Applicable	No	See Below	0	1	0	Not Applicable
2	Evidence of sub peat water flow	0	1	0	Not Applicable	No		0	1	0	Not Applicable
3	Evidence of surface water flow	0	1	0	Not Applicable	No		0	1	0	Not Applicable
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	0	1	0	Not Applicable	No		0	1	0	Not Applicable
6	General slope characteristics upslope/downslope from infrastructure location	0	1	0	Not Applicable	No		0	1	0	Not Applicable
7	Evidence of very soft/soft clay at base of peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
8	Evidence of mechanically cut peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	1	0	Not Applicable	No		0	1	0	Not Applicable
10	Evidence of bog pools	0	1	0	Not Applicable	No		0	1	0	Not Applicable
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **upgrade of a section of the existing track for the wind turbine delivery route**
	N/A - No peat present

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

Coole Wind Farm - Geotechnical Risk Register (Rev 1)

Location:	Access Track

Includes the new floating track for a section of the wind turbine delivery route south of the wind farm

Grid Reference (Eastings, Northings):	**240200**	**272570**
	239652	**272392**
Distance to Watercourse (m)	**> 150**	
Maximum Measured Peat Depth (m):	**2.8**	
Control Required:	**No**	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob	Impact	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob	Impact	Risk	Risk Rating
1	FOS = 5.7 (u), 8.3 (d)	1	1	1	Negligible	No	See Below	1	1	1	Negligible
2	Evidence of sub peat water flow	1	1	1	Negligible	No		1	1	1	Negligible
3	Evidence of surface water flow	1	1	1	Negligible	No		1	1	1	Negligible
4	Evidence of previous failures/slips	0	1	0	Not Applicable	No		0	1	0	Not Applicable
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	1	1	1	Negligible	No		1	1	1	Negligible
7	Evidence of very soft/soft clay at base of peat	2	1	2	Negligible	No		1	1	1	Negligible
8	Evidence of mechanically cut peat	3	1	3	Negligible	No		2	1	2	Negligible
9	Evidence of quaking or buoyant peat	1	1	1	Negligible	No		1	1	1	Negligible
10	Evidence of bog pools	1	1	1	Negligible	No		1	1	1	Negligible
11	Other	0	1	0	Not Applicable	No		0	1	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **the floating track for a section of the wind turbine delivery route**
i	Due to relatively deep peat along the access track, additional construction measures such as the following may be required: - use of low ground bearing pressure machinery during construction e.g. wide tracked excavator - access road to be constructed using floated techniques (subject to detailed design) - access road to be constructed using floated techniques (subject to detailed design) - detailed ground investigation to determine peat, mineral soil and bedrock condition and properties for design stage - monitoring (in the form of timber stakes as sightlines) to be installed along side the access track in deeper peat areas and regularly monitored
ii	Use of experienced geotechnical staff for site investigation at detailed design stage;
iii	Use of experienced contractors and trained operators to carry out the work;
iv	Maintain hydrology of area as far as possible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.

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APPENDIX C

Calculated FOS for Peat Slopes on Site

Calculated FoS of Natural Peat Slopes for Coole Wind Farm (Undrained Analysis)

Turbine No./Waypoint	Easting	Northing	Slope	Undrained shear strength	Bulk unit weight of Peat	Peat Depth	Surcharge Equivalent Placed Fill Depth (m)	Factor of Safety for Load Condition	
			β (deg)	c_u (kPa)	γ (kN/m^3)	(m)	Condition (2)	Condition (1)	Condition (2)
FT SEPTEMBER 2020 SITE DATA									
T14	640986	774517	1.0	6	10	1.0	2.0	**34.38**	**17.19**
T15	642732	775628	1.0	6	10	1.9	2.9	**18.10**	**11.86**
WP028	641003	775208	2.0	6	10	0.6	1.6	**28.67**	**10.75**
WP030	641006	775108	1.0	6	10	0.8	1.8	**42.98**	**19.10**
WP032	641008	775008	1.0	6	10	3.5	4.5	**9.82**	**7.64**
WP034	641001	774908	1.0	6	10	2.5	3.5	**13.75**	**9.82**
WP036	640989	774809	1.0	6	10	4.0	5.0	**8.60**	**6.88**
WP038	640983	774709	1.0	6	10	1.5	2.5	**22.92**	**13.75**
WP040	640976	774609	1.0	6	10	1.0	2.0	**34.38**	**17.19**
WP056	642131	774597	3.0	6	10	0.1	1.1	**114.80**	**10.44**
WP059	642222	774709	3.0	6	10	0.2	1.2	**57.40**	**9.57**
WP062	642321	774822	5.0	6	10	0.1	1.1	**69.11**	**6.28**
WP065	642392	774953	3.0	6	10	0.3	1.3	**38.27**	**8.83**
WP068	642446	775093	6.0	6	10	0.8	1.8	**7.21**	**3.21**
WP070	642477	775188	1.0	6	10	1.0	2.0	**34.38**	**17.19**
WP072	642508	775283	2.0	6	10	0.6	1.6	**28.67**	**10.75**
WP074	642540	775378	1.0	6	10	0.8	1.8	**42.98**	**19.10**
WP076	642572	775473	1.0	6	10	1.1	2.1	**31.26**	**16.37**
WP078	642607	775566	1.0	6	10	1.1	2.1	**31.26**	**16.37**
WP079	642648	775594	1.0	6	10	1.5	2.5	**22.92**	**13.75**
WP080	642690	775620	1.0	6	10	1.7	2.7	**20.23**	**12.73**
WP001	642390	774986	6.0	6	10	0.3	1.3	**19.24**	**4.44**
AGEC DECEMBER 2016 SITE DATA									
T1	240910	277329	2.0	6	10	7.0	8.0	**2.46**	**2.15**
T2	241477	277250	2.0	6	10	4.4	5.4	**3.91**	**3.19**
T3	241521	276690	2.0	6	10	6.1	7.1	**2.82**	**2.42**
T4	242051	276891	1.0	6	10	5.6	6.6	**6.14**	**5.21**
T5	241774	276057	2.0	6	10	0.9	1.9	**19.11**	**9.05**
T6	241226	276051	2.0	6	10	4.8	5.8	**3.58**	**2.97**
T7	240951	276634	1.0	6	10	4.0	5.0	**8.60**	**6.88**
T8	240569	276017	2.0	6	10	3.9	4.9	**4.41**	**3.51**
T9	240920	275581	3.0	6	10	6.2	7.2	**1.85**	**1.59**
T10	240380	275431	2.0	6	10	5.2	6.2	**3.31**	**2.77**
T11	239907	275132	1.0	6	10	6.2	7.2	**5.55**	**4.78**
T12	240321	274755	3.0	6	10	5.3	6.3	**2.17**	**1.82**
T13	240808	275032	2.0	6	10	7.5	8.5	**2.29**	**2.02**
BP1	241778	274360	No Peat recorded at location						
BP2	241877	274450	No Peat recorded at location						
BP3	241961	274577	No Peat recorded at location						
BP4	242074	274477	No Peat recorded at location						
BP5	242033	274425	No Peat recorded at location						
BP6	242124	274378	No Peat recorded at location						
BP7	242013	274207	No Peat recorded at location						
BP8	241909	274255	No Peat recorded at location						
BP9	241888	274225	No Peat recorded at location						
BPC1	241874	274329	No Peat recorded at location						
BPC3	241985	274471	No Peat recorded at location						
BPC4	241964	274287	No Peat recorded at location						
CC1	239933	274514	1.0	6	10	3.1	4.1	**11.09**	**8.39**
CC2	239925	274545	1.0	6	10	2.3	3.3	**14.95**	**10.42**
CC3	239981	274581	1.0	6	10	0.6	1.6	**57.31**	**21.49**
CC4	240050	274619	1.0	6	10	0.6	1.6	**57.31**	**21.49**
CC5	240072	274597	1.0	6	10	0.4	1.4	**85.96**	**24.56**
CC7	240003	274544	1.0	6	10	2.2	3.2	**15.63**	**10.75**
CC8	239961	274518	1.0	6	10	2.5	3.5	**13.75**	**9.82**
CC10	240015	274575	1.0	6	10	1.6	2.6	**21.49**	**13.22**
SUB1	239759	274798	1.0	6	10	1.8	2.8	**19.10**	**12.28**
SUB2	239833	274835	2.0	6	10	2.9	3.9	**5.93**	**4.41**
SUB3	239907	274873	2.0	6	10	3.2	4.2	**5.38**	**4.10**
SUB4	239969	274755	2.0	6	10	1.2	2.2	**14.34**	**7.82**
SUB5	240031	274637	2.0	6	10	0.5	1.5	**34.41**	**11.47**
SUB6	239956	274592	2.0	6	10	0.4	1.4	**43.01**	**12.29**
SUB7	239882	274547	2.0	6	10	1.7	2.7	**10.12**	**6.37**
SUB8	239821	274672	1.0	6	10	3.1	4.1	**11.09**	**8.39**
SUB9	239869	274763	1.0	6	10	3.4	4.4	**10.11**	**7.81**
WP001	239994	274807	1.0	6	10	3.0	4.0	**11.46**	**8.60**
WP002	241682	276069	2.0	6	10	0.9	1.9	**19.11**	**9.05**
WP003	241813	277182	2.0	6	10	3.0	4.0	**5.73**	**4.30**
1	239927	274426	0.3	6	10	1.0	2.0	**100.00**	**50.00**
2	239935	274496	0.1	6	10	1.3	2.3	**461.54**	**260.87**
3	240070	274643	0.7	6	10	0.3	1.3	**153.87**	**35.51**
4	240027	274705	0.5	6	10	3.0	4.0	**22.22**	**16.67**
6	239943	274829	0.2	6	10	3.8	4.8	**52.63**	**41.67**
7	239912	274897	0.8	6	10	3.5	4.5	**12.25**	**9.53**
8	239903	274971	2.0	6	10	3.2	4.2	**5.38**	**4.10**
9	239898	275046	0.1	6	10	3.2	4.2	**107.43**	**81.85**
10	240138	274601	3.0	6	10	0.9	1.9	**12.76**	**6.04**
11	240209	274625	6.0	6	10	2.2	3.2	**2.62**	**1.80**
12	240279	274650	4.0	6	10	4.8	5.8	**1.80**	**1.49**
13	240327	274705	0.6	6	10	5.6	6.6	**10.72**	**9.09**
14	240361	274772	0.4	6	10	4.8	5.8	**17.86**	**14.78**
16	240427	274907	1.0	6	10	5.7	6.7	**6.03**	**5.13**
17	240461	274974	2.0	6	10	5.5	6.5	**3.13**	**2.65**
18	240495	275041	2.0	6	10	5.8	6.8	**2.97**	**2.53**
19	240529	275108	0.4	6	10	4.9	5.9	**17.49**	**14.53**
20	240563	275174	0.4	6	10	5.2	6.2	**16.53**	**13.86**
22	240632	275308	0.3	6	10	4.6	5.6	**21.74**	**17.86**
23	240666	275375	3.0	6	10	3.7	4.7	**3.10**	**2.44**
24	240697	275442	0.9	6	10	2.7	3.7	**14.82**	**10.81**

Calculated FoS of Natural Peat Slopes for Coole Wind Farm (Undrained Analysis)

Turbine No./Waypoint	Easting	Northing	Slope	Undrained shear strength	Bulk unit weight of Peat	Peat Depth	Surcharge Equivalent Placed Fill Depth (m)	Factor of Safety for Load Condition	
			β (deg)	c_u (kPa)	γ (kN/m^3)	(m)	Condition (2)	Condition (1)	Condition (2)
26	240608	275522	1.0	6	10	3.8	4.8	**9.29**	**7.36**
27	240538	275535	2.0	6	10	3.6	4.6	**4.78**	**3.74**
28	240479	275488	0.1	6	10	2.4	3.4	**125.00**	**88.24**
30	240762	275438	0.1	6	10	1.3	2.3	**230.77**	**130.44**
31	240825	275398	0.1	6	10	1.5	2.5	**400.00**	**240.00**
32	240889	275359	0.4	6	10	2.4	3.4	**35.72**	**25.21**
34	240890	275217	0.9	6	10	3.6	4.6	**11.11**	**8.70**
35	240878	275143	0.6	6	10	3.7	4.7	**16.22**	**12.77**
36	240869	275088	0.6	6	10	3.3	4.3	**16.53**	**12.69**
37	240763	275475	2.0	6	10	4.6	5.6	**3.74**	**3.07**
38	240824	275519	2.0	6	10	5.2	6.2	**3.31**	**2.77**
39	240855	275543	0.4	6	10	4.9	5.9	**17.49**	**14.53**
40	240826	275539	0.4	6	10	6.3	7.3	**13.64**	**11.77**
41	240875	275596	0.1	6	10	5.5	6.5	**109.09**	**92.31**
43	240847	275713	1.1	6	10	2.2	3.2	**13.64**	**9.38**
44	240779	275745	2.7	6	10	2.6	3.6	**4.82**	**3.48**
46	240647	275814	2.3	6	10	1.7	2.7	**8.84**	**5.56**
47	240611	275879	2.0	6	10	1.5	2.5	**11.47**	**6.88**
48	240585	275940	0.4	6	10	1.3	2.3	**65.94**	**37.27**
50	241002	275740	0.8	6	10	1.7	2.7	**25.22**	**15.88**
51	241076	275742	0.1	6	10	1.3	2.3	**461.54**	**260.87**
52	241149	275729	0.4	6	10	0.3	1.3	**285.73**	**65.94**
53	241217	275761	1.0	6	10	0.3	1.3	**114.61**	**26.45**
54	241290	275779	1.0	6	10	0.4	1.4	**85.96**	**24.56**
55	241350	275818	1.0	6	10	0.3	1.3	**114.61**	**26.45**
56	241390	275881	1.0	6	10	0.2	1.2	**171.92**	**28.65**
57	241428	275946	1.0	6	10	0.5	1.5	**68.77**	**22.92**
58	241482	275996	1.1	6	10	1.0	2.0	**31.59**	**15.80**
59	241536	276048	1.0	6	10	1.6	2.6	**22.07**	**13.58**
60	241555	276069	0.2	6	10	1.4	2.4	**107.14**	**62.50**
63	241585	276130	1.3	6	10	0.6	1.6	**44.09**	**16.53**
64	241545	276194	1.3	6	10	1.1	2.1	**24.81**	**12.99**
66	241430	276258	0.5	6	10	4.9	5.9	**13.61**	**11.30**
67	241363	276224	1.0	6	10	5.1	6.1	**6.92**	**5.79**
69	241259	276168	0.9	6	10	4.5	5.5	**8.34**	**6.82**
70	241467	276311	2.0	6	10	4.6	5.6	**3.73**	**3.06**
71	241437	276379	1.0	6	10	3.4	4.4	**10.11**	**7.81**
72	241400	276437	1.0	6	10	3.9	4.9	**9.05**	**7.20**
73	241338	276479	0.8	6	10	3.5	4.5	**12.25**	**9.53**
74	241279	276526	1.2	6	10	4.8	5.8	**5.96**	**4.93**
75	241220	276572	1.7	6	10	5.3	6.3	**3.78**	**3.18**
77	241084	276628	0.1	6	10	4.5	5.5	**66.67**	**54.55**
78	241020	276638	0.5	6	10	3.3	4.3	**20.20**	**15.51**
79	241527	276221	0.5	6	10	3.5	4.5	**19.65**	**15.28**
81	241573	276356	2.2	6	10	0.9	1.9	**17.38**	**8.23**
82	241611	276421	2.2	6	10	0.3	1.3	**52.71**	**12.16**
83	241618	276490	2.0	6	10	0.8	1.8	**21.50**	**9.56**
84	241571	276545	2.5	6	10	3.8	4.8	**3.60**	**2.85**
85	241542	276615	0.7	6	10	3.6	4.6	**12.82**	**10.04**
86	241530	276645	1.1	6	10	5.6	6.6	**5.64**	**4.79**
87	241587	276511	1.7	6	10	5.5	6.5	**3.64**	**3.08**
89	241467	276600	1.7	6	10	4.4	5.4	**4.71**	**3.83**
90	241414	276654	1.9	6	10	2.7	3.7	**6.54**	**4.77**
91	241358	276703	2.2	6	10	2.2	3.2	**7.19**	**4.94**
92	241310	276760	1.0	6	10	3.1	4.1	**11.09**	**8.39**
93	241266	276820	0.8	6	10	3.6	4.6	**11.91**	**9.32**
94	241222	276881	0.1	6	10	3.8	4.8	**157.89**	**125.00**
95	241177	276942	1.0	6	10	3.4	4.4	**10.11**	**7.81**
96	241133	277002	0.6	6	10	5.3	6.3	**10.29**	**8.66**
97	241089	277063	0.1	6	10	5.1	6.1	**117.65**	**98.36**
98	241047	277125	0.9	6	10	5.6	6.6	**7.14**	**6.06**
99	241024	277163	1.0	6	10	5.1	6.1	**6.92**	**5.79**
100	241017	277210	1.0	6	10	4.9	5.9	**7.02**	**5.83**
101	240955	277252	1.0	6	10	5.8	6.8	**5.75**	**4.90**
103	241033	277230	0.5	6	10	4.8	5.8	**13.89**	**11.50**
105	241168	277281	0.7	6	10	5.2	6.2	**8.88**	**7.45**
106	241242	277290	2.0	6	10	4.7	5.7	**3.66**	**3.02**
107	241317	277298	2.0	6	10	4.4	5.4	**3.91**	**3.19**
109	241465	277284	2.0	6	10	3.7	4.7	**4.65**	**3.66**
110	241540	277278	2.0	6	10	3.8	4.8	**4.53**	**3.58**
111	241615	277272	2.0	6	10	1.1	2.1	**15.60**	**8.17**
112	241689	277277	3.0	6	10	0.3	1.3	**38.27**	**8.83**
113	241756	277250	3.0	6	10	0.1	1.1	**114.80**	**10.44**
115	241876	277192	0.5	6	10	0.4	1.4	**166.68**	**47.62**
116	241950	277183	0.6	6	10	0.1	1.1	**600.06**	**54.55**
117	242022	277163	0.3	6	10	0.4	1.4	**250.01**	**71.43**
118	242088	277130	1.4	6	10	0.1	1.1	**240.15**	**21.83**
119	242135	277073	1.0	6	10	2.0	3.0	**16.67**	**11.11**
120	242111	277006	0.7	6	10	3.4	4.4	**13.58**	**10.49**
121	242077	276956	0.2	6	10	3.7	4.7	**54.05**	**42.55**
HES 2016 PEAT DEPTH DATA									
WS-11	239871	275103	1.7	6	10	6.2	7.2	**3.26**	**2.81**
WS13	240855	275030	0.5	6	10	7.5	8.5	**8.91**	**7.86**
WS09	240923	275577	0.1	6	10	6.0	7.0	**100.33**	**85.96**
WS08	240568	276013	0.5	6	10	0.8	1.8	**93.76**	**41.67**
WS07	240950	276633	0.4	6	10	4.0	5.0	**21.59**	**17.25**
WS02	241426	277287	0.3	6	10	4.2	5.2	**28.57**	**23.08**
WS01	240876	277321	0.3	6	10	5.4	6.4	**21.42**	**18.05**
WS03	241517	276713	2.6	6	10	6.2	7.2	**2.14**	**1.84**
WS100	241441	277395	2.6	6	10	5.6	6.6	**2.39**	**2.02**
WS101	240833	277407	1.7	6	10	5.4	6.4	**3.83**	**3.24**
WS1-C	277407	274562	0.7	6	10	0.9	1.9	**51.29**	**24.30**

Calculated FoS of Natural Peat Slopes for Coole Wind Farm (Undrained Analysis)

Turbine No./Waypoint	Easting	Northing	Slope	Undrained shear strength	Bulk unit weight of Peat	Peat Depth	Surcharge Equivalent Placed Fill Depth (m)	Factor of Safety for Load Condition	
			β (deg)	c_u (kPa)	γ (kN/m^3)	(m)	Condition (2)	Condition (1)	Condition (2)
TP1-C	240039	274580	0.7	6	10	2.7	3.7	**17.10**	**12.48**
TP2-C	239994	274552	0.9	6	10	0.7	1.7	**61.55**	**24.25**
HES 2012 PEAT DEPTH DATA									
69	242338	276904	0.1	6	10	3.1	4.1	**196.08**	**147.78**
70	242196	276760	0.1	6	10	3.4	4.4	**175.44**	**135.75**
71	242080	276595	1.1	6	10	4.8	5.8	**6.60**	**5.46**
72	241953	276386	0.2	6	10	5.5	6.5	**27.08**	**22.94**
73	241754	276444	0.2	6	10	4.6	5.6	**43.10**	**35.46**
74	241865	276613	0.4	6	10	5.7	6.7	**15.08**	**12.83**
75	241979	276780	0.4	6	10	6.0	7.0	**14.38**	**12.32**
76	242089	276953	1.5	6	10	4.0	5.0	**5.56**	**4.45**
77	242161	277079	1.0	6	10	3.4	4.4	**9.69**	**7.51**
78	241973	277141	0.1	6	10	1.7	2.7	**172.41**	**109.49**
79	241863	276972	0.2	6	10	5.5	6.5	**36.63**	**30.96**
80	241754	276803	0.2	6	10	6.6	7.6	**26.08**	**22.65**
81	241644	276631	1.4	6	10	7.1	8.1	**3.48**	**3.05**
82	241451	276652	1.4	6	10	5.8	6.8	**4.15**	**3.54**
83	241561	276815	1.4	6	10	7.8	8.8	**3.15**	**2.79**
84	241672	276986	0.7	6	10	6.8	7.8	**6.79**	**5.92**
85	241786	277158	2.9	6	10	0.7	1.7	**17.60**	**7.06**
86	241605	277249	1.8	6	10	2.9	3.9	**6.56**	**4.86**
87	241485	277080	0.1	6	10	5.4	6.4	**55.56**	**46.88**
88	241374	276912	0.4	6	10	5.5	6.5	**15.50**	**13.13**
89	241190	276937	0.1	6	10	4.6	5.6	**129.87**	**106.76**
90	241065	277103	0.1	6	10	4.0	5.0	**150.00**	**120.00**
91	241316	277096	0.5	6	10	6.1	7.1	**12.34**	**10.59**
92	241422	277328	2.6	6	10	5.1	6.1	**2.59**	**2.16**
93	241394	277536	2.6	6	10	4.9	5.9	**2.69**	**2.24**
94	241322	277715	1.0	6	10	4.3	5.3	**8.17**	**6.64**
95	241118	277701	1.6	6	10	4.3	5.3	**5.02**	**4.07**
96	241142	277500	1.6	6	10	3.8	4.8	**5.63**	**4.46**
97	241166	277290	0.7	6	10	4.2	5.2	**11.10**	**8.95**
98	240924	277267	1.7	6	10	4.8	5.8	**4.35**	**3.59**
99	240896	277471	0.5	6	10	5.0	6.0	**15.00**	**12.50**
100	240876	277669	0.1	6	10	2.7	3.7	**223.05**	**162.60**
101	240793	277631	0.8	6	10	6.3	7.3	**6.86**	**5.91**
102	240829	277365	0.8	6	10	6.4	7.4	**6.69**	**5.79**
AGEC May 2017 Access Road Walkover									
1	240579	272665	2.0	No Peat recorded at location					
2	240532	272648	2.0	No Peat recorded at location					
3	240483	272651	2.0	No Peat recorded at location					
4	240434	272654	1.0	No Peat recorded at location					
5	240386	272640	1.0	No Peat recorded at location					
6	240338	272628	1.0	No Peat recorded at location					
7	240290	272614	2.0	No Peat recorded at location					
8	240245	272592	3.0	No Peat recorded at location					
9	240200	272570	1.0	6	10	0.7	1.7	**49.12**	**20.23**
10	240153	272552	2.0	6	10	1.5	2.5	**11.47**	**6.88**
11	240107	272534	1.5	6	10	2.5	3.5	**9.17**	**6.55**
12	240059	272537	1.0	6	10	1.5	2.5	**22.92**	**13.75**
13	240023	272572	0.5	6	10	1.5	2.5	**45.84**	**27.50**
14	239987	272607	1.0	6	10	1.8	2.8	**19.10**	**12.28**
15	239944	272632	1.0	6	10	1.5	2.5	**22.92**	**13.75**
16	239899	272654	0.5	6	10	0.7	1.7	**98.23**	**40.45**
17	239854	272676	1.0	6	10	1.4	2.4	**24.56**	**14.33**
18	239806	272687	0.5	6	10	2.5	3.5	**27.50**	**19.65**
19	239760	272670	0.5	6	10	2.1	3.1	**32.74**	**22.18**
20	239735	272627	1.0	6	10	1.8	2.8	**19.10**	**12.28**
21	239716	272581	1.0	6	10	2.8	3.8	**12.28**	**9.05**
22	239697	272535	0.5	6	10	2.3	3.3	**29.89**	**20.84**
23	239680	272488	1.0	6	10	2.0	3.0	**17.19**	**11.46**
24	239666	272440	2.0	6	10	2.0	3.0	**8.60**	**5.73**
25	239652	272392	2.0	6	10	2.0	3.0	**8.60**	**5.73**
							Minimum =	**1.80**	**1.49**
							Maximum =	**600.06**	**260.87**
							Average =	**43.25**	**22.20**

Notes:

(1) Assuming a bulk unit weight for peat of 10kN/m^3

(2) Assuming a surcharge equivalent to fill depth of 1m of peat i.e. 10kPa.

(3) Slope inclination (β) based on site readings and site contour plans.

(4) A lower bound undrained shear strength, cu for the peat of 6kPa was selected for the assessment. It should be noted that a cu of 6kPa for the peat. is considered a conservative value for the analysis and is not representative of all peat present across the site.

(5) Peat depths based on probes carried out by AGEC & HES.

(6) For load conditions see report text.

Calculated FoS of Natural Peat Slopes for Coole Wind Farm (Drained Analysis)

Turbine No./Waypoint	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	100% Water to height of Peat	Depth of In situ Peat	Friction Angle	Surcharge Equivalent Placed Fill	Equivalent Total Depth of Peat (m)	Factor of Safety for Load Condition	
	α (deg)	c' (kPa)	γ (kN/m^3)	γ_w (kN/m^3)	(m)	(m)	ø' (deg)	Condition (2)	Condition (2)	Condition (1)	Condition (2)
										100% Water	100% Water
FT SEPTEMBER 2020 SITE DATA											
T14	1.0	4	10.0	10.0	1.0	1.0	25	1.0	2.0	**22.92**	**24.82**
T15	1.0	4	10.0	10.0	1.9	1.9	25	1.0	2.9	**12.06**	**17.12**
WP028	2.0	4	10.0	10.0	0.6	0.6	25	1.0	1.6	**19.11**	**15.51**
WP030	1.0	4	10.0	10.0	0.8	0.8	25	1.0	1.8	**28.65**	**27.58**
WP032	1.0	4	10.0	10.0	3.5	3.5	25	1.0	4.5	**6.55**	**11.03**
WP034	1.0	4	10.0	10.0	2.5	2.5	25	1.0	3.5	**9.17**	**14.18**
WP036	1.0	4	10.0	10.0	4.0	4.0	25	1.0	5.0	**5.73**	**9.93**
WP038	1.0	4	10.0	10.0	1.5	1.5	25	1.0	2.5	**15.28**	**19.86**
WP040	1.0	4	10.0	10.0	1.0	1.0	25	1.0	2.0	**22.92**	**24.82**
WP056	3.0	4	10.0	10.0	0.1	0.1	25	1.0	1.1	**76.53**	**15.05**
WP059	3.0	4	10.0	10.0	0.2	0.2	25	1.0	1.2	**38.27**	**13.79**
WP062	5.0	4	10.0	10.0	0.1	0.1	25	1.0	1.1	**46.07**	**9.03**
WP065	3.0	4	10.0	10.0	0.3	0.3	25	1.0	1.3	**25.51**	**12.73**
WP068	6.0	4	10.0	10.0	0.8	0.8	25	1.0	1.8	**4.81**	**4.60**
WP070	1.0	4	10.0	10.0	1.0	1.0	25	1.0	2.0	**22.92**	**24.82**
WP072	2.0	4	10.0	10.0	0.6	0.6	25	1.0	1.6	**19.11**	**15.51**
WP074	1.0	4	10.0	10.0	0.8	0.8	25	1.0	1.8	**28.65**	**27.58**
WP076	1.0	4	10.0	10.0	1.1	1.1	25	1.0	2.1	**20.84**	**23.64**
WP078	1.0	4	10.0	10.0	1.1	1.1	25	1.0	2.1	**20.84**	**23.64**
WP079	1.0	4	10.0	10.0	1.5	1.5	25	1.0	2.5	**15.28**	**19.86**
WP080	1.0	4	10.0	10.0	1.7	1.7	25	1.0	2.7	**13.48**	**18.38**
WP001	6.0	4	10.0	10.0	0.3	0.3	25	1.0	1.3	**12.83**	**6.37**
AGEC DECEMBER 2016 SITE DATA											
T1	2.0	4	10.0	10.0	7.0	7.0	25	1.0	8.0	**1.64**	**3.10**
T2	2.0	4	10.0	10.0	4.4	4.4	25	1.0	5.4	**2.61**	**4.60**
T3	2.0	4	10.0	10.0	6.1	6.1	25	1.0	7.1	**1.88**	**3.50**
T4	1.0	4	10.0	10.0	5.6	5.6	25	1.0	6.6	**4.09**	**7.52**
T5	2.0	4	10.0	10.0	0.9	0.9	25	1.0	1.9	**12.74**	**13.06**
T6	2.0	4	10.0	10.0	4.8	4.8	25	1.0	5.8	**2.39**	**4.28**
T7	1.0	4	10.0	10.0	4.0	4.0	25	1.0	5.0	**5.73**	**9.93**
T8	2.0	4	10.0	10.0	3.9	3.9	25	1.0	4.9	**2.94**	**5.07**
T9	3.0	4	10.0	10.0	6.2	6.2	25	1.0	7.2	**1.23**	**2.30**
T10	2.0	4	10.0	10.0	5.2	5.2	25	1.0	6.2	**2.21**	**4.00**
T11	1.0	4	10.0	10.0	6.2	6.2	25	1.0	7.2	**3.70**	**6.89**
T12	3.0	4	10.0	10.0	5.3	5.3	25	1.0	6.3	**1.44**	**2.63**
T13	2.0	4	10.0	10.0	7.5	7.5	25	1.0	8.5	**1.53**	**2.92**
BP1	No Peat recorded at location										
BP2	No Peat recorded at location										
BP3	No Peat recorded at location										
BP4	No Peat recorded at location										
BP5	No Peat recorded at location										
BP6	No Peat recorded at location										
BP7	No Peat recorded at location										
BP8	No Peat recorded at location										
BP9	No Peat recorded at location										
BPC1	No Peat recorded at location										
BPC3	No Peat recorded at location										
BPC4	No Peat recorded at location										
CC1	1.0	4	10.0	10.0	3.1	3.1	25	1.0	4.1	**7.39**	**12.11**
CC2	1.0	4	10.0	10.0	2.3	2.3	25	1.0	3.3	**9.97**	**15.04**
CC3	1.0	4	10.0	10.0	0.6	0.6	25	1.0	1.6	**38.20**	**31.02**
CC4	1.0	4	10.0	10.0	0.6	0.6	25	1.0	1.6	**38.20**	**31.02**
CC5	1.0	4	10.0	10.0	0.4	0.4	25	1.0	1.4	**57.31**	**35.46**
CC7	1.0	4	10.0	10.0	2.2	2.2	25	1.0	3.2	**10.42**	**15.51**
CC8	1.0	4	10.0	10.0	2.5	2.5	25	1.0	3.5	**9.17**	**14.18**
CC10	1.0	4	10.0	10.0	1.6	1.6	25	1.0	2.6	**14.33**	**19.09**
SUB1	1.0	4	10.0	10.0	1.8	1.8	25	1.0	2.8	**12.73**	**17.73**
SUB2	2.0	4	10.0	10.0	2.9	2.9	25	1.0	3.9	**3.95**	**6.36**
SUB3	2.0	4	10.0	10.0	3.2	3.2	25	1.0	4.2	**3.58**	**5.91**
SUB4	2.0	4	10.0	10.0	1.2	1.2	25	1.0	2.2	**9.56**	**11.28**
SUB5	2.0	4	10.0	10.0	0.5	0.5	25	1.0	1.5	**22.94**	**16.55**
SUB6	2.0	4	10.0	10.0	0.4	0.4	25	1.0	1.4	**28.67**	**17.73**
SUB7	2.0	4	10.0	10.0	1.7	1.7	25	1.0	2.7	**6.75**	**9.19**
SUB8	1.0	4	10.0	10.0	3.1	3.1	25	1.0	4.1	**7.39**	**12.11**
SUB9	1.0	4	10.0	10.0	3.4	3.4	25	1.0	4.4	**6.74**	**11.28**
WP001	1.0	4	10.0	10.0	3.0	3.0	25	1.0	4.0	**7.64**	**12.41**
WP002	2.0	4	10.0	10.0	0.9	0.9	25	1.0	1.9	**12.74**	**13.06**
WP003	2.0	4	10.0	10.0	3.0	3.0	25	1.0	4.0	**3.82**	**6.21**
1	0.3	4	10.0	10.0	1.0	1.0	25	1.0	2.0	**66.67**	**72.19**
2	0.1	4	10.0	10.0	1.3	1.3	25	1.0	2.3	**307.69**	**376.66**
3	0.7	4	10.0	10.0	0.3	0.3	25	1.0	1.3	**102.58**	**51.26**
4	0.5	4	10.0	10.0	3.0	3.0	25	1.0	4.0	**14.82**	**24.07**
6	0.2	4	10.0	10.0	3.8	3.8	25	1.0	4.8	**35.09**	**60.16**
7	0.8	4	10.0	10.0	3.5	3.5	25	1.0	4.5	**8.16**	**13.75**
8	2.0	4	10.0	10.0	3.2	3.2	25	1.0	4.2	**3.58**	**5.91**
9	0.1	4	10.0	10.0	3.2	3.2	25	1.0	4.2	**71.62**	**118.18**
10	3.0	4	10.0	10.0	0.9	0.9	25	1.0	1.9	**8.50**	**8.71**
11	6.0	4	10.0	10.0	2.2	2.2	25	1.0	3.2	**1.75**	**2.59**
12	4.0	4	10.0	10.0	4.8	4.8	25	1.0	5.8	**1.20**	**2.14**
13	0.6	4	10.0	10.0	5.6	5.6	25	1.0	6.6	**7.14**	**13.13**
14	0.4	4	10.0	10.0	4.8	4.8	25	1.0	5.8	**11.91**	**21.34**
16	1.0	4	10.0	10.0	5.7	5.7	25	1.0	6.7	**4.02**	**7.41**
17	2.0	4	10.0	10.0	5.5	5.5	25	1.0	6.5	**2.09**	**3.82**
18	2.0	4	10.0	10.0	5.8	5.8	25	1.0	6.8	**1.98**	**3.65**
19	0.4	4	10.0	10.0	4.9	4.9	25	1.0	5.9	**11.66**	**20.98**
20	0.4	4	10.0	10.0	5.2	5.2	25	1.0	6.2	**11.02**	**20.01**
22	0.3	4	10.0	10.0	4.6	4.6	25	1.0	5.6	**14.49**	**25.78**
23	3.0	4	10.0	10.0	3.7	3.7	25	1.0	4.7	**2.07**	**3.52**
24	0.9	4	10.0	10.0	2.7	2.7	25	1.0	3.7	**9.88**	**15.61**
26	1.0	4	10.0	10.0	3.8	3.8	25	1.0	4.8	**6.19**	**10.62**
27	2.0	4	10.0	10.0	3.6	3.6	25	1.0	4.6	**3.19**	**5.40**

Calculated FoS of Natural Peat Slopes for Coole Wind Farm (Drained Analysis)

Turbine No./Waypoint	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	100% Water to height of Peat	Depth of In situ Peat	Friction Angle	Surcharge Equivalent Placed Fill	Equivalent Total Depth of Peat (m)	Factor of Safety for Load Condition	
	α (deg)	c' (kPa)	γ (kN/m^3)	γ_w (kN/m^3)	(m)	(m)	ø' (deg)	Condition (2)	Condition (2)	Condition (1)	Condition (2)
										100% Water	100% Water
28	0.1	4	10.0	10.0	2.4	2.4	25	1.0	3.4	**83.33**	**127.40**
30	0.1	4	10.0	10.0	1.3	1.3	25	1.0	2.3	**153.85**	**188.33**
31	0.1	4	10.0	10.0	1.5	1.5	25	1.0	2.5	**266.67**	**346.52**
32	0.4	4	10.0	10.0	2.4	2.4	25	1.0	3.4	**23.81**	**36.40**
34	0.9	4	10.0	10.0	3.6	3.6	25	1.0	4.6	**7.41**	**12.56**
35	0.6	4	10.0	10.0	3.7	3.7	25	1.0	4.7	**10.81**	**18.43**
36	0.6	4	10.0	10.0	3.3	3.3	25	1.0	4.3	**11.02**	**18.32**
37	2.0	4	10.0	10.0	4.6	4.6	25	1.0	5.6	**2.49**	**4.43**
38	2.0	4	10.0	10.0	5.2	5.2	25	1.0	6.2	**2.21**	**4.00**
39	0.4	4	10.0	10.0	4.9	4.9	25	1.0	5.9	**11.66**	**20.98**
40	0.4	4	10.0	10.0	6.3	6.3	25	1.0	7.3	**9.09**	**17.00**
41	0.1	4	10.0	10.0	5.5	5.5	25	1.0	6.5	**72.73**	**133.28**
43	1.1	4	10.0	10.0	2.2	2.2	25	1.0	3.2	**9.09**	**13.54**
44	2.7	4	10.0	10.0	2.6	2.6	25	1.0	3.6	**3.21**	**5.02**
46	2.3	4	10.0	10.0	1.7	1.7	25	1.0	2.7	**5.89**	**8.03**
47	2.0	4	10.0	10.0	1.5	1.5	25	1.0	2.5	**7.65**	**9.93**
48	0.4	4	10.0	10.0	1.3	1.3	25	1.0	2.3	**43.96**	**53.81**
50	0.8	4	10.0	10.0	1.7	1.7	25	1.0	2.7	**16.81**	**22.92**
51	0.1	4	10.0	10.0	1.3	1.3	25	1.0	2.3	**307.69**	**376.66**
52	0.4	4	10.0	10.0	0.3	0.3	25	1.0	1.3	**190.49**	**95.20**
53	1.0	4	10.0	10.0	0.3	0.3	25	1.0	1.3	**76.41**	**38.18**
54	1.0	4	10.0	10.0	0.4	0.4	25	1.0	1.4	**57.31**	**35.46**
55	1.0	4	10.0	10.0	0.3	0.3	25	1.0	1.3	**76.41**	**38.18**
56	1.0	4	10.0	10.0	0.2	0.2	25	1.0	1.2	**114.61**	**41.36**
57	1.0	4	10.0	10.0	0.5	0.5	25	1.0	1.5	**45.85**	**33.09**
58	1.1	4	10.0	10.0	1.0	1.0	25	1.0	2.0	**21.06**	**22.80**
59	1.0	4	10.0	10.0	1.6	1.6	25	1.0	2.6	**14.71**	**19.60**
60	0.2	4	10.0	10.0	1.4	1.4	25	1.0	2.4	**71.43**	**90.24**
63	1.3	4	10.0	10.0	0.6	0.6	25	1.0	1.6	**29.39**	**23.86**
64	1.3	4	10.0	10.0	1.1	1.1	25	1.0	2.1	**16.54**	**18.76**
66	0.5	4	10.0	10.0	4.9	4.9	25	1.0	5.9	**9.07**	**16.32**
67	1.0	4	10.0	10.0	5.1	5.1	25	1.0	6.1	**4.61**	**8.36**
69	0.9	4	10.0	10.0	4.5	4.5	25	1.0	5.5	**5.56**	**9.85**
70	2.0	4	10.0	10.0	4.6	4.6	25	1.0	5.6	**2.49**	**4.42**
71	1.0	4	10.0	10.0	3.4	3.4	25	1.0	4.4	**6.74**	**11.28**
72	1.0	4	10.0	10.0	3.9	3.9	25	1.0	4.9	**6.03**	**10.40**
73	0.8	4	10.0	10.0	3.5	3.5	25	1.0	4.5	**8.16**	**13.75**
74	1.2	4	10.0	10.0	4.8	4.8	25	1.0	5.8	**3.97**	**7.11**
75	1.7	4	10.0	10.0	5.3	5.3	25	1.0	6.3	**2.52**	**4.59**
77	0.1	4	10.0	10.0	4.5	4.5	25	1.0	5.5	**44.44**	**78.76**
78	0.5	4	10.0	10.0	3.3	3.3	25	1.0	4.3	**13.47**	**22.39**
79	0.5	4	10.0	10.0	3.5	3.5	25	1.0	4.5	**13.10**	**22.06**
81	2.2	4	10.0	10.0	0.9	0.9	25	1.0	1.9	**11.59**	**11.88**
82	2.2	4	10.0	10.0	0.3	0.3	25	1.0	1.3	**35.14**	**17.55**
83	2.0	4	10.0	10.0	0.8	0.8	25	1.0	1.8	**14.34**	**13.79**
84	2.5	4	10.0	10.0	3.8	3.8	25	1.0	4.8	**2.40**	**4.11**
85	0.7	4	10.0	10.0	3.6	3.6	25	1.0	4.6	**8.55**	**14.49**
86	1.1	4	10.0	10.0	5.6	5.6	25	1.0	6.6	**3.76**	**6.91**
87	1.7	4	10.0	10.0	5.5	5.5	25	1.0	6.5	**2.43**	**4.44**
89	1.7	4	10.0	10.0	4.4	4.4	25	1.0	5.4	**3.14**	**5.53**
90	1.9	4	10.0	10.0	2.7	2.7	25	1.0	3.7	**4.36**	**6.89**
91	2.2	4	10.0	10.0	2.2	2.2	25	1.0	3.2	**4.79**	**7.13**
92	1.0	4	10.0	10.0	3.1	3.1	25	1.0	4.1	**7.39**	**12.11**
93	0.8	4	10.0	10.0	3.6	3.6	25	1.0	4.6	**7.94**	**13.45**
94	0.1	4	10.0	10.0	3.8	3.8	25	1.0	4.8	**105.26**	**180.48**
95	1.0	4	10.0	10.0	3.4	3.4	25	1.0	4.4	**6.74**	**11.28**
96	0.6	4	10.0	10.0	5.3	5.3	25	1.0	6.3	**6.86**	**12.50**
97	0.1	4	10.0	10.0	5.1	5.1	25	1.0	6.1	**78.43**	**142.02**
98	0.9	4	10.0	10.0	5.6	5.6	25	1.0	6.6	**4.76**	**8.75**
99	1.0	4	10.0	10.0	5.1	5.1	25	1.0	6.1	**4.61**	**8.36**
100	1.0	4	10.0	10.0	4.9	4.9	25	1.0	5.9	**4.68**	**8.41**
101	1.0	4	10.0	10.0	5.8	5.8	25	1.0	6.8	**3.83**	**7.08**
103	0.5	4	10.0	10.0	4.8	4.8	25	1.0	5.8	**9.26**	**16.60**
105	0.7	4	10.0	10.0	5.2	5.2	25	1.0	6.2	**5.92**	**10.75**
106	2.0	4	10.0	10.0	4.7	4.7	25	1.0	5.7	**2.44**	**4.35**
107	2.0	4	10.0	10.0	4.4	4.4	25	1.0	5.4	**2.61**	**4.60**
109	2.0	4	10.0	10.0	3.7	3.7	25	1.0	4.7	**3.10**	**5.28**
110	2.0	4	10.0	10.0	3.8	3.8	25	1.0	4.8	**3.02**	**5.17**
111	2.0	4	10.0	10.0	1.1	1.1	25	1.0	2.1	**10.40**	**11.79**
112	3.0	4	10.0	10.0	0.3	0.3	25	1.0	1.3	**25.51**	**12.73**
113	3.0	4	10.0	10.0	0.1	0.1	25	1.0	1.1	**76.53**	**15.05**
115	0.5	4	10.0	10.0	0.4	0.4	25	1.0	1.4	**111.12**	**68.76**
116	0.6	4	10.0	10.0	0.1	0.1	25	1.0	1.1	**400.04**	**78.76**
117	0.3	4	10.0	10.0	0.4	0.4	25	1.0	1.4	**166.67**	**103.13**
118	1.4	4	10.0	10.0	0.1	0.1	25	1.0	1.1	**160.10**	**31.51**
119	1.0	4	10.0	10.0	2.0	2.0	25	1.0	3.0	**11.11**	**16.05**
120	0.7	4	10.0	10.0	3.4	3.4	25	1.0	4.4	**9.05**	**15.15**
121	0.2	4	10.0	10.0	3.7	3.7	25	1.0	4.7	**36.04**	**61.44**
HES 2016 PEAT DEPTH DATA											
WS-11	1.7	4	10.0	10.0	6.2	6.2	25	1.0	7.2	**2.18**	**4.06**
WS13	0.5	4	10.0	10.0	7.5	7.5	25	1.0	8.5	**5.94**	**11.35**
WS09	0.1	4	10.0	10.0	6.0	6.0	25	1.0	7.0	**66.89**	**124.11**
WS08	0.5	4	10.0	10.0	0.8	0.8	25	1.0	1.8	**62.50**	**60.16**
WS07	0.4	4	10.0	10.0	4.0	4.0	25	1.0	5.0	**14.39**	**24.90**
WS02	0.3	4	10.0	10.0	4.2	4.2	25	1.0	5.2	**19.05**	**33.32**
WS01	0.3	4	10.0	10.0	5.4	5.4	25	1.0	6.4	**14.28**	**26.06**
WS03	2.6	4	10.0	10.0	6.2	6.2	25	1.0	7.2	**1.42**	**2.65**
WS100	2.6	4	10.0	10.0	5.6	5.6	25	1.0	6.6	**1.59**	**2.92**
WS101	1.7	4	10.0	10.0	5.4	5.4	25	1.0	6.4	**2.56**	**4.67**
WS1-C	0.7	4	10.0	10.0	0.9	0.9	25	1.0	1.9	**34.19**	**35.08**
TP1-C	0.7	4	10.0	10.0	2.7	2.7	25	1.0	3.7	**11.40**	**18.01**
TP2-C	0.9	4	10.0	10.0	0.7	0.7	25	1.0	1.7	**41.03**	**35.01**
HES 2012 PEAT DEPTH DATA											

Calculated FoS of Natural Peat Slopes for Coole Wind Farm (Drained Analysis)

Turbine No./Waypoint	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	100% Water to height of Peat	Depth of In situ Peat	Friction Angle	Surcharge Equivalent Placed Fill	Equivalent Total Depth of Peat (m)	Factor of Safety for Load Condition	
	α (deg)	c' (kPa)	γ (kN/m^3)	γ_w (kN/m^3)	(m)	(m)	ø' (deg)	Condition (2)	Condition (2)	Condition (1)	Condition (2)
										100% Water	100% Water
69	0.1	4	10.0	10.0	3.1	3.1	25	1.0	4.1	**130.72**	**213.38**
70	0.1	4	10.0	10.0	3.4	3.4	25	1.0	4.4	**116.96**	**196.00**
71	1.1	4	10.0	10.0	4.8	4.8	25	1.0	5.8	**4.40**	**7.88**
72	0.2	4	10.0	10.0	5.5	5.5	25	1.0	6.5	**18.05**	**33.12**
73	0.2	4	10.0	10.0	4.6	4.6	25	1.0	5.6	**28.74**	**51.20**
74	0.4	4	10.0	10.0	5.7	5.7	25	1.0	6.7	**10.05**	**18.52**
75	0.4	4	10.0	10.0	6.0	6.0	25	1.0	7.0	**9.59**	**17.78**
76	1.5	4	10.0	10.0	4.0	4.0	25	1.0	5.0	**3.71**	**6.42**
77	1.0	4	10.0	10.0	3.4	3.4	25	1.0	4.4	**6.46**	**10.84**
78	0.1	4	10.0	10.0	1.7	1.7	25	1.0	2.7	**114.94**	**158.09**
79	0.2	4	10.0	10.0	5.5	5.5	25	1.0	6.5	**24.42**	**44.70**
80	0.2	4	10.0	10.0	6.6	6.6	25	1.0	7.6	**17.39**	**32.70**
81	1.4	4	10.0	10.0	7.1	7.1	25	1.0	8.1	**2.32**	**4.40**
82	1.4	4	10.0	10.0	5.8	5.8	25	1.0	6.8	**2.77**	**5.11**
83	1.4	4	10.0	10.0	7.8	7.8	25	1.0	8.8	**2.10**	**4.03**
84	0.7	4	10.0	10.0	6.8	6.8	25	1.0	7.8	**4.53**	**8.54**
85	2.9	4	10.0	10.0	0.7	0.7	25	1.0	1.7	**11.74**	**10.18**
86	1.8	4	10.0	10.0	2.9	2.9	25	1.0	3.9	**4.38**	**7.02**
87	0.1	4	10.0	10.0	5.4	5.4	25	1.0	6.4	**37.04**	**67.68**
88	0.4	4	10.0	10.0	5.5	5.5	25	1.0	6.5	**10.33**	**18.95**
89	0.1	4	10.0	10.0	4.6	4.6	25	1.0	5.6	**86.58**	**154.15**
90	0.1	4	10.0	10.0	4.0	4.0	25	1.0	5.0	**100.00**	**173.26**
91	0.5	4	10.0	10.0	6.1	6.1	25	1.0	7.1	**8.22**	**15.30**
92	2.6	4	10.0	10.0	5.1	5.1	25	1.0	6.1	**1.73**	**3.12**
93	2.6	4	10.0	10.0	4.9	4.9	25	1.0	5.9	**1.79**	**3.23**
94	1.0	4	10.0	10.0	4.3	4.3	25	1.0	5.3	**5.45**	**9.58**
95	1.6	4	10.0	10.0	4.3	4.3	25	1.0	5.3	**3.35**	**5.87**
96	1.6	4	10.0	10.0	3.8	3.8	25	1.0	4.8	**3.75**	**6.44**
97	0.7	4	10.0	10.0	4.2	4.2	25	1.0	5.2	**7.40**	**12.92**
98	1.7	4	10.0	10.0	4.8	4.8	25	1.0	5.8	**2.90**	**5.19**
99	0.5	4	10.0	10.0	5.0	5.0	25	1.0	6.0	**10.00**	**18.05**
100	0.1	4	10.0	10.0	2.7	2.7	25	1.0	3.7	**148.70**	**234.77**
101	0.8	4	10.0	10.0	6.3	6.3	25	1.0	7.3	**4.57**	**8.54**
102	0.8	4	10.0	10.0	6.4	6.4	25	1.0	7.4	**4.48**	**8.38**
AGEC May 2017 Access Road Walkover											
1	2.0	No Peat recorded at location									
2	2.0	No Peat recorded at location									
3	2.0	No Peat recorded at location									
4	1.0	No Peat recorded at location									
5	1.0	No Peat recorded at location									
6	1.0	No Peat recorded at location									
7	2.0	No Peat recorded at location									
8	3.0	No Peat recorded at location									
9	1.0	4	10.0	10.0	0.7	0.7	25	1.0	1.7	**32.75**	**29.20**
10	2.0	4	10.0	10.0	1.5	1.5	25	1.0	2.5	**7.65**	**9.93**
11	1.5	4	10.0	10.0	2.5	2.5	25	1.0	3.5	**6.11**	**9.46**
12	1.0	4	10.0	10.0	1.5	1.5	25	1.0	2.5	**15.28**	**19.86**
13	0.5	4	10.0	10.0	1.5	1.5	25	1.0	2.5	**30.56**	**39.71**
14	1.0	4	10.0	10.0	1.8	1.8	25	1.0	2.8	**12.73**	**17.73**
15	1.0	4	10.0	10.0	1.5	1.5	25	1.0	2.5	**15.28**	**19.86**
16	0.5	4	10.0	10.0	0.7	0.7	25	1.0	1.7	**65.48**	**58.40**
17	1.0	4	10.0	10.0	1.4	1.4	25	1.0	2.4	**16.37**	**20.68**
18	0.5	4	10.0	10.0	2.5	2.5	25	1.0	3.5	**18.34**	**28.36**
19	0.5	4	10.0	10.0	2.1	2.1	25	1.0	3.1	**21.83**	**32.02**
20	1.0	4	10.0	10.0	1.8	1.8	25	1.0	2.8	**12.73**	**17.73**
21	1.0	4	10.0	10.0	2.8	2.8	25	1.0	3.8	**8.19**	**13.06**
22	0.5	4	10.0	10.0	2.3	2.3	25	1.0	3.3	**19.93**	**30.08**
23	1.0	4	10.0	10.0	2.0	2.0	25	1.0	3.0	**11.46**	**16.55**
24	2.0	4	10.0	10.0	2.0	2.0	25	1.0	3.0	**5.73**	**8.27**
25	2.0	4	10.0	10.0	2.0	2.0	25	1.0	3.0	**5.73**	**8.27**
									Minimum =	**1.20**	**2.14**
									Maximum =	**400.04**	**376.66**
									Average =	**28.73**	**31.95**

Notes:

(1) Assuming a bulk unit weight of peat of 10 (kN/m^3)
(2) Assuming a surcharge equivalent to fill depth of 1.0 (m)
(3) Slope inclination (β) based on site readings and contour survey plans of site.
(4) FoS is based on slope inclination and shear test results obtained from published data.
(5) Peat depths based on probes carried out by AGEC & HES.
(6) For load conditions see Report text.
(7) Minimum acceptable factor of safety required of 1.3 for first-time failures based on BS: 6031:1981 Code of practice for Earthworks.

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APPENDIX D

Methodology for Peat Stability Risk Assessment

Methodology for Peat Stability Risk Assessment

A peat stability risk assessment was carried out for each of the main infrastructure elements at the proposed wind farm development. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRAG (2017) and MacCulloch (2005). The degree of risk is determined as a Risk Rating (R), which is the product of probability (P) and impact (I). How these factors are determined and applied in the analysis is described below.

The main approaches for assessing peat stability include the following:

(a) Geomorphological

(b) Qualitative (judgement)

(c) Index/Probabilistic (probability)

(d) Deterministic (factor of safety)

Approaches (a) to (c) listed above would be considered subjective and do not provide a definitive indication of stability; in addition, a high level of judgement/experience is required which makes it difficult to relate the findings to real conditions. FT apply a more objective approach, the deterministic approach. As part of FT's deterministic approach, a qualitative risk assessment is also carried out taking into account qualitative factors, which cannot necessarily be quantified.

Probability

The likelihood of a peat failure occurring was assessed based on the results of both the quantitative results of stability calculations (deterministic approach using factors of safety) and the assessment of the severity of several qualitative factors which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability.

The qualitative factors used in the risk assessment are outlined in Table A and have been compiled based on FT's experience of assessments and construction in peat land sites and peat failures throughout Ireland and the UK.

Table A: Qualitative Factors used to Assess Potential for Peat Failure

Qualitative Factor	Type of Feature/Indicator for each Qualitative Factor [1]	Explanation/Description of Qualitative Factor
Evidence of sub peat water flow	No	Based on site walkover observations. Sub peat water flow generally occurs in the form of natural piping at the base of peat. Where there is a constriction or blockage in natural pipes a build-up of water can occur at the base of the peat causing a reduction in effective stress at the base of the peat resulting in failure; this is particularly critical during periods of intense rainfall.
	Possibly	
	Probably	
	Yes	

Qualitative Factor	Type of Feature/Indicator for each Qualitative Factor [1]	Explanation/Description of Qualitative Factor
Evidence of surface water flow	Dry	Based on site walkover observations. The presence of surface water flow indicates if peat in an area is well drained or saturated and if any additional loading from the ponding of surface water onto the peat is likely.
	Localised/Flowing in drains	
	Ponded in drains	
	Springs/surface water	
Evidence of previous failures/slips	No	Based on site walkover observations. The presence of clustering of relict failures may indicate that particular pre-existing site conditions predispose a site to failure.
	In general area	
	On site	
	Within 500m of location	
Type of vegetation	Grass/Crops	Based on site walkover observations. The type of vegetation present indicates if peat in an area is well drained, saturated, etc. Vegetation that indicates wetter ground may also indicate softer underlying peat deposits.
	Improved Grass/Dry Heather	
	Wet Grassland/Juncus (Rushes)	
	Wetlands Sphagnum (Peat moss)	
General slope characteristics upslope/downslope from infrastructure location	Concave	Based on site walkover observations. Slope morphology in the area of the infrastructure location is an important factor. A number of recorded peat failures have occurred in close proximity to a convex break in slope.
	Planar to concave	
	Planar to convex	
	Convex	
Evidence of very soft/soft clay at base of peat	No	Based on inspection of exposures in general area from site walkover. Several reported peat failures identify the presence of a weak layer at the base of the peat along which shear failure has occurred.
	Yes	
Evidence of mechanically cut peat	No	Based on site walkover observations. Mechanically cut peat typically cut using a ‘sausage’ machine to extract

Qualitative Factor	Type of Feature/Indicator for each Qualitative Factor [1]	Explanation/Description of Qualitative Factor
	Yes	peat for harvesting. Areas which have been cut in this manner have been linked to peat instability. The mechanical cuts can notably reduce the intrinsic strength of the peat and also allow ingress of rainfall/surface water.
Evidence of quaking or buoyant peat	No	Based on site walkover observations. Quaking/buoyant peat is indicative of highly saturated peat, which would generally be considered to have a low strength. Quaking peat is a feature on sites that have been previously linked with peat instability.
	Yes	
Evidence of bog pools	No	Based on site walkover observations. Bog pools are generally an indicator of areas of weak, saturated peat. Commonly where there are open areas of water within peat these can be interconnected, with the result that there may be sub-surface bodies of water. The presence of bog pools have been previously linked with peat instability.
	Yes	
Other	Varies	In addition to the above features/ indicators and based on site recordings the following are some of the features which may be identified: Excessively deep peat, weak peat, overly steep slope angles, etc.

Note (1) The list of features/indicators for each qualitative factor are given in increasing order of probability of leading to peat instability/failure.

It should be noted that the presence of one of the qualitative factors alone from Table A is unlikely to lead to peat instability/failure. Peat instability/failure at a site is generally the combination of a number of these factors occurring at the same time at a particular location. The probability rating assigned to the quantitative and qualitative factors is judged on a 5-point scale from 1 (indicating negligible or no probability of failure) to 5 (indicating a very likely failure), as outlined in Table B.

Table B: Probability Scale

Scale	Factor of Safety	Probability
1	1.30 or greater	Negligible/None
2	1.29 to 1.20	Unlikely
3	1.19 to 1.11	Likely
4	1.01 to 1.10	Probable
5	≤1.0	Very Likely

Scale	Likelihood of Qualitative Factor leading to Peat Failure	Probability of Failure
1	Negligible/None	Least
2	Unlikely	
3	Probable	
4	Likely	
5	Very Likely	Greatest

Impact

The severity of the risk is also assessed qualitatively in terms of impact. The impact of a peat failure on the environment within and beyond the immediate wind farm site is assessed based on the potential travel distance of a peat failure. Where a peat failure enters a watercourse, it can travel a considerable distance downstream. Therefore, the proximity of a potential peat failure to a drainage course is a significant indicator of the likely potential impact.

The risk is determined based on the combination of hazard and impact. A qualitative scale has been derived for the impact of the hazard based on distance of infrastructure element to a watercourse (Table C).

The location of watercourses is based on topographic maps and supplemented by site observations from walkover survey. Note that not all watercourses are shown on maps.

Table C: Impact Scale

Scale	Criteria	Impact
1	Proposed infrastructure element greater than 150m of watercourse	Negligible/None
2	Proposed infrastructure element within 150 to 101m of watercourse	Low
3	Proposed infrastructure element within 100 to 51m of watercourse	Medium

4	Proposed infrastructure element within 50 m of watercourse	High
5	Proposed infrastructure element within 50 m of watercourse, in an environmentally sensitive area	Extremely High

Risk Rating

The degree of risk is determined as the product of probability (P) and impact (I), which gives the Risk Rating (R) as follows:

The Risk Rating is calculated from: R = P x I

Due to the 5-point scales used to assess Probability and Impact, the Risk Rating can range from 1 to 25 as shown in Table D.

Table D: Qualitative Risk Rating

		Probability				
		1	**2**	**3**	**4**	**5**
Impact	**5**	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

Risk Rating & Control Measures	
17 to 25	High: avoid working in area or significant control measures required
11 to 16	Medium: notable control measures required
5 to 10	Low: only routine control measures required
1 to 4	Negligible: none or only routine control measures required

The risk rating is calculated individually for each contributory factor. Control measures are required to reduce the risk to at least a 'Low' risk rating. The control measures in response to the qualitative risk ratings are included in the peat stability risk registers for each main infrastructure element in Appendix B.

The risk rating is calculated individually for each contributory factor. Control measures are required to reduce the risk to at least a 'Tolerable' risk rating

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APPENDIX E

Ground Investigation – Trial Pit & Window Sample Logs

TRIAL PIT LOG

TRIAL PIT NUMBER: BP-TP1

PROJECT NUMBER: P1320-0
SITE: Clonsura, Co. Westmeath
CLIENT: Element Power

DATE STARTED: 14/12/2016
LOGGED BY: M. Gill
CONTRACTOR: Paul Etherson

EASTING: 241953
NORTHING: 274535
ELEVATION: 84.50mOD

Comments	Sample Number	Sample Type	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
				84.50	0		Ground Surface
							Soft, brown topsoil, over slightly gravelly CLAY (glacial till)
				84.10			**WEATHERED BEDROCK** Dry, dark grey, clayey, sandy, angular gravels and cobbles of weathered limestone bedrock
No Water					1		
				83.30			**BEDROCK** Strong, solid limestone
No water encountered	BP-TP1-S1	B		83.20			EOH 1.3mbgl
							Total Depth of Trial Pit

REMARKS:
Bulk rock sample taken at 1.3mbgl

PIT LENGTH: 2.5m
PIT BREADTH: 1.4m
FINAL DEPTH: 1.3m
EXCAVATOR: 12 tonne

LEGEND
∇ - Water strike
D - Disturbed sample
B - Bulk disturbed sample
W - Water sample
V - Vane test
T - No. of threads
R - Average length of ribbons
Dil - Dilatancy recorded
ND - No dilatancy recorded

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SCALE

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TRIAL PIT LOG

TRIAL PIT NUMBER: BP-TP2

PROJECT NUMBER: P1320-0
SITE: Clonsura, Co. Westmeath
CLIENT: Element Power

DATE STARTED: 14/12/2016
LOGGED BY: M. Gill
CONTRACTOR: Paul Etherson

EASTING: 241969
NORTHING: 274417
ELEVATION: 97.2mOD

Comments	Sample Number	Sample Type	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
				97.20	0		Ground Surface
				97.10			**TOPSOIL** Brown, sandy, gravelly CLAY
							GLACIAL TILL Orange/brown, slighty gravelly CLAY
No Water				96.60			**WEATHERED BEDROCK** Dark, grey, clayey, sandy, angular GRAVELS and COBBLES of weathered Limestone Bedrock
					1		
No Water							
				95.45			Refusal on strong solid limestone bedrock at 1.75mbgl
					2		Total Depth of Trial Pit

REMARKS:

PIT LENGTH: 2.6m
PIT BREADTH: 1.4m
FINAL DEPTH: 1.75m
EXCAVATOR: 12 tonne

LEGEND
∇ - Water strike
D - Disturbed sample
B - Bulk disturbed sample
W - Water sample
V - Vane test
T - No. of threads
R - Average length of ribbons
Dil - Dilatancy recorded
ND - No dilatancy recorded

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TRIAL PIT LOG

TRIAL PIT NUMBER: BP-TP3

PROJECT NUMBER: P1320-0
SITE: Clonsura, Co. Westmeath
CLIENT: Element Power

DATE STARTED: 14/12/2016
LOGGED BY: M. Gill
CONTRACTOR: Paul Etherson

EASTING: 242040
NORTHING: 274357
ELEVATION: 105.0mOD

Comments	Sample Number	Sample Type	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
				105.00	0		Ground Surface
No Water				104.70			**TOPSOIL/SUBSOIL** Orange/brown, slight gravelly CLAY
				104.60			**WEATHERED BEDROCK** Dark grey, sandy, angular GRAVELS and COBBLES of weathered Limestone Bedrock
				104.30			Refusal on strong solid limestone bedrock at 0.4m

REMARKS:

PIT LENGTH: 1.9m
PIT BREADTH: 1.4m
FINAL DEPTH: 0.4m
EXCAVATOR: 12 tonne

LEGEND
∇ - Water strike
D - Disturbed sample
B - Bulk disturbed sample
W - Water sample
V - Vane test
T - No. of threads
R - Average length of ribbons
Dil - Dilatancy recorded
ND - No dilatancy recorded

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TRIAL PIT LOG

TRIAL PIT NUMBER: BP-TP4

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PROJECT NUMBER: P1320-0
SITE: Clonsura, Co. Westmeath
CLIENT: Element Power

DATE STARTED: 14/12/2016
LOGGED BY: M. Gill
CONTRACTOR: Paul Etherson

EASTING: 242000
NORTHING: 274262
ELEVATION: 114.1mOD

Comments	Sample Number	Sample Type	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
				114.10	0		Ground Surface
							TOPSOIL Brown, sandy, gravelly CLAY
				113.80			**GLACIAL TILL** Orange/brown, slighty gravelly CLAY
No Water					1		
				112.70			**WEATHERED BEDROCK** Large angular boulders and cobbles of weathere Limestone Bedrock surrounded by clay matrix
				112.60			EOH 1.5mbgl Refusal on strong, solid Limestone Bedrock
							Total Depth of Trial Pit

REMARKS:

PIT LENGTH: 2.3m
PIT BREADTH: 1.4m
FINAL DEPTH: 1.5m
EXCAVATOR: 12 tonne

LEGEND
∇ - Water strike
D - Disturbed sample
B - Bulk disturbed sample
W - Water sample
V - Vane test
T - No. of threads
R - Average length of ribbons
Dil - Dilatancy recorded
ND - No dilatancy recorded

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TRIAL PIT LOG

TRIAL PIT NUMBER: BP-TP5

PROJECT NUMBER: P1320-0
SITE: Clonsura, Co. Westmeath
CLIENT: Element Power

DATE STARTED: 14/12/2016
LOGGED BY: M. Gill
CONTRACTOR: Paul Etherson

EASTING: 241921
NORTHING: 274347
ELEVATION: 105.9mOD

Comments	Sample Number	Sample Type	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
				105.90	0		Ground Surface
							TOPSOIL Brown, sandy, gravelly CLAY
				105.50			
No Water							**GLACIAL TILL** Orange/brown, gravelly CLAY
				104.80	1		
No Water							**WEATHERED BEDROCK** Dark grey, sandy, clayey, gravels and cobbles of limestone
	Bulk Sample BP-TP5-S1 at 1.8mbgl			104.00	2		**WEATHERED BEDROCK** Cobbles and boulders of limestone in clay matrix (angular)
				103.50			Refusal on solid strong Limestone Bedrock at 2.4mbgl
					3		Total Depth of Trial Pit

REMARKS:

PIT LENGTH: 2.6m
PIT BREADTH: 1.4m
FINAL DEPTH: 2.4m
EXCAVATOR: 12 tonne

LEGEND
∇ - Water strike
D - Disturbed sample
B - Bulk disturbed sample
W - Water sample
V - Vane test
T - No. of threads
R - Average length of ribbons
Dil - Dilatancy recorded
ND - No dilatancy recorded

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TRIAL PIT LOG

TRIAL PIT NUMBER: BP-TP6

PROJECT NUMBER: P1320-0
SITE: Clonsura, Co. Westmeath
CLIENT: Element Power

DATE STARTED: 14/12/2016
LOGGED BY: M. Gill
CONTRACTOR: Paul Etherson

EASTING: 241862
NORTHING: 274379
ELEVATION: 100.5mOD

Comments	Sample Number	Sample Type	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
				100.50	0		Ground Surface
							TOPSOIL Brown, sandy, gravelly CLAY
				100.30			
No Water							**WEATHERED BEDROCK** Weathered angular Limestone bedrock
				100.15			
							EOH 0.35mbgl - refusal on strong solid Limestone Bedrock Total Depth of Trial Pit

REMARKS:

Trial pit in field that slopes steeply to west

PIT LENGTH: 1.8m
PIT BREADTH: 1.4m
FINAL DEPTH: 0.35m
EXCAVATOR: 12 tonne

LEGEND
∇ - Water strike
D - Disturbed sample
B - Bulk disturbed sample
W - Water sample
V - Vane test
T - No. of threads
R - Average length of ribbons
Dil - Dilatancy recorded
ND - No dilatancy recorded

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TRIAL PIT LOG

TRIAL PIT NUMBER: TP1-C

PROJECT NUMBER: P1320-0
SITE: Coole WF, Co. Westmeath
CLIENT: Element Power

DATE STARTED: 13/12/2016
LOGGED BY: M. Gill
CONTRACTOR: Paul Etherson

EASTING: 240039
NORTHING: 274580
ELEVATION: ~70mOD

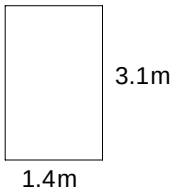
Comments	Sample Number	Sample Type	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
				70.00	0		Ground Surface
							Scraw, heather, roots, sedge
May have been dug before							Light brown, wet, soft, woody PEAT H4/H5 (may have been dug previously)
				69.10	1		Darker brown, wet, soft, woody fibrous PEAT (trace wood)
Base of pit collapsing due to water inflow			▼ 2.7mbgl	67.30	2		
				67.00	3		Loose, grey, very wet, coarse, slighty silty, slighty sandy, angular GRAVEL
Water inflow at 2.7mbgl	TP1-S1 (2.8-3.0m)	B					Total Depth of Trial Pit
					4		

REMARKS:

Water level rose from 2.7mbgl to 2.6 mbgl in 15 mins
Sample of gravel taken at 2.8-3.0mbgl

PIT LENGTH: 3.1m
PIT BREADTH: 1.4m
FINAL DEPTH: 3.0m
EXCAVATOR:

LEGEND
∇ - Water strike
D - Disturbed sample
B - Bulk disturbed sample
W - Water sample
V - Vane test
T - No. of threads
R - Average length of ribbons
Dil - Dilatancy recorded
ND - No dilatancy recorded



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TRIAL PIT LOG

TRIAL PIT NUMBER: TP2-C

PROJECT NUMBER: P1320-0
SITE: Coole WF, Co. Westmeath
CLIENT: Element Power

DATE STARTED: 13/12/2016
LOGGED BY: M. Gill
CONTRACTOR: Paul Etherson

EASTING: 239994
NORTHING: 274552
ELEVATION: ~70mOD

Comments	Sample Number	Sample Type	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
				70.00	0		Ground Surface
							(Heather and sedge) Soft, wet, brown, woody PEAT (H4/H5)
Small seepage from peat to Mineral Soil/Till Could not dig past 0.65mbgl -large cobbles and v. stiff ground			▼	69.45			
				69.35			**WEATHERED BEDROCK** Large angular Cobbles of rock surrounded by matrix of sandy silt and smaller angular gravel
							Total Depth of Trial Pit
					1		
					2		

REMARKS:

Solid ground - Shallow peat to South of proposed compound site

PIT LENGTH: 2.8m
PIT BREADTH: 1.6m
FINAL DEPTH: 0.65m
EXCAVATOR:

LEGEND
∇ - Water strike
D - Disturbed sample
B - Bulk disturbed sample
W - Water sample
V - Vane test
T - No. of threads
R - Average length of ribbons
Dil - Dilatancy recorded
ND - No dilatancy recorded

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WINDOW SAMPLE LOG

LOG NUMBER: WS1-C

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 13/12/2016 | **EASTING:** 240025

SITE: Coole WF, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 274562

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** ~70 mOD

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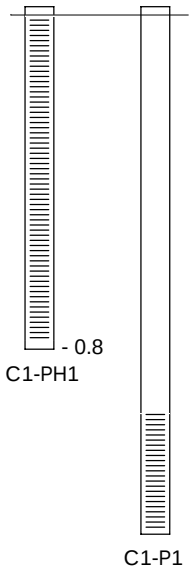
Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
		0.95mbgl	70.00 69.10 68.77	0		Ground Surface Soft, dark brown, woody PEAT (H4, H5) Grey, coarse angular GRAVEL Total Depth of Borehole

REMARKS

C1-PH1 - upstand 10cm; C1-P1 - upstand 49cm
Drilled at compound site.
Water levels 14/12/2016 - C1-PH1 - 0.28 mbTOC, C1-P1 - 0.72 mbTOC

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WINDOW SAMPLE LOG

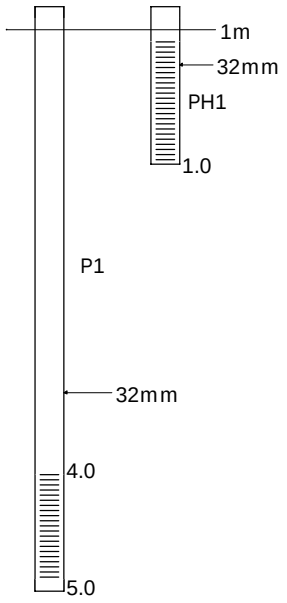
LOG NUMBER: WS01

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 15/12/2016 | **EASTING:** 240876

SITE: Coole WF, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 277321

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** 64.0mOD

HYDRO-ENVIRONMENTAL SERVICES

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	Couple WS01		64.00	0		Ground Surface
						Soft/firm, wet, dark brown, fibrous to woody PEAT
	Fimer peat at base of peat profile		58.65	5		
						Creamy, soft calcareous mud with shell fragments
			55.55			
			55.00			Dark grey, silty lacustrine CLAY
				10		EOH 9.0mbgl Total Depth of Borehole

REMARKS

Located at T01

Upstands:
- WS01-P1 = 1.0m
- WS01-PH1 = 1.05m

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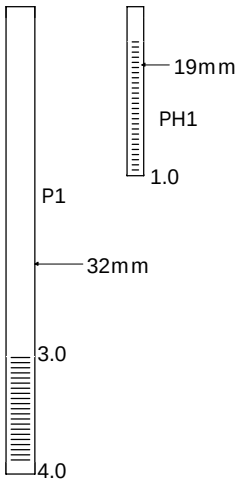
WINDOW SAMPLE LOG

LOG NUMBER: WS02

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 15/12/2016 | **EASTING:** 241426

SITE: Coole WF, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 277287

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** 62.0mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	Couple WS02		62.00	0		Ground Surface
						Soft/firm, wet, dark brown, fibrous to woody PEAT
			57.80			
				5		Creamy, soft calcareous mud with shell fragments
			55.95			
						Soft, dark grey lacustrine CLAY
			53.10			
						EOH 8.9mbgl
				10		Total Depth of Borehole

REMARKS

Piezo installed on head landjust north of T02 (241426E 277287N)

Upstands:
- WS02-P1 = 0.8m
- WS02-PH1 = 0.7m

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SCALE

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HYDRO-ENVIRONMENTAL SERVICES

WINDOW SAMPLE LOG

LOG NUMBER: WS03

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 15/12/2016 | **EASTING:** 241517

SITE: Coole WF, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 276713

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** 66.0mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
			66.00	0		Ground Surface
						Soft/firm, wet, dark brown, fibrous to woody PEAT
				5		
			59.80			Creamy, soft calcareous mud with shell fragments
			57.60			Dark grey lacustrine CLAY
			57.00			EOH 9.0mbgl
				10		Total Depth of Borehole

REMARKS

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SCALE

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HYDRO-ENVIRONMENTAL SERVICES

WINDOW SAMPLE LOG

LOG NUMBER: WS07

PROJECT NUMBER: P1320-0

DATE STARTED: 15/12/2016

EASTING: 240950

SITE: Coole WF, Co. Westmeath

LOGGED BY: M. Gill

NORTHING: 276633

CLIENT: Element Power

CONTRACTOR: HES

ELEVATION: 64.0mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
			64.00	0		Ground Surface
						Soft/firm, wet, dark brown, fibrous to woody PEAT
			60.03			
				5		Creamy, soft calcareous mud with shell fragments
			58.00			
						Soft, dark grey, lacustrine CLAY
						- Soft to firm from 8.3-9.0
			55.00			
						EOH 9.0mbgl
				10		Total Depth of Borehole

REMARKS

PAGE 1 of 1

SCALE

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WINDOW SAMPLE LOG

LOG NUMBER: WS08

HYDRO-ENVIRONMENTAL SERVICES

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 14/12/2016 | **EASTING:** 240568

SITE: Clonsura, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 276013

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** 61.0mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
			61.00	0		Ground Surface
						Soft, wet, dark brown,fibrous to woody PEAT
			60.20			
						Soft, creamy,calcareous mud, with shell fragments
			58.52			
						Soft, dark grey, lacustrine CLAY, with interbedded soft and firm clay/silt layers
				5		
			52.90			
						Loose, wet, grey sandy GRAVEL
			51.92			
						EOH 9.08mbgl
						Total Depth of Borehole
				10		

REMARKS

Refusal on gravels at 9.08mbgl

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SCALE

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HYDRO-ENVIRONMENTAL SERVICES

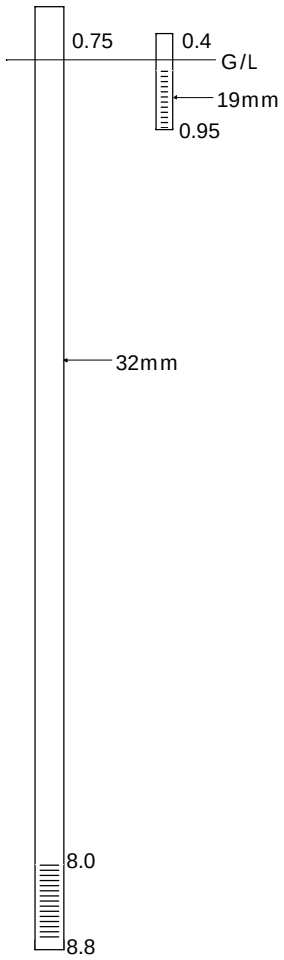
WINDOW SAMPLE LOG

LOG NUMBER: WS09

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 15/12/2016 | **EASTING:** 240923

SITE: Coole WF, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 275577

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** 66.2mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	Couple WS09		66.20	0		Ground Surface
						Soft/firm, wet, dark brown, fibrous to woody PEAT
				5		
			60.22			
			59.90			Soft, creamy, calcareous mud with shell fragments
						Soft, grey, lacustrine CLAY
			58.20			
						Loose, wet, sandy, silty GRAVEL
				10		
			55.44			
						Stiff grey GRAVEL
						EOH 10.96mbgl
						Total Depth of Borehole

REMARKS

Refusal on gravels at 10.96mbgl

Upstands:
- WS09-P1 = 0.75m
- WS09-PH1 = 0.4m

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SCALE

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WINDOW SAMPLE LOG

LOG NUMBER: WS11

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 15/12/2016 | **EASTING:** 239871

SITE: Clonsura, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 275103

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** 67.0mOD

HYDRO-ENVIRONMENTAL SERVICES

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
			67.00	0		Ground Surface
						Wet, dark brown, fibrous PEAT with woody fragments.
						Slighty harder at depth
				5		
			60.78			Soft, creamy, calcarous mud with shell fragments
			60.22			Soft, grey, lacustrine CLAY
	Water strike in gravels overflowing at ground level	59.8mbgl	59.68			Dense, grey, gravelly SAND - high water pressure
						EOH 7.32mbgl
				10		Total Depth of Borehole

REMARKS

- Very high water pressure below soft sediments
- Water spilting from hole after drilling
- Refusal on gravels at 7.32mbgl

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SCALE

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HYDRO-ENVIRONMENTAL SERVICES

WINDOW SAMPLE LOG

LOG NUMBER: WS13

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 15/12/2016 | **EASTING:** 240855

SITE: Clonsura, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 275030

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** 68.0mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
			68.00	0		Ground Surface
						Soft, wet and woody, brown, fibrous PEAT
				5		
			60.52			Soft, creamy, calcareous mud with fragment shell remains
			58.95			
			58.65			Firm, grey lacustrine CLAY
			58.35			Dense, grey, clayey, silty GRAVEL
				10		EOH 9.65mbgl
						Total Depth of Borehole

REMARKS

Refusal on gravels at 9.65mbgl

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SCALE

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WINDOW SAMPLE LOG

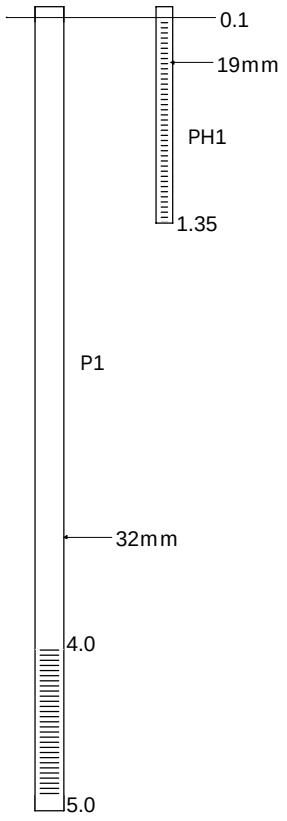
LOG NUMBER: WS100

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 15/12/2016 | **EASTING:** 241441

SITE: Coole WF, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 277395

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** 63.0mOD

HYDRO-ENVIRONMENTAL SERVICES

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	Couple WS100 Located on high bank at edge of peat works Possible fen Peat		63.00	0		Ground Surface Soft, wet, dark brown, fibrous PEAT. Slightly stiffer at depth.
			57.40	5		Creamy, soft calcareous mud with shell fragments
			57.00			EOH 6.0mbgl Total Depth of Borehole

REMARKS

Piezometers installed between T02 and Lough Bane

Upstands:
- WS100-P1 = 0.05m
- WS100-PH1 = 0.05m

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SCALE

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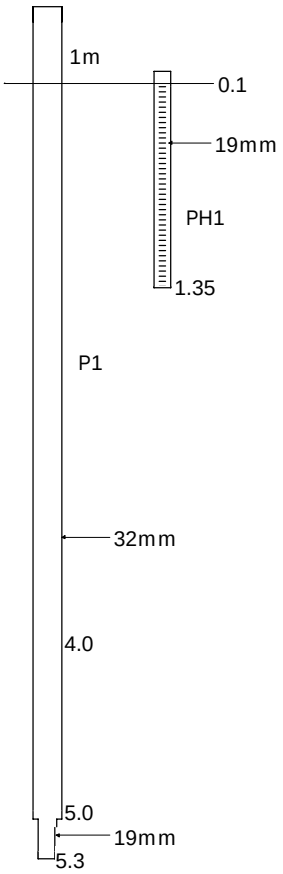
WINDOW SAMPLE LOG

LOG NUMBER: WS101

PROJECT NUMBER: P1320-0 | **DATE STARTED:** 15/12/2016 | **EASTING:** 240833

SITE: Coole WF, Co. Westmeath | **LOGGED BY:** M. Gill | **NORTHING:** 277407

CLIENT: Element Power | **CONTRACTOR:** HES | **ELEVATION:** 64.0mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	Couple WS101 Located between T01 and lake to north		64.00	0		Ground Surface
						Soft, wet, brown fibrous Peat
				5		Possible fen Peat at base
			58.60			Creamy, soft calcareous mud with shell fragments
			58.00			EOH 6.0mbgl
						Total Depth of Borehole

REMARKS

Upstands:
WS101-P1 - 1.0m
WS101-PH1 - 0.1m

PAGE 1 of 1

SCALE

HYDRO-ENVIRONMENTAL SERVICES 22 Lower Main Street Dungarvan Co. Waterford Tel: 058-44122 Fax: 058-44244 Email: info@hydroenvironmental.ie

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Ref: Coole Windfarm Limited Site Investigation Works Note

The site investigations work commenced in Coole Wind farm on the 30/6/20 works were completed on 24/7/20. The works comprised of completed 14 bore holes, there was also so geophysics studies with Peat probes carried out on certain locations in Coole wind farm site outline in the maps below. No works were carried out in the Borrow Pit for the site.

Definitions:

Boreholes

- *A borehole is a narrow shaft bored in the ground, either vertically or horizontally.*
- *Shallow drilling for site investigation and construction to provide information for the design specification for construction of structures. The information gather will provide a geotechnical designer*
- *Soil conditions – for construction*
- *Engineering properties – physical and chemical*
- *Contamination – natural & man-made*
- *Geology*

Geophysics Survey

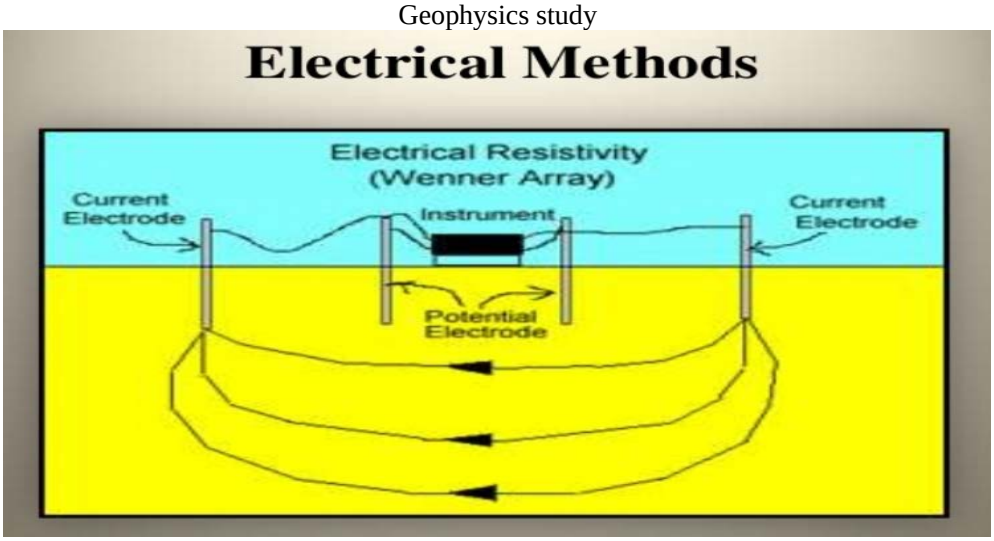
- *Geophysical survey is the systematic collection of geophysical data for spatial studies. Detection and analysis of the geophysical signals forms the core of Geophysical signal processing. This survey is completed use probes and cables with current run through the cables to gather measurements*
- *The purpose of the geophysical investigation is to provide information of the sub-soil conditions at the turbine bases including the depth to bedrock and stiffness of the overburden material*
- *Estimate the overburden stiffness*
- *Assess the depth to bedrock and the weathering and excavatability of the bedrock.*

There were samples of material extracted from the borehole's diameter was 68mm and this material was taken away for testing as part of the site investigations works to for part of the geotechnical report. The amount of material taken from the site for testing was estimated at between 8kg – 14kg samples from all 14 boreholes completed on site so in total between 100kg to 200kg of material has been taken from whole site for testing.

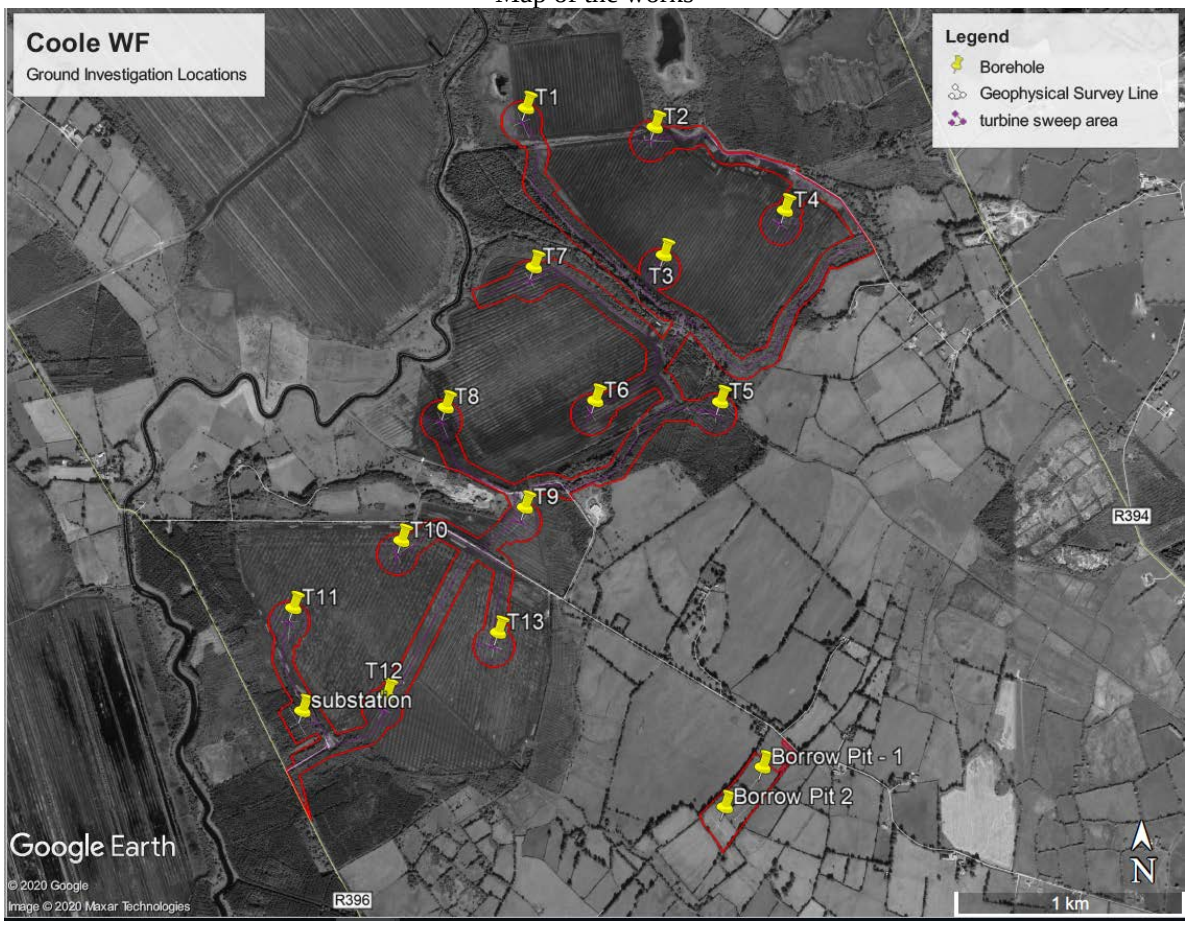
Drilling rig for Boreholes

Example of Borehole logs

Geophysics study



Map of the works



Ground Investigations Ireland Ltd
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Site Coole Wind Farm			**Borehole Number** BHT01
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 23.00m	**Ground Level (mOD)** 62.24	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240910 E 277329 N	**Dates** 22/07/2020-23/07/2020	**Project Contractor** GII	**Sheet** 1/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00											
	15						(3.50)	Poor Recovery. Driller notes: Black PEAT. Recovery consists of Black slightly silty PEAT. (Very soft)			
2.00 2.00-2.45					0,1/2,1,1,1 SPT(C) N=5						
	50										
3.50 3.50-3.95					0,0/0,1,1,1 SPT(C) N=3	58.74	3.50				
	43						(1.50)	Poor Recovery. Driller notes: Yellowish brown PEAT. Recovery consists of brown slightly sandy slightly clayey PEAT. (Very soft)			
5.00 5.00-5.45					1,1/0,0,0,1 SPT(C) N=1	57.24	5.00				
	47						(1.50)	Very soft light brownish grey sandy slightly gravelly clayey SILT with shells.			
6.50 6.50-6.95					0,0/1,1,1,1 SPT(C) N=4	55.74	6.50				
	73						(1.50)	Soft grey slightly sandy clayey SILT.			
8.00 8.00-8.45					2,1/2,2,3,2 SPT(C) N=9	54.24	8.00				
	53						(3.00)	Firm grey slightly sandy silty CLAY.			
9.50 9.50-9.95					2,2/3,3,3,3 SPT(C) N=12						

Remarks
Standpipe installed, slotted from14.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT01

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT01
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 23.00m	**Ground Level (mOD)** 62.24	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240910 E 277329 N	**Dates** 22/07/2020-23/07/2020	**Project Contractor** GII	**Sheet** 2/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	93										
11.00 11.00-11.45	80				3,2/3,5,4,4 SPT(C) N=16	51.24	11.00 (1.50)	Stiff grey slightly sandy silty CLAY.			
12.50 12.50-12.95	33				3,4/9,9,13,13 SPT(C) N=44	49.74	12.50 (2.25)	Poor Recovery. Driller notes: GRAVEL and COBBLES. Recovery consists of grey sub-angular Cobbles of Limestone. (Very dense)			
14.00 14.00-14.04	70	27	13	7	25/50 SPT(C) 25*/20 50/20	47.49	14.75 (1.25)	Weak to medium strong thinly bedded dark grey fine grained LIMESTONE with some mudstone laminations. Partially weathered. (14.75m - 16.00m) Two fracture sets. F1: 0-10 Degrees, very close to close, planar smooth-rough with black clay infilling. F2: 75-85 Degrees, Undulating rough with clay infill.			
14.75 15.50 16.00	100	87	60			46.24	16.00	Medium strong to strong thickly bedded dark grey fine grained LIMESTONE with some black mudstone laminations. Partially weathered to unweathered. (16.00m - 23.00m) One fracture set. F1: 0-10 Degrees, close to medium, planar to undulating rough with some clay smearing.			
17.00	100	97	80								
18.50	100	97	80	5			(7.00)				
20.00											

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT01

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm				**Borehole Number** BHT01
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 23.00m	**Ground Level (mOD)** 62.24	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240910 E 277329 N	**Dates** 22/07/2020-23/07/2020	**Project Contractor** GII	**Sheet** 3/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	100	93	80								
21.50	100	97	87								
23.00						39.24	23.00	Complete at 23.00m			

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT01

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT02
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 23.00m	**Ground Level (mOD)** 62.60	**Client** Statkraft	**Job Number** 9373-01-20
	Location 241474.6 E 277251.2 N	**Dates** 21/07/2020-22/07/2020	**Project Contractor** GII	**Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00											
	50						(3.50)	Very soft dark brown slightly silty fibrous PEAT.			
2.00 2.00-2.45	20				1,1/1,0,0,0 SPT(C) N=1						
3.50 3.50-3.95	73				1,1/2,1,1,1 SPT(C) N=5	59.10	3.50 (1.50)	Soft light greyish brown slightly sandy silty CLAY with shells.			
5.00 5.00-5.45	76				2,1/2,3,1,2 SPT(C) N=8	57.60	5.00 (1.50)	Firm grey silty CLAY.			
6.50 6.50-6.63	60				19,6/50 SPT(C) 25*/95 50/30	56.10	6.50 (1.40)	Very dense dark grey sub-angular to sub-rounded medium to coarse GRAVEL with occasional cobbles.			
8.00 8.00-8.29	47				12,16/16,34 SPT(C) 50/135	54.70	7.90 (1.90)	Very dense dark grey sub-angular to sub-rounded coarse GRAVEL with many cobbles.			
9.50 9.50-9.78 9.80					15,12/12,38 SPT(C) 50/130	52.80	9.80	Weak to medium strong medium bedded dark grey			

Remarks
Standpipe installed, slotted from 8.50m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a raised cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT02

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT02
Machine : Beretta T44 **Flush :** Water **Core Dia:** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 23.00m	**Ground Level (mOD)** 62.60	**Client** Statkraft	**Job Number** 9373-01-20
	Location 241474.6 E 277251.2 N	**Dates** 21/07/2020-22/07/2020	**Project Contractor** GII	**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	87	13	0	NI			(0.70)	fine grained LIMESTONE with some mudstone beds. Distinctly weathered. Non-Intact			
10.50						52.10	10.50				
11.00	87	40	20					Medium strong thin to thickly bedded dark grey fine grained LIMESTONE. Partially weathered. (10.50m - 14.50m) Three fracture sets. F1: 0-10 Degrees, close to medium, undulating rough with some clay infill. F2: 40-50 Degrees, medium spacing, undulating rough, clean. F3: 80-90 Degrees, undulating to stepped rough.			
12.50	83	56	43	11			(4.00)				
14.00											
14.50	80	60	30			48.10	14.50	Weak to medium strong medium bedded grey/dark grey fine grained LIMESTONE. Partially weathered to unweathered. (14.50m - 17.00m) Two fracture sets. F1: 0-10 Degrees, close to medium, undulating rough with some brown clay staining. F2: 75-85 Degrees, undulating rough with some brown sandy clay infill.			
15.50	80	43	17	7			(2.50)				
17.00	90	80	73	7		45.60	17.00	Medium strong thickly bedded dark grey fine grained LIMESTONE. Partially weathered to unweathered. (17.00m - 18.60m) One fracture set. F1: 0-10 Degrees, medium to widely spaced, planar to undulating rough with some black clay staining.			
18.50							(1.60)				
18.60	100	60	47	13		44.00	18.60	Weak to medium strong medium to thickly bedded grey/brown fine grained LIMESTONE. Distinctly weathered to partially weathered. (18.60m - 20.00m) Two fracture sets. F1: 0-10 Degrees, very close to medium, planar to undulating rough with some brown clay staining. F2: 80-90 Degrees, undulating rough with some clay smearing.			
20.00						42.60	20.00				

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT02

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT03
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 21.50m	**Ground Level (mOD)** 64.52	**Client** Statkraft	**Job Number** 9373-01-20
	Location 241521 E 276690.1 N	**Dates** 20/07/2020-21/07/2020	**Project Contractor** GII	**Sheet** 1/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00								Soft Dark brown slightly silty PEAT.			
	50										
2.00 2.00-2.45					1,2/2,1,2,2 SPT(C) N=7		(5.00)				
	37										
3.50 3.50-3.95					1,0/1,2,1,1 SPT(C) N=5						
	37										
5.00 5.00-5.45					0,0/0,0,1,0 SPT(C) N=1	59.52	5.00	Very soft light brown slightly sandy SILT.			
	53						(1.50)				
6.50 6.50-6.95					0,0/0,0,0,0 SPT(C) N=0	58.02	6.50	Very soft light brownish grey slightly sandy SILT with shells.			
	57						(1.50)				
8.00 8.00-8.45					1,2/2,2,3,2 SPT(C) N=9	56.52	8.00	Firm grey silty CLAY			
	63										
9.50 9.50-9.95					1,2/2,2,2,4 SPT(C) N=10		(3.00)				

Remarks
Standpipe installed, slotted from 14.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No.
9373-01-20.BHT03

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT03
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 21.50m	**Ground Level (mOD)** 64.52	**Client** Statkraft	**Job Number** 9373-01-20
	Location 241521 E 276690.1 N	**Dates** 20/07/2020-21/07/2020	**Project Contractor** GII	**Sheet** 2/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	73										
11.00 11.00-11.45	77				2,2/3,7,9,7 SPT(C) N=26	53.52	11.00	Stiff grey silty CLAY.			
12.50 12.50-12.95	40				5,9/9,7,12,12 SPT(C) N=40		(2.60)				
13.60						50.92	13.60	Medium strong thinly to medium bedded dark grey fine grained LIMESTONE with some mudstone beds laminations. Partially weathered to unweathered. (13.60m - 16.90m) Two fracture sets: F1: 0-10 Degrees, close to medium spacing, planar to undulating rough with some black clay infill. F2: 80-90 Degrees, undulating rough, clean.			
14.00	87	80	73	6							
15.50	93	90	63				(3.30)				
16.90 17.00	100	100	97			47.62	16.90	Medium strong to strong thinly to thickly bedded dark grey fine grained LIMESTONE with some mudstone laminations. Partially weathered to unweathered. (16.90m - 21.50m) One fracture set. F1: 0-10 Degrees, close to medium, planar to undulating rough with some clay staining.			
18.50	100	93	83	5			(4.60)				
20.00											

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT03

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT03
Machine : Beretta T44 **Flush :** Water **Core Dia:** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 21.50m	**Ground Level (mOD)** 64.52	**Client** Statkraft	**Job Number** 9373-01-20
	Location 241521 E 276690.1 N	**Dates** 20/07/2020-21/07/2020	**Project Contractor** GII	**Sheet** 3/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	100	93	80								
21.50						43.02	21.50	Complete at 21.50m			

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT03

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT04
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 17.00m	**Ground Level (mOD)** 63.59	**Client** Statkraft	**Job Number** 9373-01-20
	Location 242051 E 276890.1 N	**Dates** 23/07/2020-24/07/2020	**Project Contractor** GII	**Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00								Soft dark brown fibrous PEAT.			
	18										
2.00					2,2/1,0,1,2						
2.00-2.45	43				SPT(C) N=4		(5.30)				
3.50					1,0/0,1,0,1						
3.50-3.95	50				SPT(C) N=2						
5.00					2,2/3,2,3,3						
5.00-5.45	73				SPT(C) N=11	58.29	5.30	Firm light greyish brown slightly silty CLAY with shells.			
							(1.20)				
6.50					2,2/3,3,3,3	57.09	6.50	Firm grey slightly silty CLAY.			
6.50-6.95	66				SPT(C) N=12						
							(2.35)				
8.00					1,0/2,1,1,1						
8.00-8.45	93	30	30		SPT(C) N=5						
8.85						54.74	8.85	Medium strong to strong thinly to thickly bedded dark grey fine grained LIMESTONE with some mudstone laminations. Partially weathered to unweathered. (8.85m - 17.00m) Two fracture sets. F1: 0-10 Degrees, very close to wide, planar to undulating rough with some black clay staining. F2: 75-80 Degrees, undulating rough with some black clay staining.			
9.50											

Remarks
Standpipe installed, slotted from 8.50m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT04

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT04
Machine : Beretta T44 **Flush :** Water **Core Dia:** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 17.00m	**Ground Level (mOD)** 63.59	**Client** Statkraft	**Job Number** 9373-01-20
	Location 242051 E 276890.1 N	**Dates** 23/07/2020-24/07/2020	**Project Contractor** GII	**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	100	90	53	9							
11.00	100	93	67								
12.50											
13.00	100	90	77	3			(8.15)				
14.00	100	93	56	9							
15.50	100	90	67								
17.00						46.59	17.00	Complete at 17.00m			

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT04

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT06
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 17.00m	**Ground Level (mOD)** 63.34	**Client** Statkraft	**Job Number** 9373-01-20
	Location 241225.9 E 276051.5 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 1/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00											
	30						(2.00)	Soft dark brown slightly sandy fibrous PEAT			
2.00 2.00-2.45					0,1/2,2,1,1 SPT(C) N=6	61.34	2.00				
	67						(1.50)	Firm light greyish brown slightly sandy silty CLAY			
3.50 3.50-3.95					1,2/2,4,3,3 SPT(C) N=12	59.84	3.50				
	60						(1.50)	Stiff grey slightly sandy silty CLAY			
5.00 5.00-5.45					6,5/4,4,6,8 SPT(C) N=22	58.34	5.00				
	40							Poor recovery. Driller notes: Brown sandy CLAY. Recovery consists of grey subangular to subrounded fine to coarse Gravel (Very stiff)			
6.50 6.50-6.95					5,6/6,5,6,7 SPT(C) N=24						
	20										
8.00 8.00-8.20					15,10/50 SPT(C) 50/50		(6.00)				
	30										
9.50 9.50-9.95					9,9/13,13,17,7 SPT(C) N=50						

Remarks
Standpipe installed, slotted from 15.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No.
9373-01-20.BHT06

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT06
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 17.00m	**Ground Level (mOD)** 63.34	**Client** Statkraft	**Job Number** 9373-01-20
	Location 241225.9 E 276051.5 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 2/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	27										
11.00 11.00-11.38	30				14,13/14,18,18 SPT(C) 50/225	52.34	11.00	Poor recovery. Driller notes CLAY. Recovery consists of grey very gravelly slightly sandy Clay (Very stiff)			
12.50 12.50-12.88	47				12,14/14,15,18,3 SPT(C) 50/230		(5.90)				
14.00	37										
15.50	93	43	27								
16.90 17.00	80	41	23	12		46.44	16.90 (3.05)	Weak to medium strong thinly bedded dark grey fine grained LIMESTONE partially weathered. (16.90m - 19.35m) Two fracture sets. F1; 10 to 25 degrees, close to medium spaced, undulating, rough with some clay smnearing. F2: 70 to 80 degrees, close to medium spaced, undulating, rough with some clay smearing			
18.50	100	87	60								
19.95						43.39	19.95				

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT06

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT06
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 17.00m	**Ground Level (mOD)** 63.34	**Client** Statkraft	**Job Number** 9373-01-20
	Location 241225.9 E 276051.5 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 3/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
20.00											
	100	97	80					Medium strong to strong thinly bedded dark grey fine grained LIMESTONE with some Mudstone laminations partially weathered (19.95m-27.50m) Two fracture sets. F1: 10 to 25 degrees, close to medium spaced, undulating, rough with some clay infill and smearing. F2: 65 to 75 degrees, close to medium spaced undulating rough with some clay smearing			
21.50											
	100	80	73								
23.00											
	100	97	90	4			(7.55)				
24.50											
	100	97	90								
26.00											
	100	66	43								
27.50						35.84	27.50	Complete at 27.50m			

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT06

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT07
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 21.50m	**Ground Level (mOD)** 62.97	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240949.9 E 276632.8 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 1/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	23						(3.50)	Very soft dark brown fibrous PEAT.			
2.00 2.00-2.45	33				1,2/2,1,1,1 SPT(C) N=5						
3.50 3.50-3.95	33				1,1/1,2,1,1 SPT(C) N=5	59.47	3.50	Soft light greyish brown CLAY with shells			
5.00 5.00-5.45	53				1,1/2,1,2,2 SPT(C) N=7		(3.00)				
6.50 6.50-6.95	80				1,2/3,2,2,1 SPT(C) N=8	56.47	6.50	Soft to firm grey silty CLAY.			
8.00 8.00-8.45	2-				1,1/2,1,2,3 SPT(C) N=8						
9.50 9.50-9.95					2,2/1,3,2,2 SPT(C) N=8		(6.00)				

Remarks
Standpipe installed, slotted from 15.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT07

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT07
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 21.50m	**Ground Level (mOD)** 62.97	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240949.9 E 276632.8 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 2/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	20										
11.00 11.00-11.45	67				2,2/2,1,2,1 SPT(C) N=6						
12.50 12.50-12.95	80				2,3/2,3,3,3 SPT(C) N=11	50.47	12.50 (1.50)	Firm grey silty CLAY.			
14.00	37	10	10			48.97	14.00 (1.35)	Poor Recovery. Driller notes: Boulder CLAY. Recovery consists of grey slightly clayey sub-angular to sub-rounded fine to coarse Gravel and cobbles.			
15.35 15.50	100	77	47	9		47.62	15.35 (6.05)	Medium strong thickly bedded dark grey fine grained LIMESTONE with mudstone laminations. Partially weathered to unweathered. (15.35m - 21.40m) Two fracture sets. F1: 0-10 Degrees. close to medium, undulating rough with some clay infill. F2: 75-85 Degrees, undulating rough with some clay infill and staining.			
17.00	100	93	83								
18.50	97	87	50								
20.00											

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT07

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT07
Machine : Beretta T44 **Flush :** Water **Core Dia:** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 21.50m	**Ground Level (mOD)** 62.97	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240949.9 E 276632.8 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 3/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	100	80	60								
						41.57	21.40				
21.50								Complete at 21.50m			

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT07

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT08
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 19.80m	**Ground Level (mOD)** 60.96	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240568.5 E 276015.5 N	**Dates** 02/07/2020-03/07/2020	**Project Contractor** GII	**Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	22						(3.50)	Poor recovery. Recovery consists of: Very soft brown slightly sandy SILT with some organic material			
2.00 2.00-2.45	36				0,0/1,0,1,2 SPT(C) N=4						
3.50 3.50-3.95	80				1,1/0,1,1,1 SPT(C) N=3	57.46	3.50	Poor recovery. Recovery consists of: Soft grey slightly sandy SILT			
5.00 5.00-5.45	73				1,1/2,1,1,1 SPT(C) N=5		(3.50)				
6.50 6.50-6.95	60				1,2/2,2,1,5 SPT(C) N=10	53.96	7.00	Poor recovery. Recovery consists of: Stiff to very stiff grey sandy gravelly CLAY with many angular to subangular cobbles of limestone			
8.00 8.00-8.45	26				8,3/3,4,5,6 SPT(C) N=18						
9.50 9.50-9.95					6,6/4,7,4,6 SPT(C) N=21						

Remarks
Standpipe installed, slotted from 13.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	JD

Figure No. 9373-01-20.BHT08

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT08
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 19.80m	**Ground Level (mOD)** 60.96	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240568.5 E 276015.5 N	**Dates** 02/07/2020-03/07/2020	**Project Contractor** GII	**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
							(5.80)				
	46										
11.00 11.00-11.29	86				10,13/19,31 SPT(C) 50/135						
12.50 12.50-12.78 12.80	100	42	34	13	17,17/25,25 SPT(C) 50/125	48.16	12.80	Medium strong dark grey extremely fine grained LIMESTONE partially weathered (12.80m - 14.50m) One fracture set. F1: Subhorizontal, closely spaced, planar, rough, open with some clay smearing			
14.00 14.50	100	84	76	1		46.46	(1.70) 14.50	Medium strong light grey extremely fine grained LIMESTONE partially weathered (14.50m - 15.50m) One fracture set. F1: Subhorizontal, widely spaced, planar, rough, open with some clay smearing			
15.50	100	96	90	7		45.26	(1.20) 15.70	Medium strong dark grey extremely fine grained LIMESTONE partially weathered (15.50m - 19.60m) Two fracture sets. F1: Subhorizontal, closely spaced, planar, rough, open with some clay smearing. F2: 60 - 70 degrees, closely spaced, planar, rough, open with some clay smearing			
17.00	100	28	10			42.76	(2.50) 18.20	Strong light grey extremely fine grained LIMESTONE partially weathered			
18.50	100	50	44			41.36	(1.40) 19.60	Complete at 19.80m			
19.60											

Remarks

Scale (approx)	Logged By
1:50	JD

Figure No. 9373-01-20.BHT08

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm				**Borehole Number** BHT09
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 19.80m	**Ground Level (mOD)** 66.18	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240905.6 E 275583.6 N	**Dates** 01/08/2020	**Project Contractor** GII	**Sheet** 1/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00	10						(2.00)	Poor Recovery. Driller notes: Black PEAT. Recovery consists of dark brown fibrous PEAT. (Very soft.)			
2.00 2.00-2.45	0				1,0/1,1,1,1 SPT(C) N=4	64.18	2.00	Poor Recovery. Driller notes: PEAT. (Very soft)			
3.50 3.50-3.95	0				0,0/1,1,1,1 SPT(C) N=4		(3.00)				
5.00 5.00-5.45	30				1,1/0,1,1,1 SPT(C) N=3	61.18	5.00	Poor Recovery. Driller notes: PEAT onto Cobbles. Recovery consists of dak grey sub-angular to sub-rounded Cobbles.(Very soft.)			
6.50 6.50-6.85	37				5,14/10,25,15 SPT(C) 50/195	59.68	6.50	Poor Recovery. Driller notes: Gravel with cobbles. Recovery consists of grey/dark grey sub-angular to sub-rounded medium to coarse GRAVEL with occasional cobbles.(Medium dense to dense.)			
8.00 8.00-8.45	37				5,5/6,7,5,5 SPT(C) N=23		(3.00)				
9.50 9.50-9.87					7,7/9,10,31 SPT(C) 50/220	56.68	9.50	Poor Recovery. Driller notes: Gravel with Cobbles. Recovery consists of Grey sub-angular to sub-rounded medium to coarse GRAVEL with many cobbles.(Very dense.)			

Remarks
Standpipe installed, slotted from 14.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT09

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm				**Borehole Number** BHT09
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 19.80m	**Ground Level (mOD)** 66.18	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240905.6 E 275583.6 N	**Dates** 01/08/2020	**Project Contractor** GII	**Sheet** 2/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	30										
11.00 11.00-11.19	40				7,18/50 SPT(C) 25*/125 50/60		(3.00)				
12.50 12.50-12.72	83				12,19/50 SPT(C) 50/70	53.68	12.50	Very stiff dark grey slightly sandy gravelly CLAY with occasional sub-angular cobbles.			
14.00 14.00-14.21	100	43	30		15,18/50 SPT(C) 50/60		(2.20)				
14.70				8		51.48	14.70	Medium strong thinly to medium bedded dark grey fine grained LIMESTONE with some thin mudstone beds. Partially weathered. (14.70m - 15.80m) Two fracture sets. F1: 5-15 Degrees, medium, undulating rough with some clay infilling. F2: 70-80 Degrees, planar smooth with some black clay staining.			
15.50 15.80	100	90	80			50.38	(1.10) 15.80	Strong medium to thickly bedded dark grey fine grained LIMESTONE with some mudstone beds. (15.80m - 18.50m) Two fracture sets. F1: 0-10 Degrees, close to medium spaced, planar smooth to rough. F2: 40-50 Degrees, close, undulating rough, clean.			
17.00	100	87	77	7							
18.50	100	100	97				(6.50)	(18.50m - 22.30m) One fracture set. F1: 0-10 Degrees, close to wide, planar to undulating rough to smooth, clean.			
20.00											

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT09

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT09
Machine : Beretta T44 **Flush :** Water **Core Dia:** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 19.80m	**Ground Level (mOD)** 66.18	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240905.6 E 275583.6 N	**Dates** 01/08/2020	**Project Contractor** GII	**Sheet** 3/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	100	100	93	5							
21.50	100	100	56								
22.30						43.88	22.30	Complete at 22.30m			

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT09

Ground Investigations Ireland Ltd
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Site Coole Wind Farm			**Borehole Number** BHT10
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 23.00m	**Ground Level (mOD)** 67.13	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240379 E 275429.3 N	**Dates** 02/07/2020-03/07/2020	**Project Contractor** GII	**Sheet** 1/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	10							Poor Recovery. Driller notes: Black PEAT. Recovery consists of dark brown fibrous PEAT. (Very soft)			
2.00 2.00-2.45	40				0,1/1,1,0,1 SPT(C) N=3		(6.50)				
3.50 3.50-3.95	53				0,1/2,1,1,1 SPT(C) N=5						
5.00 5.00-5.45	40				0,0/1,0,1,1 SPT(C) N=3						
6.50 6.50-6.95	33				1,1/3,4,3,2 SPT(C) N=12	60.63	6.50	Poor Recovery. Driller notes: Grey boulder CLAY. Recovery consists of grey slighty sandy very clayey sub-angular to sub-rounded fine to coarse Gravel. (Very stiff)			
8.00 8.00-8.45	26				10,9/9,12,17,12 SPT(C) N=50		(5.35)				
9.50 9.50-9.95					9,9/11,13,12,17 SPT(C) N=53						

Remarks
Standpipe installed, slotted from 10.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT10

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm				**Borehole Number** BHT10
Machine : Beretta T44 **Flush :** Water **Core Dia:** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 23.00m	**Ground Level (mOD)** 67.13	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240379 E 275429.3 N	**Dates** 02/07/2020-03/07/2020	**Project Contractor** GII	**Sheet** 2/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	46										
11.00 11.00-11.45	66	36	16		8,10/10,11,11,12 SPT(C) N=44						
11.85						55.28	11.85	Weak to medium strong thin to medium bedded dark grey fine grained LIMESTONE. Partially weathered. (11.85m - 14.00m) Two fracture sets. F1: 10-30 Degrees, close to medium, undulating rough with some clay infill. F2: 70-85 Degrees, stepped rough with clay smearing.			
12.50	100	70	46	9			(2.15)				
14.00	100	23	6			53.13	14.00	Very weak to weak thinly laminated to thickly bedded dark grey/black calcareous MUDSTONE. Partially weathered. (14.00m - 16.80m) Mostly Non-intact.			
15.50	100	40	20	NI			(2.80)				
16.80						50.33	16.80	Medium strong thickly bedded grey fine grained LIMESTONE. Unweathered. (16.80m - 19.00m) One fracture set. F1: 5-15 Degrees, medium to wide, undulating rough with clay staining.			
17.00	100	93	90	3			(2.20)				
18.50											
19.00	100	86	80			48.13	19.00	Weak to medium strong dark thinly laminated to thickly bedded fine grained argillaceous LIMESTONE. Partially weathered. (19.00m - 22.00m) Two fracture sets. F1: 5-25 Degrees, very close to close, planar to undulating rough with some clay infill. F2: 65-75 Degrees, planar to undulating smooth, clean.			
20.00											

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT10

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT10
Machine : Beretta T44 **Flush :** Water **Core Dia:** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 23.00m	**Ground Level (mOD)** 67.13	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240379 E 275429.3 N	**Dates** 02/07/2020-03/07/2020	**Project Contractor** GII	**Sheet** 3/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	100	56	30	15			(3.00)				
21.50											
22.00	100	93	76	4		45.13	22.00 (1.00)	Medium strong to strong thicly bedded grey fine grained LIMESTONE. Unweathered. (22.00m- 23.00m) One fracture set. F1: 0-10 Degrees, medium to widely spaced undulating rough, clean.			
23.00						44.13	23.00	Complete at 23.00m			

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT10

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT11
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 17.00m	**Ground Level (mOD)** 66.75	**Client** Statkraft	**Job Number** 9373-01-20
	Location 239905.9 E 275130.8 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00											
	10							Dark brown PEAT. (Soft)			
2.00 2.00-2.45					1,2/2,1,1,1 SPT(C) N=5						
	57						(6.50)				
3.50 3.50-3.95					1,1/1,2,1,1 SPT(C) N=5						
	47										
5.00 5.00-5.45					1,1/2,1,2,2 SPT(C) N=7						
	50										
6.50 6.50-6.95					1,2/3,2,2,1 SPT(C) N=8	60.25	6.50				
	27							Loose grey sub-angular to sub-rounded fine to coarse GRAVEL with occasional cobbles.			
							(2.20)				
8.00 8.00-8.45					1,1/2,1,2,3 SPT(C) N=8						
8.70	53					58.05	8.70				
								Medium strong thin to thickly bedded dark grey fine grained LIMESTONE with occasional mudstone beds. Partially weathered to unweathered. (8.70m - 17.00m) Two fracture sets. F1: 0-10 Degrees, close to medium, planar to undulating rough with some clay infill. F2: 80-90 Degrees, planar rough with some clay staining.			
9.50 9.50-9.95					2,2/1,3,2,2 SPT(C) N=8						

Remarks
Standpipe installed, slotted from 15.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BH11

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT11
Machine : Beretta T44 **Flush :** Water **Core Dia:** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 17.00m	**Ground Level (mOD)** 66.75	**Client** Statkraft	**Job Number** 9373-01-20
	Location 239905.9 E 275130.8 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	97	80	60								
11.00	97	87	73								
12.50	100	100	93	8			(8.30)				
14.00	93	77	63								
15.50	93	83	73								
17.00						49.75	17.00	Complete at 17.00m			

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BH11

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT12
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 24.50m	**Ground Level (mOD)** 68.58	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240320 E 274754 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 1/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00								Poor Recovery. Driller notes: Black PEAT. Recovery consists of dark brown fibrous PEAT. (Very soft.)			
	20										
2.00 2.00-2.45					0,0/1,1,1,2 SPT(C) N=5						
	37										
3.50 3.50-3.95					1,0/0,2,0,0 SPT(C) N=2						
	67										
5.00 5.00-5.45					2,2/1,1,0,1 SPT(C) N=3						
	67						(12.50)				
6.50 6.50-6.95					0,2/1,0,1,0 SPT(C) N=2						
	20										
8.00 8.00-8.45					0,2/0,0,1,0 SPT(C) N=1						
	20										
9.50 9.50-9.95					0,0/0,0,0,1 SPT(C) N=1						

Remarks
Standpipe installed, slotted from 15.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BH12

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT12
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 24.50m	**Ground Level (mOD)** 68.58	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240320 E 274754 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 2/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	20										
11.00 11.00-11.45	47				0,0/0,0,0,0 SPT(C) N=0						
12.50 12.50-12.95	43				6,5/6,5,4,4 SPT(C) N=19	56.08	12.50 (1.50)	Poor Recovery. Driller notes: Grey Silt. Recovery consists of grey silty CLAY.(Stiff)			
14.00	67	43	43			54.58	14.00 (0.85)	Poor Recovery. Driller notes: GRAVEL and Cobbles. Recovery consists of grey sub-angular to sub-rounded coarse GRAVEL with occasional cobbles. (Dense)			
14.85 15.50	100	70	43	6		53.73	14.85 (2.35)	Weak thickly bedded brown/grey fine grained LIMESTONE. Distinctly weathered. (14.85m - 17.00m) One fracture set. F1: 10-30 Degrees, close to medium spaced, stepped rough with some brown clay infill. (17.00m - 20.00m) Two fracture sets. F1: 0-15 Degrees, close to medium, planar rough with some clay infill. F2: 80-90 Degrees, stepped rough, clean.			
17.00	100	70	33	15		51.38	17.20 (2.80)	Weak to medium strong thickly bedded dark grey fine grained argillaceous LIMESTONE. Partially weathered to unweathered. (20.00m - 24.50m) One fracture set. F1: 0-10 Degrees, close to wide, planar to undulating rough with some clay staining.			
18.50	100	77	53								
20.00											

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BH12

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT12
Machine : Beretta T44 **Flush :** Water **Core Dia :** 63.5 mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 24.50m	**Ground Level (mOD)** 68.58	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240320 E 274754 N	**Dates** 07/07/2020	**Project Contractor** GII	**Sheet** 3/3

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	93	90	77			48.58	20.00	Medium strong to strong thickly bedded dark grey fine grained LIMESTONE. Partially weathered to unweathered.			
21.50	97	93	87	4			(4.50)				
23.00	97	97	93								
24.50						44.08	24.50	Complete at 24.50m			

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BH12

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm				**Borehole Number** BHT13
Machine : Beretta T44 **Flush :** **Core Dia :** mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 20.00m	**Ground Level (mOD)** 67.06	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240806.7 E 275031.2 N	**Dates** 09/07/2020	**Project Contractor** GII	**Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00								Poor Recovery. Driller notes: Black PEAT. Recovery consists of dark brown fibrous PEAT. (Very Soft)			
	10										
2.00 2.00-2.45					0,1/0,0,1,1 SPT(C) N=2						
	40										
3.50 3.50-3.95					1,2/1,2,1,1 SPT(C) N=5						
	53						(8.00)				
5.00 5.00-5.45					0,0/0,0,0,0 SPT(C) N=0						
	10										
6.50 6.50-6.95					0,0/0,1,0,1 SPT(C) N=2						
	13										
8.00 8.00-8.45					0,1/1,0,1,2 SPT(C) N=4	59.06	8.00	Soft light brownish grey slightly sandy SILT.			
	67						(1.30)				
						57.76	9.30	Poor Recovery. Driller notes: Black gravelly CLAY. Recovery consists of dark grey slightly clayey sub-angular to sub-rounded medium to coarse Gravel with many cobbles. (Stiff to very stiff)			
9.50 9.50-9.95					3,3/4,2,3,5 SPT(C) N=14						

Remarks
Standpipe installed, slotted from 14.00m to 1.00m BGL with a pea gravel surround, sealed from 1.00m to GL with plain pipe and a benthonite surround, finished with a rasied cover.

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT13

Ground Investigations Ireland Ltd
www.gii.ie

Site Coole Wind Farm			**Borehole Number** BHT13
Machine : Beretta T44 **Flush :** **Core Dia :** mm **Method :** Rotary Cored	**Casing Diameter** 102mm to 20.00m	**Ground Level (mOD)** 67.06	**Client** Statkraft	**Job Number** 9373-01-20
	Location 240806.7 E 275031.2 N	**Dates** 09/07/2020	**Project Contractor** GII	**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
	37										
11.00 11.00-11.45	53				6,6/2,12,10,26 SPT(C) N=50		(4.75)				
12.50 12.50-12.95	47				7,7/8,9,12,13 SPT(C) N=42						
14.00 14.05	100	97	90			53.01	14.05	Medium strong to strong thinly to thickly bedded dark grey very fine grained LIMESTONE with some mudstone beds and laminations. Partially weathered to unweathered. (14.05m - 20.00m) Two fracture sets.F1: 0-10 Degrees, close to medium, planar to undulating rough with some clay smearing. F2: 80-90 Degrees, undulating rough, clean.			
15.50	100	97	80								
17.00	100	100	90	4			(5.95)				
18.50	100	100	100								
20.00						47.06	20.00				

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No. 9373-01-20.BHT13

Ground Investigations Ireland Ltd
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Site Coole Wind Farm			**Borehole Number** SUBSTATION
Machine : Beretta T44 **Flush :** **Core Dia :** mm **Method :** Rotary Cored	**Casing Diameter** 102mm cased to 12.50m	**Ground Level (mOD)** 65.07	**Client** Statkraft	**Job Number** 9373-01-20
	Location 239944 E 274806.9 N	**Dates** 01/08/2020	**Project Contractor** GII	**Sheet** 1/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00										
	33						(2.00)	Very soft dark brown fibrous PEAT.		
2.00						63.07	2.00			
2.00-2.45	60				1,1/3,5,4,4 SPT(C) N=16		(1.50)	Stiff grey sandy silty CLAY onto a grey sub-angular to sub-rounded Gravel.		
3.50						61.57	3.50			
3.50-3.64	47				25/50 SPT(C) 25*/75 50/60		(2.55)	Dense grey sub-angular to sub-rounded medium to coarse GRAVEL with many cobbles.		
5.00										
5.00-5.20	60	23	13		14,25/50 SPT(C) 50/50					
6.05						59.02	6.05			
6.50	93	70	53					Medium strong thin to thickly bedded dark grey fine grained LIMESTONE with beds of black mudstone. Partially weathered to unweathered. (6.05m - 12.50m) Two fracture sets. F1: 5-15 Degrees, very close to medium, planar to undulating rough with some clay infill. F2: 75-85 Degrees, undulating rough with calcite precipate on fracture surface.		
8.00	100	97	73	10			(6.45)			
9.50										

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No.

Ground Investigations Ireland Ltd
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Site Coole Wind Farm			**Borehole Number** SUBSTATION
Machine : Beretta T44 **Flush :** **Core Dia :** mm **Method :** Rotary Cored	**Casing Diameter** 102mm cased to 12.50m	**Ground Level (mOD)** 65.07	**Client** Statkraft	**Job Number** 9373-01-20
	Location 239944 E 274806.9 N	**Dates** 01/08/2020	**Project Contractor** GII	**Sheet** 2/2

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
	100	93	57							
11.00	100	97	63							
12.50						52.57	12.50	Complete at 12.50m		

Remarks

Scale (approx)	Logged By
1:50	Tmcl

Figure No.

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