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Appendix 8.1 (Volume 1 of 4)

Geotechnical and Peat Stability Report

Keerglen Wind Farm

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CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

GEOTECHNICAL & PEAT STABILITY REPORT

KEERGLEN WIND FARM

Prepared for: **ABO Energy Ireland Ltd**

Date: **June 2024**

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GEOTECHNICAL & PEAT STABILITY ASSESSMENT REPORT
KEERGLEN WIND FARM

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Abstract: Fehily Timoney and Company (FT) were engaged by ABO Energy Ireland Ltd to undertake a geotechnical assessment of the proposed Keerglen 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

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Fehily Timoney and Company (FT) was engaged by ABO Energy Ireland Ltd to undertake a geotechnical and peat stability assessment of the proposed Keerglen wind farm site the 'Proposed Development'), located in north Co. Mayo. In accordance with planning guidelines compiled by the Department of the Environment, Heritage and Local Government (Draft Revised Wind Energy Development Guidelines, DoHPLG, 2019), where peat >0.5m thickness is present on a proposed wind farm development, a peat stability assessment is required.

A walkover including intrusive peat depth probing, trial pits, 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, Scottish Government, 2017).

The findings, which involved a stability analysis of approximately 234 locations, show that the site has an acceptable margin of safety, a low to moderate risk of peat failure and is suitable for the proposed wind farm project. 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.

The proposed wind farm comprises 8 no. wind turbines and associated infrastructure. A detailed description of the Proposed Development is included in Chapter 4 of the EIAR.

The southern part of the site slopes steadily from the south to the north towards the Keerglen River, ranging in elevation from 100 to 196mOD, with drainage channels running typically towards the Keerglen River from the north and south. The land use within the Proposed Development site comprises open peatland.

Slope inclinations at the main infrastructure locations range from 4 to 10 degrees. The relatively uniform topography on site reflects the relatively low risk of peat failure that has been determined following this peat stability assessment. Ground conditions comprised mainly of blanket peat overlying clay and gravel overlying bedrock.

Between May 2022 and February 2024, 250 no. peat depth readings were taken within the proposed development site. Peat depth recorded during the site walkovers and from the ground investigation ranged from 0.0 to 4.8m with an average peat depth of 1.7m. 70% of the probes recorded peat depths of less than 2.0m with 95% of peat depth probes recorded peat depths of less than 3.0m. A number of localised readings recorded peat depths from 3.0 to 4.8m. The average peat depth at the proposed turbine locations is 1.8m.

The purpose of the stability analysis was 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 for the Proposed Development, which analysed the turbine locations, access roads and related infrastructure, resulted in FoS above the minimum acceptable value of 1.3 and hence the site has a satisfactory margin of safety.

The risk assessment uses the results of the stability analysis 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 peat failure at the site. The results of the risk assessment are given in Appendix B. A construction buffer zone plan based on qualitative factors identified during the site walkover is included as Drawing P22-070-0600-0002.

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In summary, the Keerglen wind farm site has an acceptable margin of safety, and therefore is considered to be at **low** risk of peat failure subject to the specified mitigation measures and is suitable for wind farm development.

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2. INTRODUCTION

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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 c.100 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.

FT have been involved in over 100 wind farm developments in both Ireland and the UK at various stages of development i.e., preliminary feasibility, planning, design, construction, and operational stage and have established themselves as one of the leading engineering consultancies in peat stability assessment, geohazard mapping in peat land areas, investigation of peat failures and site assessment of peat.

This Report was written by Ian Higgins (FT Technical Director, MSc in Geotechnical Engineering) Ian is a Technical Director with Fehily Timoney and has 25 years' experience in geotechnical engineering.

2.2 Project Description

FT was engaged in February 2022 by ABO Energy Ireland Ltd. to undertake a geotechnical and peat stability assessment of the proposed Keerglen Wind Farm.

The Proposed Development is located approximately 5.5km southwest of Ballycastle, Co. Mayo.

The Proposed Development site comprises predominantly blanket peatland. The surrounding landscape to the south and north is rolling hillsides with land-use comprising forestry and blanket peatland.

The Proposed Development will comprise 8 no. wind turbines and associated hardstanding areas, 1 no. electricity substation, 1 no. borrow pit, 2 no. temporary construction compound, upgrade of existing roads, construction of new site access roads, underground cabling connecting to the existing Tawnaghmore substation, road widening and accommodation works along the turbine delivery route, 1 no. temporary meteorological mast, site drainage and all associated work as described in Chapter 4 of the EIAR.

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 aforementioned 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.

This peat stability assessment has been undertaken taking into account peat failures that have occurred on peatland sites (such as recent failures at Shass Mountain (2020), Co. Leitrim and Meenbog (2020), Co. Donegal).

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The lessons learned from both peat slide events have been incorporated into the design of this project and the construction methodologies to be implemented. The Meenbog failure occurred during the construction of a section of floating road on a wind farm on sidelong ground in an area of weak peat. This construction technique is not proposed on the Keerglen site. It is important that the existing site drainage is maintained during construction to avoid a similar failure to that on Shass Mountain, which occurred following heavy rainfall, and this is referenced in the Risk Assessments for the turbines/access roads.

A constraints study was initially undertaken by the Environmental, Hydrogeological and Ecological members of the design team to determine the developable area on the site, prior to the site reconnaissance by engineering geologists/geotechnical engineers from FT. The extent and depth of ground investigation and peat stability analysis by FT have been undertaken in accordance with guidance within PLHRAG (2nd Edition, 2017) to investigate peat slopes that have the potential to impact on the proposed development, as applicable. Sufficient peat depth data has been recorded during the site walkovers to enable the characterisation of the peat depth across the proposed development site as shown in Drawing 22-070-600-0001, with additional detail at infrastructure locations. The peat stability assessment is undertaken to identify peat slopes at risk from the proposed development, and to identify peat slopes that may pose a risk to the proposed development.

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

(1) Desk study, involving the review of publicly available soils and geology maps, records of historical peat failures, aerial photography.

(2) Site reconnaissance including shear strength and peat depth measurements undertaken following initial multidisciplinary constraints study (by the design team) to determine the proposed construction areas within the site i.e. the area within the overall site where development is possible following multidisciplinary review and assessment of constraints (refer to Chapter 3 of the EIAR).

(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 (2022, 2023 and 2024) and HES (2022).

(5) Factor of safety plan – compiled for the short-term critical condition (undrained) for 234 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, as well as areas where construction works should be avoided.

(7) A peat stability 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.

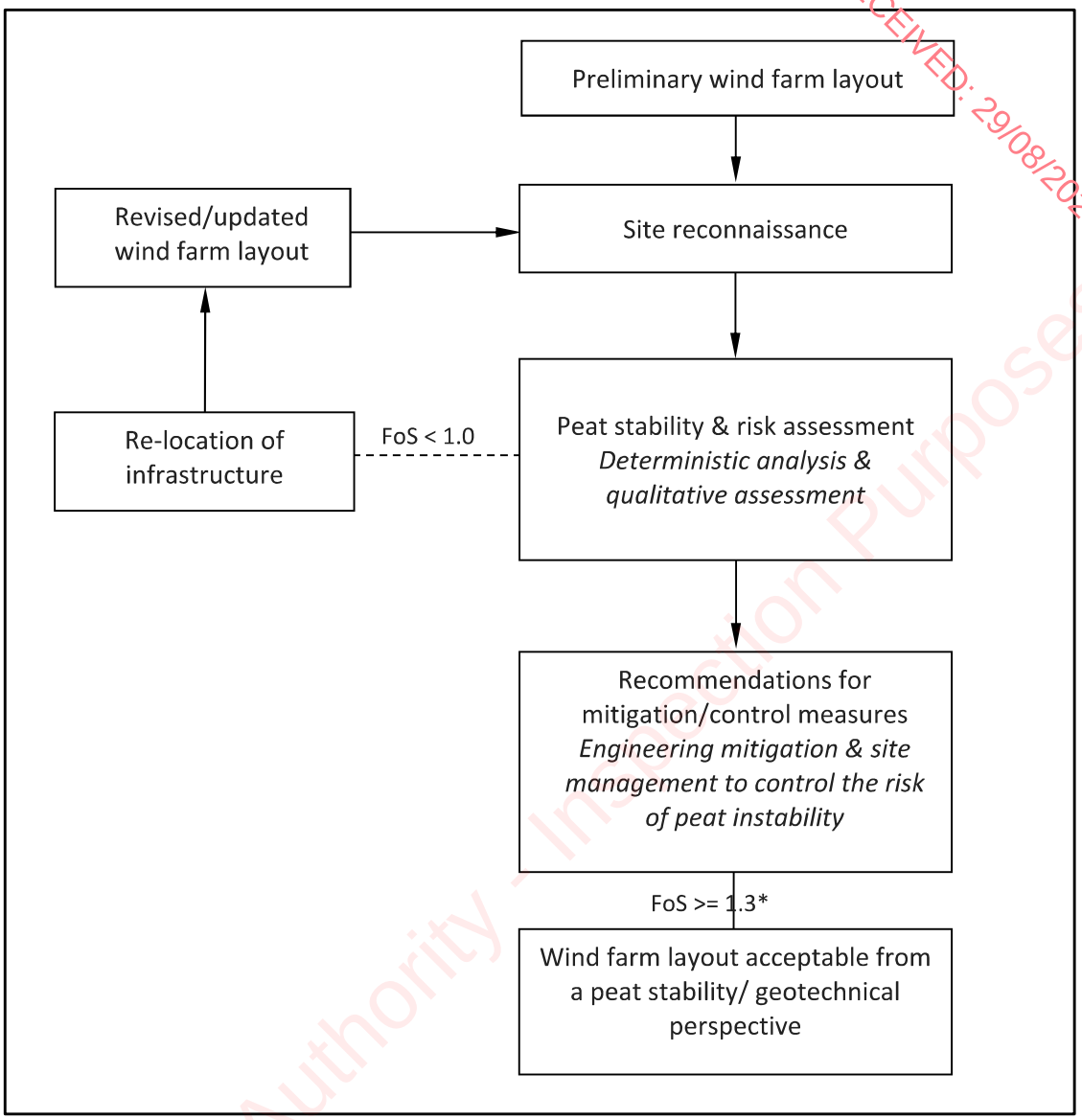
(8) Review of ground investigation carried out at the site by Irish Drilling Ltd. (IDL) and Whiteford Geoservices Ltd.

(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 the 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.

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Figure 2.1: Methodology for Peat Stability Assessment



*An FoS of between 1.0 and 1.3 does not mean that a failure will occur, but that the area requires attention. Mitigation measures can be provided for areas with an FoS of between 1.0 and 1.3 to reduce the risk of failure.

As for all construction projects, a detailed engineering construction design must be carried out by the appointed construction stage designer prior to any construction work commencing on site. This must take account of the consented project details and any conditions imposed by that consent. This must include a confirmatory peat stability assessment to account for any changes in the environment which may have occurred in the time leading up to the commencement of construction.

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.

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

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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. FT have been involved with in excess of 100 wind farm developments across Ireland and the UK at various stages of development, from preliminary feasibility stage through planning and from scheme development at tender design and detailed design stage, through to the construction and operational stages. 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

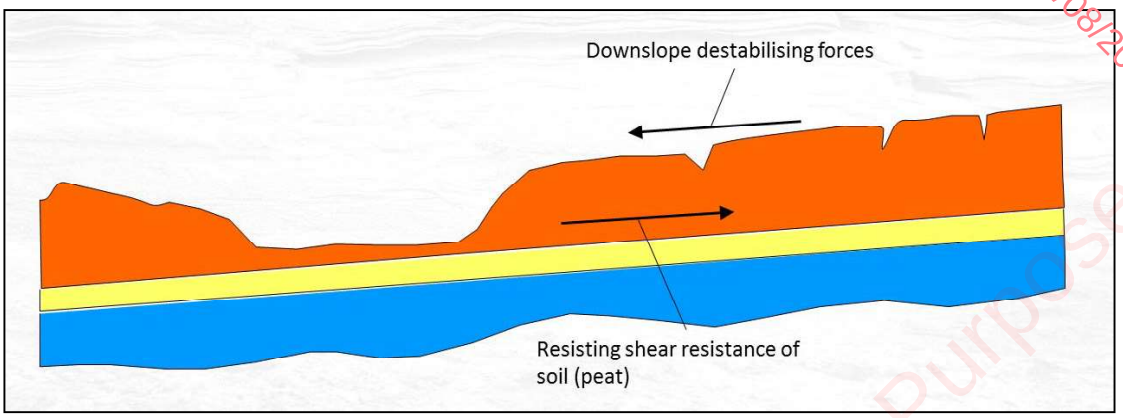
The peat stability assessment is carried out across a wide area of peatland to determine the stability of peat slopes and to identify areas of peatland that are suitable for development; this allows the layout of infrastructure on a particular wind farm site to be optimised. The assessment provides a 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).

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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.

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

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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.

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3. DESK STUDY

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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

The Geological Survey of Ireland online dataset viewer (GSI, 2024) for the site were used to verify the soil and 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, 2024) on peat failures/landslides in the vicinity of the site.

3.2 Soils, Subsoil & Bedrock

A review of the Geological Survey of Ireland online database and published documents from GSI was carried out.

The GSI subsoils maps indicates that the site is underlain predominantly of blanket peat, with some pockets of till derived from Devonian and Carboniferous sandstones and Alluvium, both associated with the river channel within the site.

In relation to bedrock, the site location and surrounding area is underlain by the following formations:

- Downpatrick Formation, described as a cross bedded sandstone and siltstone.

The nearest quarry is located approximately 13km east of the site location in Kilalla, Co. Mayo.

No karst features were identified within 5km of the Proposed Development site.

No geological heritage sites are noted within the site boundary, the closest geological heritage site is located approximately 5km north of the proposed development and is described as Brookhill Delta, a raised glaciomarine delta deposit exposed in two sand and gravel quarries.

The landslide susceptibility of the Proposed Development site was classified by the GSI (2022) as generally “moderately low” but ranges from “low” to “high” susceptibility, with the higher risk areas corresponding to the river channel running through the site. This is to be expected due to the steeper slopes present along the river channel.

There are two recorded peat failures within 1km of the site. A failure to the west of the site is believed to have occurred in the 1950’s (1954/55). This is described as a bog burst which entered the Keerglen River. The failure to the south is undated.

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4. FINDINGS OF SITE RECONNAISSANCE

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4.1 Site Reconnaissance

As part of the assessment of potential peat failure at the Proposed Development 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 lines/flush zones
- 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 FT comprised a walkover inspection of the site from the 30th May to the 2nd June 2022, the 19th to the 20th April 2023 and the 26th February 2024. Weather conditions for the site visits were predominately dry.

The findings from the site walkover 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 is typically covered in a layer of peat and has an undulating terrain. Peat depths vary across the site depending on mainly topography. Generally deeper peat was encountered in the flatter areas of the site with thinner peat on the surrounding slopes. The site comprises open peatland (see Appendix A).

(2) A total of approximately 250 no. peat depth probes were carried out on site during the various site visits. Peat depths recorded across the site ranged from 0 to 4.8m with an average depth of 1.7m (Drawing P22-070-0600-0001). Approximately 95% of peat depth probes recorded peat depths of less than 3.0m. A number of localised readings were recorded where peat depths were between 3.0 and 4.8m.

(3) The peat depths recorded at the turbine locations varied from 0.2 to 3.0m with an average depth of 1.8m.

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(4) With respect to the proposed new access roads, peat depths are typically less than 2.0m (average 1.6m) with localised depths of up to 4.4m recorded.

(5) The Proposed Development will comprise both the upgrade of existing tracks and the construction of new proposed access roads, as well as widening of the local public road. The construction of new proposed access roads will be carried out using an excavate and replace construction technique which involves the removal and replacement of peat or soft ground where encountered, and replacement with granular fill.

(6) Slope angles at the turbine locations ranged from 4 to 10 degrees. These slope angle readings 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 the site.

(7) The slope angle quoted typically reflects the slope within the footprint of each infrastructure location.

(8) Numerous localised areas of ponded water (bog pools) were recorded. This is not unexpected given the ground conditions and the flat terrain present in localised areas across the site. Some areas of peat creep were recorded, indicating that some movement of the saturated peat has occurred. A number of areas of mechanically cut peat have also been recorded across the site.

(9) Areas of peat cutting are present across the site. These areas have had drains excavated in order to drain the peat. Evidence of machine cutting of the in-situ peat was noted in the peat bays.

(10) Peat strengths recorded across the site vary from 1 to 43kPa. The lowest shear strength was recorded in the west of the site, outside of the development area, and is not considered representative of the peat within the development area in general. The lowest shear strength recorded inside the development area was 5kPa.

(11) Two past failures are present close to the site, and these have been described in Section 3.2. Areas of bog pools and peat creep were noted to the south and southwest of the site, outside of the proposed development area. A small historical peat failure was noted during the site walkover, to the east of T06. However, no evidence of ongoing peat instability was noted in these areas during the site walkovers.

(12) A summary of the site walkover findings for the wind farm are as follows:

(a) The site is typically covered in a layer of peat with undulating terrain open peatland. Peat depths recorded across the site ranged from 0 to 4.8m with an average depth of 1.7m.

(b) A construction buffer zone plan has been produced for the site (Drawing P22-070-0600-0002). This shows areas on the site with an elevated or higher construction risk. No development is proposed in these areas. The above identified buffer areas are based on qualitative factors identified during the walkover survey e.g. relatively deep peat, quaking peat, bog pools, mechanically cut peat, historical peat landslide, etc.

(c) 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 assessments, see Sections 6, 7 and 8 of this report for details.

(d) Based on the findings from the walkover survey, the Proposed Development is considered to have a low to moderate risk of peat failure.

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5. GROUND INVESTIGATION

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A ground investigation was carried out at the Proposed Development site by Irish Drilling Limited (IDL) under the supervision of FT during April 2023. Ground investigation in the form of trial pits were carried out on the 3rd and 4th of April 2023. An additional ground investigation was undertaken by Whiteford Geoservices Ltd. during August 2023 to investigate the proposed borrow pit location.

The ground investigations by IDL comprised 15 no. trial pits with associated laboratory testing. The trial pits were carried out at various locations across the Proposed Development site to provide information on the ground conditions at turbine locations, and to investigate the potential to develop borrow pits within the site.

The laboratory testing included the following:

- Classification testing for overburden material
- Determination of dry density/moisture content relationship

The trial pits logs, photographs and associated laboratory testing are included within Appendix E of this report. A ground investigation location plan is included as Drawing P22-070-0600-0003 in this report.

The investigation by Whiteford Geoservices Ltd. comprised a geophysical survey followed by 7 no. trial pits and associated laboratory testing. The factual report for the trial pitting is included in Appendix F of this report.

5.1 Summary of Ground Conditions

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

Peat – Typically described as light brown & brown pseudofibrous peat. Peat thicknesses from the trial pits ranged from 0.3 to 2.7m.

Glacial Till – Very soft to stiff brown and grey slightly sandy gravelly Silt with occasional cobbles. The thickness of the layer is variable across the site.

Glacial Sands and Gravels – bluish grey slightly sandy subangular to rounded fine to coarse psammite Gravel.

Bedrock – yellow grey, slightly discoloured fine-grained Sandstone

Groundwater recorded in the trial pits varied from none to seepages and inflows between 0.5 and 3.75m bgl.

5.2 Summary of Laboratory Tests

Based on the results of the particle size distribution (PSD) tests, the descriptions on the final trial pit logs have been updated.

Atterberg limit tests carried out on the samples classify the cohesive material as Clay of low plasticity.

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Point load strength testing on samples of the bedrock indicated a rock strength ranging from weak to very strong.

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5.3 Summary of Geotechnical Parameters

Table 5-1 contains characteristic geotechnical parameters for the main material types likely to be encountered on the Proposed Development site. Where direct measurement of parameters has not been carried out, established correlations with measured properties have been used to derive values. Characteristic values are defined as a cautious estimate of the value affecting the occurrence of limit state based on clause 2.4.5.2 from Eurocode 7.

Table 5-1: Summary of Geotechnical Parameters

Material Type/Strata	Unit Weight	Geotechnical Parameters		
		Undrained Parameters	Drained Parameters	
	γ (kN/m^3)	c_u (kPa)	φ' (°)(4)	c' (kPa)
Peat	10	5 (3)	25	4
Glacial Till	19	30	30	0
Glacial Sand and Gravel	21	-	32	0
Sandstone bedrock	23	-	30	250

Notes
Note (1) The above parameters are indicative only and have been derived based on experience and from a review of the ground investigation carried out at the site.
Note (2) Where direct measurement of parameters has not been carried out, established correlations with measured properties have been used to derive values.
Note (3) A lower bound undrained shear strength, c_u for the peat of 5kPa was selected. The lowest recorded value within the development boundary on the Keerglen wind farm site was 5kPa, recorded in one location within the development footprint, hence a value of 5kPa is considered to be a conservative value.
Note (4) φ' (°) – internal angle of shearing resistance.

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

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

6.1 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 5 probes were carried out around the turbine location, and an average peat depth was calculated.

6.2 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.

6.3 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.

6.4 Summary of Findings

Based on the peat depths recorded across the site by FT and HES, the peat varied in depth from 0 to 4.8m with an average depth of 1.7m. All peat depth probes carried out on site have been utilised to produce a peat depth contour plan for the site (Drawing P22-070-0600-0001).

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.

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Table 6.1: Peat Depth & Slope Angle at Proposed Infrastructure Locations

Turbine	Easting	Northing	Peat Depth Range (m) (1)	Average Peat Depth (m)	Slope Angle (°) (2)
T01	505565	832360	1.8-2.3	2.1	5
T02	505470	831909	2.0-3.0	2.5	6
T03	505827	831743	0.9-1.5	1.3	7
T04	505920	832214	0.9-1.2	1.1	10
T05	506383	832271	1.7-2.5	2.1	4
T06	506344	831817	1.6-2.0	1.8	7
T07	506978	831969	1.5-1.8	1.7	4
T08	507325	832404	0.8-1.6	1.1	10
Substation	506358	832101	1.8-2.1	1.9	3

Note (1) Based on probe results from the site walkovers. 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.

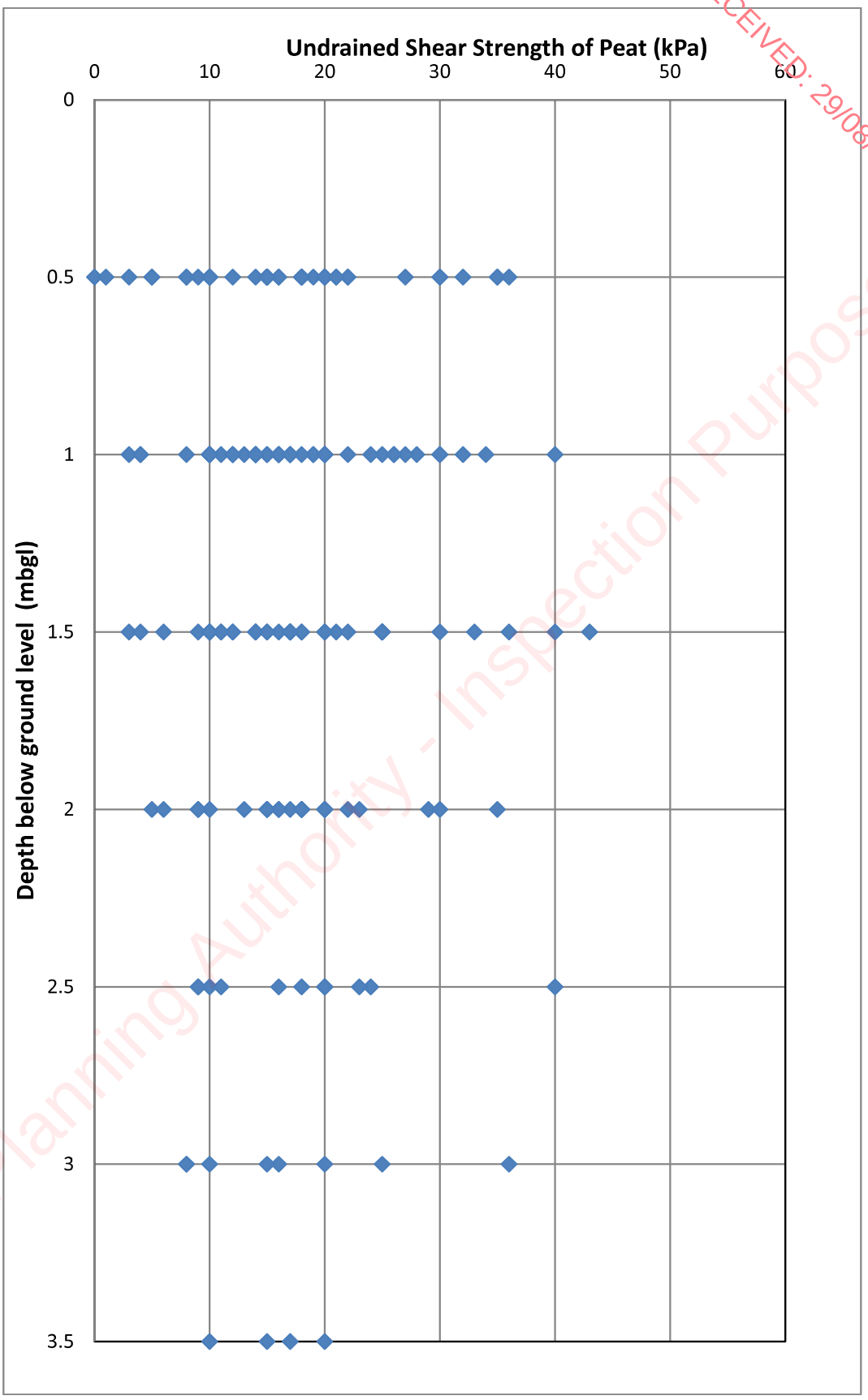
In addition to probing, in-situ shear vane testing was carried out as part of the ground investigation. Strength testing was carried out at turbine and other selected locations across the site to provide representative coverage of indicative peat strengths. The results of the vane testing with depth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

The hand vane results indicate undrained shear strengths in the range 1 to 40kPa, with an average value of about 15kPa. The majority of the strengths recorded would be typical of drained peat as is present on the Proposed Development site. The lowest strength was recorded outside of the proposed development area.

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 Keerglen is generally 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 less likelihood of failure on the Proposed Development site. However, some low strength values were recorded across the Keerglen site, and as such additional mitigation measures are proposed to reduce the risk of peat failure during construction (see Section 8.1).

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Figure 6.1: Undrained Shear Strength (c_u) Profile for Peat with Depth



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7. PEAT STABILITY ASSESSMENTS

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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.

7.1 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 7.1 shows a summary of the published information on peat together with drained strength values.

From Table 7.1 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°

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Table 7.1: 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

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7.2 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 1.0 indicates that a slope is unstable, a FoS of greater than 1.0 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 7.2.

Table 7.2: 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 5kPa was selected for the assessment based on the c_u values recorded within the proposed development boundary. It should be noted that a c_u of 5kPa 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 generally has a higher undrained strength, with only localised area of low strength peat recorded.

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

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

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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 (Peat)
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 5kPa, was selected for the assessment. The lowest recorded value on the Keerglen wind farm site during the site walkover was 1kPa, recorded in two specific locations containing bog pools, which are not considered representative of the majority of the site. It should be noted that a c_u of 5kPa 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 majority of the shear strength values recorded in the peat have a higher undrained strength.

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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.

7.3 Results of Analysis

7.3.1 Undrained Analysis for the Peat

The results of the undrained analysis for the natural peat slopes at all locations analysed 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 7.1. 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, including along access roads and in areas of peat placement, are summarised in Table 7.3 to 7.5.

The calculated FoS for load condition 1 is in excess of 1.30 for 233 of the 234 locations analysed with a range of FoS of 1.28 to 71.68, indicating a low risk of peat instability. One location recorded a value of 1.28 (marginal FoS), however this was recorded in an area where no development is proposed.

The calculated FoS for load condition 2 is in excess of 1.30 for 223 of the 234 locations analysed with a range of FoS of 1.00 to 11.95, again indicating a low risk of peat instability. One location recorded a value of 1.29 (marginal FoS) along the access road spur to T4, and a value of 1.2 was recorded on the access road south of T3, with the remainder of the low FoS results (all between 1.0 and 1.3) outside of the proposed development footprint. As these sections of road will be founded and no storage of peat is planned on the downslope side of the roads, there is not considered to be a high risk of peat failure in these areas during construction, provided the appropriate mitigation measures are implemented.

Table 7.3: Factor of Safety Results (Undrained Condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T01	505565	832360	**2.50**	**1.75**
T02	505470	831909	**1.92**	**1.44**
T03	505827	831743	**2.76**	**1.65**
T04	505920	832214	**2.44**	**1.33**
T05	506383	832271	**2.87**	**2.05**
T06	506344	831817	**2.07**	**1.38**
T07	506978	831969	**3.99**	**2.57**
T08	507325	832404	**2.19**	**1.35**
Substation	506358	832101	**4.56**	**3.09**

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Table 7.4: Factor of Safety Results along Access Roads (Undrained Condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Main Access Road	Varies		1.97	1.33
Spur to T1	Varies		2.74	1.86
Spur to T2	Varies		2.62	1.80
Spur to T3	Varies		2.00	1.41
T3-T6	Varies		1.60	1.20
Spur to T4	Varies		2.73	1.29
Spur to T5	Varies		3.98	3.12
Spur to T6	Varies		2.02	1.30
Spur to T7	Varies		4.23	2.66

Table 7.5: Factor of Safety Results Peat Placement Areas (Undrained Condition)

Location	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T7 (CC38)	Varies		5.31	3.42
T6 (EXR-027)	Varies		2.02	1.30
Track to T4 (PPR-028)	Varies		2.73	1.29
Track to T2 (PPR-032)	Varies		3.42	2.32
Track to T3 (PPR-037)	Varies		2.00	1.41
Upslope of Main Spine Road (1) (EXR-012)	Varies		3.84	2.30
Upslope of Main Spine Road (2) (I55)	Varies		3.60	2.21
Upslope of Main Spine Road (3) (EXR016)	Varies		5.31	3.42
Upslope of Main Spine Road (4) (EXR021)	Varies		2.66	1.39

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7.3.2 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, including along access roads and in areas of peat placement, are summarised in Table 7.6 to 7.8. As stated previously, the drained loading condition examines the effect of in particular, rainfall on the existing stability of the natural peat slopes and represents the post construction phase of the development.

The calculated FoS for load condition 1 is in excess of 1.30 for 229 of the 234 locations analysed with a range of FoS of 0.89 to 57.34, indicating a relatively low risk of peat instability. The locations with an FoS of <1.3 are outside of the development footprint, with the exception of one marginal failure (a result of 1.28) along the section of access road south of T3.

The calculated FoS for load condition 2 is in excess of 1.30 for 233 of the 234 locations analysed with a range of FoS of 1.19 to 20.68, indicating a low risk of peat instability. The single location with an FoS of <1.3 is located on the edge of a narrow stream valley, where no development is proposed.

Table 7.6: Factor of Safety Results (Drained Conditions)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T01	505565	832360	**2.00**	**3.01**
T02	505470	831909	**1.33**	**2.14**
T03	505827	831743	**2.20**	**2.84**
T04	505920	832214	**1.95**	**2.27**
T05	506383	832271	**2.30**	**3.55**
T06	506344	831817	**1.65**	**2.37**
T07	506978	831969	**3.19**	**4.43**
T08	507325	832404	**1.46**	**1.92**
Substation	506358	832101	**3.64**	**5.34**

Table 7.7: Factor of Safety Results along access roads (Drained Condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Main Access Road	Varies		**1.71**	**2.69**
Spur to T1	Varies		**1.74**	**3.07**
Spur to T2	Varies		**2.09**	**3.11**
Spur to T3	Varies		**1.60**	**2.44**
T3 to T4	Varies		**1.28**	**2.07**

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Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Spur to T4	Varies		1.92	2.92
Spur to T5	Varies		3.19	5.40
Spur to T6	Varies		1.61	2.22
Spur to T7	Varies		3.33	5.02

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Table 7.8: Factor of Safety Results Peat Placement Areas (Drained Condition)

Location	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T7 (CC38)	Varies		4.25	5.91
T6 (EXR-027)	Varies		1.61	2.22
T4 (PPR-028)	Varies		2.19	2.19
Track to T2 (PPR-032)	Varies		2.74	4.01
Track to T3 (PPR-037)	Varies		1.60	2.44
Upslope of Main Spine Road (1) (EXR-012)	Varies		3.07	3.97
Upslope of Main Spine Road (2) (I55)	Varies		2.88	3.82
Upslope of Main Spine Road (3) (EXR016)	Varies		4.25	5.91
Upslope of Main Spine Road (4) (EXR021)	Varies		2.13	2.37

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8. PEAT STABILITY RISK ASSESSMENT

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A peat stability risk assessment was carried out for the main infrastructure elements at the Proposed Development. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRA (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 8.1. 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 8.1: 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.

8.1 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 8.2.

The risk rating for each infrastructure element at the Proposed Development is designated Negligible or Low following some general 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) and are summarised below:

- Detailed ground investigation to confirm peat, mineral soil and bedrock condition and properties.
- Use of experienced geotechnical staff for site investigation.
- Excavations will require temporary support and regular inspection.
- Side casting of excavated material only in designated areas.
- No temporary stockpiling of materials on in-situ peat.
- Maintain hydrology of area as far as possible by maintaining existing drains to prevent the build-up of water pressures in the peat, leading to the peat becoming "buoyant".
- Use of experienced contractors and trained operators to carry out the work.
- Monitoring upslope and downslope of open excavations.

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- Limits on the length of excavation (10m) left open before backfilling.

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Table 8.2: 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-General Control Measure Implementation Risk Rating	Post-General Control Measure Implementation Risk Rating Category
T01	Low	5 to 10	Yes	Negligible	1 to 4
T02	Low	5 to 10	Yes	Negligible	1 to 4
T03	Negligible	1 to 4	Yes	Negligible	1 to 4
T04	Negligible	1 to 4	Yes	Negligible	1 to 4
T05	Negligible	1 to 4	Yes	Negligible	1 to 4
T06	Low	5 to 10	Yes	Low	5 to 10
T07	Medium	11 to 16	Yes	Low	5 to 10
T08	Low	5 to 10	No	Low	5 to 10
Substation	Negligible	1 to 4	Yes	Negligible	1 to 4
Main Access Road	Medium	11 to 16	Yes	Low	5 to 10
Spur to T1	Negligible	1 to 4	Yes	Negligible	1 to 4
Spur to T2	Negligible	1 to 4	Yes	Negligible	1 to 4
Spur to T3	Negligible	1 to 4	Yes	Negligible	1 to 4
T3 to T4	Negligible	1 to 4	Yes	Negligible	1 to 4
Spur to T4	Negligible	1 to 4	Yes	Negligible	1 to 4
Spur to T5	Negligible	1 to 4	Yes	Negligible	1 to 4
Spur to T6	Low	5 to 10	Yes	Negligible	1 to 4
Spur to T7	Negligible	1 to 4	Yes	Negligible	1 to 4

While there are no areas which record a risk rating of higher than Medium, the low strength of peat in localised areas across the site and the presence of bog pools indicate that restrictions will be required when constructing sections of the Proposed Development. These restrictions would be required around T3 and T7, and along a section of access road between T3 and T4. In these areas movement monitoring will be required both upslope and downslope of the excavations, which will be monitored daily. Open sections of excavation will be limited to <10m in length, and works will be supervised by the Project Geotechnical Engineer.

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9. INDICTATIVE FOUNDATION TYPE AND FOUNDATION DEPTH FOR TURBINES

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9.1 Summary

Based on a review of the ground investigation and walkover information for the Proposed Development site, an assessment of the likely foundation type and founding depths for each turbine location was carried out. A summary of this assessment is provided in Table 9-1.

Table 9-1: Summary of Indicative Turbine Foundation Type and Founding Depths

Turbine No.	Turbine Foundation Type	Relevant GI	Indicative founding depth (m bgl)	Comment
T01	Gravity foundation	Trial pit/ Peat probes	3.5m	Ground investigation findings indicate that a gravity foundation will be suitable.
T02	Gravity/Piled foundation	Trial pit/ Peat probes	>3.5m	Ground investigation finding indicates that either a gravity or piled foundation will be required.
T03	Gravity foundation	Trial pit/ Peat probes	3.0m	Ground investigation findings indicate that a gravity foundation will be suitable.
T04	Gravity/Piled foundation	Trial pit/ Peat probes	>3.5m	Ground investigation finding indicates that either a gravity or piled foundation will be required.
T05	Gravity/Piled foundation	Trial pit/ Peat probes	>4.5m	Ground investigation finding indicates that either a gravity or piled foundation will be required.
T06	Gravity/Piled foundation	Trial pit/ Peat probes	>3.0m	Ground investigation finding indicates that either a gravity or piled foundation will be required.
T07	Gravity/Piled foundation	Trial pit/ Peat probes	>4.5m	Ground investigation finding indicates that either a gravity or piled foundation will be required.
T08	Gravity/Piled foundation	Trial pit/ Peat probes	>4.5m	Ground investigation finding indicates that either a gravity or piled foundation will be required.

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It should be noted that confirmatory ground investigation will be carried out prior to construction at each turbine location, in the form of a borehole with in-situ SPT testing at 1m intervals in the overburden and follow-on rotary core through bedrock, to confirm the foundation types and founding stratums indicated in Table 9-1. It is likely that following the completion of further ground investigation prior to construction that the turbine

bases will be deemed suitable for gravity type foundations. Alternatively, piled foundations may be required at certain locations.

For gravity type turbine foundations, where the depth of excavation exceeds the required founding depth for the proposed turbine base, up-fill material consisting of granular fill (6N) shall be used to backfill the excavation to the required founding depth.

For the piled turbine foundations, a typical piling type and configuration could be up to 16 no. 900mm rotary bored piles.

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10. FOUNDING DETAILS FOR INFRASTRUCTURE ELEMENTS (EXCEPT TURBINES)

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This section provides a summary of the founding details for various elements of the proposed infrastructure across the Proposed Development site. The detailed methodologies for the construction these elements of the Proposed Development are included in Chapter 4 of the EIAR.

10.1 Access Roads

The access roads on site will be constructed as excavate and replace (founded) type construction, which, given the ground conditions and type of terrain present, is deemed the most appropriate construction approach. Floating road construction will not be undertaken on the Proposed Development.

The total length of new proposed access road to be constructed on site is 6.9km (see Drawing P22-070-0600-0005 of the Peat and Spoil Management Plan – Appendix 4-2 of the EIAR).

The proposed make-up of the founded access roads is a minimum stone thickness of 500mm. The requirement for a layer of geotextile and geogrid and the necessary stone thickness will be confirmed at pre-construction stage.

See the Peat & Spoil Management Plan for the Proposed Development for further details on the proposed access roads on site.

10.2 Crane Hardstands

The crane hardstands will be constructed using the founded technique (i.e. not floated) technique.

Crane hardstands are constructed using compacted Class 1/6F material on a suitable sub-formation to achieve the required bearing resistance. The hardstands will be designed for the most critical loading combinations from the crane.

The hardstands will require to be founded on competent material underlying the peat deposits. The founding levels for the hardstands will be variable across the site and will be confirmed at pre-construction stage.

The make-up of the hardstands will include a minimum of 1000mm of granular stone fill with a layer of geotextile and/or geogrid, if deemed necessary by the Designer.

10.3 Substation Foundations & Platforms

The substation platform will be constructed using the founded technique (i.e. not floated technique). The substation foundations will comprise strip/raft foundations under the main footprint of the building with a basement/pit for cable connections.

Substation platforms are constructed using compacted Class 1/6F material on a suitable sub-formation to achieve the required bearing resistance.

The substation platform will require to be founded on competent material underlying the peat deposits.

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Given the ground conditions present at the proposed substation, the foundations will require to be founded on firm glacial till or medium dense granular material. The peat will not be a be a suitable founding stratum for the substation foundations. The founding depth for substation platforms is to be 1.5-2.0m.

The make-up of the substation platform will include up to 1000mm of granular stone fill with a layer of geotextile and/or geogrid if deemed necessary by the Designer. At the underside of the substation foundations, a layer of structural up-fill (class 6N) will be required.

10.4 Construction Compound Platforms

The construction compound platforms will be constructed using the founded technique (i.e. not floated technique).

The construction compound platforms are constructed using compacted Class 1/6F material on a suitable sub-formation to achieve the required bearing resistance.

The construction compound platforms will be founded on material underlying the peat deposits.

Typical founding depth for construction compound platforms will require excavations from 1.0m to 3.0m bgl.

The typical make-up of the construction compound platform will include up to 750mm of granular stone fill with possibly a layer of geotextile and/or geogrid.

10.5 Peat Placement Areas

A number of peat storage/remediation locations were reviewed as part of the assessment of the site. These are located upslope of the proposed roads across the Proposed Development. The placement of peat in these areas will be limited to a maximum of 1m in height and 15m in width, and the stability of these areas is covered under load condition 2 as reported in Section 7 of this report.

Additional discussion of the peat placement areas is provided in the Peat and Spoil Management Plan (FT, 2024) for the Proposed Development.

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11. SUMMARY AND RECOMMENDATIONS

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11.1 Summary

The following summary is given.

FT was engaged by ABO Energy Ireland Ltd. to undertake a geotechnical and peat stability assessment of the Proposed Development site.

The findings of the peat assessment showed that the site has a low to moderate risk of peat failure and is suitable for the proposed wind farm development. The findings include recommendations and control measures for construction work in peat lands, all of which will be implemented in full to ensure that all works adhere to an acceptable standard of safety.

The site is typically covered in blanket peat with undulating terrain of open peatland.

Peat thicknesses recorded during the site walkovers from 250 probes ranged from 0.0 to 4.8m with an average depth of 1.7m. 70% of the probes recorded peat depths of less than 2.0m, with 95% of peat depth probes recorded peat depths of less than 3.0m. The deeper peat areas were avoided, where possible, when optimising the wind farm layout for site. The average peat depth at any of the proposed turbine locations is 1.8m.

Slope inclinations at the main infrastructure locations range from 2 to 10 degrees.

An analysis of peat sliding was carried out at the main infrastructure locations across the Proposed Development 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 and 2 for the locations analysed, showed that all locations have an acceptable FoS of greater than 1.3, indicating a low risk of peat failure. The undrained analysis is considered the most critical condition for the peat slopes.

A drained analysis was also carried out, which examined 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, showed that all locations have an acceptable FoS of greater than 1.3.

The peat stability risk assessment at each infrastructure location, along access roads, in peat placement areas and at settlement pond locations identified a number of mitigation/control measures to reduce the potential risk of peat failure. 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 Development 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 provided appropriate mitigation measures, such as using founded roads, and implementing and maintaining an appropriate drainage system are implemented. The findings include recommendations and mitigation/control measures for construction work in peat lands, all of which will be implemented in full to ensure that all works adhere to an acceptable standard of safety.

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11.2 Recommendations

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The following recommendations are given, all of which will be implemented in full.

Notwithstanding that the Proposed Development site has a low to moderate risk of peat failure a number of mitigation/control measures are prescribed 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 implemented throughout design and construction works (Appendix B).

The proposed construction method for all the new proposed access roads at the wind farm is excavate and replace type construction.

The measures prescribed given in FT's report 'Peat & Spoil Management Plan - Keerglen Wind Farm, County Mayo' (FT, 2024) will be implemented in full during the design and construction stage of the wind farm development.

To minimise the risk of construction activity causing potential peat instability the Construction Method Statements (CMS's) for the project will implement in full, 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.

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12. REFERENCES

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Appendix 8.1 (Volume 2 of 4)

Geotechnical and Peat Stability Report

Keerglen Wind Farm

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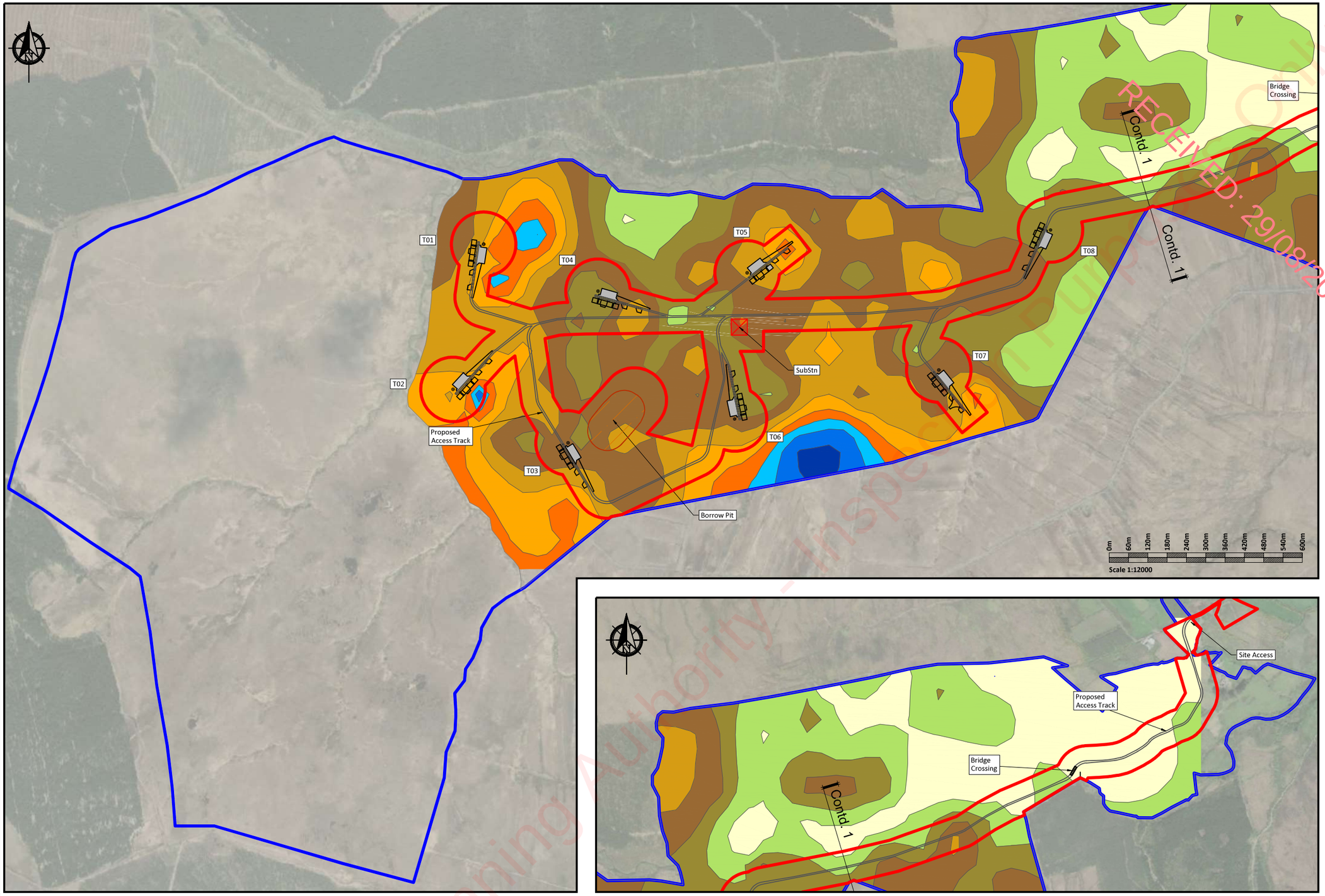
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DRAWINGS

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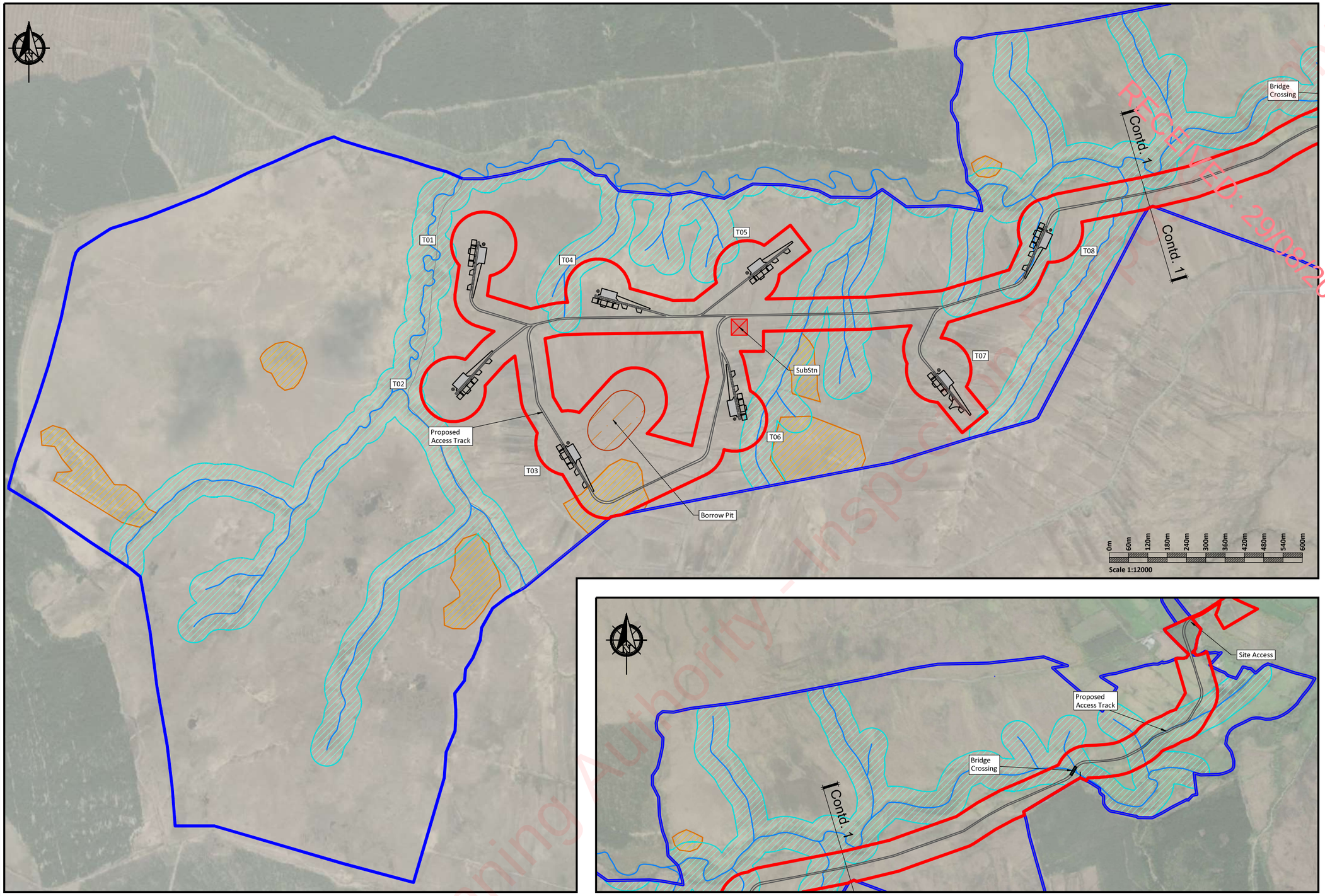
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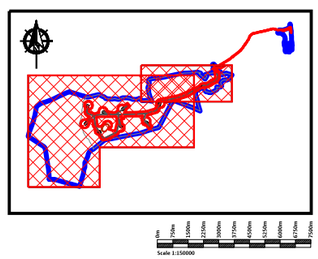
Rev.	Description	App By	Date
A	FOR INFORMATION	BDH	26.04.24

PROJECT	KEERGLEN WINDFARM PEAT ASSESSMENT
CLIENT	ABO WIND
SHEET	PEAT DEPTH CONTOUR PLAN
Date	26.04.24
Project number	P22-070
Scale (@ A3)	1:12000
Drawn by	POR
Checked by	IH
Drawing Number	P22-070-0600-0001
Rev	A

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26 April 2024





Legend:

- Site Boundary
- Folio Boundary

Construction Buffer Zone Legend:

- Watercourses / Lakes with 50m buffer
- Marginal buffer zones that will require supervision and implementation of control measures for any works in these areas.

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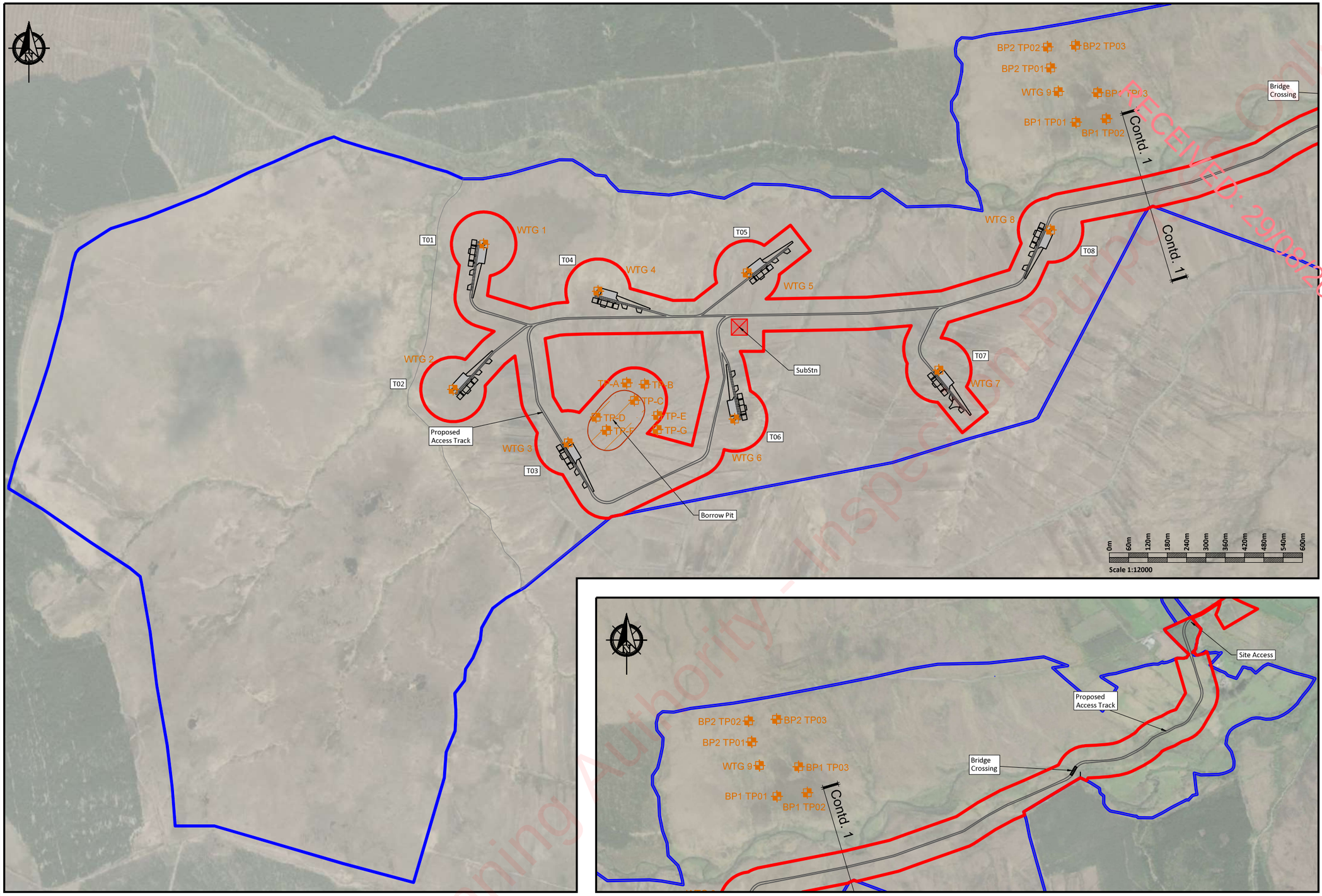
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Rev.	Description	App By	Date
A	FOR INFORMATION	BDH	26.04.24

PROJECT: KEERGLEN WINDFARM PEAT ASSESSMENT		CLIENT: ABO WIND	
SHEET: CONSTRUCTION BUFFER ZONE PLAN	Date: 26.04.24	Project number: P22-070	Scale (@ A3): 1:12000
	Drawn by: POR	Drawing Number: P22-070-0600-0002	Rev: A
	Checked by: IH		

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26 April 2024



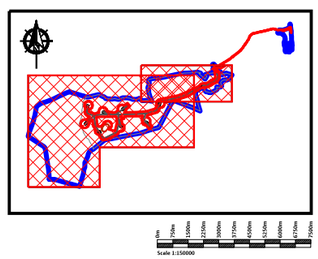
Legend:

- Site Boundary
- Folio Boundary

Ground Investigtion Legend:

- TP... Trial Pit Location

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Rev.	Description	App By	Date
A	FOR INFORMATION	BDH	26.04.24

PROJECT: KEERGLEN WINDFARM PEAT ASSESSMENT		CLIENT: ABO WIND	
SHEET: GROUND INVESTIGATION LOCATION PLAN	Date: 26.04.24	Project number: P22-070	Scale (@ A3): 1:12000
	Drawn by: POR	Drawing Number: P22-070-0600-0003	Rev: A
	Checked by: IH		

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26 April 2024



Legend:

Site Boundary

Folio Boundary

Factor of Safety Legend:

0 < 1.0

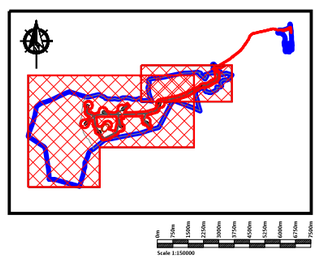
≥ 1.0 < 1.3

≥ 1.3

Increasing Stability

No Peat Recorded At This Location

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Rev.	Description	App By	Date
A	FOR INFORMATION	BDH	26.04.24

PROJECT: KEERGLEN WINDFARM PEAT ASSESSMENT

CLIENT: ABO WIND

SHEET: FACTOR OF SAFETY PLAN – SHORT TERM CRITICAL

Date: 26.04.24

Drawn by: POR

Checked by: IH

Project number: P22-070

Scale (@ A3): 1:12000

Drawing Number: P22-070-0600-0004

Rev: A

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26 April 2024

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APPENDIX A

Photos from Site Walkover

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Photo 1: Typical view across centre of site



Photo 2: View across Keerlglen River looking north

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Photo 3: Existing founded access road, NE corner of site

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APPENDIX B

Peat Stability Risk Registers

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Keerglen Wind Farm - Peat Stability Risk Register (Rev 0)

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Location:	Turbine T1

Grid Reference (Eastings, Northings):	505565	832360
Distance to Watercourse (m)	100 - 150	
Min & Max Measured Peat Depth (m):	1.8-2.3	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.75 (u), 2.00 (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	2	2	4	Negligible	No		2	2	4	Negligible
4	Evidence of previous failures/slips	2	2	4	Negligible	No		2	2	4	Negligible
5	Type of vegetation	2	2	4	Negligible	No		2	2	4	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	3	2	6	Low	No		2	2	4	Negligible
7	Evidence of very soft/soft clay at base of peat	0	2	0	Not Applicable	No		0	2	0	Not Applicable
8	Evidence of mechanically cut peat	2	2	4	Negligible	No		2	2	4	Negligible
9	Evidence of quaking or buoyant peat	2	2	4	Negligible	No		2	2	4	Negligible
10	Evidence of bog pools	0	2	0	Not Applicable	No		0	2	0	Not Applicable
11	Other	0	2	0	Not Applicable	No		0	2	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T1**
i	Due to relatively deep peat at this turbine location, additional construction measures such as the following will be required: - excavation side walls to be supported (e.g. boulders, sheet piles) - temporary works designer may be required to provide excavation support design -daily detailed inspection of excavation faces -potential for greater water inflow into excavation requiring removal of water using pumping -increased exclusion zone around excavation to avoid accidental loading of crest of slope
ii	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for site investigation;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.
vi	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.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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Keerglen Wind Farm - Peat Stability Risk Register (Rev 0)

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Location:	Turbine T2

Grid Reference (Eastings, Northings):	505470	831909
Distance to Watercourse (m)	100 - 150	
Min & Max Measured Peat Depth (m):	2.0-3.0	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.44 (u), 1.33 (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	2	2	4	Negligible	No		2	2	4	Negligible
4	Evidence of previous failures/slips	2	2	4	Negligible	No		2	2	4	Negligible
5	Type of vegetation	2	2	4	Negligible	No		2	2	4	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	2	4	Negligible	No		2	2	4	Negligible
7	Evidence of very soft/soft clay at base of peat	3	2	6	Low	No		2	2	4	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	0	2	0	Not Applicable	No		0	2	0	Not Applicable
10	Evidence of bog pools	3	2	6	Low	No		2	2	4	Negligible
11	Relatively deep peat	2	2	4	Negligible	No		2	2	4	Negligible

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T2**
i	Due to relatively deep peat at this turbine location, additional construction measures such as the following will be required: - excavation side walls to be supported (e.g. boulders, sheet piles) - temporary works designer may be required to provide excavation support design -daily detailed inspection of excavation faces -potential for greater water inflow into excavation requiring removal of water using pumping -increased exclusion zone around excavation to avoid accidental loading of crest of slope
ii	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for site investigation;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.
vi	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.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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Location:	Turbine T3

Grid Reference (Eastings, Northings):	505827	831743
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	0.9-1.8	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.65 (u), 2.20 (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	2	1	2	Negligible	No		2	1	2	Negligible
4	Evidence of previous failures/slips	2	1	2	Negligible	No		2	1	2	Negligible
5	Type of vegetation	2	1	2	Negligible	No		2	1	2	Negligible
6	General slope characteristics upslope/downslope from infrastructure location	2	1	2	Negligible	No		2	1	2	Negligible
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	4	1	4	Negligible	No		2	1	2	Negligible
9	Evidence of quaking or buoyant peat	4	1	4	Negligible	No		2	1	2	Negligible
10	Evidence of bog pools	4	1	4	Negligible	No		2	1	2	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 **Turbine T3**
i	Due to the presence of mechanically cut peat at this turbine location, additional construction measures such as the following will be required: - excavation side walls to be supported (e.g. boulders, sheet piles) - temporary works designer may be required to provide excavation support design -daily detailed inspection of excavation faces -potential for greater water inflow into excavation requiring removal of water using pumping -increased exclusion zone around excavation to avoid accidental loading of crest of slope
ii	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for site investigation;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.
vi	Inspection & approval of turbine base sub-formation by a competent person where a gravity type foundation base is constructed.
vii	Slope monitoring required upslope and downslope of excavation, monitored daily.
viii	No materials to be stockpiled or sidecast onto peat in this area

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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Location:	Turbine T4

Grid Reference (Eastings, Northings):	505920	832214
Distance to Watercourse (m)	100 - 150	
Min & Max Measured Peat Depth (m):	0.9-1.2	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 3.91 (u), 3.37 (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	2	2	4	Negligible	No		2	2	4	Negligible
4	Evidence of previous failures/slips	2	2	4	Negligible	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	2	2	4	Negligible	No		2	2	4	Negligible
7	Evidence of very soft/soft clay at base of peat	0	2	0	Not Applicable	No		0	2	0	Not Applicable
8	Evidence of mechanically cut peat	2	2	4	Negligible	No		0	2	0	Not Applicable
9	Evidence of quaking or buoyant peat	0	2	0	Not Applicable	No		0	2	0	Not Applicable
10	Evidence of bog pools	0	2	0	Not Applicable	No		0	2	0	Not Applicable
11	Other	0	2	0	Not Applicable	No		0	2	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Construction for **Turbine T4**
i	Due to the presence of mechanically cut peat at this turbine location, additional construction measures such as the following will be required: - excavation side walls to be supported (e.g. boulders, sheet piles) - temporary works designer may be required to provide excavation support design -daily detailed inspection of excavation faces -potential for greater water inflow into excavation requiring removal of water using pumping -increased exclusion zone around excavation to avoid accidental loading of crest of slope
ii	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for site investigation;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.
vi	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.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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Location:	Turbine T5

Grid Reference (Eastings, Northings):	506383	832271
Distance to Watercourse (m)	> 150	
Min & Max Measured Peat Depth (m):	1.7-2.5	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.05 (u), 2.30 (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	2	1	2	Negligible	No		2	1	2	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	2	1	2	Negligible	No		2	1	2	Negligible
7	Evidence of very soft/soft clay at base of peat	2	1	2	Negligible	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	3	1	3	Negligible	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 **Turbine T5**
i	Due to relatively deep peat at this turbine location, additional construction measures such as the following will be required: - excavation side walls to be supported (e.g. boulders, sheet piles) - temporary works designer may be required to provide excavation support design -daily detailed inspection of excavation faces -potential for greater water inflow into excavation requiring removal of water using pumping -increased exclusion zone around excavation to avoid accidental loading of crest of slope
ii	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for site investigation;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.
vi	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.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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Location:	Turbine T6

Grid Reference (Eastings, Northings):	506344	831817
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	1.6-2.0	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.38 (u), 1.65 (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	2	3	6	Low	No		2	3	6	Low
4	Evidence of previous failures/slips	2	3	6	Low	No		2	3	6	Low
5	Type of vegetation	2	3	6	Low	No		2	3	6	Low
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		2	3	6	Low
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	3	3	9	Low	No		2	3	6	Low
9	Evidence of quaking or buoyant peat	3	3	9	Low	No		2	3	6	Low
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 T6**
i	Due to relatively deep peat at this turbine location, additional construction measures such as the following will be required: - excavation side walls to be supported (e.g. boulders, sheet piles) - temporary works designer may be required to provide excavation support design -daily detailed inspection of excavation faces -potential for greater water inflow into excavation requiring removal of water using pumping -increased exclusion zone around excavation to avoid accidental loading of crest of slope
ii	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for site investigation;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.
vi	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.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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Location:	Turbine T7

Grid Reference (Eastings, Northings):	506978	831969
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	1.5-1.8	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.57 (u), 3.19 (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	2	3	6	Low	No		2	3	6	Low
4	Evidence of previous failures/slips	2	3	6	Low	No		2	3	6	Low
5	Type of vegetation	2	3	6	Low	No		2	3	6	Low
6	General slope characteristics upslope/downslope from infrastructure location	2	3	6	Low	No		2	3	6	Low
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	4	3	12	Medium	No		2	3	6	Low
9	Evidence of quaking or buoyant peat	4	3	12	Medium	No		2	3	6	Low
10	Evidence of bog pools	2	3	6	Low	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 T7**
i	Due to soft and machine cut peat at this turbine location, additional construction measures such as the following will be required: - excavation side walls to be supported (e.g. boulders, sheet piles) - temporary works designer may be required to provide excavation support design -daily detailed inspection of excavation faces -potential for greater water inflow into excavation requiring removal of water using pumping -increased exclusion zone around excavation to avoid accidental loading of crest of slope
ii	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for site investigation;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Detailed ground investigation to determine peat, mineral soil and bedrock condition and properties.
vi	Inspection & approval of turbine base sub-formation by a competent person where a gravity type foundation base is constructed.
vii	Slope monitoring required upslope and downslope of excavation, monitored daily.
viii	No materials to be stockpiled or sidecast onto peat in this area

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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Location:	Turbine T8

Grid Reference (Eastings, Northings):	507325	832404
Distance to Watercourse (m)	50 - 100	
Min & Max Measured Peat Depth (m):	0.8-1.6	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.35 (u), 1.46 (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	2	3	6	Low	No		2	3	6	Low
4	Evidence of previous failures/slips	2	3	6	Low	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	2	3	6	Low	No		2	3	6	Low
7	Evidence of very soft/soft clay at base of peat	0	3	0	Not Applicable	No		0	3	0	Not Applicable
8	Evidence of mechanically cut peat	3	3	9	Low	No		2	3	6	Low
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 T8**
i	Maintain hydrology of area as far as possible;
ii	Use of experienced geotechnical staff for site investigation;
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.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

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APPENDIX C

Calculated FOS for Peat Slopes on Site

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Calculated FoS of Natural Peat Slopes for Keerglen 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)
T1	505565	832360	5	5	10	2.3	3.3	**2.50**	**1.75**
T2	505470	831909	6	6	10	3.0	4.0	**1.92**	**1.44**
T3	505827	831743	7	5	10	1.5	2.5	**2.76**	**1.65**
T4	505920	832214	10	5	10	1.2	2.2	**2.44**	**1.33**
T5	506383	832271	4	5	10	2.5	3.5	**2.87**	**2.05**
T6	506344	831817	7	5	10	2.0	3.0	**2.07**	**1.38**
T7	506978	831969	4	3	10	1.8	2.8	**2.40**	**1.54**
T8	507325	832404	10	6	10	1.6	2.6	**2.19**	**1.35**
SS	506358	832101	3	5	10	2.1	3.1	**4.56**	**3.09**
PPR-001	507522	833065	4	5	10	1.0	2.0	**7.19**	**3.59**
PPR-002	507497	832974	4	5	10	1.5	2.5	**4.79**	**2.87**
PPR-003	507450	832894	5	5	10	0.8	1.8	**7.20**	**3.20**
PPR-004	507372	832832	4	5	10	0.8	1.8	**8.98**	**3.99**
PPR-005	507288	832778	4	5	10	0.9	1.9	**7.98**	**3.78**
PPR-006	507208	832720	4	5	10	1.5	2.5	**4.79**	**2.87**
PPR-007	507246	832637	9	5	10	0.5	1.5	**6.47**	**2.16**
PPR-008	507320	832569	2	5	10	0.2	1.2	**71.68**	**11.95**
PPR-009	507344	832483	8	5	10	0.9	1.9	**4.03**	**1.91**
PPR-010	507302	832392	10	5	10	0.9	1.9	**3.25**	**1.54**
PPR-011	507261	832301	7	5	10	2.1	3.1	**1.97**	**1.33**
PPR-012	507226	832240	3	5	10	1.8	2.8	**5.31**	**3.42**
PPR-013	506981	832164	3	5	10	1.7	2.7	**5.63**	**3.54**
PPR-014	506881	832156	3	5	10	1.7	2.7	**5.63**	**3.54**
PPR-015	506782	832148	3	5	10	2.5	3.5	**3.83**	**2.73**
PPR-016	506682	832144	4	5	10	2.1	3.1	**3.42**	**2.32**
PPR-017	506582	832142	4	5	10	1.9	2.9	**3.78**	**2.48**
PPR-018	506342	832138	3	5	10	1.5	2.5	**6.38**	**3.83**
PPR-019	506295	832066	6	5	10	1.2	2.2	**4.01**	**2.19**
PPR-020	506328	831972	8	5	10	1.8	2.8	**2.02**	**1.30**
PPR-021	506348	831874	7	5	10	1.2	2.2	**3.44**	**1.88**
PPR-022	506360	831815	7	5	10	1.4	2.4	**2.95**	**1.72**
PPR-023	506272	832164	4	5	10	0.9	1.9	**7.98**	**3.78**
PPR-024	506351	832226	3	5	10	1.5	2.5	**6.38**	**3.83**
PPR-025	506430	832288	3	5	10	1.8	2.8	**5.31**	**3.42**
PPR-026	506509	832349	2	5	10	3.6	4.6	**3.98**	**3.12**
PPR-027	506057	832160	5	5	10	2.4	3.4	**2.40**	**1.69**
PPR-028	505961	832186	12	5	10	0.9	1.9	**2.73**	**1.29**
PPR-029	505647	832189	3	5	10	2.8	3.8	**3.42**	**2.52**
PPR-030	505597	832275	3	5	10	2.3	3.3	**4.16**	**2.90**
PPR-031	505549	832356	5	5	10	2.1	3.1	**2.74**	**1.86**
PPR-032	505620	832040	4	5	10	2.1	3.1	**3.42**	**2.32**
PPR-033	505548	831972	5	5	10	2.2	3.2	**2.62**	**1.80**
PPR-034	505481	831898	4	5	10	2.0	3.0	**3.59**	**2.40**
PPR-035	505699	832032	2	5	10	2.7	3.7	**5.31**	**3.87**
PPR-036	505737	831862	4	5	10	2.6	3.6	**2.76**	**2.00**
PPR-037	505788	831776	6	5	10	2.4	3.4	**2.00**	**1.41**
PPR-038	505840	831691	6	5	10	1.8	2.8	**2.67**	**1.72**
PPR-039	505892	831605	3	5	10	2.4	3.4	**3.99**	**2.81**
PPR-040	505970	831564	2	5	10	1.8	2.8	**7.96**	**5.12**
PPR-041	506060	831607	4	5	10	1.5	2.5	**4.79**	**2.87**
PPR-042	506150	831650	3	5	10	2.2	3.2	**4.35**	**2.99**
PPR-043	506240	831694	6	5	10	3.0	4.0	**1.60**	**1.20**
PPR-044	506969	831955	4	3	10	1.7	2.7	**2.54**	**1.60**
PPR-045	507032	831877	3	3	10	2.3	3.3	**2.50**	**1.74**
PPR-046	507025	831861	3	5	10	2.0	3.0	**4.78**	**3.19**
EXR-001	508427	833179	4	No peat recorded at this location					
EXR-002	508332	833148	5	No peat recorded at this location					
EXR-003	508233	833132	5	5	10	0.4	1.4	**14.40**	**4.11**
EXR-004	508135	833116	6	5	10	0.4	1.4	**12.02**	**3.44**
EXR-005	508036	833101	6	5	10	0.3	1.3	**16.03**	**3.70**
EXR-006	507938	833097	5	5	10	0.8	1.8	**7.20**	**3.20**
EXR-007	507838	833099	3	5	10	0.5	1.5	**19.13**	**6.38**
EXR-008	507738	833107	3	5	10	0.5	1.5	**19.13**	**6.38**
EXR-009	507641	833101	4	5	10	1.0	2.0	**7.19**	**3.59**
EXR-010	507545	833073	2	No peat recorded at this location					
EXR-011	507132	832208	3	5	10	1.9	2.9	**5.04**	**3.30**
EXR-012	507036	832178	5	5	10	1.5	2.5	**3.84**	**2.30**
EXR-013	506957	832127	3	5	10	1.6	2.6	**5.98**	**3.68**
EXR-014	506919	832035	3	5	10	0.8	1.8	**11.96**	**5.31**
EXR-015	506520	832141	3	5	10	1.4	2.4	**6.83**	**3.99**
EXR-016	506420	832139	3	5	10	1.8	2.8	**5.31**	**3.42**
EXR-017	506320	832138	4	5	10	1.2	2.2	**5.99**	**3.27**
EXR-018	506220	832136	8	5	10	0.7	1.7	**5.18**	**2.13**
EXR-019	506120	832134	6	5	10	0.8	1.8	**6.01**	**2.67**
EXR-020	506020	832133	5	5	10	2.7	3.7	**2.13**	**1.56**
EXR-021	505920	832131	10	5	10	1.1	2.1	**2.66**	**1.39**
EXR-022	505820	832129	8	5	10	1.4	2.4	**2.59**	**1.51**
EXR-023	505722	832110	4	5	10	2.3	3.3	**3.12**	**2.18**
EXR-024	505710	832029	2	5	10	2.7	3.7	**5.31**	**3.87**
EXR-025	505724	831930	4	5	10	2.0	3.0	**3.59**	**2.40**
EXR-026	506305	831999	6	5	10	1.3	2.3	**3.70**	**2.09**
EXR-027	506302	831900	8	5	10	1.8	2.8	**2.02**	**1.30**
EXR-028	506279	831803	7	5	10	1.8	2.8	**2.30**	**1.48**
2023_POI_001	505554	831885	4	5	10	4.8	5.8	**1.50**	**1.24**
I_1	505478	831760	3	5	10	3.3	4.3	**2.90**	**2.22**
I_2	505478	831885	5	5	10	1.9	2.9	**3.03**	**1.99**
I_3	505478	832010	4	5	10	2.1	3.1	**3.42**	**2.32**
I_4	505478	832135	4	5	10	2.5	3.5	**2.87**	**2.05**

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Calculated FoS of Natural Peat Slopes for Keerglen 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)
I_5	505478	832260	3	5	10	2.0	3.0	**4.78**	**3.19**
I_6	505603	831635	3	5	10	2.7	3.7	**3.54**	**2.59**
I_7	505603	831760	3	5	10	1.7	2.7	**5.63**	**3.54**
I_8	505603	831885	3	5	10	2.8	3.8	**3.42**	**2.52**
I_9	505603	832010	3	5	10	3.0	4.0	**3.19**	**2.39**
I_10	505603	832135	3	5	10	2.0	3.0	**4.78**	**3.19**
I_11	505603	832260	3	5	10	4.4	5.4	**2.17**	**1.77**
I_12	505728	831635	4	5	10	2.1	3.1	**3.42**	**2.32**
I_13	505728	831760	4	5	10	1.0	2.0	**7.19**	**3.59**
I_14	505728	831885	4	5	10	2.1	3.1	**3.42**	**2.32**
I_15	505728	832010	4	5	10	2.4	3.4	**2.99**	**2.11**
I_16	505728	832135	3	5	10	1.8	2.8	**5.31**	**3.42**
I_17	505728	832260	3	5	10	2.2	3.2	**4.35**	**2.99**
I_18	505728	832385	3	5	10	4.1	5.1	**2.33**	**1.88**
I_19	505853	831760	6	5	10	1.0	2.0	**4.81**	**2.40**
I_20	505853	831885	7	5	10	1.5	2.5	**2.76**	**1.65**
I_21	505853	832010	6	5	10	1.2	2.2	**4.01**	**2.19**
I_22	505853	832135	6	5	10	1.8	2.8	**2.67**	**1.72**
I_23	505853	832260	3	5	10	1.4	2.4	**6.83**	**3.99**
I_24	505978	831760	2	5	10	2.3	3.3	**6.23**	**4.34**
I_25	505978	831885	6	5	10	1.6	2.6	**3.01**	**1.85**
I_26	505978	832010	7	5	10	1.8	2.8	**2.30**	**1.48**
I_27	505978	832135	6	5	10	2.1	3.1	**2.29**	**1.55**
I_28	505978	832260	3	5	10	2.0	3.0	**4.78**	**3.19**
I_29	506103	831760	4	5	10	2.0	3.0	**3.59**	**2.40**
I_30	506103	831885	4	5	10	1.7	2.7	**4.23**	**2.66**
I_31	506103	832010	6	5	10	1.2	2.2	**4.01**	**2.19**
I_32	506103	832135	6	5	10	1.8	2.8	**2.67**	**1.72**
I_33	506103	832260	3	5	10	0.9	1.9	**10.63**	**5.04**
I_34	506228	831885	4	5	10	1.4	2.4	**5.13**	**2.99**
I_35	506228	832010	8	8	10	2.7	3.7	**2.15**	**1.57**
I_36	506228	832135	6	5	10	1.4	2.4	**3.44**	**2.00**
I_37	506228	832260	3	5	10	2.6	3.6	**3.68**	**2.66**
I_38	506353	831885	5	5	10	1.0	2.0	**5.76**	**2.88**
I_39	506353	832010	5	5	10	1.0	2.0	**5.76**	**2.88**
I_40	506353	832135	5	5	10	2.1	3.1	**2.74**	**1.86**
I_41	506353	832260	3	5	10	1.8	2.8	**5.31**	**3.42**
I_42	506478	831885	3	5	10	0.9	1.9	**10.63**	**5.04**
I_43	506478	832010	3	5	10	2.0	3.0	**4.78**	**3.19**
I_44	506478	832135	3	5	10	1.4	2.4	**6.83**	**3.99**
I_45	506478	832260	3	5	10	2.5	3.5	**3.83**	**2.73**
I_46	506603	831885	4	5	10	2.5	3.5	**2.87**	**2.05**
I_47	506603	832010	3	5	10	2.6	3.6	**3.68**	**2.66**
I_48	506603	832135	2	5	10	2.7	3.7	**5.31**	**3.87**
I_49	506603	832260	15	8	10	1.8	2.8	**1.78**	**1.14**
I_50	506728	831885	3	5	10	1.8	2.8	**5.31**	**3.42**
I_51	506728	832010	3	5	10	2.5	3.5	**3.83**	**2.73**
I_52	506728	832135	3	5	10	1.6	2.6	**5.98**	**3.68**
I_53	506728	832260	3	5	10	1.1	2.1	**8.70**	**4.56**
I_54	506853	832010	3	5	10	1.3	2.3	**7.36**	**4.16**
I_55	506853	832135	5	5	10	1.6	2.6	**3.60**	**2.21**
I_56	506853	832260	2	5	10	1.8	2.8	**7.96**	**5.12**
I_57	506978	832010	2	5	10	1.8	2.8	**7.96**	**5.12**
I_58	506978	832135	3	5	10	1.5	2.5	**6.38**	**3.83**
I_59	506978	832260	3	5	10	3.4	4.4	**2.81**	**2.17**
I_60	507103	832010	3	5	10	1.3	2.3	**7.36**	**4.16**
I_61	507103	832135	3	5	10	1.5	2.5	**6.38**	**3.83**
I_62	507103	832260	3	5	10	1.4	2.4	**6.83**	**3.99**
I_63	507228	832260	2	5	10	2.0	3.0	**7.17**	**4.78**
I_64	507228	832760	5	5	10	1.7	2.7	**3.39**	**2.13**
I_65	507353	832635	30	8	10	0.2	1.2	**9.24**	**1.54**
I_66	507353	832760	5	5	10	0.5	1.5	**11.52**	**3.84**
I_67	507478	832760	3	5	10	1.7	2.7	**5.63**	**3.54**
I_68	507603	832760	6	5	10	1.9	2.9	**2.53**	**1.66**
I_69	507603	832885	5	5	10	0.5	1.5	**11.52**	**3.84**
I_70	507728	832760	5	5	10	1.5	2.5	**3.84**	**2.30**
I_71	507728	832885	2	5	10	0.9	1.9	**15.93**	**7.55**
I_72	507853	832635	2	5	10	0.9	1.9	**15.93**	**7.55**
I_73	507853	832760	20	No peat recorded at this location					
I_74	507853	832885	7	5	10	0.3	1.3	**13.78**	**3.18**
I_75	505572	832350	3	5	10	3.6	4.6	**2.66**	**2.08**
I_76	506864	831924	3	5	10	2.4	3.4	**3.99**	**2.81**
I_77	507306	832385	8	5	10	1.0	2.0	**3.63**	**1.81**
I_78	507347	832530	2.5	5	10	1.8	2.8	**6.37**	**4.10**
I_79	507353	832844	13	5	10	0.4	1.4	**5.70**	**1.63**
I_80	507478	832864	8	5	10	1.0	2.0	**3.63**	**1.81**
I_81	507959	832835	15	No peat recorded at this location					
I_82	507958	832589	2	5	10	2.3	3.3	**6.23**	**4.34**
I_83	507733	832670	3	No peat recorded at this location					
I_84	507505	832666	15	5	10	0.4	1.4	**5.00**	**1.43**
CC_1	505438	832466	7	5	10	1.8	2.8	**2.30**	**1.48**
CC_2	505588	832471	6	5	10	2.2	3.2	**2.19**	**1.50**
CC_3	505733	832506	5	5	10	3	4.0	**1.92**	**1.44**
CC_4	505867	832482	7	5	10	1.7	2.7	**2.43**	**1.53**
CC_5	505997	832428	4	5	10	0.4	1.4	**17.96**	**5.13**
CC_6	506146	832419	5	5	10	0.8	1.8	**7.20**	**3.20**
CC_7	506293	832408	5	5	10	1.2	2.2	**4.80**	**2.62**
CC_8	506432	832451	5	5	10	2.2	3.2	**2.62**	**1.80**
CC_9	506578	832426	8	5	10	1.3	2.3	**2.79**	**1.58**
CC_10	506724	832411	5	5	10	2.3	3.3	**2.50**	**1.75**

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Calculated FoS of Natural Peat Slopes for Keerglen 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)
CC_11	506865	832382	3	5	10	2	3.0	**4.78**	**3.19**
CC_12	507015	832383	3	5	10	1.2	2.2	**7.97**	**4.35**
CC_13	507158	832392	5	5	10	1.5	2.5	**3.84**	**2.30**
CC_14	507186	832530	15	5	10	1	2.0	**2.00**	**1.00**
CC_15	507129	832666	9	5	10	1.9	2.9	**1.70**	**1.12**
CC_16	507116	832812	6	5	10	2.1	3.1	**2.29**	**1.55**
CC_17	507180	832922	6	5	10	2	3.0	**2.40**	**1.60**
CC_18	507329	832944	6	5	10	0.5	1.5	**9.62**	**3.21**
CC_19	507476	832970	4	5	10	0.45	1.5	**15.97**	**4.96**
CC_20	507623	832999	6	5	10	0.25	1.3	**19.24**	**3.85**
CC_21	507770	833031	13	5	10	0.3	1.3	**7.60**	**1.75**
CC_22	507917	833054	14	8	10	1.2	2.2	**2.84**	**1.55**
CC_23	508016	832970	6	5	10	0.9	1.9	**5.34**	**2.53**
CC_24	508088	832839	18	8	10	0.4	1.4	**6.81**	**1.94**
CC_25	508031	832744	8	No peat recorded at this location					
CC_26	508068	832602	2	5	10	0.8	1.8	**17.92**	**7.96**
CC_27	508108	832458	2	5	10	2.0	3.0	**7.17**	**4.78**
CC_28	508029	832444	3	5	10	0.8	1.8	**11.96**	**5.31**
CC_29	507888	832494	3	5	10	2.0	3.0	**4.78**	**3.19**
CC_30	507747	832546	2	5	10	1.8	2.8	**7.96**	**5.12**
CC_31	507607	832587	2	No peat recorded at this location					
CC_32	507500	832493	3	5	10	1.5	2.5	**6.38**	**3.83**
CC_33	507431	832360	3	5	10	1.0	2.0	**9.57**	**4.78**
CC_34	507363	832227	4	5	10	0.8	1.8	**8.98**	**3.99**
CC_35	507294	832093	3	5	10	1.0	2.0	**9.57**	**4.78**
CC_36	507224	831961	5	5	10	0.4	1.4	**14.40**	**4.11**
CC_37	507109	831885	3	5	10	3.5	4.5	**2.73**	**2.13**
CC_38	506965	831842	3	5	10	1.8	2.8	**5.31**	**3.42**
CC_39	506822	831797	3	5	10	2.5	3.5	**3.83**	**2.73**
CC_40	506676	831766	3	3	10	4.5	5.5	**1.28**	**1.04**
CC_41	506529	831738	2	5	10	4.5	5.5	**3.19**	**2.61**
CC_42	506382	831709	3	5	10	2.8	3.8	**3.42**	**2.52**
CC_43	506234	831681	6	5	10	2.8	3.8	**1.72**	**1.27**
CC_44	506087	831652	5	5	10	1.7	2.7	**3.39**	**2.13**
CC_45	505941	831623	2	5	10	2.0	3.0	**7.17**	**4.78**
CC_46	505818	831542	3	5	10	3.4	4.4	**2.81**	**2.17**
CC_47	505702	831447	3	5	10	2.6	3.6	**3.68**	**2.66**
CC_48	505586	831352	5	5	10	3.9	4.9	**1.48**	**1.18**
100	504238	831760	7	5	10	1.9	2.9	**2.18**	**1.43**
101	504343	831656	5	5	10	1.3	2.3	**4.43**	**2.50**
102	504539	832217	5	5	10	2.2	3.2	**2.62**	**1.80**
103	504967	832224	4	5	10	0.9	1.9	**7.98**	**3.78**
104	504577	831789	5	5	10	3.3	4.3	**1.75**	**1.34**
105	504990	831833	4	5	10	3.2	4.2	**2.25**	**1.71**
FT (2024)									
1	508689	833292	6	No peat recorded at this location					
2	508691	833172	7	5	10	0.2	1.2	**20.67**	**3.44**
3	508720	833077	10	5	10	0.2	1.2	**19.49**	**2.54**
4	508677	832972	8	5	10	0.9	1.9	**4.27**	**1.96**
5	508573	832923	12	No peat recorded at this location					
6	508465	832856	10	No peat recorded at this location					
7	508337	832833	10	5	10	0.1	1.1	**29.24**	**2.66**
8	508255	832771	7	5	10	1.0	2.0	**4.13**	**2.07**
9	508157	832728	7	No peat recorded at this location					
10	508080	832691	6	5	10	0.9	1.9	**5.66**	**2.60**
11	507984	832632	7	5	10	2.1	3.1	**1.97**	**1.33**
12	507859	832587	6	5	10	0.7	1.7	**6.87**	**2.83**
							Minimum =	**1.28**	**1.00**
							Maximum =	**71.68**	**11.95**
							Average =	**5.81**	**2.84**

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 8kPa 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.

(5) Peat depths based on probes carried out by FT.

(6) For load conditions see report text.

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Calculated FoS of Natural Peat Slopes for Keerglen Wind Farm - Drained Analysis

Turbine No./Waypoint	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	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)	ø' (deg)	Condition (2)	Condition (2)	Condition (1)	Condition (2)
									100% Water	100% Water
T1	5	4	10.0	10.0	2.3	25	1.0	3.3	2.00	3.01
T2	6	4	10.0	10.0	3.0	25	1.0	4.0	1.33	2.14
T3	7	4	10.0	10.0	1.5	25	1.0	2.5	2.20	2.84
T4	10	4	10.0	10.0	1.2	25	1.0	2.2	1.95	2.27
T5	4	4	10.0	10.0	2.5	25	1.0	3.5	2.30	3.55
T6	7	4	10.0	10.0	2.0	25	1.0	3.0	1.65	2.37
T7	4	4	10.0	10.0	1.8	25	1.0	2.8	3.19	4.43
T8	10	4	10.0	10.0	1.6	25	1.0	2.6	1.[illegible]	1.92
SS	3	4	10.0	10.0	2.1	25	1.0	3.1	3.[illegible]	5.34
PPR-001	4	4	10.0	10.0	1.0	25	1.0	2.0	5.75	6.21
PPR-002	4	4	10.0	10.0	1.5	25	1.0	2.5	3.83	4.97
PPR-003	5	4	10.0	10.0	0.8	25	1.0	1.8	5.76	5.52
PPR-004	4	4	10.0	10.0	0.8	25	1.0	1.8	7.19	6.90
PPR-005	4	4	10.0	10.0	0.9	25	1.0	1.9	6.39	6.54
PPR-006	4	4	10.0	10.0	1.5	25	1.0	2.5	3.83	4.97
PPR-007	9	4	10.0	10.0	0.5	25	1.0	1.5	5.18	3.69
PPR-008	2	4	10.0	10.0	0.2	25	1.0	1.2	57.34	20.68
PPR-009	8	4	10.0	10.0	0.9	25	1.0	1.9	3.22	3.27
PPR-010	12	4	10.0	10.0	0.9	25	1.0	1.9	2.19	2.19
PPR-011	7	4	10.0	10.0	2.1	25	1.0	3.1	1.57	2.29
PPR-012	3	4	10.0	10.0	1.8	25	1.0	2.8	4.25	5.91
PPR-013	3	4	10.0	10.0	1.7	25	1.0	2.7	4.50	6.13
PPR-014	3	4	10.0	10.0	1.7	25	1.0	2.7	4.50	6.13
PPR-015	3	4	10.0	10.0	2.5	25	1.0	3.5	3.06	4.73
PPR-016	4	4	10.0	10.0	2.1	25	1.0	3.1	2.74	4.01
PPR-017	4	4	10.0	10.0	1.9	25	1.0	2.9	3.03	4.28
PPR-018	3	4	10.0	10.0	1.5	25	1.0	2.5	5.10	6.62
PPR-019	6	4	10.0	10.0	1.2	25	1.0	2.2	3.21	3.77
PPR-020	8	4	10.0	10.0	1.8	25	1.0	2.8	1.61	2.22
PPR-021	7	4	10.0	10.0	1.2	25	1.0	2.2	2.76	3.23
PPR-022	7	4	10.0	10.0	1.4	25	1.0	2.4	2.36	2.96
PPR-023	4	4	10.0	10.0	0.9	25	1.0	1.9	6.39	6.54
PPR-024	3	4	10.0	10.0	1.5	25	1.0	2.5	5.10	6.62
PPR-025	3	4	10.0	10.0	1.8	25	1.0	2.8	4.25	5.91
PPR-026	2	4	10.0	10.0	3.6	25	1.0	4.6	3.19	5.40
PPR-027	5	4	10.0	10.0	2.4	25	1.0	3.4	1.92	2.92
PPR-028	12	4	10.0	10.0	0.9	25	1.0	1.9	2.19	2.19
PPR-029	3	4	10.0	10.0	2.8	25	1.0	3.8	2.73	4.36
PPR-030	3	4	10.0	10.0	2.3	25	1.0	3.3	3.33	5.02
PPR-031	5	4	10.0	10.0	2.1	25	1.0	3.1	2.19	3.21
PPR-032	4	4	10.0	10.0	2.1	25	1.0	3.1	2.74	4.01
PPR-033	5	4	10.0	10.0	2.2	25	1.0	3.2	2.09	3.11
PPR-034	4	4	10.0	10.0	2.0	25	1.0	3.0	2.87	4.14
PPR-035	2	4	10.0	10.0	2.7	25	1.0	3.7	4.25	6.71
PPR-036	4	4	10.0	10.0	2.6	25	1.0	3.6	2.21	3.45
PPR-037	6	4	10.0	10.0	2.4	25	1.0	3.4	1.60	2.44
PPR-038	6	4	10.0	10.0	1.8	25	1.0	2.8	2.14	2.96
PPR-039	3	4	10.0	10.0	2.4	25	1.0	3.4	3.19	4.87
PPR-040	2	4	10.0	10.0	1.8	25	1.0	2.8	6.37	8.86
PPR-041	4	4	10.0	10.0	1.5	25	1.0	2.5	3.83	4.97
PPR-042	3	4	10.0	10.0	2.2	25	1.0	3.2	3.48	5.17
PPR-043	6	4	10.0	10.0	3.0	25	1.0	4.0	1.28	2.07
PPR-044	4	4	10.0	10.0	1.7	25	1.0	2.7	3.38	4.60
PPR-045	3	4	10.0	10.0	2.3	25	1.0	3.3	3.33	5.02
PPR-046	3	4	10.0	10.0	2.0	25	1.0	3.0	3.83	5.52
EXR-001	4	4	10.0	10.0	No peat recorded at this location					
EXR-002	5	4	10.0	10.0	No peat recorded at this location					
EXR-003	5	4	10.0	10.0	0.4	25	1.0	1.4	11.52	7.10
EXR-004	6	4	10.0	10.0	0.4	25	1.0	1.4	9.62	5.92
EXR-005	6	4	10.0	10.0	0.3	25	1.0	1.3	12.83	6.37
EXR-006	5	4	10.0	10.0	0.8	25	1.0	1.8	5.76	5.52
EXR-007	3	4	10.0	10.0	0.5	25	1.0	1.5	15.31	11.03
EXR-008	3	4	10.0	10.0	0.5	25	1.0	1.5	15.31	11.03
EXR-009	4	4	10.0	10.0	1.0	25	1.0	2.0	5.75	6.21
EXR-010	2	4	10.0	10.0	No peat recorded at this location					
EXR-011	3	4	10.0	10.0	1.9	25	1.0	2.9	4.03	5.71
EXR-012	5	4	10.0	10.0	1.5	25	1.0	2.5	3.07	3.97
EXR-013	3	4	10.0	10.0	1.6	25	1.0	2.6	4.78	6.37
EXR-014	3	4	10.0	10.0	0.8	25	1.0	1.8	9.57	9.20
EXR-015	3	4	10.0	10.0	1.4	25	1.0	2.4	5.47	6.90
EXR-016	3	4	10.0	10.0	1.8	25	1.0	2.8	4.25	5.91
EXR-017	4	4	10.0	10.0	1.2	25	1.0	2.2	4.79	5.64
EXR-018	8	4	10.0	10.0	0.7	25	1.0	1.7	4.15	3.66
EXR-019	6	4	10.0	10.0	0.8	25	1.0	1.8	4.81	4.60
EXR-020	5	4	10.0	10.0	2.7	25	1.0	3.7	1.71	2.69
EXR-021	10	4	10.0	10.0	1.1	25	1.0	2.1	2.13	2.37
EXR-022	8	4	10.0	10.0	1.4	25	1.0	2.4	2.07	2.59
EXR-023	4	4	10.0	10.0	2.3	25	1.0	3.3	2.50	3.76
EXR-024	2	4	10.0	10.0	2.7	25	1.0	3.7	4.25	6.71
EXR-025	4	4	10.0	10.0	2.0	25	1.0	3.0	2.87	4.14
EXR-026	6	4	10.0	10.0	1.3	25	1.0	2.3	2.96	3.60
EXR-027	8	4	10.0	10.0	1.8	25	1.0	2.8	1.61	2.22
EXR-028	7	4	10.0	10.0	1.8	25	1.0	2.8	1.84	2.54
2023_POI_001	4	4	10.0	10.0	4.8	26	1.0	5.8	1.20	2.19
I_1	3	4	10.0	10.0	3.3	25	1.0	4.3	2.32	3.85
I_2	5	4	10.0	10.0	1.9	25	1.0	2.9	2.42	3.43
I_3	4	4	10.0	10.0	2.1	25	1.0	3.1	2.74	4.01
I_4	4	4	10.0	10.0	2.5	25	1.0	3.5	2.30	3.55
I_5	3	4	10.0	10.0	2.0	25	1.0	3.0	3.83	5.52
I_6	3	4	10.0	10.0	2.7	25	1.0	3.7	2.83	4.47

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Calculated FoS of Natural Peat Slopes for Keerglen Wind Farm - Drained Analysis

Turbine No./Waypoint	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	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)	ø' (deg)	Condition (2)	Condition (2)	Condition (1)	Condition (2)
									100% Water	100% Water
I_7	3	4	10.0	10.0	1.7	25	1.0	2.7	4.50	6.13
I_8	3	4	10.0	10.0	2.8	25	1.0	3.8	2.73	4.36
I_9	3	4	10.0	10.0	3.0	25	1.0	4.0	2.55	4.14
I_10	3	4	10.0	10.0	2.0	25	1.0	3.0	3.83	5.52
I_11	3	4	10.0	10.0	4.4	25	1.0	5.4	1.74	3.07
I_12	4	4	10.0	10.0	2.1	25	1.0	3.1	2.74	4.01
I_13	4	4	10.0	10.0	1.0	25	1.0	2.0	5.75	6.21
I_14	4	4	10.0	10.0	2.1	25	1.0	3.1	2.74	4.01
I_15	4	4	10.0	10.0	2.4	25	1.0	3.4	[illegible]	3.65
I_16	3	4	10.0	10.0	1.8	25	1.0	2.8	4.25	5.91
I_17	3	4	10.0	10.0	2.2	25	1.0	3.2	3.48	5.17
I_18	3	4	10.0	10.0	4.1	25	1.0	5.1	1.87	3.25
I_19	6	4	10.0	10.0	1.0	25	1.0	2.0	3.85	4.14
I_20	7	4	10.0	10.0	1.5	25	1.0	2.5	2.20	2.84
I_21	6	4	10.0	10.0	1.2	25	1.0	2.2	3.21	3.77
I_22	6	4	10.0	10.0	1.8	25	1.0	2.8	2.14	2.96
I_23	3	4	10.0	10.0	1.4	25	1.0	2.4	5.47	6.90
I_24	2	4	10.0	10.0	2.3	25	1.0	3.3	4.99	7.52
I_25	6	4	10.0	10.0	1.6	25	1.0	2.6	2.40	3.19
I_26	7	4	10.0	10.0	1.8	25	1.0	2.8	1.84	2.54
I_27	6	4	10.0	10.0	2.1	25	1.0	3.1	1.83	2.67
I_28	3	4	10.0	10.0	2.0	25	1.0	3.0	3.83	5.52
I_29	4	4	10.0	10.0	2.0	25	1.0	3.0	2.87	4.14
I_30	4	4	10.0	10.0	1.7	25	1.0	2.7	3.38	4.60
I_31	6	4	10.0	10.0	1.2	25	1.0	2.2	3.21	3.77
I_32	6	4	10.0	10.0	1.8	25	1.0	2.8	2.14	2.96
I_33	3	4	10.0	10.0	0.9	25	1.0	1.9	8.50	8.71
I_34	4	4	10.0	10.0	1.4	25	1.0	2.4	4.11	5.17
I_35	8	4	10.0	10.0	2.7	25	1.0	3.7	1.07	1.68
I_36	6	4	10.0	10.0	1.4	25	1.0	2.4	2.75	3.45
I_37	3	4	10.0	10.0	2.6	25	1.0	3.6	2.94	4.60
I_38	5	4	10.0	10.0	1.0	25	1.0	2.0	4.61	4.97
I_39	5	4	10.0	10.0	1.0	25	1.0	2.0	4.61	4.97
I_40	5	4	10.0	10.0	2.1	25	1.0	3.1	2.19	3.21
I_41	3	4	10.0	10.0	1.8	25	1.0	2.8	4.25	5.91
I_42	3	4	10.0	10.0	0.9	25	1.0	1.9	8.50	8.71
I_43	3	4	10.0	10.0	2.0	25	1.0	3.0	3.83	5.52
I_44	3	4	10.0	10.0	1.4	25	1.0	2.4	5.47	6.90
I_45	3	4	10.0	10.0	2.5	25	1.0	3.5	3.06	4.73
I_46	4	4	10.0	10.0	2.5	25	1.0	3.5	2.30	3.55
I_47	3	4	10.0	10.0	2.6	25	1.0	3.6	2.94	4.60
I_48	2	4	10.0	10.0	2.7	25	1.0	3.7	4.25	6.71
I_49	15	4	10.0	10.0	1.8	25	1.0	2.8	0.89	1.19
I_50	3	4	10.0	10.0	1.8	25	1.0	2.8	4.25	5.91
I_51	3	4	10.0	10.0	2.5	25	1.0	3.5	3.06	4.73
I_52	3	4	10.0	10.0	1.6	25	1.0	2.6	4.78	6.37
I_53	3	4	10.0	10.0	1.1	25	1.0	2.1	6.96	7.88
I_54	3	4	10.0	10.0	1.3	25	1.0	2.3	5.89	7.20
I_55	5	4	10.0	10.0	1.6	25	1.0	2.6	2.88	3.82
I_56	2	4	10.0	10.0	1.8	25	1.0	2.8	6.37	8.86
I_57	2	4	10.0	10.0	1.8	25	1.0	2.8	6.37	8.86
I_58	3	4	10.0	10.0	1.5	25	1.0	2.5	5.10	6.62
I_59	3	4	10.0	10.0	3.4	25	1.0	4.4	2.25	3.76
I_60	3	4	10.0	10.0	1.3	25	1.0	2.3	5.89	7.20
I_61	3	4	10.0	10.0	1.5	25	1.0	2.5	5.10	6.62
I_62	3	4	10.0	10.0	1.4	25	1.0	2.4	5.47	6.90
I_63	2	4	10.0	10.0	2.0	25	1.0	3.0	5.73	8.27
I_64	5	4	10.0	10.0	1.7	25	1.0	2.7	2.71	3.68
I_65	30	4	10.0	10.0	0.2	25	1.0	1.2	4.62	1.44
I_66	5	4	10.0	10.0	0.5	25	1.0	1.5	9.21	6.62
I_67	3	4	10.0	10.0	1.7	25	1.0	2.7	4.50	6.13
I_68	6	4	10.0	10.0	1.9	25	1.0	2.9	2.03	2.86
I_69	5	4	10.0	10.0	0.5	25	1.0	1.5	9.21	6.62
I_70	5	4	10.0	10.0	1.5	25	1.0	2.5	3.07	3.97
I_71	2	4	10.0	10.0	0.9	25	1.0	1.9	12.74	13.06
I_72	2	4	10.0	10.0	0.9	25	1.0	1.9	12.74	13.06
I_73	20	4	10.0	10.0	No peat recorded at this location					
I_74	7	4	10.0	10.0	0.3	25	1.0	1.3	11.02	5.47
I_75	3	4	10.0	10.0	3.6	25	1.0	4.6	2.13	3.60
I_76	3	4	10.0	10.0	2.4	25	1.0	3.4	3.19	4.87
I_77	8	4	10.0	10.0	1.0	25	1.0	2.0	2.90	3.11
I_78	2.5	4	10.0	10.0	1.8	25	1.0	2.8	5.10	7.09
I_79	13	4	10.0	10.0	0.4	25	1.0	1.4	4.56	2.75
I_80	8	4	10.0	10.0	1.0	25	1.0	2.0	2.90	3.11
I_81	15	4	10.0	10.0	No peat recorded at this location					
I_82	2	4	10.0	10.0	2.3	25	1.0	3.3	4.99	7.52
I_83	3	4	10.0	10.0	No peat recorded at this location					
I_84	15	4	10.0	10.0	0.4	25	1.0	1.4	4.00	2.39
CC_1	7	4	10.0	10.0	1.8	25	1.0	2.8	1.84	2.54
CC_2	6	4	10.0	10.0	2.2	25	1.0	3.2	1.75	2.59
CC_3	5	4	10.0	10.0	3	25	1.0	4.0	1.54	2.48
CC_4	7	4	10.0	10.0	1.7	25	1.0	2.7	1.95	2.63
CC_5	4	4	10.0	10.0	0.4	25	1.0	1.4	14.37	8.87
CC_6	5	4	10.0	10.0	0.8	25	1.0	1.8	5.76	5.52
CC_7	5	4	10.0	10.0	1.2	25	1.0	2.2	3.84	4.52
CC_8	5	4	10.0	10.0	2.2	25	1.0	3.2	2.09	3.11
CC_9	8	4	10.0	10.0	1.3	25	1.0	2.3	2.23	2.70
CC_10	5	4	10.0	10.0	2.3	25	1.0	3.3	2.00	3.01
CC_11	3	4	10.0	10.0	2	25	1.0	3.0	3.83	5.52
CC_12	3	4	10.0	10.0	1.2	25	1.0	2.2	6.38	7.52
CC_13	5	4	10.0	10.0	1.5	25	1.0	2.5	3.07	3.97
CC_14	15	4	10.0	10.0	1	25	1.0	2.0	1.60	1.67
CC_15	9	4	10.0	10.0	1.9	25	1.0	2.9	1.36	1.91

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Calculated FoS of Natural Peat Slopes for Keerglen Wind Farm - Drained Analysis

Turbine No./Waypoint	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	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)	ø' (deg)	Condition (2)	Condition (2)	Condition (1)	Condition (2)
									100% Water	100% Water
CC_16	6	4	10.0	10.0	2.1	25	1.0	3.1	1.83	2.67
CC_17	6	4	10.0	10.0	2	25	1.0	3.0	1.92	2.76
CC_18	6	4	10.0	10.0	0.5	25	1.0	1.5	7.70	5.52
CC_19	4	4	10.0	10.0	0.45	25	1.0	1.5	12.77	8.56
CC_20	6	4	10.0	10.0	0.25	25	1.0	1.3	15.39	6.63
CC_21	13	4	10.0	10.0	0.3	25	1.0	1.3	6.08	2.96
CC_22	14	4	10.0	10.0	1.2	25	1.0	2.2	1.42	1.62
CC_23	6	4	10.0	10.0	0.9	25	1.0	1.9	4.28	4.36
CC_24	18	4	10.0	10.0	0.4	25	1.0	1.4	2.00	2.00
CC_25	8	4	10.0	10.0	No peat recorded at this location					
CC_26	2	4	10.0	10.0	0.8	25	1.0	1.8	14.34	13.79
CC_27	2	4	10.0	10.0	2.0	25	1.0	3.0	5.73	8.27
CC_28	3	4	10.0	10.0	0.8	25	1.0	1.8	9.57	9.20
CC_29	3	4	10.0	10.0	2.0	25	1.0	3.0	3.83	5.52
CC_30	2	4	10.0	10.0	1.8	25	1.0	2.8	6.37	8.86
CC_31	2	4	10.0	10.0	No peat recorded at this location					
CC_32	3	4	10.0	10.0	1.5	25	1.0	2.5	5.10	6.62
CC_33	3	4	10.0	10.0	1.0	25	1.0	2.0	7.65	8.28
CC_34	4	4	10.0	10.0	0.8	25	1.0	1.8	7.19	6.90
CC_35	3	4	10.0	10.0	1.0	25	1.0	2.0	7.65	8.28
CC_36	5	4	10.0	10.0	0.4	25	1.0	1.4	11.52	7.10
CC_37	3	4	10.0	10.0	3.5	25	1.0	4.5	2.19	3.68
CC_38	3	4	10.0	10.0	1.8	25	1.0	2.8	4.25	5.91
CC_39	3	4	10.0	10.0	2.5	25	1.0	3.5	3.06	4.73
CC_40	3	4	10.0	10.0	4.5	25	1.0	5.5	1.70	3.01
CC_41	2	4	10.0	10.0	4.5	25	1.0	5.5	2.55	4.51
CC_42	3	4	10.0	10.0	2.8	25	1.0	3.8	2.73	4.36
CC_43	6	4	10.0	10.0	2.8	25	1.0	3.8	1.37	2.18
CC_44	5	4	10.0	10.0	1.7	25	1.0	2.7	2.71	3.68
CC_45	2	4	10.0	10.0	2.0	25	1.0	3.0	5.73	8.27
CC_46	3	4	10.0	10.0	3.4	25	1.0	4.4	2.25	3.76
CC_47	3	4	10.0	10.0	2.6	25	1.0	3.6	2.94	4.60
CC_48	5	4	10.0	10.0	3.9	25	1.0	4.9	1.18	2.03
100	7	4	10.0	10.0	1.9	25	1.0	2.9	1.74	2.45
101	5	4	10.0	10.0	1.3	25	1.0	2.3	3.54	4.32
102	5	4	10.0	10.0	2.2	25	1.0	3.2	2.09	3.11
103	4	4	10.0	10.0	0.9	25	1.0	1.9	6.39	6.54
104	5	4	10.0	10.0	3.3	25	1.0	4.3	1.40	2.31
105	4	4	10.0	10.0	3.2	25	1.0	4.2	1.80	2.96
FT (2024)										
1	6	4	10.0	10.0	No peat recorded at this location					
2	7	4	10.0	10.0	0.2	25	1.0	1.2	16.53	5.92
3	10	4	10.0	10.0	0.2	25	1.0	1.2	15.59	4.33
4	8	4	10.0	10.0	0.9	25	1.0	1.9	3.41	3.36
5	12	4	10.0	10.0	No peat recorded at this location					
6	10	4	10.0	10.0	No peat recorded at this location					
7	10	4	10.0	10.0	0.1	25	1.0	1.1	23.39	4.53
8	7	4	10.0	10.0	1.0	25	1.0	2.0	3.31	3.55
9	7	4	10.0	10.0	No peat recorded at this location					
10	6	4	10.0	10.0	0.9	25	1.0	1.9	4.53	4.48
11	7	4	10.0	10.0	2.1	25	1.0	3.1	1.57	2.29
12	6	4	10.0	10.0	0.7	25	1.0	1.7	5.50	4.87
								Minimum =	0.89	1.19
								Maximum =	57.34	20.68
								Average =	4.46	4.94

Notes:

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

(2) Assuming a surcharge equivalent to fill depth of 1.0m.

(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 FT.

(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

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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	

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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

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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.

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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

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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

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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

Impact \ Probability	1	2	3	4	5
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 Information (IDL, 2023)

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IRISH DRILLING LIMITED

LOUGHREA, CO. GALWAY, IRELAND

CONTRACT DRILLING
SITE INVESTIGATION

Phone: (091) 841 274
Fax: (091) 847 687

email: info@irishdrilling.ie

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KEERGLEN WIND FARM

SITE INVESTIGATION CONTRACT FACTUAL REPORT

ABO Wind Ireland,
Unit 3 Aspen Court,
Cornelscourt,
D18 K400.

Fehily Timoney & Company,
Consulting Engineers,
Unit 6,
Bagenalstown Industrial Park,
Royal Oak Road,
Bagenalstown,
Co. Carlow,
R21 XW81.

	Prepared by	Approved by	Rev. Issue Date:	Revision No.
	Ronan Killeen	Declan Joyce	23rd May 2023	23 _MO_105/01
Signature				

FOREWORD

The trial pit records have been compiled from an examination of the samples by a Geotechnical Engineer and from the Drillers' descriptions.

The report presents an opinion on the configuration of the strata within the site based on the trial pit results. The assumptions, though reasonable, are given for guidance only and no liability can be accepted for changes in conditions not revealed by the trial pits.

The fieldwork was carried out in accordance with IS EN 1997-2 and BS5930, 2015 Code of Practice for Site Investigations with precedence given to IS EN 1997-2 where applicable.

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Contents:

1.0	Introduction
2.0	The Site & Geology
3.0	Fieldwork
4.0	Laboratory Testing

Book 1 of 1

Appendix 1	Trial Pit Records
Appendix 2	Photographs (Trial Pits)
Appendix 3	Laboratory Test Results
Appendix 4	Site Plan
Appendix 5	AGS Data

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1.0 Introduction.

Irish Drilling Ltd. (IDL) was instructed by Fehiliy Timoney & Partners, Consulting Engineers, on behalf of ABO Wind Ireland, to carry out a site investigation at the site of the proposed Keerglen Wind Farm Project.

This site investigation was carried out to provide detailed factual geotechnical information of the underlying ground conditions at the location of the proposed works.

The fieldwork commenced on April 4th 2023 and was completed on April 5th 2023.

2.0 Site & Geology

The site is located near Ballycastle, County Mayo.

The site is agricultural in nature and the fieldwork was carried out peatlands.

Weather conditions in general were quite variable with the majority of the fieldwork carried out over a typical spring period in Ireland.

Geological Survey maps of the area indicate that the site is underlain by Shales and Sandstone Rock Formations.

A Site Plan, prepared by the client's representatives to show approximate fieldwork locations, is included with this report.

3.0 Fieldwork.

The following plant was mobilised to site to carry out fieldwork operations:

1nr Zaxis 130 Wide-Tracked Excavator.

Fieldwork carried out to date has included the following:

Fifteen trial pits were excavated on site using the tracked excavator.

The pits were logged and photographed by an Engineer with observations made on ground conditions, pit stability, water ingress and services encountered.

Small and bulk disturbed soil samples were recovered at each change in strata and returned to the laboratory and presented for testing.

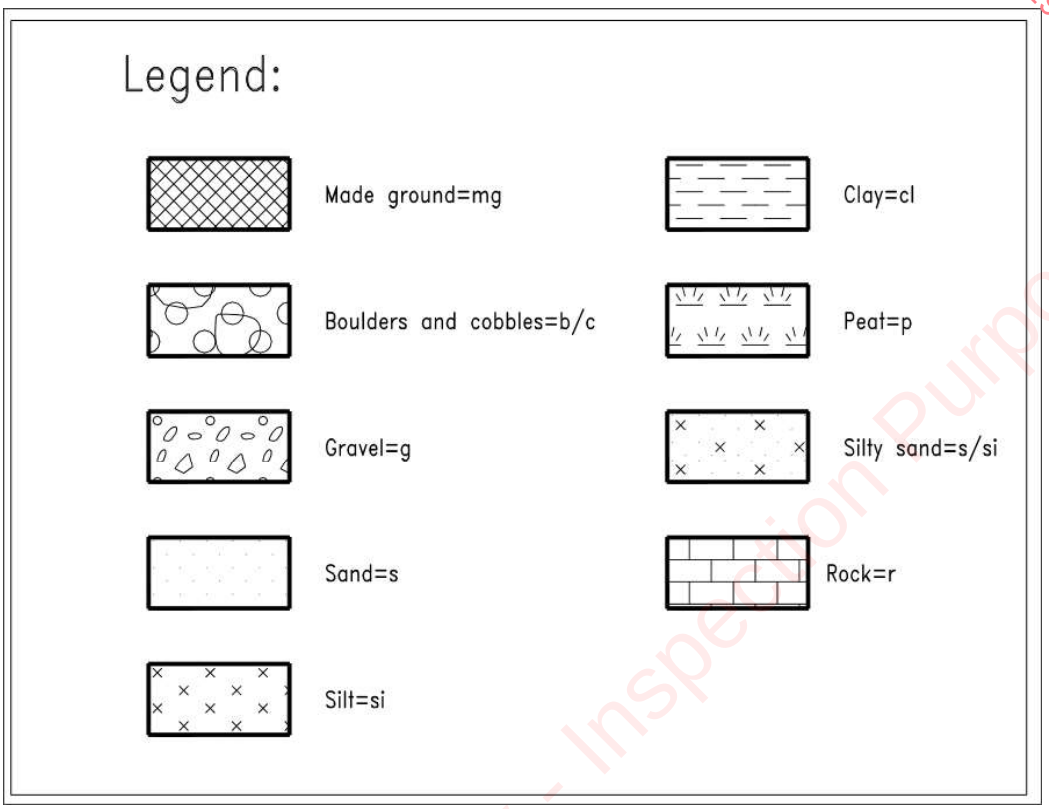
In-situ tests consisting of hand shear vane tests were also carried out where possible in cohesive soils.

The pits were excavated to depths ranging from 2.70m to 4.50m below ground level.

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The following Key Legend Table details the symbology used on the engineering logs to describe ground conditions encountered:



Ground conditions encountered during the completion of the fieldwork were typical and as expected for this region and predominantly consisted of Peat overlying Glacial Tills.

The Glacial Tills in general consisted of silty sands and gravels with cobbles and boulders and/or slightly gravelly sandy silt with cobbles and boulders.

Soft brown peat was also encountered in many of the trial pits at depths ranging from 0.45m to 2.70m below ground level.

For detailed descriptions of the ground conditions encountered please refer to the engineering logs included as Appendix 1 to this report.

The trial pit locations were set out on site using a Trimble CU Bluetooth GPS Surveying Unit and the co-ordinates are included on the logs presented in the appendices.

All fieldwork co-ordinates are reported to Irish Transverse Mercator (ITM) with Reduced Levels recorded relative to Malin Head Datum and with an accuracy level of + or – 0.10m.

The fieldwork was carried out in accordance with IS EN 1997-2 and BS5930, 2015 Code of Practice for Site Investigations with precedence given to IS EN 1997-2 where applicable.

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4.0 Laboratory Testing

Representative samples recovered from the trial pits were scheduled for testing in the laboratory.

The test schedules were prepared by the Client's Engineer and included some or all of the following tests on disturbed soil samples:

* Moisture Content.
* Atterberg Limits.
* Particle Size Distribution.
* Sedimentation.
* Chemical (pH and Sulphate).

The records of these laboratory tests are included as Appendix 3 of this factual report.

The soil descriptions as noted on the trial pit logs are in general visual descriptions as observed and logged by our Engineers and are described in accordance with IS EN 1997-2 and BS5930, 2015 Code of Practice for Site Investigations.

Soils descriptions (cohesive or otherwise) are also initially assessed based on the texture and 'feel' of the soil materials as witnessed by our Geotechnical Engineers and in accordance with IS EN 1997-2 and BS5930.

Where laboratory classification tests have been carried out on soil or rock samples then these visual descriptions have been amended accordingly to take into account the results of these classification tests.

The records of all fieldwork, laboratory test results and photographs are included in the appendices of this Factual Report.

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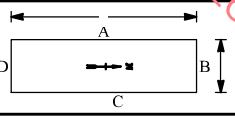
Ronan Killeen
Chartered Engineer
Irish Drilling Limited
May 23rd 2023

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Appendix 01
Trial Pit Records

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PROJECT: Keerglen Wind Farm	**TRIALPIT:** BP1TP01
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 507,404.3 N 832,738.8
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
Ground level: 136.37m O.D.	**Rev:**
GROUNDWATER Water strikes: 1st: dry 2nd: 3rd: Rose to after:	**DATE:** 5.4.23
PIT DIRECTION: 0° **PIT DIMENSION:** 4.50m * 1.20 **LOGGED BY:** DF	Shoring/Support: N/A Stability: Pit stable.



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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							135.92	0.45	Heather over firm brown fibrous PEAT. H2 B3 F3 R1 W1 TV0 TH0.	
							135.62	0.75	Firm yellowish brown SILT with rootlets.	
1			B 1 D 2	0.85-1.05 0.85-1.05					Stiff light greyish blue slightly gravelly SILT with occasional cobbles. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.	
									1.30m: with occasional boulders. Boulders are angular to rounded.	
									1.50m: becoming firm damp.	
2							133.57	2.80		
3			B 3 D 4	2.80-3.00 2.80-3.00					Brownish grey very silty SAND and GRAVEL with frequent cobbles. Gravel is subrounded to rounded fine to coarse. Cobbles are subrounded of limestone.	
									3.10m: with occasional boulders. Boulders are up to 500mm in length.	
4							131.87	4.50		
									END TP terminated at 4.50m bgl on REs instruction.	
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

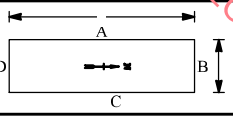
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** BP1TP02
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 507,497.9 N 832,749.6
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
Ground level: 136.60m O.D.	**Rev:**
GROUNDWATER Water strikes: 1st: dry 2nd: 3rd: Rose to after:	**DATE:** 5.4.23
PIT DIRECTION: 0° **PIT DIMENSION:** 4.60m * 1.20 **LOGGED BY:** DF	Shoring/Support: N/A Stability: Pit stable.



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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0										
							134.40	2.20	Heather over firm light brown fibrous PEAT. H2 B3 F3.	
2			B 1	2.30-2.50			134.00	2.60	Stiff bluish grey slightly sandy slightly gravelly SILT. Gravel is subangular to subrounded fine to coarse.	
			B 2	2.80-3.00			133.50	3.10	Soft wet grey sandy gravelly SILT with frequent cobbles and occasional boulders. Gravel is subangular to subrounded fine to coarse. Cobbles are angular to subrounded. Boulders are subangular. Boulders are up to 400mm in length.	
3			B 3	3.40-3.60			132.20	4.40	Soft greenish grey sandy gravelly SILT with frequent cobbles. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular.	
4									END	
									TP terminated at 4.40m bgl on REs instruction.	
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

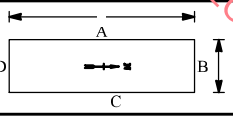
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** BP1TP03
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 507,471.1 N 832,830.6
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
Ground level: 138.38m O.D.	**Rev:**
GROUNDWATER Water strikes: 1st: dry Rose to after: 2nd: 3rd:	**DATE:** 5.4.23
PIT DIRECTION: 0° **PIT DIMENSION:** 4.40m * 1.20 **LOGGED BY:** DF	Shoring/Support: N/A Stability: Pit unstable. Sidewall collapse from 2.40m bgl.



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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							137.88	0.50	Heather over firm brown fibrous PEAT. H3 B3 F3 R0.	
							137.68	0.70	Firm yellowish brown sandy SILT.	
1							137.28	1.10	Firm yellowish brown sandy SILT.	
			B 1	1.10-1.30					Grey slightly gravelly silty fine SAND with occasional cobbles. Cobbles are angular.	
2							135.98	2.40		
			B 2	2.60-2.80					Dark grey gravelly coarse SAND with occasional cobbles. Gravel is subangular to rounded fine to coarse. Cobbles are subangular to subrounded.	
3							135.28	3.10		
									Firm greenish grey slightly sandy slightly gravelly SILT with frequent cobbles. Gravel is subangular to rounded fine to coarse. Cobbles are subrounded.	
4							133.98	4.40		
									END TP terminated at 4.40m bgl on REs instruction.	
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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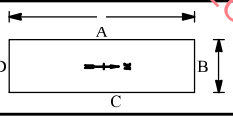
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** BP2TP01
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 507,328.0 N 832,909.5
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
	Rev:
Ground level: 153.22m O.D.	**DATE:** 5.4.23

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 0°
PIT DIMENSION: 4.60m * 1.30
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse.

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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0										
							152.57	0.65	Heather over spongy dark brownish black pseudo fibrous PEAT. H5.	
1							151.92	1.30	Firm dark brown slightly gravelly organic SILT with occasional cobbles. Gravel is subangular fine to coarse. Cobbles are subangular to subrounded.	
			B 1 B 2	1.30-1.50 1.30-1.50					Firm light grey SILT.	
2										
3							150.02	3.20		
			B 3	3.40-3.60					Wet grey slightly silty gravelly fine to medium SAND with occasional cobbles. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded. Sand flowing into TP.	
4							148.92	4.30		
						END			TP terminated at 4.30m bgl. Unable to progress TP - wet sand flowing into TP.	
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

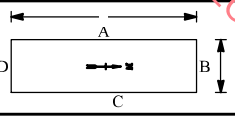
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** BP2TP02
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 507,315.6 N 832,972.4
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
Ground level: 157.43m O.D.	**Rev:**
GROUNDWATER	**DATE:** 5.4.23
Water strikes: Rose to after:	**PIT DIRECTION:** 0°
1st: dry	**PIT DIMENSION:** 4.70m * 1.20
2nd:	**LOGGED BY:** DF
3rd:	Shoring/Support: N/A
	Stability: Pit stable.



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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							157.13	0.30	Heather over firm brown fibrous PEAT. H2.	
							156.63	0.80	Soft mottled brown SILT.	
1			B 1	0.90-1.10					Yellowish brown slightly silty fine SAND.	
2			B 2	2.10-2.30			154.73	2.70	2.10-2.30m: brown fine sandy SILT.	
3									Wet bluish grey sandy gravelly SILT locally very gravelly with frequent cobbles. Cobbles are subrounded.	
4			B 3	4.00-4.20			152.93	4.50		
									END TP terminated at 4.50m bgl on REs instruction.	
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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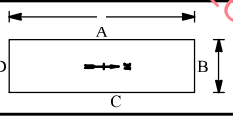
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** BP2TP03
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 507,402.4 N 832,977.2
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
	Rev:
Ground level: 151.35m O.D.	**DATE:** 5.4.23

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 0°
PIT DIMENSION: 4.50m * 1.20
LOGGED BY: DF



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0									Heather over spongy brownish black pseudo fibrous PEAT. H6 B1 F2 R1 W1 TV0 TH0.	
							150.30	1.05		
1			B 1	1.10-1.30					Light brownish grey silty fine SAND locally very sandy.	
							149.55	1.80		
2			B 2 D 3	2.00-2.20 2.00-2.20					Soft damp light grey slightly gravelly sandy SILT with frequent cobbles. Gravel is subrounded fine to coarse. Cobbles are subrounded.	
3							147.65	3.70		
4			B 4	4.00-4.20					Bluish grey slightly clayey sandy subangular to subrounded fine to coarse GRAVEL with frequent cobbles. Cobbles are subangular to subrounded.	
							146.85	4.50		
									END TP terminated at 4.50m bgl on REs instruction.	
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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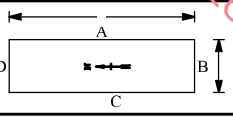
PROJECT: Keerglen Wind Farm
LOCATION: Co Mayo
TRIALPIT: WTG01
Sheet 1 of 1

CLIENT: ABO Wind Ireland
ENGINEER: FTCO
Co-ordinates: E 505,565.1 N 832,359.1
Rig: Zaxis 130 LCN
Rev:

Ground level: 160.31m O.D.
DATE: 4.4.23

GROUNDWATER
Water strikes: **Rose to after:**
1st: 2.80m 20min 2.70m
2nd:
3rd:

PIT DIRECTION: 180°
PIT DIMENSION: 4.00m * 1.20
LOGGED BY: PC



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse from g/l to 2.50m bgl and 2.80m to 3.40m bgl.

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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0									Moss and heather over spongy dark orangish brown pseudo fibrous PEAT. H6 F2 R1 TV0 TH0.	
			VANE	0.50	13 kN/m² 19mm vane					
1			B 1	1.00-1.10	10 kN/m² 19mm vane 11 kN/m² 19mm vane					
2			B 2	2.40-2.50			157.81	2.50		
		1					157.51	2.80	Stiff light brownish grey slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of psammite.	
			B 3	2.80-2.90			157.41	2.90	Firm dark grey slightly gravelly sandy SILT with occasional cobbles. Sand is fine to coarse. Cobbles are subangular to rounded of psammite.	
3							156.91	3.40	Light grey slightly sandy silty subangular to rounded fine to coarse psammite GRAVEL with occasional cobbles. Sand is fine to coarse. Cobbles are subangular to rounded of psammite.	
									END	
									TP terminated at 3.40m bgl. Unable to keep TP open - sidewall collapse.	
4										
5										
6										
7										
8										
9										
10										

Remarks: Ingress of water at 2.80m bgl. TP backfilled with arisings.

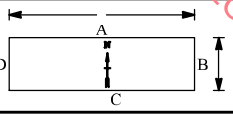
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** WTG02
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 505,470.0 N 831,909.6
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
Ground level: 167.88m O.D.	**Rev:**
GROUNDWATER Water strikes: 1st: 2.70m Rose to after: 20min 2.40m 2nd: 3rd:	**PIT DIRECTION:** 90° **PIT DIMENSION:** 4.00m * 1.20 **LOGGED BY:** PC
	DATE: 4.4.23
	Shoring/Support: N/A Stability: Pit unstable. Sidewall collapse from g/l to 2.70m bgl.



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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0			VANE	0.50	10 kN/m² 19mm vane 11 kN/m² 19mm vane 10 kN/m² 19mm vane				Moss and heather over spongy dark orangish brown pseudo fibrous PEAT. H4 B2 F2 R2 W1 TV0 TH0 A1.	
1		1								
2			B 1 D 2	2.70-2.80 2.70-2.80			165.18	2.70		
3			B 3	3.50-3.60			164.28	3.60	Very soft damp grey slightly sandy gravelly SILT with occasional cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of psammite. Cobbles are subangular to rounded of psammite.	
4						END			TP terminated at 3.60m bgl. Unable to keep TP open - sidewall collapse.	
5										
6										
7										
8										
9										
10										

Remarks: Ingress of water at 2.70m bgl. TP backfilled with arisings.

Scale: 1:50

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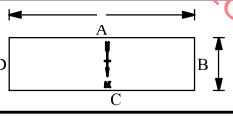
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TRIALPIT KEERGLEN TPS FILE 1 APRIL 14 2023.GPJ ID GINT AGS 4_0_4.GDT 23/5/23

PROJECT: Keerglen Wind Farm	**TRIALPIT:** WTG03
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 505,827.3 N 831,743.4
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
	Rev:
Ground level: 186.52m O.D.	**DATE:** 4.4.23

GROUNDWATER
Water strikes: **Rose to after:**
1st: 2.50m 20min 2.45m
2nd:
3rd:

PIT DIRECTION: 270°
PIT DIMENSION: 4.00m * 1.20
LOGGED BY: PC



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse from g/l.

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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0			VANE B 1	0.50 0.50-0.60	11 kN/m² 19mm vane 10 kN/m² 19mm vane				Moss and heather over spongy dark brown pseudo fibrous PEAT. H5 B2 F2 R1 W0 TV0 TH0 A1.	
1			B 2	1.50-1.60			185.02	1.50		
							184.52	2.00	Very stiff greyish brown slightly sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of quartz and psammite.	
2		1							Bluish grey slightly sandy silty subangular to rounded fine to coarse quartz and psammite GRAVEL with occasional cobbles. Sand is fine to coarse. Cobbles are subangular to rounded of psammite.	
3			B 3	2.90-3.00			183.52	3.00	2.90-3.00m; grey very gravelly very silty SAND.	
						END			TP terminated at 3.00m bgl. Unable to keep TP open - sidewall collapse.	
4										
5										
6										
7										
8										
9										
10										

Remarks: Ingress of water at 2.50m bgl. TP backfilled with arisings.

Scale: 1:50

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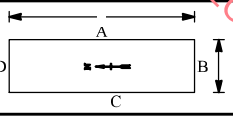
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** WTG04
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 505,920.0 N 832,214.2
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
	Rev:
Ground level: 161.18m O.D.	**DATE:** 4.4.23

GROUNDWATER

Water strikes:		Rose to after:	
1st:	0.50m	20min	0.60m
2nd:	1.30m	20min	1.10m
3rd:	2.00m	20min	1.50m

PIT DIRECTION: 180°
PIT DIMENSION: 4.00m * 1.20
LOGGED BY: PC



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse from g/l to 2.00m bgl and 2.00m to 3.00m bgl.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0										
		1	VANE	0.50	9 kN/m² 19mm vane 13 kN/m² 19mm vane 12 kN/m² 19mm vane		159.88	1.30	Moss and heather over spongy dark brown pseudo fibrous PEAT. H6 B2 F1 R0 W0 TV0 TH0 A1.	
1		2								
		3	B 1	1.30-1.40			159.38	1.80	Stiff brownish grey slightly sandy gravelly SILT with occasional cobbles. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of psammite. Cobbles are of psammite.	
		3	B 2	1.80-1.90			158.18	3.00	Grey gravelly silty fine to coarse SAND with occasional cobbles. Gravel is subangular to rounded fine to coarse of psammite. Cobbles are subrounded to rounded of psammite.	
2										
3			B 3	3.40-3.50			157.68	3.50	Very soft damp grey slightly sandy gravelly SILT with occasional cobbles and occasional boulders. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse. Cobbles are subrounded to rounded. Boulders are subrounded to rounded. Boulders are up to 400mm in length.	
									END	
									TP terminated at 3.50m bgl. Unable to keep TP open - sidewall collapse.	
4										
5										
6										
7										
8										
9										
10										

Remarks: Ingress of water at 0.50m bgl. Ingress of water at 1.30m bgl. Ingress of water at 3.40m bgl. TP backfilled with arisings.

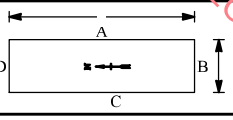
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** WTG05
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 506,383.2 N 832,270.6
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
Ground level: 151.18m O.D.	**Rev:**
GROUNDWATER	**DATE:** 4.4.23
Water strikes: Rose to after:	**PIT DIRECTION:** 180°
1st: dry	**PIT DIMENSION:** 4.00m * 1.20
2nd:	**LOGGED BY:** PC
3rd:	Shoring/Support: N/A
	Stability: Pit unstable. Sidewall collapse from g/l to 2.10m bgl.



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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0			VANE	0.50	10 kN/m² 19mm vane 11 kN/m² 19mm vane				Moss and heather over spongy dark orangish brown pseudo fibrous PEAT. H6 B2 F1 R1 W1 TV0 TH0 A1.	
2			B 1 D 2	2.10-2.20 2.10-2.20			149.08	2.10	Soft damp bluish grey slightly sandy gravelly SILT with occasional cobbles and rare boulders. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of psammite. Cobbles are subangular to rounded of psammite. Boulders are subrounded to rounded of psammite. Boulders are up to 450mm in length.	
4			B 3 D 4	3.60-3.70 3.60-3.70			146.68	4.50	END	
									TP terminated at 4.50m bgl on REs instruction.	

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

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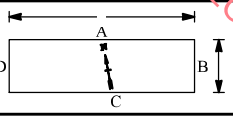
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TRIALPIT KEERGLEN TPS FILE 1 APRIL 14 2023.GPJ ID GINT AGS 4_0_4.GDT 23/5/23

PROJECT: Keerglen Wind Farm	**TRIALPIT:** WTG06
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 506,343.8 N 831,817.2
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
	Rev:
Ground level: 168.31m O.D.	**DATE:** 4.4.23

GROUNDWATER
Water strikes: **Rose to after:**
1st: dry
2nd:
3rd:

PIT DIRECTION: 100°
PIT DIMENSION: 4.00m * 1.20
LOGGED BY: PC



Shoring/Support: N/A
Stability: Pit unstable. Sidewall collapse from g/l.

Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0			VANE	0.50	10 kN/m² 19mm vane 9 kN/m² 19mm vane 11 kN/m² 19mm vane		165.71	2.60	Cotton grass over spongy dark orangish brown pseudo fibrous PEAT. H5 B2 F2 R2 W0 TV0 TH0 A1.	
						END	165.61	2.70	Firm brownish grey slightly gravelly SILT. Visual inspection before TP collapsed. TP terminated at 2.70m bgl. Unable to keep TP open - sidewall collapse.	

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

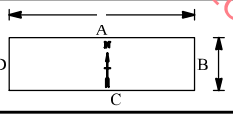
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** WTG07
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 506,978.1 N 831,969.3
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
Ground level: 159.98m O.D.	**Rev:**
GROUNDWATER	**DATE:** 4.4.23
Water strikes: Rose to after:	**PIT DIRECTION:** 90°
1st: dry	**PIT DIMENSION:** 4.00m * 1.20
2nd:	**LOGGED BY:** PC
3rd:	Shoring/Support: N/A
	Stability: Pit unstable. Sidewall collapse.



Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0			VANE	0.50	14 kN/m² 19mm vane 12 kN/m² 19mm vane 11 kN/m² 19mm vane				Cotton grass over spongy dark orangish brown pseudo fibrous PEAT. H5 B2 F1 R1 W0 TV0 TH0 A1.	
							158.08	1.90		
2			B 1	2.00-2.10					Stiff brownish grey slightly gravelly sandy SILT with some organic material. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of psammite.	
							157.48	2.50		
3			B 2 D 3	2.80-2.90 2.80-2.90					Soft damp light blue slightly sandy gravelly SILT with rare cobbles. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of psammite. Cobbles are subrounded to rounded of psammite.	
4							155.48	4.50		
						END			TP terminated at 4.50m bgl on REs instruction.	
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

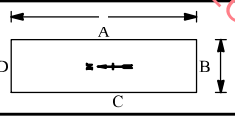
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PROJECT: Keerglen Wind Farm	**TRIALPIT:** WTG08
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 507,325.2 N 832,403.8
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
Ground level: 133.71m O.D.	**Rev:**
GROUNDWATER	**DATE:** 4.4.23
Water strikes: **Rose to after:**	**PIT DIRECTION:** 180°
1st: dry	**PIT DIMENSION:** 4.00m * 1.20
2nd:	**LOGGED BY:** PC
3rd:	Shoring/Support: N/A
	Stability: Pit stable.



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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0			VANE	0.50	15 kN/m² 19mm vane		133.01	0.70	Moss and heather over spongy dark orangish brown pseudo fibrous PEAT. H5 F1 R1 W0 TV1 TH1 A0.	
			B 1	0.70-0.80	13 kN/m² 19mm vane					
1					14 kN/m² 19mm vane		131.91	1.80	Stiff greyish brown slightly sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of psammite and quartzite.	
2			B 2	2.60-2.70			130.81	2.90	Greyish brown gravelly silty fine to coarse SAND with rare cobbles. Gravel is subangular to rounded fine to coarse of quartzite and psammite. Cobbles are subrounded to rounded of quartzite and psammite. 2.60-2.70m: light greyish brown slightly gravelly sandy silt.	
3									Firm bluish grey slightly sandy gravelly SILT with occasional cobbles and rare boulders. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of quartzite and psammite. Cobbles are subrounded to rounded of quartzite and psammite. Boulders are subrounded to rounded of quartzite and psammite. Boulders are up to 1000mm in length.	
4			B 3	4.40-4.50			129.21	4.50		
			D 4	4.40-4.50		END			TP terminated at 4.50m bgl on REs instruction.	
5										
6										
7										
8										
9										
10										

Remarks: TP dry on excavation. TP backfilled with arisings.

Scale: 1:50

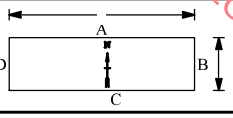
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TRIALPIT KEERGLEN TPS FILE 1 APRIL 14 2023.GPJ ID GINT AGS 4_0_4.GDT 23/5/23

PROJECT: Keerglen Wind Farm	**TRIALPIT:** WTG09
LOCATION: Co Mayo	**Sheet** 1 of 1
CLIENT: ABO Wind Ireland	**Co-ordinates:** E 507,349.1 N 832,834.0
ENGINEER: FTCO	**Rig:** Zaxis 130 LCN
Ground level: 142.82m O.D.	**Rev:**
GROUNDWATER	**DATE:** 5.4.23
Water strikes: Rose to after:	**PIT DIRECTION:** 90°
1st: dry	**PIT DIMENSION:** 4.70m * 1.20
2nd:	**LOGGED BY:** DF
3rd:	Shoring/Support: N/A
	Stability: Pit unstable. Sidewall collapse.



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Depth (m)	Date	Water	Samples	Depth (m)	SPT (N) / In Situ Vane Tests	LEGEND	Elevation m O.D.	Depth (m)	DESCRIPTION	Instrument/ Backfill
0							142.57	0.25	Heather over firm brown fibrous PEAT.	
							142.37	0.45	Stiff yellowish brown sandy SILT.	
1			B 1 D 2	0.90-1.10 0.90-1.10			141.42	1.40	Soft damp bluish grey sandy gravelly SILT with occasional large boulders. Gravel is angular to rounded fine to coarse.	
							141.22	1.60	Grey silty fine SAND.	
2									Firm bluish grey slightly sandy slightly gravelly SILT with frequent cobbles. Cobbles are subrounded.	
3			B 3	2.80-3.00					3.00m: with occasional 100mm thick lenses of coarse sand.	
4							138.42	4.40		
						END			TP terminated at 4.40m bgl on REs instruction.	
5										
6										
7										
8										
9										
10										

Remarks: Rapid ingress of water at 3.75m bgl. TP backfilled with arisings.

Scale: 1:50

Irish drilling LTD

Ph.
Fax

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TRIALPIT KEERGLEN TPS FILE 1 APRIL 14 2023.GPJ ID GINT AGS 4_0_4.GDT 23/5/23

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Appendix 8.1 (Volume 3 of 4)

Geotechnical and Peat Stability Report

Keerglen Wind Farm

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Appendix 02
Trial Pit Photographs

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Figure 1 H:\23MO105_Keerglen \Bp1_tp01...jpg



Figure 3 H:\23MO105_Keerglen \Bp1_tp01.jpg



Figure 2 H:\23MO105_Keerglen \Bp1_tp01..jpg



Figure 4 H:\23MO105_Keerglen \Bp1_tp02...jpg



Figure 5 H:\23MO105_Keerglen \Bp1_tp02..jpg



Figure 7 H:\23MO105_Keerglen \Bp1_tp03...jpg



Figure 6 H:\23MO105_Keerglen \Bp1_tp02.jpg



Figure 8 H:\23MO105_Keerglen \Bp1_tp03..jpg



Figure 9 H:\23MO105_Keerglen \Bp1_tp03.jpg



Figure 11 H:\23MO105_Keerglen \Bp2_tp01...jpg



Figure 10 H:\23MO105_Keerglen \Bp2_ tp03...jpg



Figure 12 H:\23MO105_Keerglen \Bp2_tp01..jpg



Figure 13 H:\23MO105_Keerglen \Bp2_tp01.jpg



Figure 15 H:\23MO105_Keerglen \Bp2_tp02..jpg



Figure 14 H:\23MO105_Keerglen \Bp2_tp02...jpg



Figure 16 H:\23MO105_Keerglen \Bp2_tp03..jpg



Figure 17 H:\23MO105_Keerglen \Bp2_tp03.jpg



Figure 19 H:\23MO105_Keerglen \Wtg9...jpg



Figure 18 H:\23MO105_Keerglen \Bp2_tp2.jpg



Figure 20 H:\23MO105_Keerglen\ Wtg9..jpg



Figure 21 H:\23MO105_Keerglen\ Wtg9.jpg



Figuur 1
H:\23MO105_Keerglen\keerglen\WTG1\Keerglen_WTG01 (1).jpg



Figuur 2
H:\23MO105_Keerglen\keerglen\WTG1\Keerglen_WTG01 (2).jpg

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Figuur 3
H:\23MO105_Keerglen\keerglen\WTG1\Keerglen_WTG01 (3).jpg


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Figuur 5
H:\23MO105_Keerglen\keerglen\WTG2\Keerglen_WTG02 (1).jpg



Figuur 4
H:\23MO105_Keerglen\keerglen\WTG1\Keerglen_WTG01 (4).jpg



Figuur 6
H:\23MO105_Keerglen\keerglen\WTG2\Keerglen_WTG02 (2).jpg



Figuur 7
H:\23MO105_Keerglen\keerglen\WTG2\Keerglen_WTG02 (3).jpg


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Figuur 9
H:\23MO105_Keerglen\keerglen\WTG3\Keerglen_WTG03 (1).jpg



Figuur 8
H:\23MO105_Keerglen\keerglen\WTG2\Keerglen_WTG02 (4).jpg



Figuur 10
H:\23MO105_Keerglen\keerglen\WTG3\Keerglen_WTG03 (2).jpg



Figuur 11
H:\23MO105_Keerglen\keerglen\WTG3\Keerglen_WTG03 (3).jpg


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Figuur 13
H:\23MO105_Keerglen\keerglen\WTG4\Keerglen_WTG04 (1).jpg



Figuur 12
H:\23MO105_Keerglen\keerglen\WTG3\Keerglen_WTG03 (4).jpg



Figuur 14
H:\23MO105_Keerglen\keerglen\WTG4\Keerglen_WTG04 (2).jpg



Figuur 15
H:\23MO105_Keerglen\keerglen\WTG4\Keerglen_WTG04 (3).jpg



Figuur 17
H:\23MO105_Keerglen\keerglen\WTG5\Keerglen_WTG05 (1).jpg



Figuur 16
H:\23MO105_Keerglen\keerglen\WTG4\Keerglen_WTG04 (4).jpg



Figuur 18
H:\23MO105_Keerglen\keerglen\WTG5\Keerglen_WTG05 (2).jpg

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Figuur 19
H:\23MO105_Keerglen\keerglen\WTG5\Keerglen_WTG05 (3).jpg



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Figuur 21
H:\23MO105_Keerglen\keerglen\WTG6\Keerglen_WTG06 (1).jpg



Figuur 20
H:\23MO105_Keerglen\keerglen\WTG5\Keerglen_WTG05 (4).jpg



Figuur 22
H:\23MO105_Keerglen\keerglen\WTG6\Keerglen_WTG06 (2).jpg



Figuur 23
H:\23MO105_Keerglen\keerglen\WTG6\Keerglen_WTG06 (3).jpg



Figuur 25
H:\23MO105_Keerglen\keerglen\WTG7\Keerglen_WTG07 (1).jpg



Figuur 24
H:\23MO105_Keerglen\keerglen\WTG6\Keerglen_WTG06 (4).jpg



Figuur 26
H:\23MO105_Keerglen\keerglen\WTG7\Keerglen_WTG07 (2).jpg

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Figuur 27
H:\23MO105_Keerglen\keerglen\WTG7\Keerglen_WTG07 (3).jpg



Figuur 29
H:\23MO105_Keerglen\keerglen\WTG8\Keerglen_WTG08 (1).jpg



Figuur 28
H:\23MO105_Keerglen\keerglen\WTG7\Keerglen_WTG07 (4).jpg



Figuur 30
H:\23MO105_Keerglen\keerglen\WTG8\Keerglen_WTG08 (2).jpg

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Figuur 31
H:\23MO105_Keerglen\keerglen\WTG8\Keerglen_WTG08 (3).jpg



Figuur 32
H:\23MO105_Keerglen\keerglen\WTG8\Keerglen_WTG08 (4).jpg

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Appendix 03
Laboratory Test Results

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Project ID	**2023MO105**		Client	ABO Wind Ireland	Remarks	Turna
Project Name	**Keerglen Wind Farm**		Due Date	17/04/2023 11:10		
Schedule ID	2023MO105_1		Scheduled Date	17/04/2023 11:10		

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Sample Details							Classification						Chemical / Concrete								Compaction					Compressibility			Strength (Total)						Shear Stregth (Effective Stress)			Rock		Other / notes	
Location	Depth (m)	Base Depth	Sample Type	Sample Ref	Date Sampled	Storage	Moisture Content	Atterberg 4 Point	Particle Density by Gas Jar	Particle Density by Small Pyknometer	Particle Size Distribution	Hydrometer	Organic Content	Loss On Ignition	Sulphate Total	Sulphate Water Gravimetric	Carbonate Titration	ph	Chloride Content	Chloride Content Acid	Compaction Light	Compaction Heavy	Compaction Vibrating Hammer	Moisture Condition Value	Moisture Condition Relationship	CBR	Consolidation	Pressures	Swelling Pressure Test	Laboratory Vane test	Small Direct Shearbox	Ring shear Test	Triaxial Quick Undrained	(Specify Cell Pressure)	Triaxial UU Multi Stage	Triaxial UU Multi Specimen	Consolidated Drained Triaxial Test	Consolidated Undrained Triaxial Test	Consolidated Undrained Triaxial Multis	Rock Uniaxial compression	Point Load	als job ref:	
BP1TP01	0.85	1.05	B	1	05/04/23																																				
BP1TP01	0.85	1.05	D	2	05/04/23																																				
BP1TP01	2.80	3.00	B	3	05/04/23						1	1																													
BP1TP01	2.80	3.00	D	4	05/04/23		1	1																																
BP1TP02	2.30	2.50	B	1	05/04/23																																				
BP1TP02	2.80	3.00	B	2	05/04/23																																				
BP1TP02	3.40	3.60	B	3	05/04/23																																				
BP1TP03	1.10	1.30	B	1	05/04/23																																				
BP1TP03	2.60	2.80	B	2	05/04/23																																				
BP2TP01	1.30	1.50	B	1	05/04/23																																				
BP2TP01	1.30	1.50	B	2	05/04/23																																				
BP2TP01	3.40	3.60	B	3	05/04/23		1				1																														
BP2TP02	0.90	1.10	B	1	05/04/23																																				
BP2TP02	2.10	2.30	B	2	05/04/23		1				1																														
BP2TP02	4.00	4.20	B	3	05/04/23																																				
BP2TP03	1.10	1.30	B	1	05/04/23																																				
BP2TP03	2.00	2.20	B	2	05/04/23																																				
BP2TP03	2.00	2.20	D	3	05/04/23																																				
BP2TP03	4.00	4.20	B	4	05/04/23																																				
WTG01	1.00	1.10	B	1	04/04/23																																				
WTG01	2.40	2.50	B	2	04/04/23								1		1	1		1																							ALS 230502-29	
WTG01	2.80	2.90	B	3	04/04/23		1				1																														
WTG02	2.70	2.80	B	1	04/04/23						1	1																													
WTG02	2.70	2.80	D	2	04/04/23		1	1																																
WTG02	3.50	3.60	B	3	04/04/23										1	1		1																							ALS 230502-29	
WTG03	0.50	0.60	B	1	04/04/23																																				
WTG03	1.50	1.60	B	2	04/04/23																																				
WTG03	2.90	3.00	B	3	04/04/23		1				1																														
WTG04	1.30	1.40	B	1	04/04/23																																				
WTG04	1.80	1.90	B	2	04/04/23		1				1																														
WTG04	3.40	3.50	B	3	04/04/23																																				
WTG05	2.10	2.20	B	1	04/04/23						1	1																													

0 = test scheduled,
1 = test completed as scheduled,
0* = sample not suitable for scheduled test

Project ID	**2023MO105**	Client	ABO Wind Ireland	Remarks	
Project Name	**Keerglen Wind Farm**	Due Date	17/04/2023 11:10		
Schedule ID	2023MO105_1	Scheduled Date	17/04/2023 11:10		

Sample Details							Classification						Chemical / Concrete								Compaction					Compressibility			Strength (Total)							Shear Stregth (Effective Stress)			Rock		Other / notes	
Location	Depth (m)	Base Depth	Sample Type	Sample Ref	Date Sampled	Storage	Moisture Content	Atterberg 4 Point	Particle Density by Gas Jar	Particle Density by Small Pyknometer	Particle Size Distribution	Hydrometer	Organic Content	Loss On Ignition	Sulphate Total	Sulphate Water Gravimetric	Carbonate Titration	ph	Chloride Content	Chloride Content Acid	Compaction Light	Compaction Heavy	Compaction Vibrating Hammer	Moisture Condition Value	Moisture Condition Relationship	CBR	Consolidation	Pressures	Swelling Pressure Test	Laboratory Vane test	Small Direct Shearbox	Ring shear Test	Triaxial Quick Undrained	(Specify Cell Pressure)	Triaxial UU Multi Stage	Triaxial UU Multi Specimen	Consolidated Drained Triaxial Test	Consolidated Undrained Triaxial Test	Consolidated Undrained Triaxial Multis	Rock Uniaxial compression	Point Load	als job ref:	
WTG05	2.10	2.20	D	2	04/04/23		1	1																																	
WTG05	3.60	3.70	B	3	04/04/23						1	1			1	1		1																						ALS 230502-29		
WTG05	3.60	3.70	D	4	04/04/23		1	1																																	
WTG07	2.00	2.10	B	1	04/04/23																																				
WTG07	2.80	2.90	B	2	04/04/23																																				
WTG07	2.80	2.90	D	3	04/04/23																																				
WTG08	0.70	0.80	B	1	04/04/23																																				
WTG08	2.60	2.70	B	2	04/04/23		1				1																														
WTG08	4.40	4.50	B	3	04/04/23										1	1		1																						ALS 230502-29		
WTG08	4.40	4.50	D	4	04/04/23																																				
WTG09	0.90	1.10	B	1	05/04/23																																				
WTG09	0.90	1.10	D	2	05/04/23																																				
WTG09	2.80	3.00	B	3	05/04/23		1	1			1	1																													
Scheduled							11	5	0	0	11	5	1	0	4	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Completed					17/05/23		11	5	0	0	11	5	1	0	4	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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0 = test scheduled,
1 = test completed as scheduled,
0* = sample not suitable for scheduled test

Summary of Classification Test Results

Project No.: 2023MO105

Project Name: Keerglen Wind Farm

Hole No.	Sample Ref	Top	Base	Type		Soil Description	Density bulk / dry Mg/m3		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Remarks
BP1TP01	4	2.80	3.00	D		Dark brownish-grey very silty SAND and GRAVEL.			12.0	63	20	13	7		CL
BP2TP01	3	3.40	3.60	B		Dark gravelly silty medium SAND.			17.0	57					
BP2TP02	2	2.10	2.30	B		Golden brown fine sandy SILT.			23.0	100					
WTG01	3	2.80	2.90	B		Dark grey slightly gravelly sandy SILT. Sand is fine and medium.			19.0	73					
WTG02	2	2.70	2.80	D		Dark greenish-grey slightly gravelly sandy SILT.			25.0	79	29	20	9		CL
WTG03	3	2.90	3.00	B		Grey very gravelly very silty SAND.			19.0	60					
WTG04	2	1.80	1.90	B		Dark greyish-brown silty GRAVEL and SAND.			14.0	48					
WTG05	2	2.10	2.20	D		Dark grey slightly gravelly sandy SILT. Sand is medium.			23.0	75	26	17	9		CL
WTG05	4	3.60	3.70	D		Dark bluish-grey slightly gravelly sandy SILT.			12.0	60	22	12	10		CL
WTG08	2	2.60	2.70	B		Light greyish-brown slightly gravelly sandy SILT.			13.0	68					
WTG09	3	2.80	3.00	B		Dark grey very gravelly very silty SAND.			11.0	59	19	13	6		ML

All tests performed in accordance with BS1377:1990 unless specified otherwise

Key: w = water content, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index

Density test: Linear measurement unless : wd - water displacement; wi - immersion in water

Liquid Limit: 4pt cone unless : 1pt - single point test; NP - Non Plastic

Particle density: sp - small pyknometer; gj - gas jar

Date Printed: 17/05/2023

QC From No: R1

Approved By: DCS

Table 1 sheet 1

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

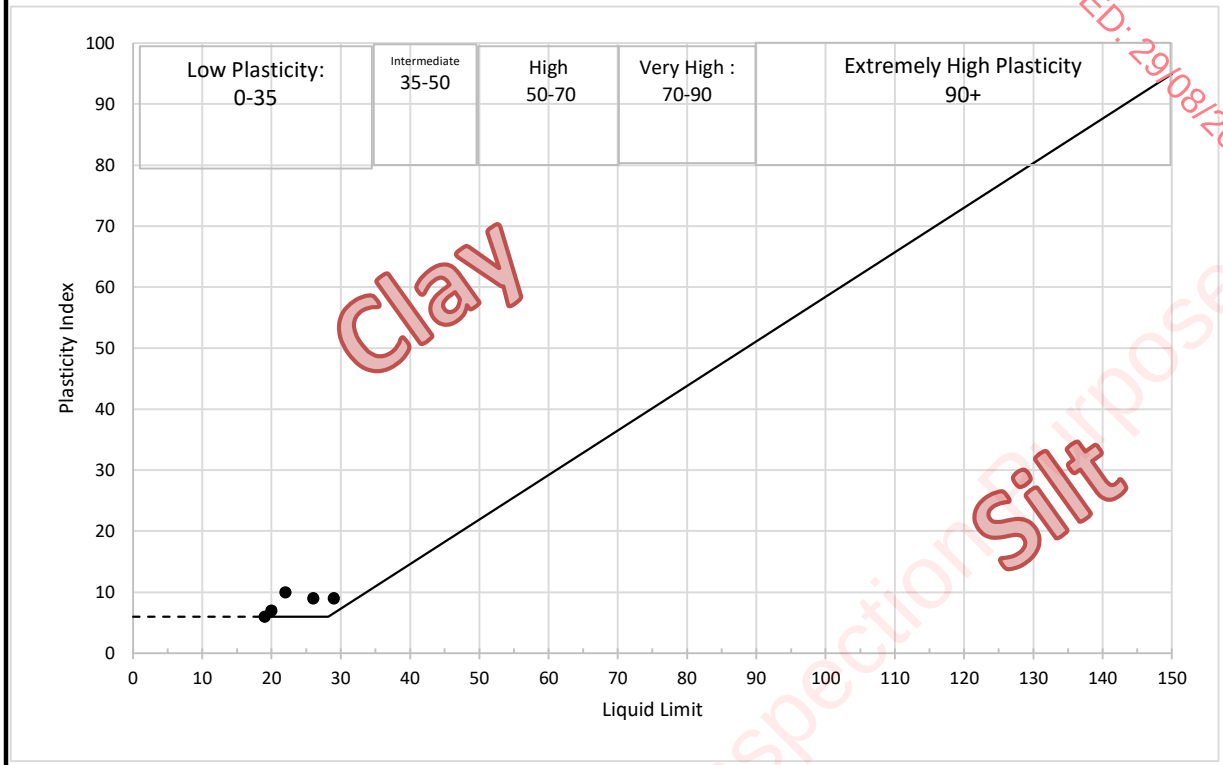
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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	Plasticity (A-Line) Chart	Project Number
Project Name:	**Keerglen Wind Farm**	
Location:		2023MO105

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Abreviations in the remarks column of the Classification Summary Sheet: C = Clay, M = Silt

Plasticity abeviations: L = Low, I = Intermediate = H = High, V = Very High, E = Extremely High.

The letter O is added to the symbol of any material containing a significant proportion of organic material.

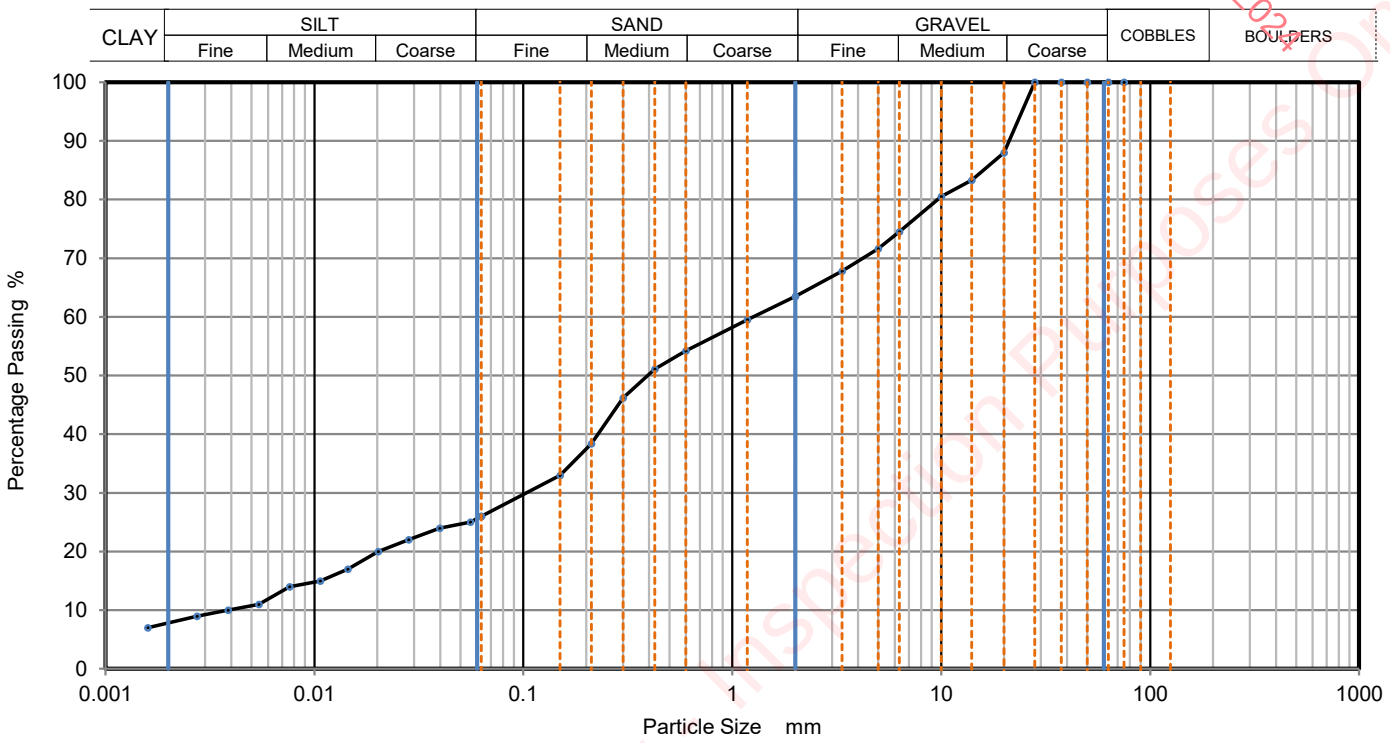
Chart taken from BS5930: 2010

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QC Form: R1

IRISH DRILLING LIMITED	**PARTICLE SIZE DISTRIBUTION**	Job Ref	**2023MO105**
		Borehole/Pit No.	BP1TP01
Site Name	Keerglen Wind Farm	Sample No.	3
Soil Description	Dark brownish-grey very silty SAND and GRAVEL.	Depth, m	2.80
Specimen Reference	Specimen Depth m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	IDL12023041718

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0630	26
		0.0558	25
75	100	0.0397	24
63	100	0.0283	22
50	100	0.0202	20
37.5	100	0.0145	17
28	100	0.0107	15
20	88	0.0076	14
14	83	0.0054	11
10	81	0.0039	10
6.3	75	0.0027	9
5	72	0.0016	7
3.35	68		
2	64		
1.18	60		
0.6	54	Particle density (assumed)	
0.425	51	2.65 Mg/m3	
0.3	46		
0.212	38		
0.15	33		
0.063	26		

Dry Mass of sample, g	861

Sample Proportions	% dry mass
Very coarse	0
Gravel	37
Sand	38
Silt	18
Clay	8

Grading Analysis		
D100	mm	
D60	mm	1.26
D30	mm	0.104
D10	mm	0.00396
Uniformity Coefficient		320
Curvature Coefficient		2.2

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	17/05/2023 12:07	1
				QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

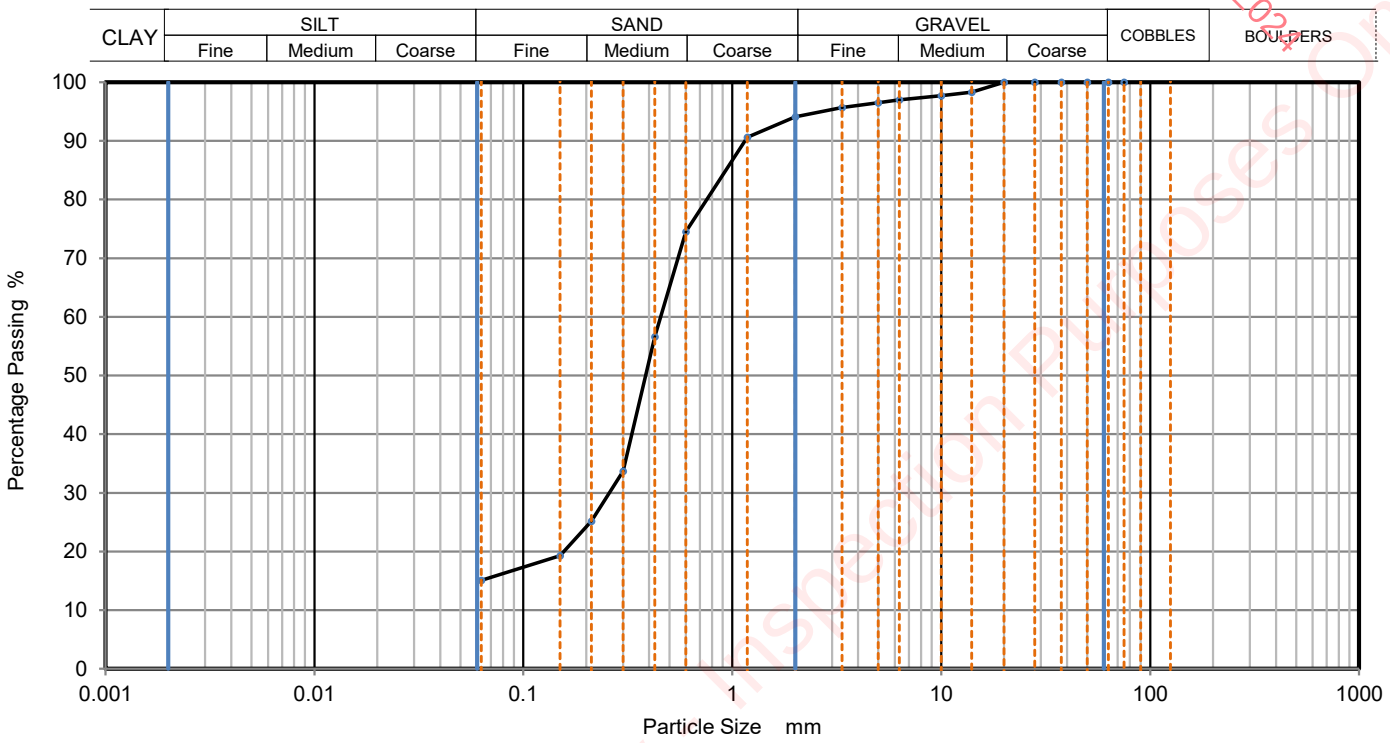
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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PARTICLE SIZE DISTRIBUTION

				Job Ref	**2023MO105**
				Borehole/Pit No.	BP2TP01
Site Name	Keerglen Wind Farm			Sample No.	3
Soil Description	Dark gravelly silty medium SAND.			Depth, m	3.40
Specimen Reference		Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	IDL12023041727

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	98		
10	98		
6.3	97		
5	97		
3.35	96		
2	94		
1.18	91		
0.6	75		
0.425	57		
0.3	34		
0.212	25		
0.15	19		
0.063	15		

Dry Mass of sample, g	940

Sample Proportions	% dry mass
Very coarse	0
Gravel	6
Sand	79
Fines <0.063mm	15

Grading Analysis		
D100	mm	
D60	mm	0.454
D30	mm	0.258
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	17/05/2023 12:07	1
				QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

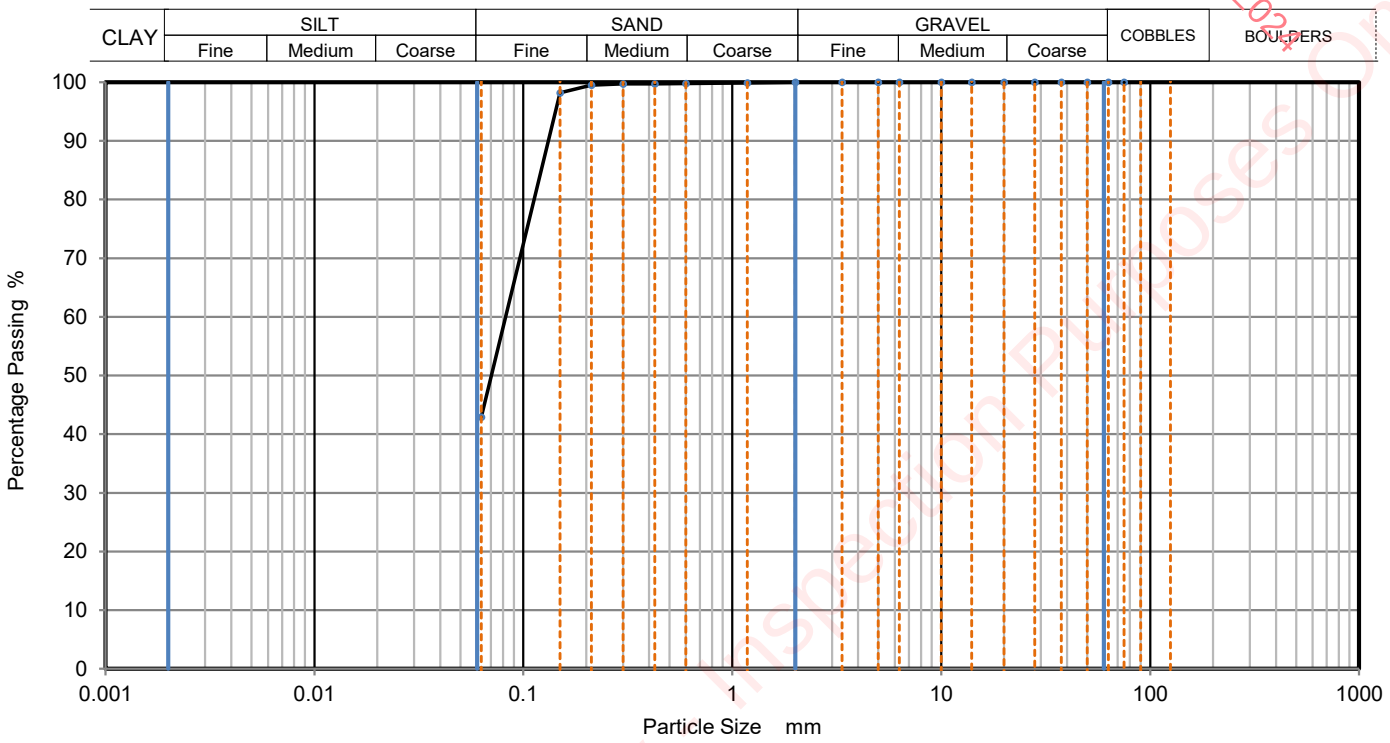
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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PARTICLE SIZE DISTRIBUTION

				Job Ref	**2023MO105**
				Borehole/Pit No.	BP2TP02
Site Name	Keerglen Wind Farm			Sample No.	2
Soil Description	Golden brown fine sandy SILT.			Depth, m	2.10
Specimen Reference		Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	IDL12023041729

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	100		
0.3	100		
0.212	100		
0.15	98		
0.063	43		

Dry Mass of sample, g	797

Sample Proportions	% dry mass
Very coarse	0
Gravel	0
Sand	57
Fines <0.063mm	43

Grading Analysis		
D100	mm	
D60	mm	0.0824
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	17/05/2023 12:07	1
				QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

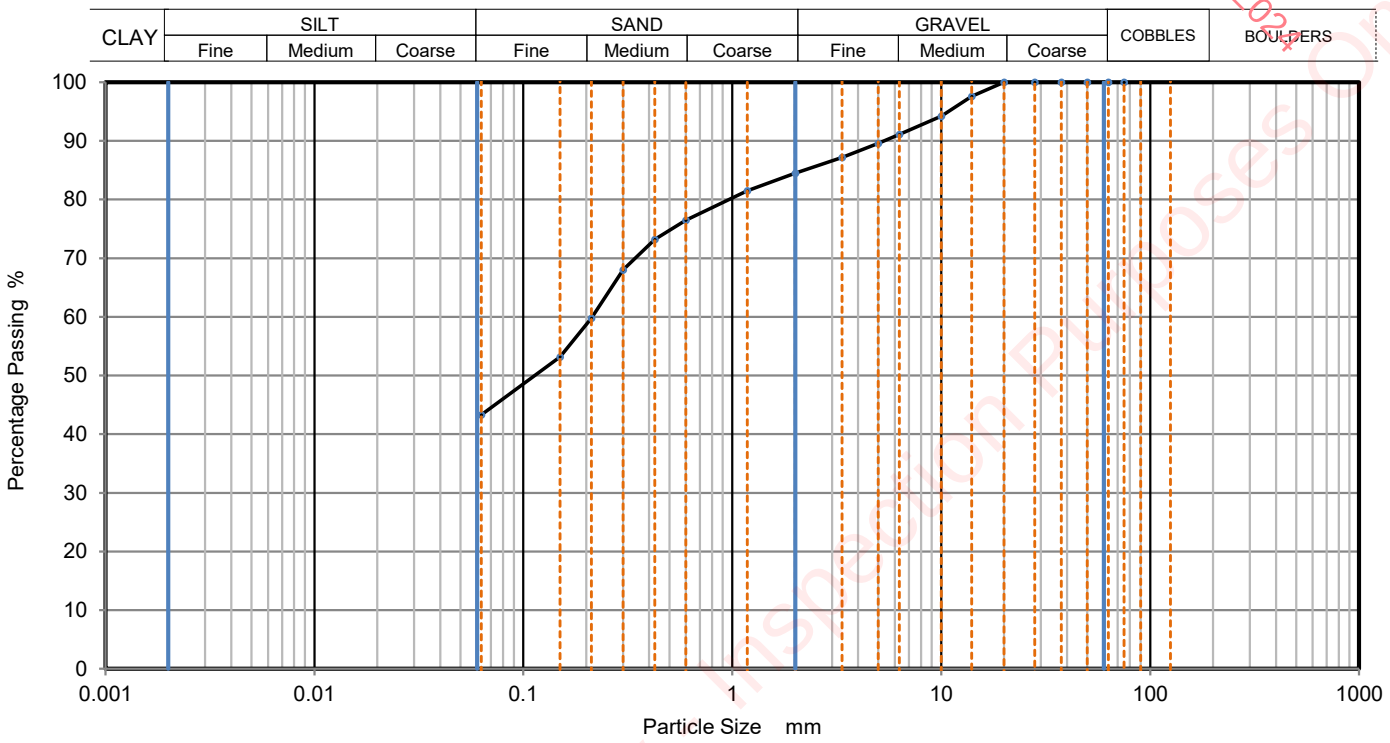
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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PARTICLE SIZE DISTRIBUTION

Job Ref	2023MO105		
Borehole/Pit No.	WTG01		
Site Name	Keerglen Wind Farm	Sample No.	3
Soil Description	Dark grey slightly gravelly sandy SILT. Sand is fine and medium.	Depth, m	2.80
Specimen Reference		Specimen Depth	m
Sample Type	B		
Test Method	BS1377:Part 2:1990, clause 9.2	KeyLAB ID	IDL12023041738

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	98		
10	94		
6.3	91		
5	90		
3.35	87		
2	85		
1.18	82		
0.6	77		
0.425	73		
0.3	68		
0.212	60		
0.15	53		
0.063	43		

Dry Mass of sample, g	1007

Sample Proportions	% dry mass
Very coarse	0
Gravel	16
Sand	41
Fines <0.063mm	43

Grading Analysis		
D100	mm	
D60	mm	0.213
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

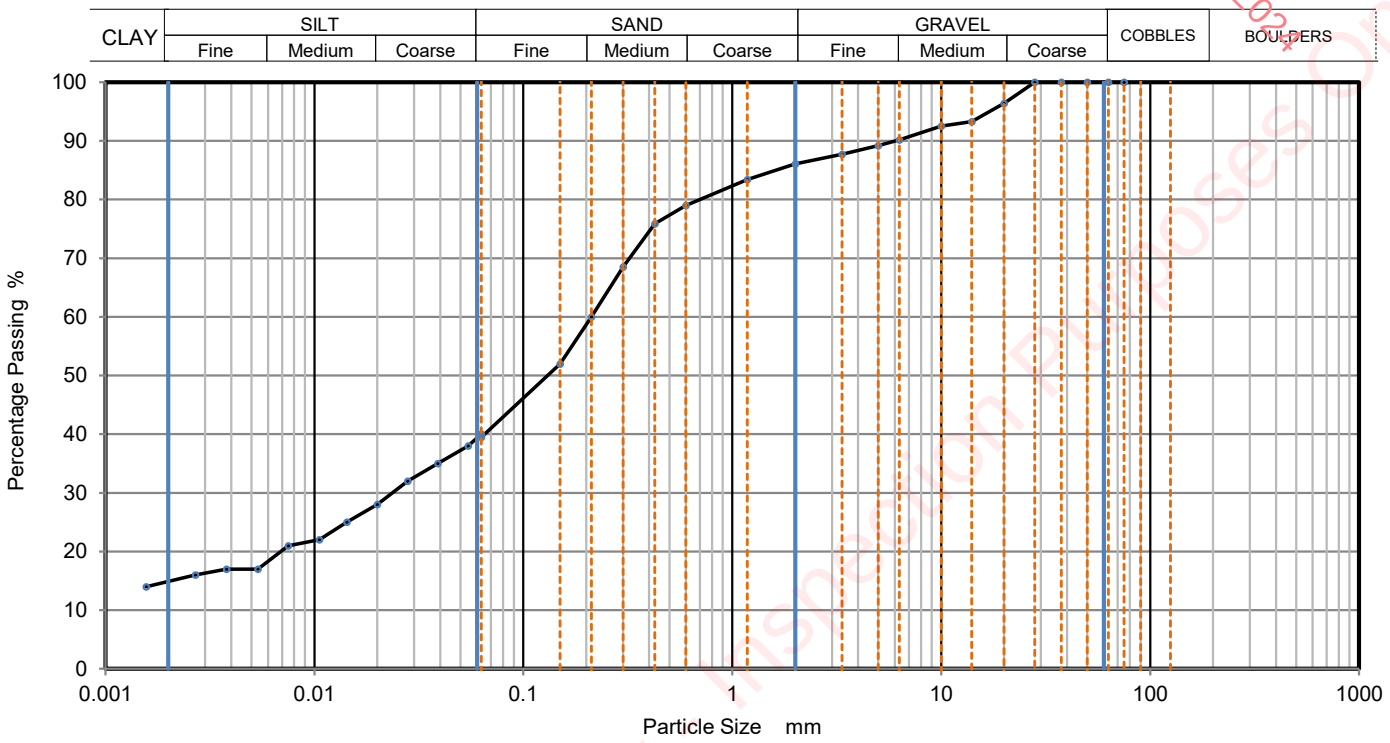
Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	17/05/2023 12:07	1
				QC From No:R2

Mayo Planning Authority Inspection Purposes Only!

PARTICLE SIZE DISTRIBUTION

Job Ref	2023MO105		
Borehole/Pit No.	WTG02		
Site Name	Keerglen Wind Farm	Sample No.	1
Soil Description	Dark greenish-grey slightly gravelly sandy SILT.	Depth, m	2.70
Specimen Reference		Specimen Depth / m	
Sample Type	B		
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	IDL12023041740

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0630	40
		0.0545	38
75	100	0.0390	35
63	100	0.0279	32
50	100	0.0200	28
37.5	100	0.0143	25
28	100	0.0106	22
20	96	0.0075	21
14	93	0.0054	17
10	93	0.0038	17
6.3	90	0.0027	16
5	89	0.0016	14
3.35	88		
2	86		
1.18	83		
0.6	79	Particle density (assumed)	
0.425	76	2.65 Mg/m3	
0.3	69		
0.212	60		
0.15	52		
0.063	40		

Dry Mass of sample, g	972

Sample Proportions	% dry mass
Very coarse	0
Gravel	14
Sand	47
Silt	25
Clay	15

Grading Analysis		
D100	mm	
D60	mm	0.212
D30	mm	0.0236
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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Operator	Checked	Approved	Sheet printed	
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				QC From No:R2

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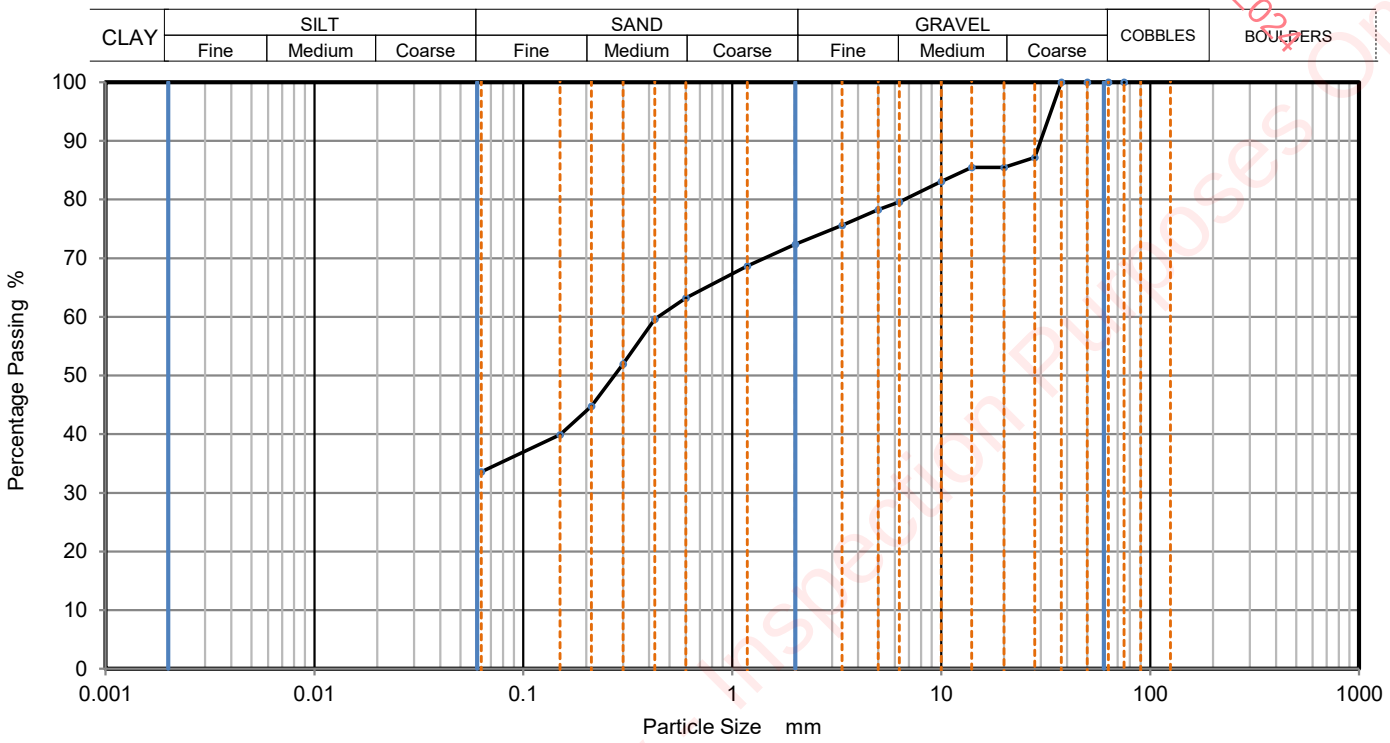
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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PARTICLE SIZE DISTRIBUTION

				Job Ref	**2023MO105**
				Borehole/Pit No.	WTG03
Site Name	Keerglen Wind Farm			Sample No.	3
Soil Description	Grey very gravelly very silty SAND.			Depth, m	2.90
Specimen Reference		Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	IDL12023041746

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	87		
20	86		
14	86		
10	83		
6.3	80		
5	78		
3.35	76		
2	72		
1.18	69		
0.6	63		
0.425	60		
0.3	52		
0.212	45		
0.15	40		
0.063	34		

Dry Mass of sample, g	1134

Sample Proportions	% dry mass
Very coarse	0
Gravel	28
Sand	39
Fines <0.063mm	34

Grading Analysis		
D100	mm	
D60	mm	0.44
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
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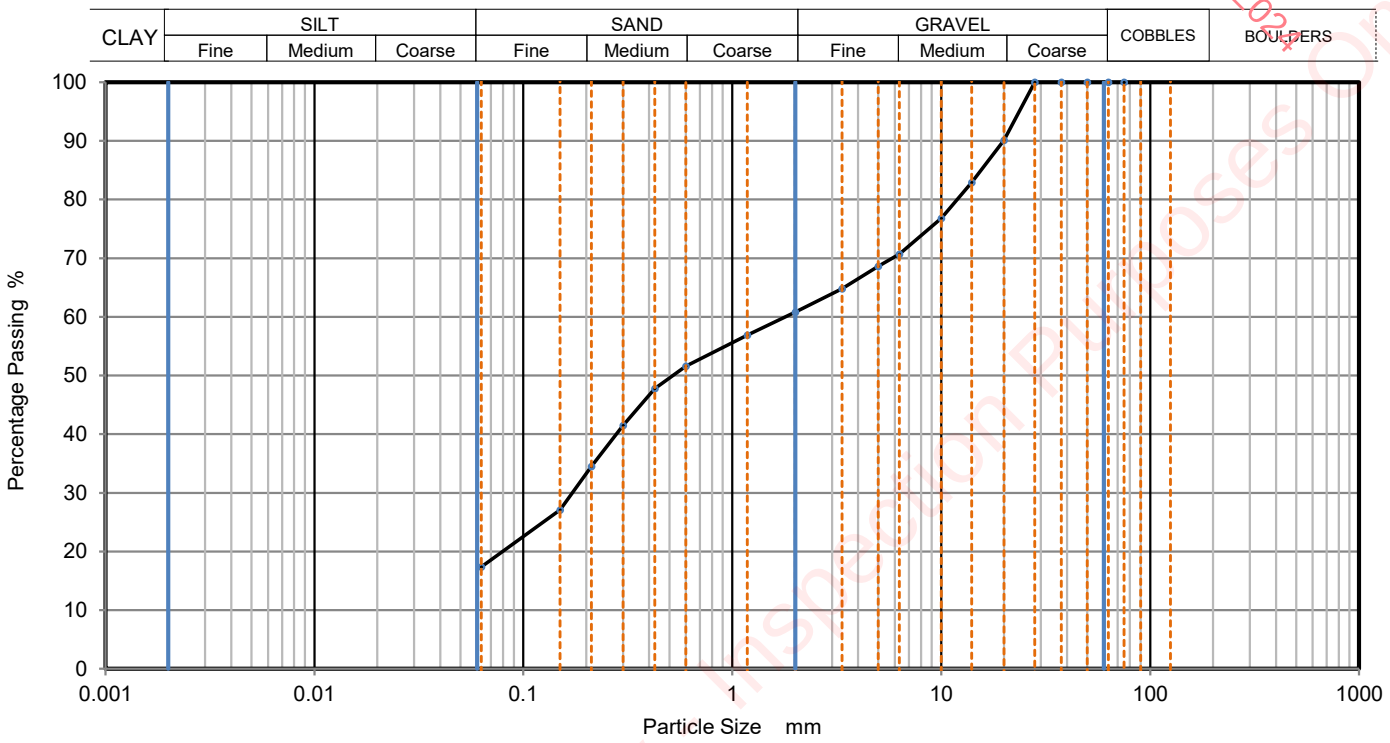
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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PARTICLE SIZE DISTRIBUTION

Job Ref	2023MO105		
Borehole/Pit No.	WTG04		
Site Name	Keerglen Wind Farm	Sample No.	2
Soil Description	Dark greyish-brown silty GRAVEL and SAND.	Depth, m	1.80
Specimen Reference		Specimen Depth	m
Sample Type	B		
Test Method	BS1377:Part 2:1990, clause 9.2	KeyLAB ID	IDL12023041749

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	90		
14	83		
10	77		
6.3	71		
5	69		
3.35	65		
2	61		
1.18	57		
0.6	52		
0.425	48		
0.3	42		
0.212	35		
0.15	27		
0.063	17		

Dry Mass of sample, g	1063

Sample Proportions	% dry mass
Very coarse	0
Gravel	39
Sand	43
Fines <0.063mm	17

Grading Analysis		
D100	mm	
D60	mm	1.79
D30	mm	0.172
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

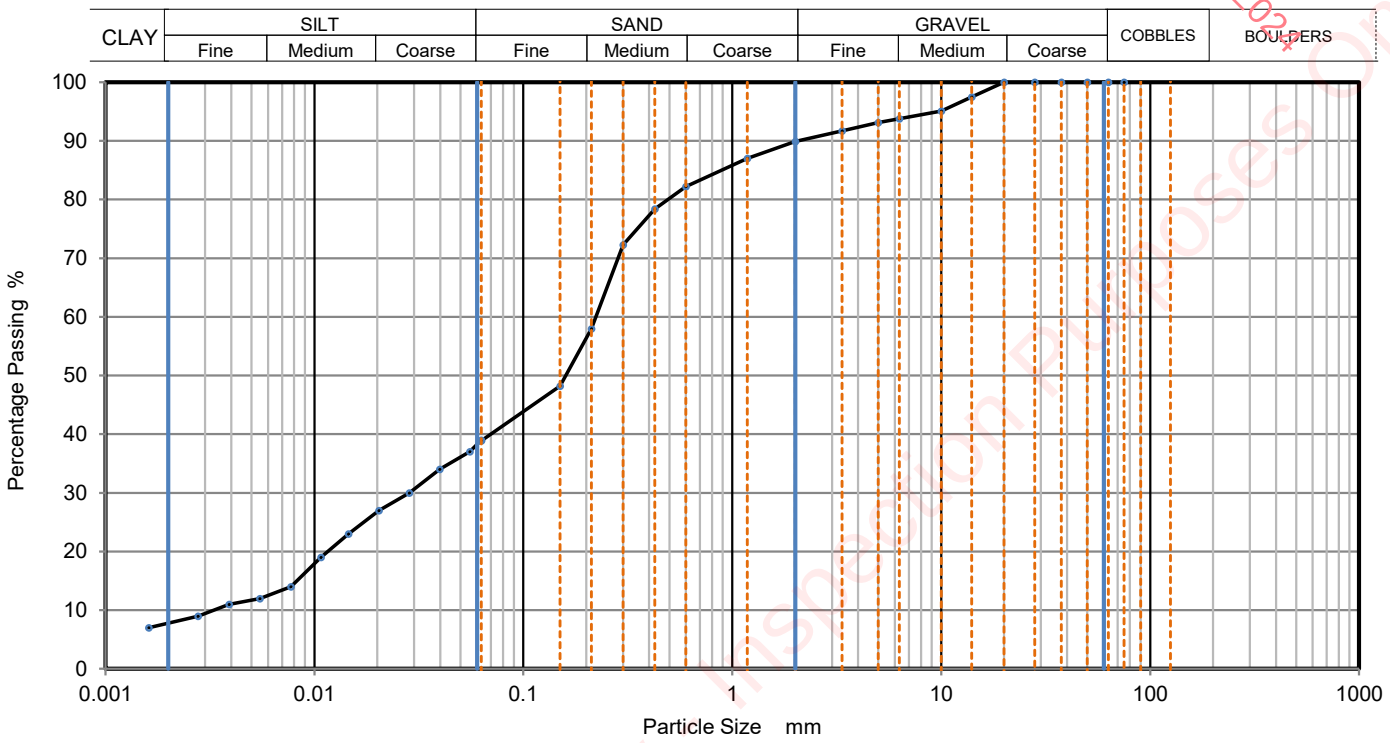
Operator	Checked	Approved	Sheet printed	
		Dympna Darcy B.Sc.	17/05/2023 12:07	1
				QC From No:R2

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PARTICLE SIZE DISTRIBUTION

Job Ref	2023MO105		
Borehole/Pit No.	WTG05		
Site Name	Keerglen Wind Farm	Sample No.	1
Soil Description	Dark grey slightly gravelly sandy SILT. Sand is medium.	Depth, m	2.10
Specimen Reference		Specimen Depth	m
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	IDL12023041752

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0630	39
		0.0555	37
75	100	0.0397	34
63	100	0.0284	30
50	100	0.0203	27
37.5	100	0.0145	23
28	100	0.0107	19
20	100	0.0077	14
14	98	0.0055	12
10	95	0.0039	11
6.3	94	0.0028	9
5	93	0.0016	7
3.35	92		
2	90		
1.18	87		
0.6	82	Particle density (assumed)	
0.425	78	2.65	Mg/m3
0.3	72		
0.212	58		
0.15	48		
0.063	39		

Dry Mass of sample, g	856

Sample Proportions	% dry mass
Very coarse	0
Gravel	10
Sand	51
Silt	31
Clay	8

Grading Analysis		
D100	mm	
D60	mm	0.223
D30	mm	0.0283
D10	mm	0.00347
Uniformity Coefficient		64
Curvature Coefficient		1

Remarks

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Operator	Checked	Approved	Sheet printed	
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				QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

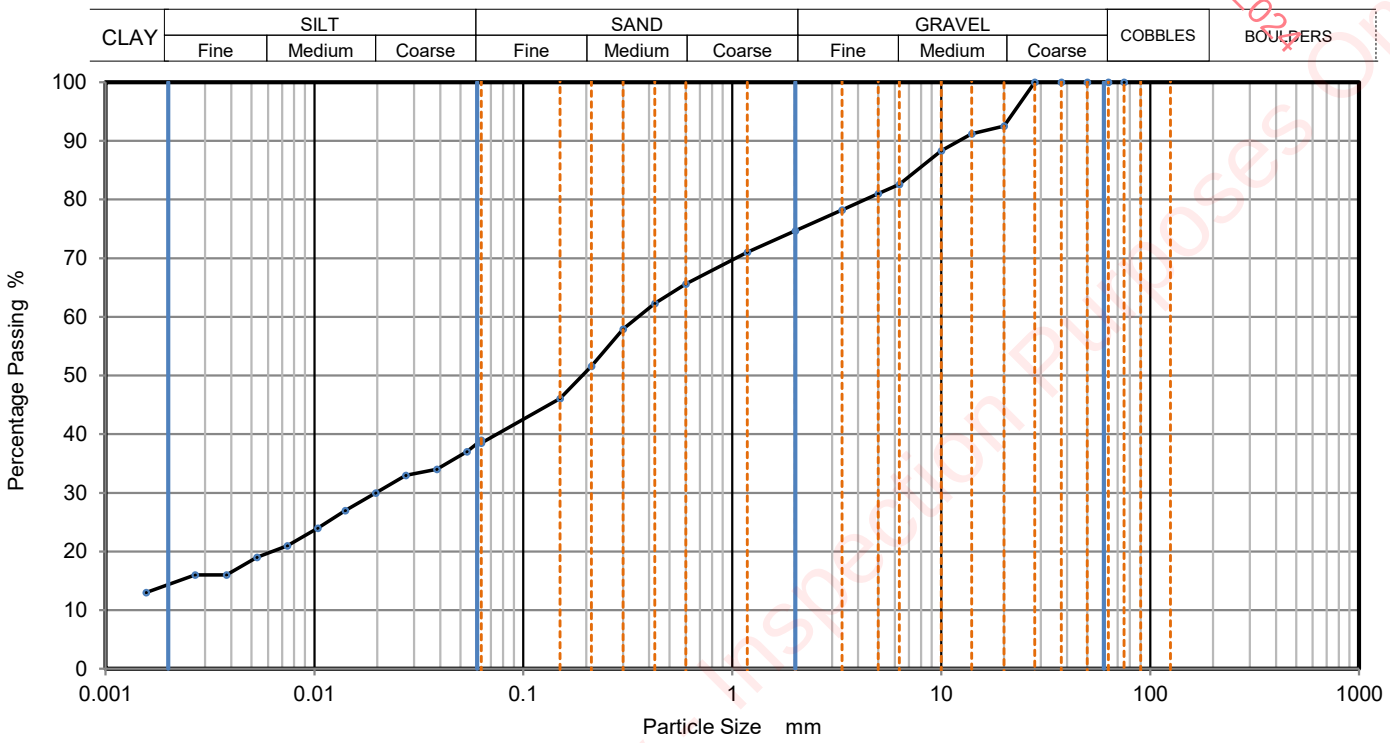
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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PARTICLE SIZE DISTRIBUTION

Job Ref	2023MO105		
Borehole/Pit No.	WTG05		
Site Name	Keerglen Wind Farm	Sample No.	3
Soil Description	Dark bluish-grey slightly gravelly sandy SILT.	Depth, m	3.60
Specimen Reference		Specimen Depth	m
Sample Type	B		
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	IDL12023041754

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0630	39
		0.0538	37
75	100	0.0385	34
63	100	0.0274	33
50	100	0.0196	30
37.5	100	0.0140	27
28	100	0.0104	24
20	93	0.0074	21
14	91	0.0053	19
10	88	0.0038	16
6.3	83	0.0027	16
5	81	0.0016	13
3.35	78		
2	75		
1.18	71		
0.6	66	Particle density (assumed)	
0.425	62	2.65	Mg/m3
0.3	58		
0.212	52		
0.15	46		
0.063	39		

Dry Mass of sample, g	962

Sample Proportions	% dry mass
Very coarse	0
Gravel	25
Sand	36
Silt	25
Clay	14

Grading Analysis		
D100	mm	
D60	mm	0.355
D30	mm	0.0198
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
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				QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

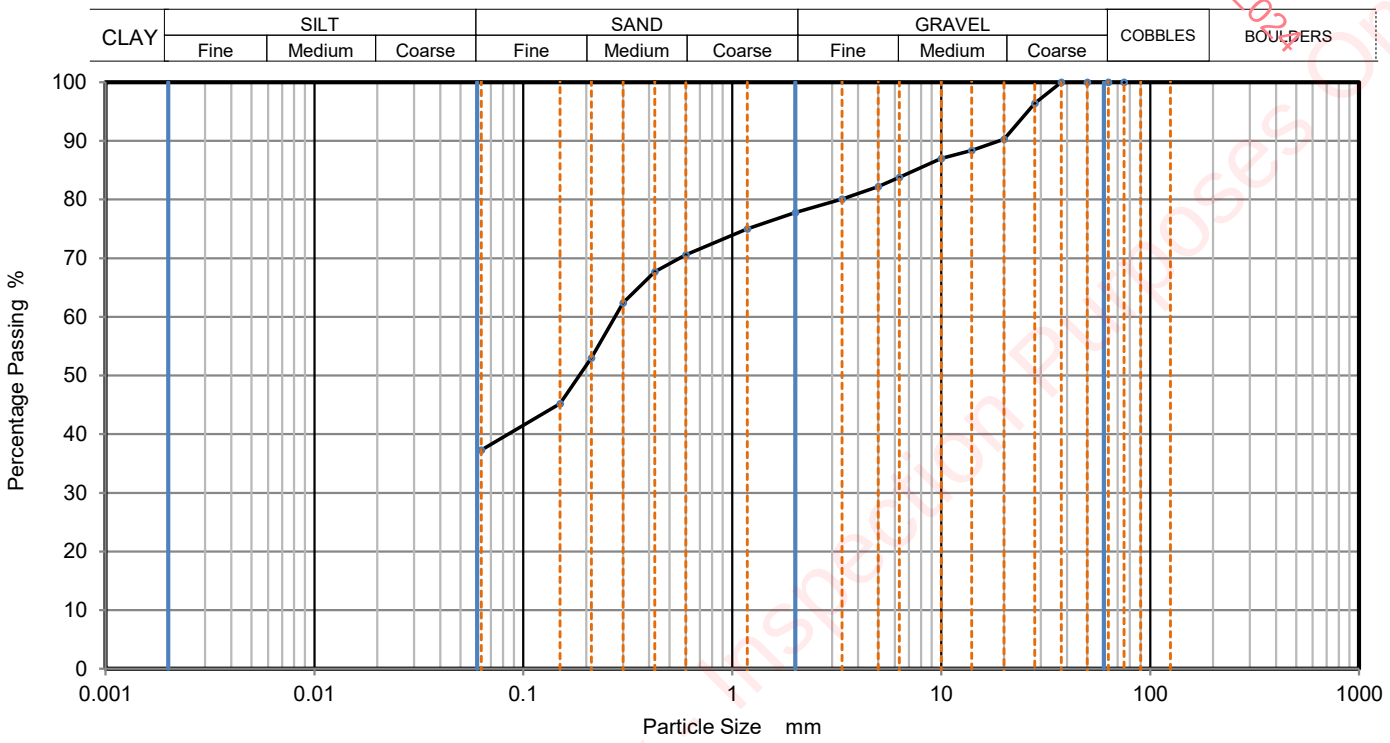
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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PARTICLE SIZE DISTRIBUTION

Job Ref	2023MO105		
Borehole/Pit No.	WTG08		
Site Name	Keerglen Wind Farm	Sample No.	2
Soil Description	Light greyish-brown slightly gravelly sandy SILT.	Depth, m	2.60
Specimen Reference		Specimen Depth / m	
Sample Type	B		
Test Method	BS1377:Part 2:1990, clause 9.2	KeyLAB ID	IDL12023041763

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	96		
20	90		
14	88		
10	87		
6.3	84		
5	82		
3.35	80		
2	78		
1.18	75		
0.6	71		
0.425	68		
0.3	62		
0.212	53		
0.15	45		
0.063	37		

Dry Mass of sample, g: 1048

Sample Proportions	% dry mass
Very coarse	0
Gravel	22
Sand	41
Fines <0.063mm	37

Grading Analysis		
D100	mm	
D60	mm	0.274
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operator	Checked	Approved	Sheet printed	
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				QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

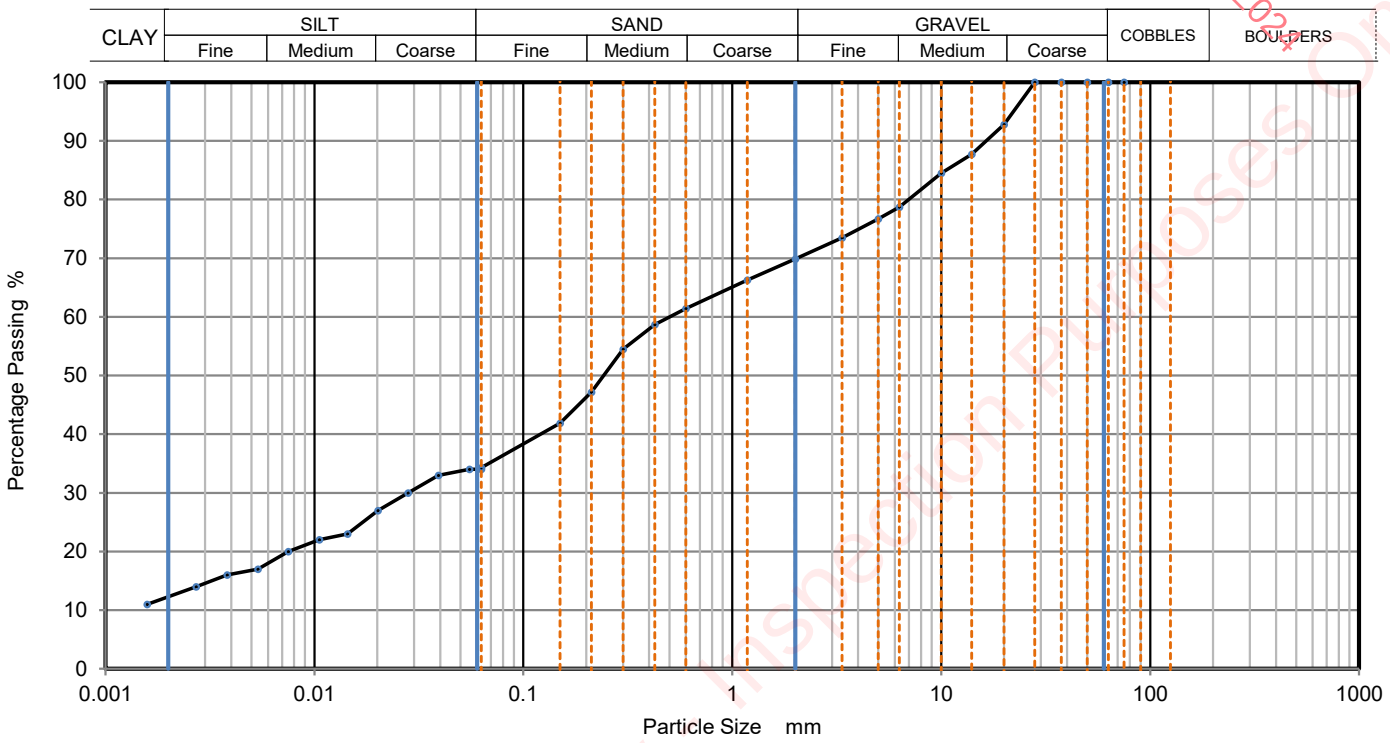
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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PARTICLE SIZE DISTRIBUTION

Job Ref	2023MO105		
Borehole/Pit No.	WTG09		
Site Name	Keerglen Wind Farm	Sample No.	3
Soil Description	Dark grey very gravelly very silty SAND.	Depth, m	2.80
Specimen Reference		Specimen Depth	m
Sample Type	B		
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5	KeyLAB ID	IDL12023041768

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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
		0.0630	34
		0.0552	34
75	100	0.0392	33
63	100	0.0281	30
50	100	0.0201	27
37.5	100	0.0144	23
28	100	0.0106	22
20	93	0.0075	20
14	88	0.0054	17
10	85	0.0038	16
6.3	79	0.0027	14
5	77	0.0016	11
3.35	74		
2	70		
1.18	66		
0.6	61	Particle density (assumed)	
0.425	59	2.65 Mg/m3	
0.3	55		
0.212	47		
0.15	42		
0.063	34		

Dry Mass of sample, g: 903

Sample Proportions	% dry mass
Very coarse	0
Gravel	30
Sand	36
Silt	22
Clay	12

Grading Analysis		
D100	mm	
D60	mm	0.501
D30	mm	0.0293
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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		Dympna Darcy B.Sc.	17/05/2023 12:07	1
				QC From No:R2

Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39

Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

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Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528777
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

RECEIVED: 29/08/2024

Irish Drilling Limited
Old Galway Road
Loughrea
Co. Galway

Attention: Dympna Darcy

CERTIFICATE OF ANALYSIS

Date of report Generation:	10 May 2023
Customer:	Irish Drilling Limited
Sample Delivery Group (SDG):	230502-29
Your Reference:	2023MO105
Location:	Keerglen WF
Report No:	688205
Order Number:	12445

We received 4 samples on Tuesday May 02, 2023 and 4 of these samples were scheduled for analysis which was completed on Wednesday May 10, 2023. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.
The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

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Approved By:

Sonia McWhan

Operations Manager

1291

CERTIFICATE OF ANALYSIS

SDG: 230502-29 **Report Number:** 688205 **Superseded Report:**
Client Ref.: 2023MO105 **Location:** Keerglen WF

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
27929257	WTG01	B2	2.40 - 2.50	05/04/2023
27929259	WTG02	B3	3.50 - 3.60	05/04/2023
27929261	WTG05	B3	3.60 - 3.70	04/04/2023
27929263	WTG08	B3	4.40 - 4.50	04/04/2023

Only received samples which have had analysis scheduled will be shown on the following pages.

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Validated

CERTIFICATE OF ANALYSIS

SDG: 230502-29 **Report Number:** 688205 **Superseded Report:**
Client Ref.: 2023MO105 **Location:** Keerglen WF

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

			Lab Sample No(s)	Customer Sample Reference	AGS Reference	Depth (m)	Container	Sample Type
			27929257	WTG01	B2	2.40 - 2.50	250g Amber Jar (ALE210)	S
			27929259	WTG02	B3	3.50 - 3.60	250g Amber Jar (ALE210)	S
			27929261	WTG05	B3	3.60 - 3.70	250g Amber Jar (ALE210)	S
			27929263	WTG08	B3	4.40 - 4.50	250g Amber Jar (ALE210)	S
Anions by Kone (soil)	All	NDPs: 0 Tests: 4	X	X	X	X		
pH	All	NDPs: 0 Tests: 4	X	X	X	X		
Sample description	All	NDPs: 0 Tests: 4	X	X	X	X		
Total Sulphate	All	NDPs: 0 Tests: 4	X	X	X	X		

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CERTIFICATE OF ANALYSIS

SDG: 230502-29 **Report Number:** 688205 **Superseded Report:**
Client Ref.: 2023MO105 **Location:** Keerglen WF

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Inclusions	Inclusions 2
27929257	WTG01	2.40 - 2.50	Dark Brown	Sand	Stones	Vegetation
27929259	WTG02	3.50 - 3.60	Grey	Sand	Stones	Vegetation
27929261	WTG05	3.60 - 3.70	Grey	Sand	Stones	Vegetation
27929263	WTG08	4.40 - 4.50	Grey	Sand	Stones	Vegetation

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These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

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Validated

CERTIFICATE OF ANALYSIS

SDG: 230502-29 **Report Number:** 688205 **Superseded Report:**
Client Ref.: 2023MO105 **Location:** Keerglen WF

Results Legend
- # ISO17025 accredited.
- M mCERTS accredited.
- aq Aqueous / settled sample.
- diss.filt Dissolved / filtered sample.
- tot.unfilt Total / unfiltered sample.
- * Subcontracted - refer to subcontractor report for accreditation status.
- ** % recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
- (F) Trigger breach confirmed
- 1-4+§@ Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	WTG01	WTG02	WTG05	WTG08
			Depth (m)	2.40 - 2.50	3.50 - 3.60	3.60 - 3.70	4.40 - 4.50
			Sample Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
			Date Sampled	05/04/2023	05/04/2023	04/04/2023	04/04/2023
			Sample Time	-	-	-	-
			Date Received	02/05/2023	02/05/2023	02/05/2023	02/05/2023
			SDG Ref	230502-29	230502-29	230502-29	230502-29
			Lab Sample No.(s)	27929257	27929259	27929261	27929263
			AGS Reference	B2	B3	B3	B3
Moisture Content Ratio (% of as received sample)	%	PM024		22	14	11	9.3
pH	1 pH Units	TM133		5.4 @ M	8.08 @ M	8.74 @ M	8.69 @ M
Sulphate, Total	<48 mg/kg	TM221		99.6 M	49.2 M	218 M	218 M
Water Soluble Sulphate as SO4 2:1 Extract	<0.004 g/l	TM243		0.004 M	0.0112 @ M	0.0082 M	0.0049 @ M

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Table of Results - Appendix

Method No	Description
PM024	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material
TM133	Determination of pH in Soil and Water using the GLpH pH Meter
TM221	Determination of Acid Extractable Sulphate in Soils by ICP OES
TM243	Mixed Anions In Soils By Kone

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden (Method codes TM).

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CERTIFICATE OF ANALYSIS

SDG: 230502-29 **Report Number:** 688205 **Superseded Report:**
Client Ref.: 2023MO105 **Location:** Keerglen WF

Test Completion Dates

Lab Sample No(s)	27929257	27929259	27929261	27929263
Customer Sample Ref.	WTG01	WTG02	WTG05	WTG08
AGS Ref.	B2	B3	B3	B3
Depth	2.40 - 2.50	3.50 - 3.60	3.60 - 3.70	4.40 - 4.50
Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
Anions by Kone (soil)	05-May-2023	05-May-2023	05-May-2023	05-May-2023
pH	10-May-2023	10-May-2023	10-May-2023	10-May-2023
Sample description	02-May-2023	02-May-2023	02-May-2023	02-May-2023
Total Sulphate	09-May-2023	04-May-2023	04-May-2023	04-May-2023

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Appendix General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 15 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

20. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials andd soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

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Appendix 04
Site Plan

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BP2 TP02
BP2 TP03
BP2 TP01
WTG 9
BP1 TP03
BP1 TP01
BP1 TP02
WTG 8
WTG 1
WTG 5
WTG 4
WTG 7
WTG 2
WTG 6
WTG 3

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Appendix 05
AGS Data

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Appendix 8.1 (Volume 4 of 4)

Geotechnical and Peat Stability Report

Keerglen Wind Farm

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FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

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APPENDIX F

Ground Investigation Information (Whiteford, 2023)

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Borrow Pit Potential Assessment at Keerglen Wind Farm, Co. Mayo, Ireland

Stage 2 – Follow-up Geotechnical Investigation and Laboratory Testing

Report No: 2225-23A Rev01

16th October 2023

This document has been prepared by Whiteford Geoservices Ltd on behalf of

ABO Wind Ireland Ltd

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C LABORATORY TESTING

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1 INTRODUCTION

In June 2023 Whiteford Geoservices were appointed by ABO Wind Ireland Ltd to investigate potential sites for a borrow pit at Keerglen Wind Farm, near Ballycastle, Co. Mayo.

Whiteford Geoservices' proposal consisted of a three-stage investigation process, as follows: -

Stage 1 – Geophysical Reconnaissance

a) Select the most promising region within the wind farm boundary to investigate. This area would have minimal environmental constraints, be outside the main construction zone and contain a topography with the best potential for yielding rock at an attainable depth (i.e. a small hill or local high point).

b) Use geophysical survey methods to map the subsurface to a depth of approximately 10m below existing ground surface to identify areas where rock could be present. Although a number of suitable geophysical survey techniques were appropriate for this stage Electrical Resistivity Tomography (ERT) was selected because of both its ability to rapidly map the sub surface, as a series of parallel profiles and the general accuracy of the ground modelling achieved.

c) The ERT surveys would be employed to search for regions of elevated ground resistivity in the subsurface, the most promising of which, would then be targeted for follow-on assessment in Stage 2.

Stage 2 – Exploratory Trial Hole Investigation

a) Excavate a series of trial holes at the target locations derived from an examination of the geophysical survey findings.

b) Recover suitable samples for laboratory testing.

Should Stage 2 yield suitable borrow pit locations then the assessment would proceed to Stage 3, Laboratory Testing

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Stage 3 – Laboratory Testing of Rock / Aggregate

a) Undertake a suite of laboratory aggregate tests to determine the suitability of the "won" aggregate for use in the construction of the wind farm.

The following report presents the findings of the Stage 2 investigations along with Stage 2 laboratory testing.

A sketch of the typical borrow pit arrangements required to extract the aggregate underlying deposits is provided in Appendix A.

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2 SITE AND GEOLOGY

2.1 The Site

Keerglen Wind Farm site is situated approximately 8.5km north west of Kincon, Killala, County Mayo on an upland region of intact blanket bog and cut-over peat bog.

Land utilisation is limited and restricted to sheep grazing and small-scale turf cutting. Evidence of ongoing turf cutting is evident on the lands adjacent to, and within the survey area employed for both the stage 1 and stage 2 Investigations.

2.2 Published Geology

2.2.1 Solid Geology

According to the Geological Survey of Ireland (GSI) online database, the entire Keerglen Wind Farm site is underlain by the Downpatrick Limestone Formation.

GSI identifies this formation as, “A sequence of interbedded rock types comprising: near shore marine mudstones and siltstones; alluvial and deltaic sandstones and siltstones; and fully marine bioclastic limestones interbedded with calcareous shales”.

It is anticipated that the shallowest rock type present below the peat and glacial till soils will be either Sandstone or Shale. Although, not as versatile as “hard rock” alternatives such as basalt and limestone these types of rock are often a viable source of construction fill material.

2.2.2 Superficial Geology

Superficial soils present within the wind farm boundary consist of peat overlying glacial till soils derived from Devonian and Carboniferous sandstones.

Alluvium is present within the river valley bottoms.

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3 FIELDWORK

3.1 General

All stage 1 and stage 2 fieldwork was carried out in general accordance with BS 5930:2015+A1:2020 and other related standards.

Please refer to Report 2225-23 "Keerglen Wind Farm – Borrow Pit Assessment – Stage 1" for the location of geophysical investigations undertaken as part of these stage 1 works.

The location of Stage 2 exploratory holes are identified on the plan contained in Appendix A of this report.

3.2 Geophysical Surveys

The geophysical survey was undertaken in Stage 1 of the SI Campaign and involved the following non-destructive testing techniques (Refer to Report 2225-23 for further details).

METHOD	LOCATION	MAXIMUM DEPTH (m)	EQUIPMENT
2D Electrical Resistivity Tomography	7 Nr. Parallel profiles, approximately 50m apart, centred on a local high point north west of WTG3.	approx. 15m	Mangusta Electrical Resistivity Imaging System.

Table 1 –Geophysical Methods Deployed

3.3 Exploratory Holes

The exploratory holes undertaken in Stage 2 are detailed within the following table.

METHOD	QUANTITY	MAXIMUM DEPTH (m)	REMARKS
Trial Holes	7 Nr.	5.10m (TP-A, TP-B & TP-G)	All trial holes were undertaken using a 13T Zaxis 130 LCN Wide-Tracked Excavator.

Table 2 Exploratory Holes

The engineering logs contained within Appendix B provide descriptions of the strata encountered, together with observations made during excavation works. Please refer to Appendix D for photographs recorded during trial pitting works.

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3.4 Topographical Survey

A topographical survey of exploratory hole locations was undertaken post-completion of all associated investigation works and is detailed in the table below.

EQUIPMENT	COORDINATE SYSTEM
Leica RTK / GNSS DGPS System	Irish Transverse Mercator (ITM) / Malin Head (Ordnance Datum)

Table 3 – Topographic Surveying Details

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4 SURVEY RESULTS

4.1 Introduction

The interpreted results of the Stage 2 Investigations are contained in Appendices A, B and C, as an annotated plan detailing the assessment findings, engineering trial pit logs and geotechnical soil / rock laboratory test results.

4.2 Summary of Results for Stage 1 - Geophysical Surveys

a. Profiles L1 to L5 identified low resistivity superficial peats and glacial till soils overlying materials with higher resistivity at depths of approximately 4 – 6m. These zones of higher resistivity were such that they could either represent weathered sandstone rock or gravels and as such were deemed viable targets for Stage 2. (See Figure 1, below)

b. Profiles L6 and L7 did not show significant variation in resistivity, which is relatively low in magnitude.
As such these locations offered low potential with respect to suitability as a borrow pit.

This analysis resulted in a series of proposed targets being selected as candidates for follow-up geotechnical investigation by exploratory trial holes. See table below.

Target Number	Geophysical Profile Nr	Profile Chainage (m)	Resistivity (Ωm)	Easting	Northing
A	K1	160	>600	506005.0	831928.5
B	K1	220	>600	506064.2	831928.3
C	K2	180	>700	506030.7	831876.4
D	K3	60	> 600	505907.4	831826.0
E	K3	260	> 600	506105.5	831826.0
F	K4	100	> 500	505949.7	831773.4
G	K4	260	> 500	506107.7	831774.7

Table 4 – Potential Targets identified following analysis of Stage 1 ERT data

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4.3 Summary of Results for Stage 2 Investigations

4.3.1 Trial Pit Investigation

The following table summarises the trial pit investigation results

Trial Hole Reference	Easting / Northing	Depth to rock (m)	Peat Thickness (m)	Depth to Weathered Rock layer (m)
TP-A	E506009.30 N831929.90	N/A	1.55	N/A
TP-B	E506065.00 N831925.70	N/A	2.20	N/A
TP-C	E506033.30 N831875.70	N/A	1.80	3.70
TP-D	E505914.40 N831826.10	0.20	0.20	N/A
TP-E	E506105.10 N831828.20	N/A	1.80	N/A
TP-F	E505946.80 N831782.10	N/A	1.80	3.60
TP-G	E506104.40 N831784.80	N/A	1.85	N/A

Table 5 – Summary of Stage 2 findings with respect to rock identification

4.3.2 Laboratory Test Results

The following table summarises the laboratory test results

TEST TYPE	RESULTS	APPLICATION OF RESULTS
Natural Moisture Content (Soils)	14.3 % – 17.1 % Natural Moisture Content	Soil Classification
Natural Moisture Content (Rock)	2.65 % – 14.49 % Natural Moisture Content	Rock Classification
Particle Size Distribution	PSD correlation with Trial Holes (Stratum Descriptions) Glacial till between 3 – 5m in thickness is mainly classified as silty, slightly clayey, gravelly SAND or silty, slightly clayey sandy GRAVEL	Soil Classification
Bulk Density (Soils)	2054 – 2081kg/m3	Density Determination

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Bulk Density (Rock)	1754 – 2301kg/m3	Density Determination
Dry Density (Soils)	1777 – 1979kg/m3	Density Determination
Schmidt Hammer Tests	UCS = 25Mpa – 33MPa. Samples recovered from TP-D and TP-F	Rock Strength
Point Load Test	PL = <1.00 – 12.90MPa Average = 5.49MPa Carried out on small fragments recovered from TP-C, TP-D and TP-F	Rock Strength

Table 6 – Potential Targets identified following analysis of Stage 2 and 3 findings

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5 DISCUSSION

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5.1 Findings of follow-up Geotechnical Trial Pitting Works

Seven of the eight target locations were investigated by excavating a trial hole using a 13T wide tracked 360° excavator.

The following is an illustration of the findings of the trial pitting works: -

1. Although the co-ordinates identified in the phase 1 report were used to identify the location of each trial hole, in all cases these had to be adjusted to avoid very soft ground, areas where peat harvesting was underway, as well as hazards such as “peat pipes” and “bog holes”.

2. Intact sandstone rock was only definitely encountered in Trial Pit TP-D at a depth of 0.20m below existing ground level. What was exposed in this pit was an isolated ridge of locally hard rock, identified as a fine-grained crystalline SANDSTON (see photographs in Appendix D)E. The ridge itself was narrow at the inspection point (c. 2 – 3m wide) and orientated on a bearing of 024° – 204° to the north.

   This rock is moderately weak to locally medium strong. As such it would be best employed as construction fill rather than crushing for dressed stone. Depending on the depth from which the rock is quarried, crushing can be expected to generate a significant amount of sand along with angular gravel aggregate.

3. The electrical resistivity of sandstone rock is generally in agreement with the results obtained from the geophysical ERT surveys.

4. Trial holes TP-C and TP-F recorded the presence of dense boulders at the base of the exploratory holes, which the author believes to be the top of a weathered rock profile. In these cases, the rock fragments recovered were weak to moderately weak and the author believes the intact sandstone rock stratum to be beyond the reach of the excavator, 5 – 7m below ground level.

5. Peat thickness varied from 1.55m to 2.20m with the exception of TP-D where only 0.20m overlaid the sandstone rock outcrop.

6. All areas where SI was undertaken coincided with domestic scale turf cutting, where the existing peat has been mechanically cut to a depth of at least 1.0m.

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This was observed to cause very unstable excavation sidewalls within the excavations which rapidly collapsed where this had been done. This low sidewall integrity meant that it was not possible to excavate to the full depth of the machine's capability, without collapse occurring first.

In summary, the following overall opinion can be formed from the borrow pit investigations: -

A. Rock is present at the Keerglen Wind Farm site. This rock is a fine-grained SANDSTONE which is moderately weak to medium strong when intact, likely to create significant sand content when crushed but useful as a construction fill material.

B. The rock was observed to be present in two forms at the site, i) as a ridge of locally hard sandstone (as in TP-D) and ii) more generally at depths of over 5m (probably 6 – 7m).

C. Exploitation of the ridge of sandstone will be relatively straightforward as this occurs at a shallow depth. However, exploitation of the deeper rock formation will involve the removal and stockpiling of a significant amount of peat and granular till soils upon lands that are particularly sensitive.

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6 REFERENCES

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APPENDICES

Appendix A	Drawings
Appendix B	Exploratory Holes
Appendix C	Laboratory Testing
Appendix D	Site Photographs

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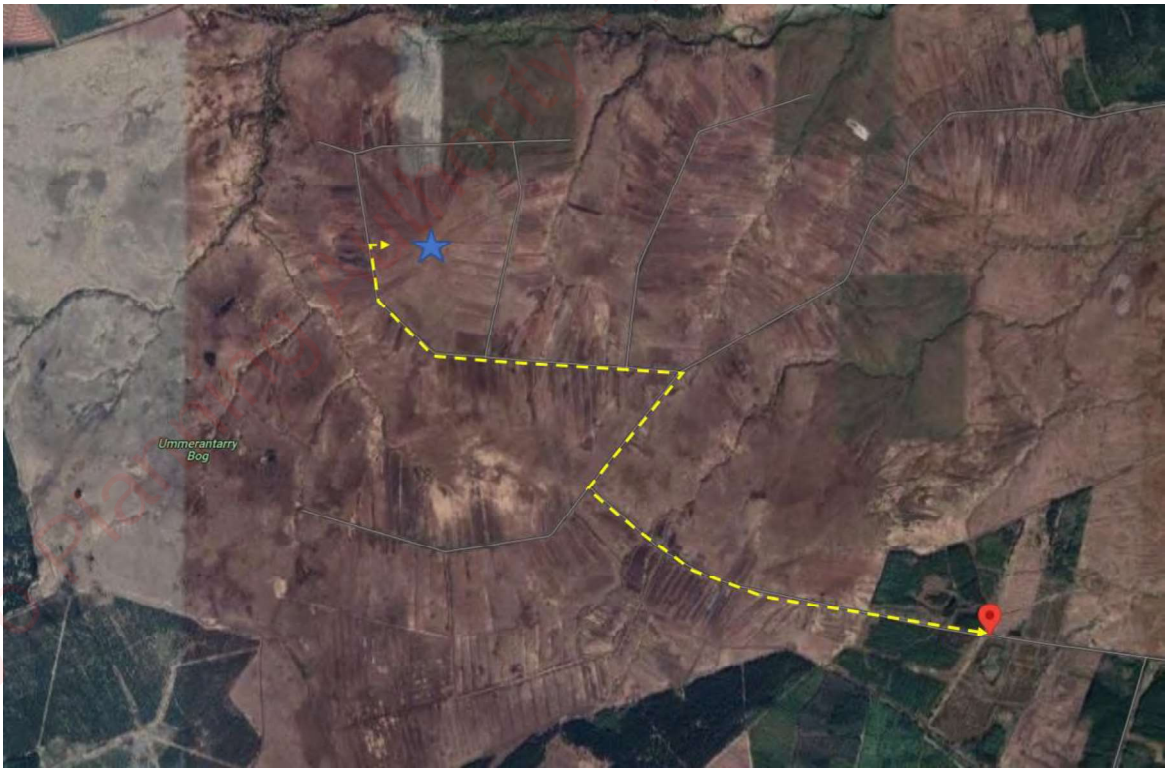
APPENDIX A
DRAWINGS

General Site Location Plan	1 x A4
Interpreted Data – Potential Borrow Pit Locations	1 x A3
Schematic Representation of Typical Borrow Pit Required to Exploit Site "Won" Aggregate	1 x A3

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P1 - General Location Plan (map view)
(© googlemaps 2023)



P2 - General Location Plan (map view)
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2225-23 Keerglen Wind Farm - Borrow Pit Assessment

Investigation Findings

22 August 2023

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Key

- As-Built TP Location (Stage 2)
- Stage 1 - Target
- Stage 1 - Geophysical ERT Profiles
- Sandstone Ridge Medium weak (0.2 - 0.5m depth)
- Weathered rock encountered (3.6 - 3.7m depth)
- Antcipated extent of sandstone rock (c. 5.0 - 6.0m depth)

Notes:

1. All depths are relative to ground level existing at the time of the survey / investigation.
2. All positions relate to the Irish Transverse Mercator 75 coordinate system.
3. Any elevations are provided relative to Ordnance Datum Malin Head

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Designed by	Checked by	Approved by - date	Drawing No.	Date	Scale
J. W.		22/08/2023	2225-D1	22/08/2023	NTS

Whiteford Geoservices Ltd
Straid House
2 Main Street, Straid,
BALLYCLARE, Co. Antrim,
UK BT39 9 NE

Borrow Pit Assessment
Results of Investigations - Rock Occurrence

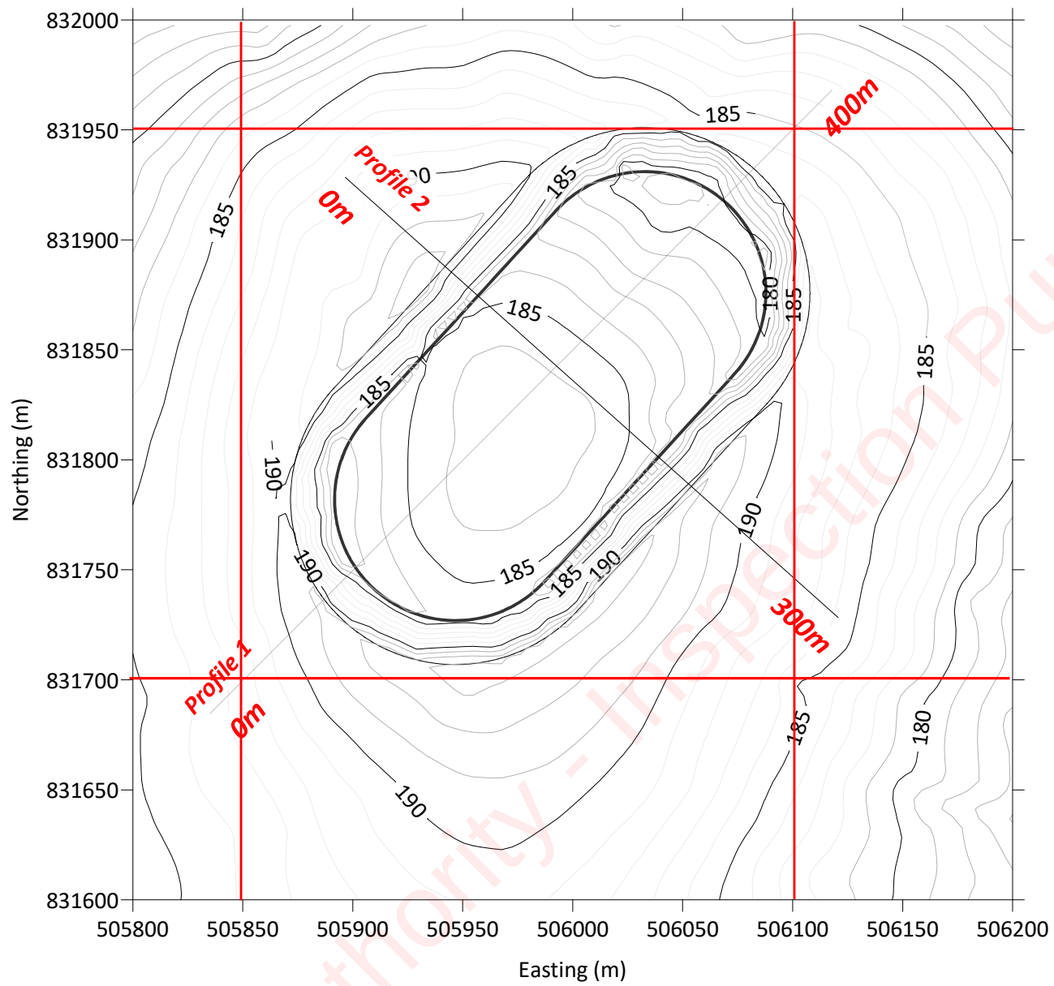
Keerglen Wind Farm | Edition 1 | Sheet A3

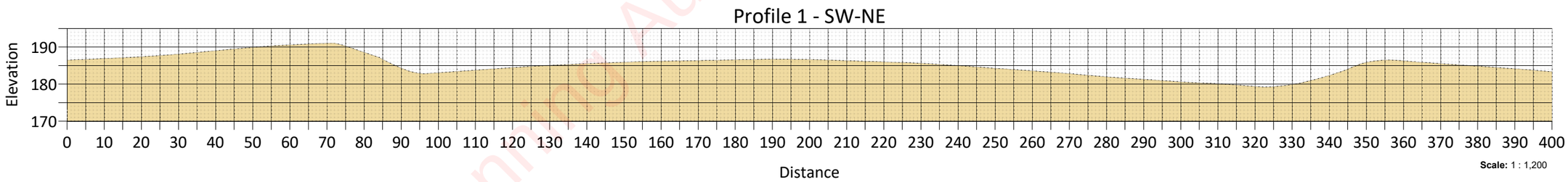
Mayo Planning Authority Use Only
Received on Planning Portal

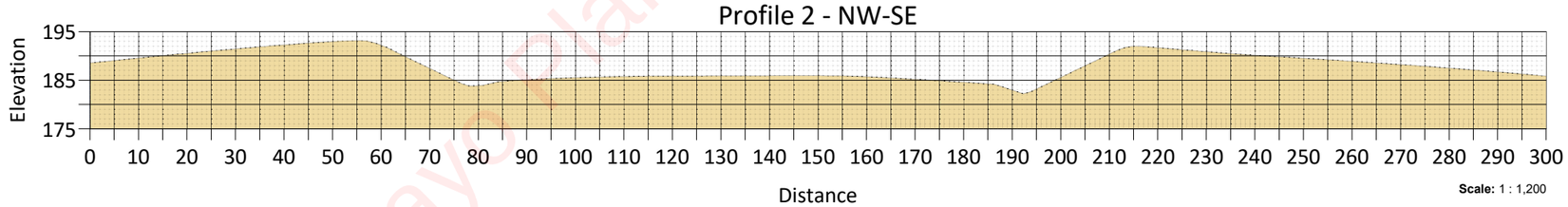
2225-23 Keerglen Wind Farm - Borrow Pit Assessment

Sections Through Purposed Borrrow Pit

28th September 2023







Notes:

1. All depths are relative to ground level existing at the time of the survey / investigation.
2. All positions relate to the Irish Transverse Mercator 75 coordinate system.
3. Any elevations are provided relative to Ordnance Datum Malin Head

Designed by	Checked by	Approved by - date	Drawing No.	Date	Scale
J. W.		28/09/2023	2225-X1	28/09/2023	NTS

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Borrow Pit Assessment
Sections Through Purposed Borrrow Pit

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APPENDIX B
EXPLORATORY HOLES

Trial Hole Engineering Logs	10 x A4

whiteford
explore the possibilities

Address: 2 Main Street, Straid, Ballyclare
BT39 9NE, UK
Tel: (028) 9334 9351
Email: Info@whitefordgeoservices.com
Website: www.whitefordgeoservices.com

Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506009.30 N831929.90
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-A	TP	191.50m AoD	JW	1:25	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Soft dark brown PEAT
					1.55	189.95		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					1.85	189.65		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
					3.40	188.10		Loose, brown, slightly clayey fine grained SAND
		4.10 - 4.60	B					

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
5.00	1.20	Unstable					

Remarks

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Email: Info@whitefordgeoservices.com
Website: www.whitefordgeoservices.com

Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506009.30 N831929.90
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-A	TP	191.50m AoD	JW	1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Sample and In Situ Testing: Type	Sample and In Situ Testing: Results	Depth (m)	Level (m)	Legend	Stratum Description
					5.10	186.40		Loose, brown, slightly clayey fine grained SAND End of Pit at 5.100m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
		Unstable			0.00	5.10	Arisings

Remarks

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Website: www.whitefordgeoservices.com

Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506065.00 N831925.70
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-B	TP	190.05m AoD	JW	1:25	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Very soft dark brown spongy PEAT
					2.20	187.85		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					2.40	187.65		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
5.10	1.20	Unstable					

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506065.00 N831925.70
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-B	TP	190.05m AoD	JW	1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Sample and In Situ Testing: Type	Sample and In Situ Testing: Results	Depth (m)	Level (m)	Legend	Stratum Description
					5.10	184.95		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
								End of Pit at 5.100m

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Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
		Unstable			0.00	5.10	Arisings

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506033.30 N831875.70
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-C	TP	194.69m AoD	JW	1:25	Sheet 1 of 1

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Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Very soft dark brown spongy PEAT
					1.80	192.89		
								Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					2.00	192.69		
		3.10 - 3.60	B					Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
					3.70	190.99		Dense, pinkish grey sandy gravelly COBBLES and BOULDERS. Angular to sub angular. Fragments of pink, tabular, sub angular fine grained sandstone recovered.
					4.60	190.09		End of Pit at 4.600m

1 2 3 4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
5.00	1.20	Unstable			0.00	4.60	Arisings

Remarks

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Website: www.whitefordgeoservices.com

Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E505914.40 N831826.10
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-D	TP	193.94m AoD	JW	1:25	Sheet 1 of 1

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Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.20 - 0.60	B		0.20	193.74		Soft dark brown PEAT
								Yellow grey stained black, discoloured to slightly discoloured, fine grained, SANDSTONE, very weak to weak. Slightly weathered.
					4.60	189.34		End of Pit at 4.600m

1
2
3
4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
8.60	2.60	Unstable			0.00	4.60	Arisings

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506105.10 N831828.20
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-E	TP	191.06m AoD	JW	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Very soft dark brown spongy PEAT
					1.80	189.26		Loose light brown silty/clayey fine grained SAND
					2.00	189.06		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					4.30	186.76		End of Pit at 4.300m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.80	1.20	Unstable			0.00	4.30	Arisings

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E505946.80 N831782.10
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-F	TP	196.00m AoD	JW	1:25	Sheet 1 of 1

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Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Very soft dark brown spongy PEAT
					1.80	194.20		Loose light brown silty/clayey fine grained SAND
					2.10	193.90		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
		3.10 - 3.60	B		2.50	193.50		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
					3.60	192.40		Dense, pinkish grey sandy gravelly COBBLES and BOULDERS. Angular to sub angular.
					3.80	192.20		End of Pit at 3.800m

1 2 3 4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.60	1.20	Unstable			0.00	3.80	Arisings

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506104.40 N831784.80
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-G	TP	188.58m AoD	JW	1:25	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Very soft dark brown spongy PEAT
					1.85	186.72		Loose light brown silty/clayey fine grained SAND
					2.10	186.48		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					3.20	185.38		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
		4.00 - 4.50	B					

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
5.50	1.20	Unstable					

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506104.40 N831784.80
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-G	TP	188.58m AoD	JW	1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Sample and In Situ Testing: Type	Sample and In Situ Testing: Results	Depth (m)	Level (m)	Legend	Stratum Description
					5.10	183.48		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
								End of Pit at 5.100m

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Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
		Unstable			0.00	5.10	Arisings

Remarks

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APPENDIX C
LABORATORY TESTING

Soils: Moisture Content, Bulk Density & Dry Density	1 x A4
Rock: Moisture Content, Bulk Density & Dry Density	1 x A4
Soil: Particle Size Distribution	2 x A4
Rock: Point Load Test Results	1 x A4
Rock: Schmidt Hammer Test Results	1 x A4

Moisture, Bulk & Dry Density Results

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Location: Kerrglen Wind Farm

Client: Abo Wind Ireland Ltd

Job No: 2225-23

Hole ID	*Depth*	*Moisture Content %*	*Bulk Density (kg/m^3)*	*Dry Density (kg/m^3)*
TP-G	4.50	17.10	2081	1777
TP-G	4.60	14.30	2054	1979

Operator	Checked	Approved
Dr Sivakumar - QUB	JMCN	JW

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Rock Moisture & Bulk Density Results

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Location: Kerrglen Wind Farm

Client: Abo Wind Ireland Ltd

Job No: 2225-23

Hole ID	*Depth*	*Moisture Content %*	*Bulk Density (kg/m^3)*
TP-C	3.60	6.36	2288
TP-D	0.60	14.49	1754
TP-F	3.60	2.65	2381

Operator	Checked	Approved
JMCN	JMCN	JW

VINI Geotechnical Testing

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	90.8
28.000	88.4
20.000	88.4
14.000	87.2
10.000	85.2
6.300	83.9
5.000	80.5
3.350	77.6
2.000	72.3
1.180	63.3
0.600	47.8
0.425	40.4
0.300	34.4
0.212	28.9
0.150	24.2
0.063	16.7
0.044	15.6
0.031	14.5
0.020	11.6
0.012	9.4
0.009	7.7
0.006	6.0
0.004	4.8
0.003	3.7
0.002	3.1
0.001	1.4



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
3.1		13.6			55.6			27.7		0.0	0.0

Sample Description **Silty slightly clayey gravelly fine to coarse SAND**

Project Keerglen WF

Project No. 2225-23

BH/TP No. TP-A

Sample No.

Operator	SS	Checked	VS	Approved	VS	Date sample tested	10/08/2023	Depth	4.6 m

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VINI Geotechnical Testing

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

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Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	94.0
28.000	81.8
20.000	75.5
14.000	74.3
10.000	72.9
6.300	67.8
5.000	64.9
3.350	60.4
2.000	53.8
1.180	47.9
0.600	41.7
0.425	39.0
0.300	36.4
0.212	33.4
0.150	30.3
0.063	22.4
0.045	20.4
0.032	17.7
0.021	15.9
0.012	12.3
0.009	10.4
0.006	8.6
0.004	7.3
0.003	6.4
0.002	5.0
0.001	3.2



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
5.0		17.4			31.4			46.2		0.0	0.0

Sample Description **Silty slightly clayey sandy fine to coarse GRAVEL**

Project Keerglen WF

Project No. 2225-23

BH/TP No. TP-G

Sample No.

Operator	SS	Checked	VS	Approved	VS	Date sample tested	10/08/2023	Depth	4.5m

Schmidt Rebound Hardness

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Location: Keerglen Wind Farm

Client:ABO Wind Ireland Ltd

Job no: 2225-23

Sample no:	*Sample Depth (m)*	*Diameter (mm)*	*Test Direction*	*"N" Rebound Number*	*Compressive Strength MPa*
TP-C	3.60	45	Vertical	32.4	33
TP-D	0.60	32	Vertical	0.0	0
TP-F	3.60	51	Vertical	27.7	25

Operator	Checked	Approved
JMCN	JW	JW

ASTM C805

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Point Load Testing

Location: Keerglen Wind Farm

Project No: 2225-23

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Sample no:	Postion	Sample Depth (m)	Diameter (mm) "D"	Max Load (kN) "P"	Point Load Strength (Mpa) "I_s"	Size Correction Factor (F)	Corrected Point Load Strength (MPa) "$I_{s(50)}$"
TP-C	IL	3.60	45	16.108	7.95	0.95	7.59
TP-C	IL	3.60	24	6.403	11.12	0.72	7.99
TP-C	IL	3.60	56	18.2	5.80	1.05	6.11
TP-D	IL	0.60	30	0.278	0.31	0.79	0.25
TP-D	IL	0.60	25	0.01	0.02	0.73	0.01
TP-D	IL	0.60	30	0.334	0.37	0.79	0.29
TP-F	IL	3.60	46	28.393	13.42	0.96	12.92
TP-F	IL	3.60	45	20.42	10.08	0.95	9.62
TP-F	IL	3.60	63	16.72	4.21	1.11	4.67

Operator	Checked	Approved
JMCN	JMCN	JW

AS TM D5731-08

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APPENDIX D
TRIAL HOLE PHOTOGRAPHS

Photographic Plates 15 x A4

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Trial Pit TP-A



Trial Pit TP-A

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Trial Pit TP-A



Trial Pit TP-B

RECEIVED: 29/08/2024



Trial Pit TP-B



Trial Pit TP-B

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Trial Pit TP-C



Trial Pit TP-C

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RECEIVED: 29/08/2024

Trial Pit TP-C



Trial Pit TP-C

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Trial Pit TP-D



Trial Pit TP-D

RECEIVED: 29/08/2024



Trial Pit TP-D



Trial Pit TP-D

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Trial Pit TP-D



Trial Pit TP-D

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Trial Pit TP-D



Trial Pit TP-D

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Trial Pit TP-D



Trial Pit TP-E

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Trial Pit TP-E



Trial Pit TP-E

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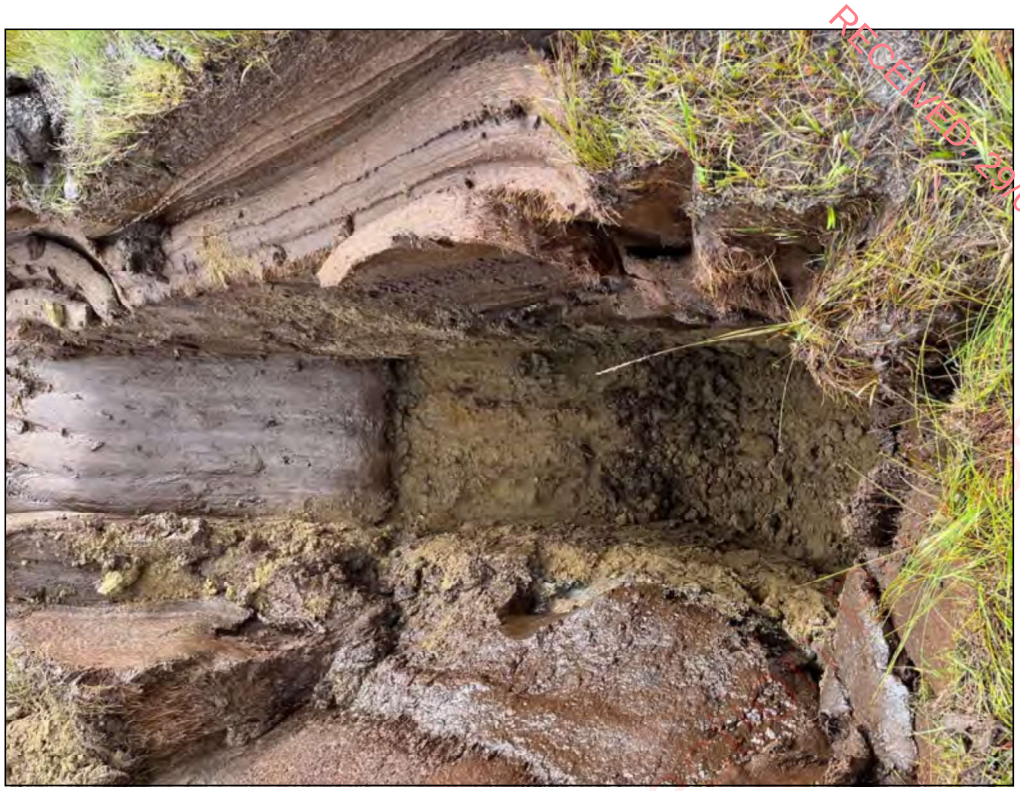
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Trial Pit TP-E



Trial Pit TP-F



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Trial Pit TP-F



Trial Pit TP-F

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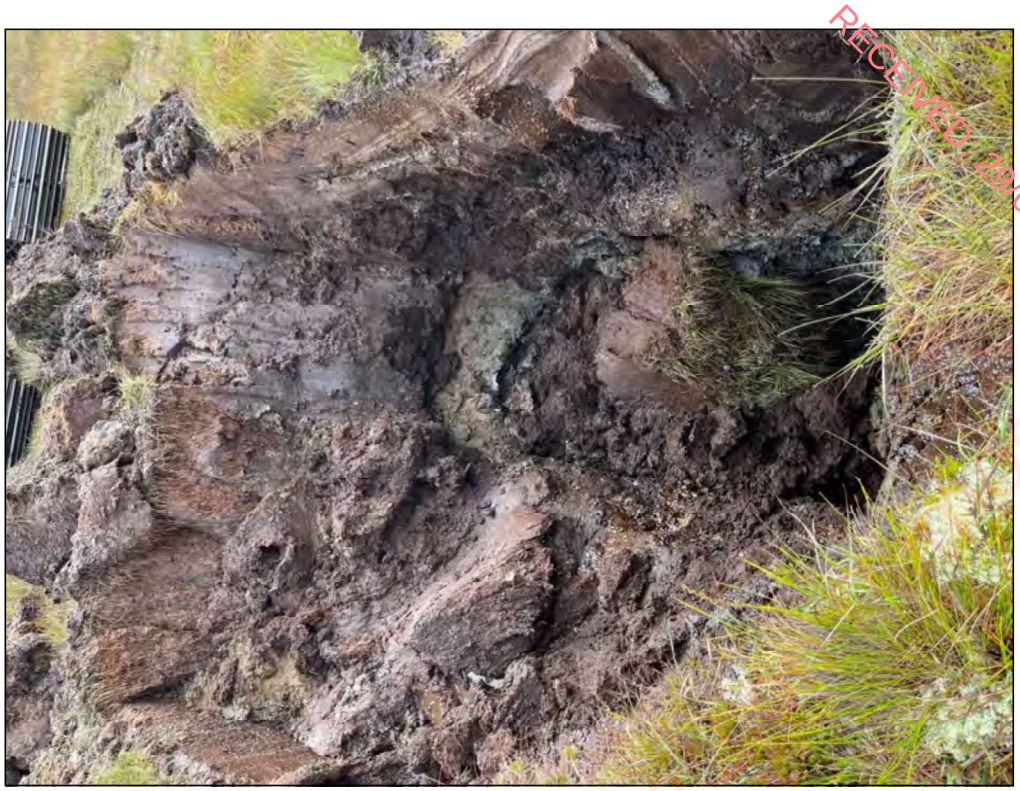


Trial Pit TP-G



Trial Pit TP-G

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Trial Pit TP-G



Trial Pit TP-G

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QUALITY ISO 9001:2015 NSAI Certified
ENVIRONMENT ISO 14001:2015 NSAI Certified

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Appendix 8.2

Peat and Spoil Management Plan

Keerglen Wind Farm

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CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

PEAT & SPOIL MANAGEMENT PLAN

KEERGLEN WIND FARM

Prepared for: **ABO Wind Ltd**

25 years ABO WIND

Date: May 2024

Unit 6, Bagenalstown Industrial Park, Bagenalstown,
Co. Carlow, R21 XW81, Ireland
T: +353 59 9723800 E: info@ftco.ie

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PEAT AND SPOIL MANAGEMENT PLAN
KEERGLEN WIND FARM

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REVISION CONTROL TABLE, CLIENT, KEYWORDS AND ABSTRACT
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	TC	BdeH	01.05.24

Client: ABO Wind Ltd

Keywords: Peat, Spoil, Management, Excavation, Borrow Pits

Abstract: Fehily Timoney and Company (FT) were engaged by ABO Wind Ltd. to compile a Peat and Spoil Management Plan (PSMP) for Keerglen wind farm. The purpose of this report is to provide a Peat and Spoil Management Plan for the construction phase of the wind farm. The report describes how peat and spoil which will be excavated from infrastructure locations such as turbine bases and roads and will be handled and placed/reinstated onsite. The report also provides construction details for the types of roads which will be put in place at the site and proposed peat and spoil placement/reinstatement areas which will be developed at the site.

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1. INTRODUCTION

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1.1 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 c.100 members of staff, including engineers, scientists, planners and technical support staff. We 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.

This Report was written by Ian Higgins (FT Principal Geotechnical Engineer, MSc in Geotechnical Engineering). Ian is a Technical Director with Fehily Timoney and has over 25 years' experience in geotechnical engineering.

1.2 Project Description

Fehily Timoney and Company (FT) was engaged in May 2022 by ABO Wind Ltd. to compile a Peat and Spoil Management Plan for the proposed Keerglen wind farm site (the 'Proposed Development').

The Proposed Development will be located at a site located approximately 5km southwest of Ballycastle, Co. Mayo.

The Proposed Development site comprises open blanket peatland. The surrounding landscape is undulating with land-use comprising forestry, cutover bog, agriculture, and blanket peatland.

1.3 Purpose

The purpose of this report is to provide a peat and spoil management plan with particular reference to peat stability for the construction phase of the project. The report describes how peat and spoil which will be excavated from infrastructure locations such as turbine bases and roads will be handled and placed/reinstated onsite. The report also provides construction details for the types of roads which will be put in place at the site and proposed peat and spoil placement/reinstatement areas which will be developed at the site.

This peat and spoil management plan also includes a monitoring programme which will be implemented during the construction phase of the wind farm and a contingency plan should peat instability/failure occur at the site.

As for all construction projects, a detailed engineering construction design must be carried out by the appointed construction stage designer prior to any construction work commencing on site. This must take account of the consented project details and any conditions imposed by that consent. This must include a detailed peat stability assessment to account for any changes in the environment which may have occurred in the time leading up to the commencement of construction and a peat and spoil management plan to allow for the most appropriate geotechnical and environmental led solutions to be developed for the management of peat and spoil.

As work is carried out on site the contents of the peat and spoil management plan and peat stability monitoring programme will be implemented in full and updated (if required) in the Construction & Environmental Management Plan (CEMP) for the construction phase.

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This peat and spoil management plan contains some drainage guidelines for construction works and for management of peat on site. It should be noted that the control of water quality and drainage measures for site is outlined in detail in Chapter 7 of the Environmental Impact Assessment Report (EIAR).

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1.4 Peat Instability Definition

Peat instability in this report is defined as a mass movement of a body of peat that would have a significant adverse impact on the surrounding environment. Peat instability excludes localised movement of peat that would occur below a floating access road (not proposed as part of this development), creep movement or localised erosion type events.

Adherence to the peat and spoil management plan should reasonably minimise the potential for all such peat movements. However, it is noted that due to the soft ground nature of the peat terrain it is not possible to completely avoid such localised peat movement as described above.

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2. CONSTRUCTION ACTIVITIES COVERED BY PEAT AND SPOIL MANAGEMENT PLAN

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2.1 Construction Activities

For the construction phase of the Keerglen wind farm the activities that will generate peat and spoil are as follows:

(1) Upgrade of existing access tracks (as excavate and replace tracks)
(2) Construction of new excavated roads through peat
(3) Excavation and placement of arisings
(4) Excavations in peat and overburden for borrow pits
(5) Excavations in peat for turbine bases, hardstands and other infrastructure foundations
(6) Excavations for underground cables

Peat and spoil management of the above construction activities are covered individually in this report.

2.2 Road Construction Types

To provide access within the site and to connect the wind turbines and associated infrastructure existing tracks will need to be upgraded and new access roads will need to be constructed. The road construction preliminary design has taken into account the following key factors:

(1) Buildability considerations
(2) Maximising use of existing infrastructure
(3) Minimising excavation arisings
(4) Peat stability
(5) Serviceability requirements for construction and wind turbine delivery and maintenance vehicles
(6) Requirement to minimise disruption to peat hydrology

Whilst the above key factors are used to determine the road design the actual construction technique employed for a particular length of road will be determined by the prevailing ground conditions encountered along that length of road.

The general road construction techniques to be considered are given in Table 2-1.

This report describes the most suitable type of road construction for each section of access road based on the ground/site conditions recorded during the site walkovers. It should be noted that this report does not include a detailed design for the access roads on the Proposed Development site.

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Table 2.1: General Road Construction Techniques

Construction Method	Typical Site Conditions			Comment
	Construction Type	Typical Peat Depth (m)	Typical Slope Inclination (degs)	
Upgrade of existing access roads	Type A	<2.5	Varies	Upgrade existing excavated/ floated access roads to the required width and finished with a layer of selected granular fill – Drawing P22-070-0600-0005.
Construction of new excavated roads through peat	Type B	Typically, less than 2.0m, locally up to 4.4m	Varies	New access road construction technique envisaged for various locations on site – Drawing P22-070-0600-0005.

Further details on access road construction types A and B are given in Sections 3 and 4 of the report.

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3. UPGRADE OF EXISTING ACCESS ROADS – TYPE A

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Up to 2.0km of existing access track requiring upgrade is present across the Keerglen wind farm site and have been in operation for a significant number of years. The existing access roads appear to have been constructed using a floating construction technique. Upgrade works will involve the excavation and replacement of the existing access road. The proposed locations for upgrade of the existing access roads on site are shown in Drawing P22-070-0600-0005 and details are shown in Drawing P22-070-0600-0006.

3.1 Upgrading Existing Access Tracks Construction Methodology

This methodology includes procedures that will be included in the construction to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations, which are discussed separately in Chapter 3 of the EIAR.

(1) Access road construction will be to the line and level requirements as per design/planning conditions.

(2) For upgrading of all existing access roads (Type A – Drawing P22-070-0600-0006) the following guidelines apply:

- (a) Excavation of the access road will take place to a competent stratum beneath the peat, removing all peat and soft clay and backfilled with suitable granular fill.
- (b) Benching of the excavation will be required between the existing section of access road and the widened section of access road where the depth of excavation exceeds 500mm.
- (c) For a founded access road, the surface of the existing access road will be overlaid with up to 500mm of selected granular fill.
- (d) Access roads will be finished with a layer of capping across the full width of the road.
- (e) A layer of geogrid/geotextile may be required at the surface of the existing access road where the existing tracks shows signs of rutting, etc.
- (f) For excavations in peat, side slopes will be not greater than 1 (v): 3 (h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required to ensure stability.

(3) The finished road width will have a running width of 5m, with wider sections on bends and corners.

(4) On side long sloping ground any road widening works required will be done on the upslope side of the existing access road, where possible.

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4. CONSTRUCTION OF NEW EXCAVATED ROADS THROUGH PEAT – TYPE B

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The excavation of peat and spoil and founding of access roads on competent stratum (below the peat) for new access roads will be carried out at various locations on the site. The proposed locations for new excavated access roads on site are shown in Drawing P22-070-0600-005 and details are shown in Drawing P22-070-0600-007.

Excavate and replace type access roads are the conventional method for construction of access roads on peatland sites and the preferred construction technique for this site provided sufficient placement/reinstatement capacity is available on site for the excavated peat. This construction method will also be used to replace existing floating roads within the site.

4.1 New Excavated Road Construction Methodology

This methodology includes procedures that will be adopted in the construction to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations, which are discussed in Chapter 3 and 7 of the EIAR.

(1) Prior to commencing the construction of the excavated roads, movement monitoring posts will be installed in areas where the peat depth is greater than 2.0m, and in areas identified within the peat stability risk assessment (see Geotechnical & Peat Stability Assessment, FT, 2024) as requiring monitoring.

(2) Interceptor drains will be installed upslope of the access road alignment to divert any surface water away from the construction area.

(3) Excavation of roads will be to the line and level given in the design requirements. Excavation will take place to a competent stratum beneath the peat.

(4) Road construction will be carried out in sections of approximately 20m lengths i.e. no more than 20m of access road will be excavated without replacement with stone fill. This length will be reduced to 5m in areas identified within the peat stability risk assessments.

(5) Once excavated, peat will be temporarily stored in localised areas adjacent to excavations for roads and hardstands before being placed into the permanent peat storage areas within the borrow pits. All peat placement areas will be upslope of founded roads/hardstands and will be inspected by the Project Geotechnical Engineer before material is stored in the area. No material is to be sidecast or stored on the in-situ peat on the downslope side of the access roads.

(6) Excavation of materials with respect to control of peat stability:

(a) Acrotelm (to about 0.3 to 0.4m of peat) will be required for landscaping and will be stripped and temporarily stockpiled for re-use as required. Acrotelm stripping will be undertaken prior to main excavations.

(b) Where possible, the acrotelm will be placed with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation.

(c) All catotelm peat (peat below about 0.3 to 0.4m depth) will be transported immediately on excavation to the designated placement areas or the borrow pit.

(7) Excavation side slopes in peat will be not greater than 1 (v): 3 (h). This slope inclination will be reviewed during construction, as appropriate. Should areas of weaker peat be encountered then

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slacker slopes will be required. Battering of the side slopes of the excavations will be carried out as the excavation progresses.

(8) End-tipping of stone onto the road during the construction/upgrading of the access road will be carefully monitored to ensure that excessive impact loading, which may adversely affect the adjacent peat, is limited.

(9) The excavated access road will be constructed with a minimum of 750mm of selected granular fill. Granular fill to be placed and compacted in layers in accordance with the TII Specification for Road Works.

(10) Access roads will be finished with a layer of capping across the full width of the road.

(11) A layer of geogrid/geotextile may be required at the surface of the competent stratum, where this stratum is cohesive in nature.

(12) Where slopes of greater than 5 degrees are encountered along with relatively deep peat (i.e. greater than 1.5m) and where it is proposed to construct the access road perpendicular to the slope contours it is best practice to start construction at the bottom of the slope and work towards the top, where possible. This method avoids any unnecessary loading to the adjacent peat and greatly reduces any risk of peat instability.

(13) Where the above is not possible, a specific Risk Assessment Method Statement (RAMS) from the contractor will be produced, detailing how the downslope works will be undertaken, including that all plant would operate from the already constructed section of track, with no loading of the peat on the downslope slope and limiting the length of ground to be stripped/excavated at any one time. Movement monitoring posts (as described in the Peat & Spoil Management Plan, Appendix 4-2) will also be installed downslope of the works area to allow for ongoing monitoring during the construction works.

(14) A final surface layer will be placed over the excavated road and graded to accommodate wind turbine construction and delivery traffic.

(15) The construction and upgrading of access roads in areas of deep peat (greater than 2m) will be inspected on a routine basis (by the Site Manager/Ecological Clerk of Works/Project Geotechnical Engineer) during the works, particularly before/following trafficking by heavy vehicular loads.

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5. EXCAVATION AND STORAGE OF PEAT AND SPOIL

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5.1 Excavation and Storage of Arisings Methodology

This methodology includes procedures that are to be included in the construction phase to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations, described in Chapter 3 of the EIAR.

(1) All excavated peat and spoil will be either temporarily stockpiled locally at turbine hardstands or transported immediately on excavation the borrow pit (see Drawing P22-070-0600-0005) or to one of the designated peat placement areas alongside the access roads or adjacent to the turbine locations. No material is to be sidecast or stored on the in-situ peat on the downslope side of the access roads/hardstands.

(2) Further details on the construction and reinstatement of the borrow pit are given in Section 5.4.

(3) Further details on the placement of excavated material to designated peat placement areas close to turbines are given in Section 6.5.

(4) Some of the peat, in particular the acrotelm (upper layer of the peat), excavated during construction will be used for landscaping purposes.

5.2 Summary of Peat and Spoil Volumes on Site

A summary of the excavated peat and spoil volumes calculated for the proposed Keerglen wind farm site is given in Table 5-1.

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Table 5.1: Summary of Excvated Peat and Spoil Volumes on Site

Infrastructure Element [1]	Proposed Dimensions	Peat Volume (m^3) [2]	Spoil (non-peat) Volume (m^3) (2) and (3)	Comment
8 no. Turbines and Hardstands	25m diameter excavation footprint for turbine foundation with 75 x 35m hardstand area.	55,000	1,000	
Access Roads	Assumed 5m running surface with 6m wide development footprint.	90,000	6,500	
Substation	Hardstanding area of 50 x 50m.	5,000	600	
Borrow Pit	235 x 110m.	47,500	22,000	
	Total =	**197,500m^3**	**41,100m^3**	**Total = 238,600m^3 (peat and spoil volume) [4]**

Note (1) The location of the infrastructure elements on site are shown on Drawing P22-070-0600-0005.

Note (2) A factor of 10% (bulking factor of 10%) has been applied to the excavated peat and spoil volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the site.

Note (3) It should be noted that the excavated rock volume is not included in the total volume quoted above in Table 5-1. It is assumed that the excavated rock volume will be re-used on site as part of the construction works for the development and hence will not require reinstatement on site.

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5.3 Summary of Peat and Spoil Placement/Reinstatement Areas on Site

A summary of the proposed peat and spoil placement/reinstatement areas at the Proposed Development site are given in Table 5-2.

Table 5.2: Summary of Peat and Spoil Placement/Reinstatement Areas on Site

Location (1)	Peat and Spoil Volume (m^3)	Comment
Borrow Pit	195,000	See Drawing P22-070-0600-0008 for further details
Peat placement alongside access roads	36,500	1m in height, 15m in width, along upslope side of founded roads, where slopes are relatively shallow (<5 degrees) (Drawing P22-070-0600-0009)
Landscaping (2)	16,000	It is estimated that 2,000m^3 of peat will be required for landscaping purposes at each of the 8 no. turbine locations.
Total =	**247,500m^3**	

Note (1) The location of the proposed borrow pits at the site are shown on Drawing P22070-0600-0005.

Note (2) Some of the acrotelm (upper layer of the peat) excavated during construction will be used for landscaping purposes.

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5.4 Construction and Reinstatement of Borrow Pit

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The locations of the proposed borrow pit is shown on Drawing P22-070-0600-0008. The peat depth within the development footprint of the borrow pit between 1.5 and 2.0m. the peat is underlain by a slightly clayey gravelly Sand, with weathered bedrock (sandstone) at between 3.5 and 4.0m bgl. The borrow pit location was selected based on the relatively shallow depth to bedrock. Bedrock (Sandstone) will be excavated and reused across the site as granular fill for roads and hardstands.

Upon removal of the rock from the individual cells within the borrow pit, it is proposed to reinstate the borrow pit using excavated peat and spoil. The excavated rock from the borrow pit will be used in the construction of the infrastructure elements (turbine bases, roads, etc.) at the wind farm. The contractor excavating the rock will be required to develop the borrow pit in a way which will allow the excavated peat and spoil to be placed safely. It is proposed to construct cells within the borrow pit for the placement of the excavated peat and spoil. This is to allow for the safe placement and grading of the peat and spoil using dumper trucks and excavators. It also eliminates the need to construct above ground retaining structures which may have an unnecessary visual impact and increase the development footprint of the proposed wind farm. The text below provides design and construction commitments for the borrow pit.

It should be noted that there are significant excavation works required in order to develop the borrow pit at the site. Excavation works will be undertaken and supervised by an experienced contractor and the Project Geotechnical Engineer. The text below provides some design and construction guidelines for the borrow pit.

Drawing P22-070-0600-0008 show typical construction details for the borrow pit.

The borrow pit will be constructed as follows:

(1) Peat and overburden will be removed and temporarily stored in localised areas adjacent to the borrow pit locations before being placed into the permanent peat storage areas within the borrow pits. The rock within the proposed borrow pit footprints will be removed by either breaking or blasting depending on its excavatability, which will be determined from confirmatory ground investigation carried out at the proposed borrow pits. The ground investigation will comprise rotary core drilling with associated engineering logging including rock quality designation and strength and durability testing. Data from the available ground investigation undertaken to date indicates that the rock can be removed by breaking. It is unlikely that blasting will be required to remove the bedrock.

(2) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road. As excavation progresses into the back edge of the borrow pits, localised deepening of the borrow pit floors may be required depending on extraction operations.

(3) Slopes within the excavated rock formed around the perimeter of the borrow pits will be formed at stable inclinations to suit local in-situ rock conditions. Exposed sections of the rock slopes will be left with irregular faces and declivities to promote re-vegetation and provide a naturalistic appearance.

(4) The stability of the rock faces within the borrow pit will be inspected by the Project Geotechnical Engineer upon excavation to ensure stability during construction works and in the long term. This inspection will allow unfavourable rock conditions to be identified and suitable mitigation measures to be applied such as removal of loose rock, in line with best practice guidelines.

(5) It will be necessary to construct rock buttresses founded on in-situ rock within the borrow pits to create individual cells (2 no.). The cells will be opened in sequence and filled as needed. The rock buttresses will be constructed of rock fill from the borrow pit excavation, placed and compacted in layers. The founding stratum for each rock buttress will be intact bedrock and will be inspected and approved by the Project Geotechnical Engineer.

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(6) The rock buttresses will be constructed in stages to allow infilling of peat and spoil within cells. The buttress will be constructed of selected rock fill and placed and compacted in suitable layers to form a buttress of sufficient stability to retain the placed peat and spoil.

(7) Infilling of the peat and spoil will commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress. The contractor excavating the rock will be required to develop the borrow pit in a way which will allow the excavated peat and spoil to be reinstated safely.

(8) A number of rock buttresses to form cells with the borrow pit will be required to ensure access for trucks and excavators can be achieved. See Drawing P22-070-0600-0008 for the location of the rock buttresses. The locations of the rock buttresses shown on Drawing P22-070-0600-0008 for the borrow pit are indicative only and may change subject to local conditions encountered on site during construction and as a result of the confirmatory ground investigation. The rock buttresses will be wide enough (up to 4m) to allow construction traffic access for tipping and grading during the placement of the excavated peat and spoil. The permanent side slopes of the rock buttress will be constructed at between 40 to 60 degrees.

(9) The rock buttresses will be wide enough (up to 4m at the crest) to allow construction traffic access for tipping and grading during the placement of the excavated peat and spoil. The permanent side slopes of the rock buttress will be constructed between 40 to 60 degrees.

(10) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttress will be constructed of well graded granular rock fill of about 100mm up to typically 500mm in size. In addition, drains will be placed through the buttresses to allow surface water to drain from the surface of the placed peat.

(11) The use of temporary access ramps and long reach excavators during the placement of the excavated peat and spoil will be required.

(12) The surface of the placed peat and spoil will be shaped to allow efficient run-off of surface water from the placed arisings towards the perimeter of the borrow pit.

(13) As the internal buttresses are slightly higher than the retained peat, drains will be provided at regular intervals through the berms, at the same level as the top of the peat surface, to prevent ponding of water around the edges of the repositories. These drains will be 150mm diameter flexible plastic drainage pipe or equivalent.

(14) A layer of geogrid to strengthen the surface of the placed peat and spoil within the borrow pit will be required.

(15) An interceptor drain will also be installed around the perimeter of the borrow pit. This drain will divert any surface water away from the borrow pit and hence prevent water from ponding and lodging during construction and also when reinstated.

(16) Temporary control of groundwater within the borrow pits will be required and measures will be determined as part of the ground investigation programme. A temporary pump and suitable outfall locations will be required during construction.

(17) Settlement ponds have been designed at the lower side/outfall location of the borrow pit.

(18) The acrotelm will be placed with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the peat and spoil within the borrow pit.

(19) Supervision by the Project Geotechnical Engineer is required for the development of the borrow pit.

(20) All the above-mentioned requirements will be implemented by the Contractor during construction.

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5.5 Designated Peat Placement Areas alongside Access Roads

The following commitments for the placement of peat alongside the access roads and as landscaping around turbines will be implemented during construction. These areas have been selected based on the depth of peat and the slope angle.

(1) Excavated peat will be placed/spread on the upslope side of sections of access road. These locations are shown in Figure P22-070-0600-0005.

(2) The peat placed within the areas shown on Drawing P22-070-0600-0005 will be restricted to a maximum height of 1m over a 15m wide corridor. Weak/liquified peat must be placed within the proposed borrow pit and not stored within these areas.

(3) The placement of excavated peat will be avoided without first establishing the adequacy of the ground to support the load. The placement of peat and spoil within the placement areas will require the use of long reach excavators, low ground pressure machinery and possibly bog mats in particular for drainage works.

(4) Where there is any doubt as to the stability of the peat surface then no material will be placed on to the peat surface. The risk of peat instability is reduced by not placing any loading onto the peat surface.

(5) It should be ensured that the surface of the placed peat is shaped to allow efficient run-off of surface water. Shaping of the surface of the peat will be carried out as placement of peat within the placement area progresses. This will reduce the likelihood of debris run-off and reduce the risk of instability in the placed peat.

(6) Finished/shaped side slopes in the placed peat will be not greater than 1 (v): 4 (h). This slope inclination will be reviewed during construction, as appropriate.

(7) The acrotelm will be placed on the finished surface with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the placed peat within the placement areas.

(8) Movement monitoring instrumentation will be placed around the areas where peat has been placed. The locations where monitoring is required will be identified by the Project Geotechnical Engineer on site.

(9) Supervision by the Project Geotechnical Engineer is required for the works.

(10) An interceptor drain will be installed upslope of the designated peat placement areas to divert any surface water away from these areas. This will help ensure stability of the placed peat and reduce the likelihood of debris run-off.

(11) All the above-mentioned commitments will be undertaken by the Contractor during construction.

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6. EXCAVATIONS IN PEAT FOR TURBINE BASES, HARDSTANDINGS AND INFRASTRUCTURE FOUNDATIONS

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The turbine bases will be founded on competent founding strata which will require excavation through peat and any soft overburden. Some turbine bases may require a piled solution following confirmatory ground investigations by the Contractor.

Similarly, crane hardstandings, construction compound, substation platforms and met mast foundations are to be founded on competent mineral soil which will also require excavation through peat and spoil. Excavations for the borrow pits will also require the removal of peat and non-peat spoil overlying the rock.

6.1 Methodology

This methodology includes procedures that will be included in the construction to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations, which are covered in Chapter 4 of the EIAR.

(1) With respect to placement of arisings from excavations the commitments given in Section 6 are to be followed.

(2) All excavations within peat will be adequately supported or peat slopes will be battered to a safe slope inclination typically of 1(v): 3(h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required.

(3) Excavations will be kept reasonably free from water at all times. Water will be prevented from being impounded within excavations by either using drainage channels cut into the excavation face or by pumping.

(4) Where water is channelled or pumped from an excavation then this water will be fed into an established watercourse or drainage ditch following suitable treatment, as described in Chapter 7 of the EIAR.

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7. EXCAVATIONS FOR UNDERGROUND CABLES

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A 110kV connection between the Keerglen Wind Farm and the national electricity grid or large energy users at Killala Business Park will be necessary to export electricity. It is proposed that the Keerglen Wind Farm will connect to the national grid via an existing substation located in at Tawnaghmore or to a large energy user at Killala Business Park to the east of the Proposed Development. The proposed underground electricity export connection is approximately 22.8km in length and will follow existing roads and the public road corridor.

The proposed underground electricity export connection construction methodology, including proposals for water crossings on the underground cabling routes is described in Appendix 3.2 of the EIAR.

It is proposed to install the underground cable at a uniform level within the footprint of the access roads and TDR. The underground electricity export connection route will encounter peat and till derived from limestone and will be constructed on solid ground to Eirgird specifications.

7.1 Methodology

This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability. The methodology is not intended to cover all aspects of construction such as drainage and environmental considerations, which are described in Chapter 4 of the EIAR.

(1) With respect to placement of arisings from excavations the guidelines given in Section 6 will be followed.

(2) All excavations within peat will be adequately supported or peat slopes will be battered to a safe slope inclination typically of 1(v): 3(h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required.

(3) Similarly, all excavations within non-peat overburden for the cable trench will be adequately supported or battered to a safe slope inclination typically of 1(v): 1.5 or 2(h). This slope inclination will be reviewed during construction, as appropriate.

(4) Excavations will be kept reasonably free from water at all times.

(5) Any overburden excavated from the cable trench will be transported to the borrow pit for storage. Any pavement materials containing tar will be transported to an authorised waste facility.

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8. GENERAL COMMITMENTS FOR GOOD CONSTRUCTION PRACTICE

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To minimise the risk of construction activity causing potential peat instability the Construction Method Statements (CMS) for the project will also implement, but not be limited to, the general measures below together with the specific measures.

(1) Uncontrolled concentrated water discharge onto peat slopes identified as being unsuitable for such discharge will be avoided. All water discharged from excavations during work will be piped over areas specifically assessed as being unsuitable and hence directly into suitable drainage lines.

(2) All excavations will be suitably supported to prevent collapse and development of tension cracks.

(3) Avoidance of placing fill and excavations in the vicinity of steeper peat slopes, that is at the crest or toe of the slope.

(4) Installation and regular monitoring of geotechnical instrumentation during construction in areas of possible poor ground, such as deeper peat deposits (see Section 9).

(5) Site reporting procedures will be implemented to ensure that working practices are suitable for the encountered ground conditions. Ground conditions to be assessed by suitably experienced geotechnical engineer.

(6) Regular briefing of all site staff (e.g. toolbox talks) to provide feedback on construction and ground performance and to promote reporting of any observed change in ground conditions.

(7) Routine inspection of the wind farm site by the Contractor and Project Geotechnical Engineer will be undertaken and will include an assessment of ground stability conditions (e.g. cracking, excessive floating road settlement, disrupted surface, closed-up drains) and drainage conditions (e.g. blocked drains, absence of water in previously flowing drains, springs, etc).

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9. INSTRUMENTATION

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9.1 Movement Monitoring Posts

To monitor possible peat movements, it is proposed to install sighting posts upslope and downslope of the access road at staggered intervals at locations where the peat depth is greater than 2.0m. Additional monitoring locations will be required at infrastructure locations with deeper peat deposits, as determined by the Designer or Project Geotechnical Engineer. Details of sighting posts are given below.

(1) A line of sighting posts will comprise:

(a) A line of wooden stakes (typically 1 to 1.5m long) placed vertically into the peat to form a straight line.

(b) The sighting line will comprise 6 no. posts at 5m centres that is a line some 25m long.

(c) A string line will be attached to the first and last posts and all intervening posts will be adjusted so they are just touching the string line.

(2) Lines of sighting posts will be placed across the existing slope about 5m away from the area to be worked. The posts will be located along the road at 10m intervals in areas of deep peat (say greater than 2.0m). Where there are relatively steeper slopes or softer ground a sighting line will be placed down the slope, or at any location where monitoring is deemed necessary by the Designer or the Project Geotechnical Engineer.

(3) Each line of sighting posts will be uniquely referenced with each post in the line given a reference. The post reference will be marked on each post (e.g. reference 1-1, 1-2, 1-3, 1-4, 1-5, 1-6 for posts in line 1).

(4) The sighting lines will be monitored at the beginning of each working day, and during the day where considered appropriate (e.g. when working activity is concentrated at a specific location).

(5) Monitoring of the posts will comprise sighting along the line and recording any relative movement of posts from the string line.

(6) Where increased movements are recorded the frequency of monitoring will be increased.

(7) A monitoring record will be kept of the date, time and relative movement of each post, if any. This record will be updated and stored as a spreadsheet.

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10. CONTINGENCY MEASURES

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10.1 Excessive Movement

Where there is excessive movement or continuing peat movement recorded at a monitoring location or identified at any location within the site but no apparent signs of distress to the peat (e.g. cracking, surface rippling) then the following will be carried out.

(1) All activities (if any) will cease within the affected area.

(2) Increased monitoring at the location will be carried out. The area will be monitored until such time as movements have ceased.

(3) Re-commencement of activities will only start following a cessation of movement and agreement with all parties (Contractor/Engineer/Designer).

10.2 Onset of Peat Slide

In the unlikely event where there is the onset or actual detachment of peat (e.g. cracking, surface rippling) then the following will be carried out.

(1) On alert of a peat slide incident, all activities (if any) in the area will cease and all available resources will be diverted to assist in the required mitigation procedures.

(2) Action will be taken to prevent a peat slide reaching any watercourse. This will take the form of the construction of check barrages on land. Due to the terrain and the inability to predict locations it may not be possible to implement any on-land prevention measures, in this case a watercourse check barrage will be implemented.

(3) All relevant authorities will be notified if a peat slide event occurs on site.

(4) For localised peat slides that do not represent a risk to a watercourse and have essentially come to rest the area will be stabilised initially by rock infill, if required. The failed area and surrounding area will then be assessed by the engineering staff and stabilisation procedures implemented. The area will be monitored, as appropriate, until such time as movements have ceased.

10.3 Check Barrages

Whilst it is not anticipated based on the analysis undertaken that a peat slide will occur on site, as a contingency a check barrage procedure is included below.

The check barrage procedure deals with preventing a peat slide from moving downstream within a watercourse.

The most effective method of preventing excessive peat slide debris from travelling downstream in a watercourse is the use of a check barrage. A check barrage comprises the placement of rock fill across a watercourse. The check barrage is a highly permeable construction that will allow the passage of water but will prevent peat debris from passing through. Rock fill will comprise well-graded coarse rock pieces from about 300mm up to typically 1000mm.

The rock fill for the check barrage will be sourced from the borrow pit on site.

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The size of the barrage will vary depending on the scale of the peat debris to be contained and the geometry of the watercourse at the barrage location. In general, due to the low speed of a peat slide there is generally little impact force and most of the lateral load is due to fluid pressure on the upslope face of the barrage.

The check barrage will fill the entire channel width of the watercourse up to a height of 3 to 4m with a crest width of typically 2m and side slopes of about 45 degrees depending on the geometry of the barrage location.

The check barrage procedure is as follows:

(1) Access to the check barrage location will be along the existing access roads on the wind farm site and/or along public roads, where possible. When it is necessary to form the barrage then rock fill will be placed across the watercourse to effectively block the passage of peat debris.

(2) Operatives employed to carry out the construction of the check barrage will be inducted by means of a briefing by on-site supervisors as to the proposed location of the check barrage.

(3) The check barrage provides containment for peat debris in the highly unlikely event of a major peat slide. Further remedial measures, should they be required, will be assessed by the Contractor and the Project Geotechnical Engineer, and carried out as soon as physically possible when the location and extent of the failure is established.

(4) Where a barrage was constructed as a precaution and no peat debris reached the watercourse then the barrage will be removed as soon as any measures to prevent further peat sliding is agreed with all parties (Contractor/Engineer/Designer).

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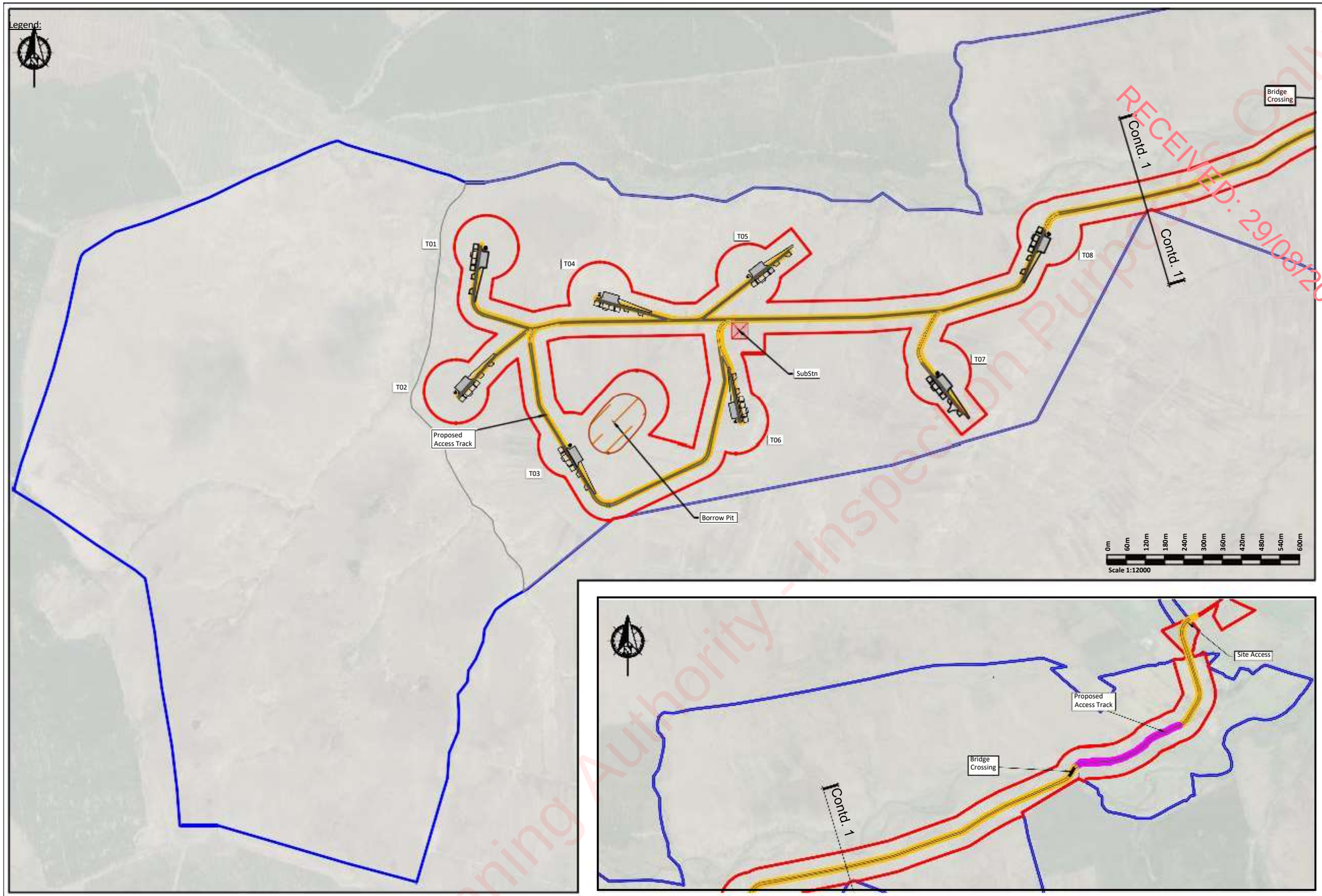
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DRAWINGS

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Legend:

- Site Boundary
- Folio Boundary



PLAN

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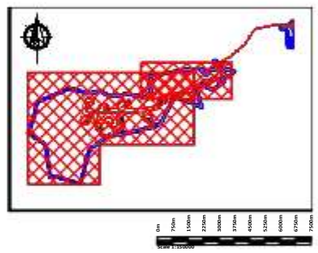
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Road Type Legend:

Type A -
Upgrade of Existing Excavated Access Tracks

Type B -
New Excavate & Replace Access Road



KEYPLAN

Scale 1:150000

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Rev.	Description	App By	Date
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PROJECT: KEERGLEN WINDFARM PEAT ASSESSMENT

CLIENT: ABO WIND

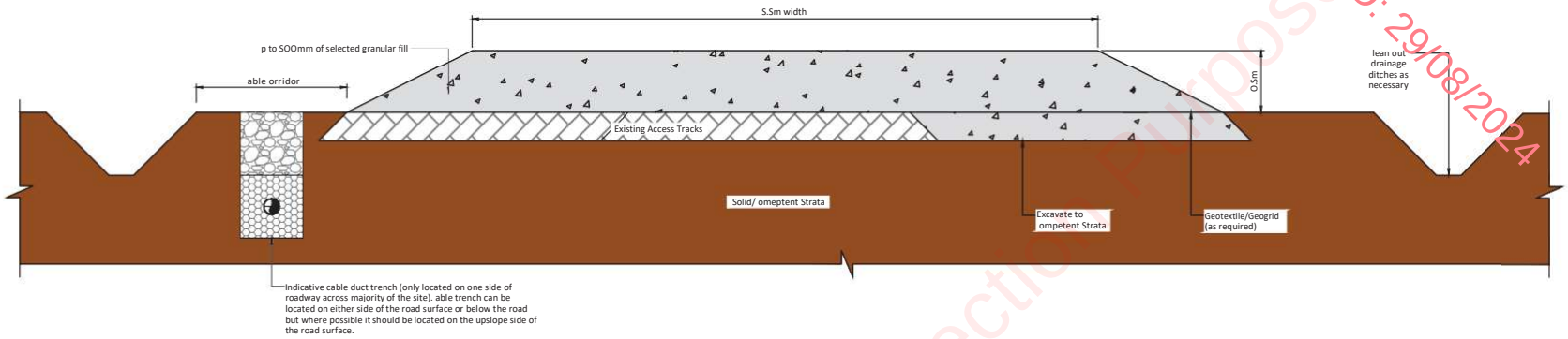
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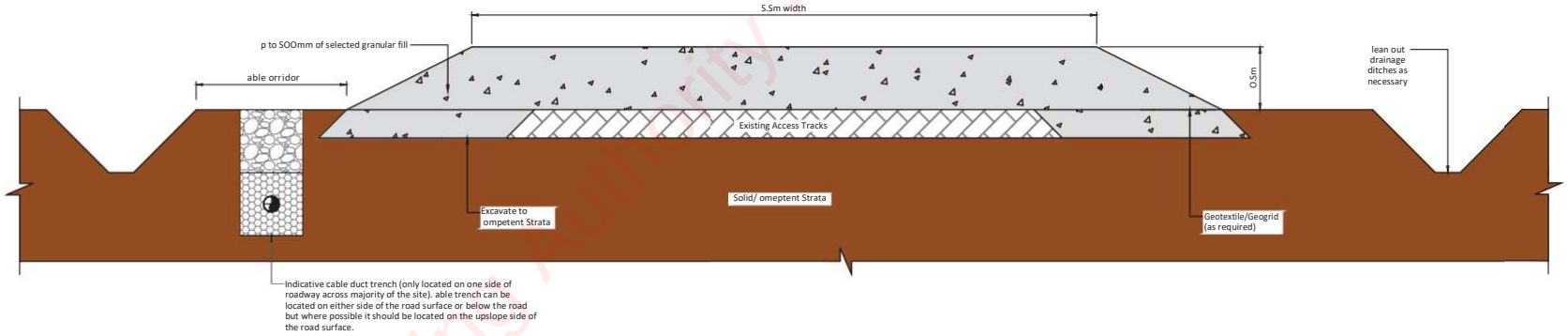
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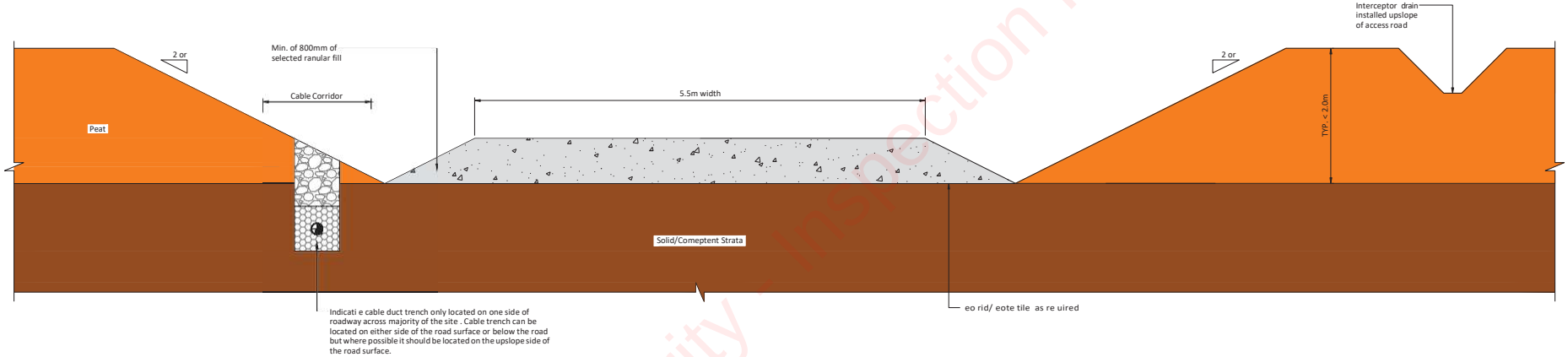
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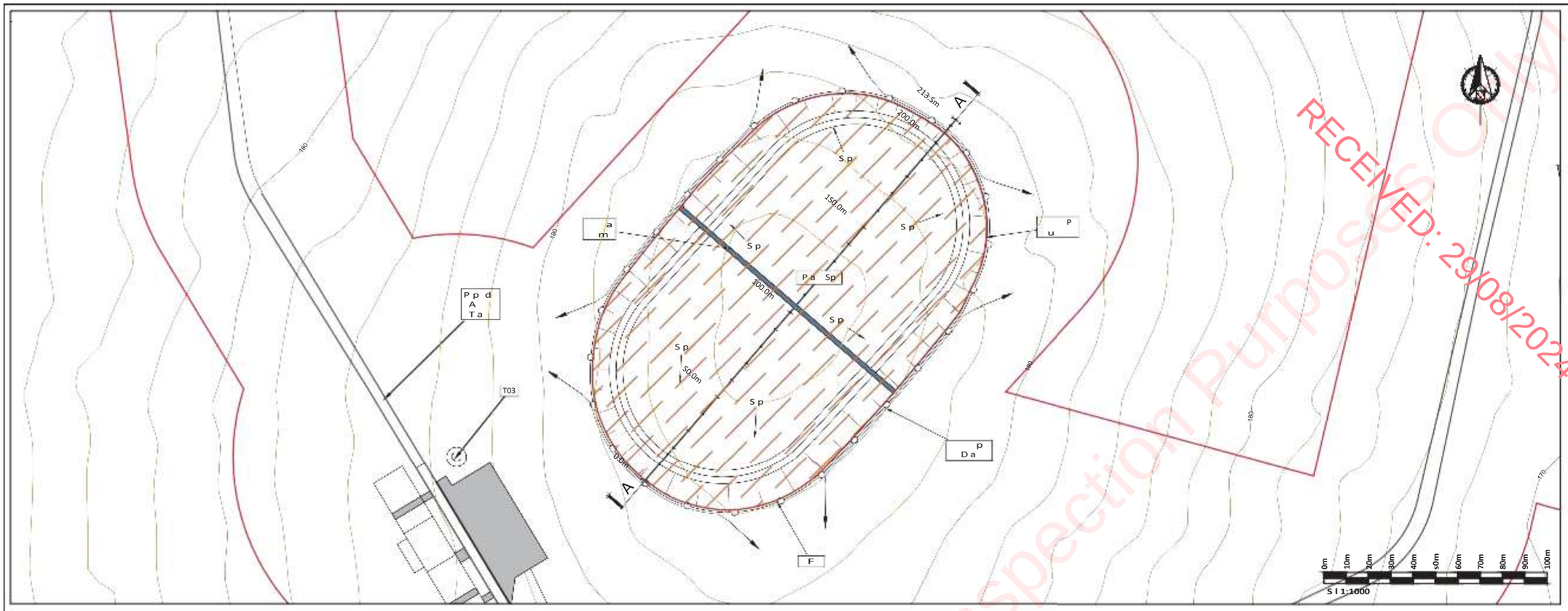
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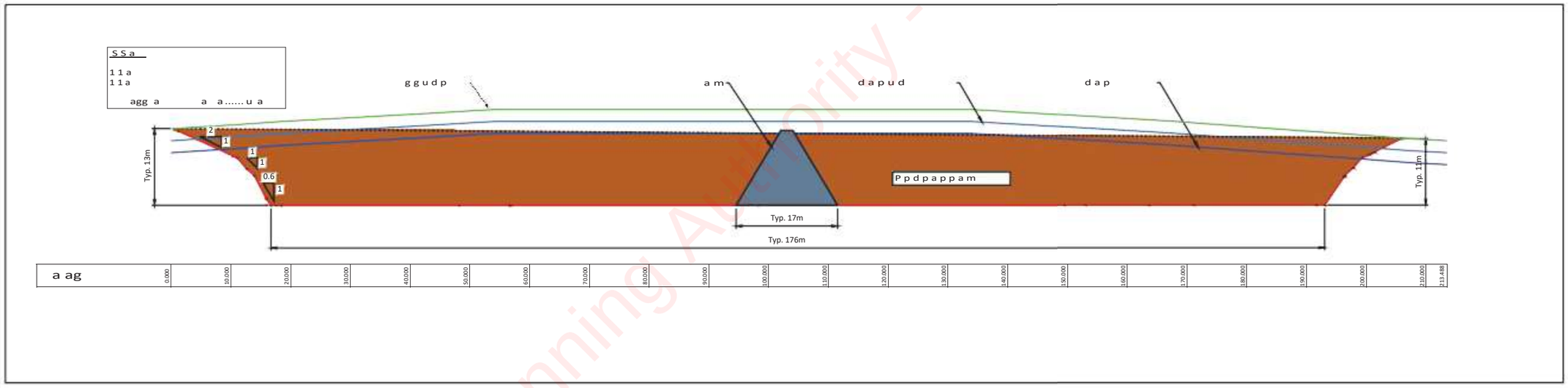
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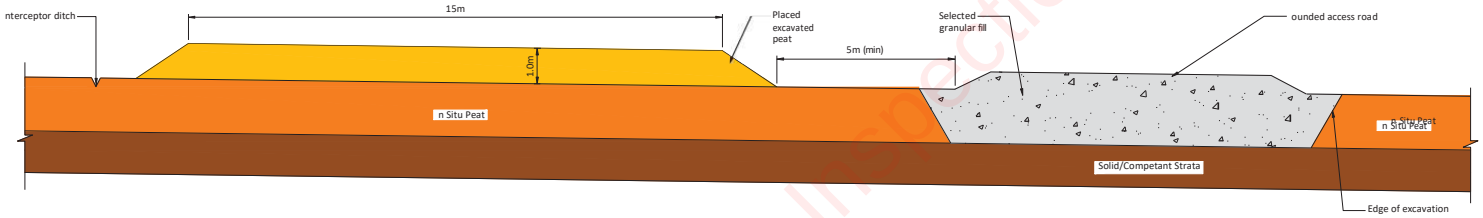
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Notes:

1) Peat/spoil material will spread to a depth not exceeding 1.0m in height.
2) See section 5.5 of the Peat & Spoil Management Plan.
3) ndicative locations are given for drainage measures such as drainage ditches.
4) Stored peat to be shaped to allow surface water runoff.
5) Supervision by suitably qualified engineer is required during the works.

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Appendix 8.3

Borrow Pit Potential Assessment

Keerglen Wind Farm

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whiteford
explore the possibilities

Borrow Pit Potential Assessment at Keerglen Wind Farm, Co. Mayo, Ireland

Stage 2 – Follow-up Geotechnical Investigation and Laboratory Testing

Report No: 2225-23A Rev01

16th October 2023

This document has been prepared by Whiteford Geoservices Ltd on behalf of

ABO Wind Ireland Ltd

Whiteford Geoservices Ltd, 2 Main Street, Straid, Co. Antrim, BT39 9NE
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2.2 Published Geology

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B EXPLORATORY HOLES

C LABORATORY TESTING

D TRIAL PIT PHOTOGRAPHS

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1 INTRODUCTION

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In June 2023 Whiteford Geoservices were appointed by ABO Wind Ireland Ltd to investigate potential sites for a borrow pit at Keerglen Wind Farm, near Ballycastle, Co. Mayo.

Whiteford Geoservices' proposal consisted of a three-stage investigation process, as follows: -

Stage 1 – Geophysical Reconnaissance

a) Select the most promising region within the wind farm boundary to investigate. This area would have minimal environmental constraints, be outside the main construction zone and contain a topography with the best potential for yielding rock at an attainable depth (i.e. a small hill or local high point).

b) Use geophysical survey methods to map the subsurface to a depth of approximately 10m below existing ground surface to identify areas where rock could be present. Although a number of suitable geophysical survey techniques were appropriate for this stage Electrical Resistivity Tomography (ERT) was selected because of both its ability to rapidly map the sub surface, as a series of parallel profiles and the general accuracy of the ground modelling achieved.

c) The ERT surveys would be employed to search for regions of elevated ground resistivity in the subsurface, the most promising of which, would then be targeted for follow-on assessment in Stage 2.

Stage 2 – Exploratory Trial Hole Investigation

a) Excavate a series of trial holes at the target locations derived from an examination of the geophysical survey findings.

b) Recover suitable samples for laboratory testing.

Should Stage 2 yield suitable borrow pit locations then the assessment would proceed to Stage 3, Laboratory Testing

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Stage 3 – Laboratory Testing of Rock / Aggregate

a) Undertake a suite of laboratory aggregate tests to determine the suitability of the "won" aggregate for use in the construction of the wind farm.

The following report presents the findings of the Stage 2 investigations along with Stage 2 laboratory testing.

A sketch of the typical borrow pit arrangements required to extract the aggregate underlying deposits is provided in Appendix A.

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2 SITE AND GEOLOGY

2.1 The Site

Keerglen Wind Farm site is situated approximately 8.5km north west of Kiltcon, Killala, County Mayo on an upland region of intact blanket bog and cut-over peat bog.

Land utilisation is limited and restricted to sheep grazing and small-scale turf cutting. Evidence of ongoing turf cutting is evident on the lands adjacent to, and within the survey area employed for both the stage 1 and stage 2 Investigations.

2.2 Published Geology

2.2.1 Solid Geology

According to the Geological Survey of Ireland (GSI) online database, the entire Keerglen Wind Farm site is underlain by the Downpatrick Limestone Formation.

GSI identifies this formation as, "A sequence of interbedded rock types comprising: near shore marine mudstones and siltstones; alluvial and deltaic sandstones and siltstones; and fully marine bioclastic limestones interbedded with calcareous shales".

It is anticipated that the shallowest rock type present below the peat and glacial till soils will be either Sandstone or Shale. Although, not as versatile as "hard rock" alternatives such as basalt and limestone these types of rock are often a viable source of construction fill material.

2.2.2 Superficial Geology

Superficial soils present within the wind farm boundary consist of peat overlying glacial till soils derived from Devonian and Carboniferous sandstones.

Alluvium is present within the river valley bottoms.

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3 FIELDWORK

3.1 General

All stage 1 and stage 2 fieldwork was carried out in general accordance with BS 5930:2015+A1:2020 and other related standards.

Please refer to Report 2225-23 "Keerglen Wind Farm – Borrow Pit Assessment – Stage 1" for the location of geophysical investigations undertaken as part of these stage 1 works.

The location of Stage 2 exploratory holes are identified on the plan contained in Appendix A of this report.

3.2 Geophysical Surveys

The geophysical survey was undertaken in Stage 1 of the SI Campaign and involved the following non-destructive testing techniques (Refer to Report 2225-23 for further details).

METHOD	LOCATION	MAXIMUM DEPTH (m)	EQUIPMENT
2D Electrical Resistivity Tomography	7 Nr. Parallel profiles, approximately 50m apart, centred on a local high point north west of WTG3.	approx. 15m	Mangusta Electrical Resistivity Imaging System.

Table 1 –Geophysical Methods Deployed

3.3 Exploratory Holes

The exploratory holes undertaken in Stage 2 are detailed within the following table.

METHOD	QUANTITY	MAXIMUM DEPTH (m)	REMARKS
Trial Holes	7 Nr.	5.10m (TP-A, TP-B & TP-G)	All trial holes were undertaken using a 13T Zaxis 130 LCN Wide-Tracked Excavator.

Table 2 Exploratory Holes

The engineering logs contained within Appendix B provide descriptions of the strata encountered, together with observations made during excavation works. Please refer to Appendix D for photographs recorded during trial pitting works.

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3.4 Topographical Survey

A topographical survey of exploratory hole locations was undertaken post-completion of all associated investigation works and is detailed in the table below.

EQUIPMENT	COORDINATE SYSTEM
Leica RTK / GNSS DGPS System	Irish Transverse Mercator (ITM) / Malin Head (Ordnance Datum)

Table 3 – Topographic Surveying Details

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4 SURVEY RESULTS

4.1 Introduction

The interpreted results of the Stage 2 Investigations are contained in Appendices A, B and C, as an annotated plan detailing the assessment findings, engineering trial pit logs and geotechnical soil / rock laboratory test results.

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4.2 Summary of Results for Stage 1 - Geophysical Surveys

a. Profiles L1 to L5 identified low resistivity superficial peats and glacial till soils overlying materials with higher resistivity at depths of approximately 4 – 6m. These zones of higher resistivity were such that they could either represent weathered sandstone rock or gravels and as such were deemed viable targets for Stage 2. (See Figure 1, below)

b. Profiles L6 and L7 did not show significant variation in resistivity, which is relatively low in magnitude.
As such these locations offered low potential with respect to suitability as a borrow pit.

This analysis resulted in a series of proposed targets being selected as candidates for follow-up geotechnical investigation by exploratory trial holes. See table below.

Target Number	Geophysical Profile Nr	Profile Chainage (m)	Resistivity (Ωm)	Easting	Northing
A	K1	160	>600	506005.0	831928.5
B	K1	220	>600	506064.2	831928.3
C	K2	180	>700	506030.7	831876.4
D	K3	60	> 600	505907.4	831826.0
E	K3	260	> 600	506105.5	831826.0
F	K4	100	> 500	505949.7	831773.4
G	K4	260	> 500	506107.7	831774.7

Table 4 – Potential Targets identified following analysis of Stage 1 ERT data

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4.3 Summary of Results for Stage 2 Investigations

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4.3.1 Trial Pit Investigation

The following table summarises the trial pit investigation results

Trial Hole Reference	Easting / Northing	Depth to rock (m)	Peat Thickness (m)	Depth to Weathered Rock layer (m)
TP-A	E506009.30 N831929.90	N/A	1.55	N/A
TP-B	E506065.00 N831925.70	N/A	2.20	N/A
TP-C	E506033.30 N831875.70	N/A	1.80	3.70
TP-D	E505914.40 N831826.10	0.20	0.20	N/A
TP-E	E506105.10 N831828.20	N/A	1.80	N/A
TP-F	E505946.80 N831782.10	N/A	1.80	3.60
TP-G	E506104.40 N831784.80	N/A	1.85	N/A

Table 5 – Summary of Stage 2 findings with respect to rock identification

4.3.2 Laboratory Test Results

The following table summarises the laboratory test results

TEST TYPE	RESULTS	APPLICATION OF RESULTS
Natural Moisture Content (Soils)	14.3 % – 17.1 % Natural Moisture Content	Soil Classification
Natural Moisture Content (Rock)	2.65 % – 14.49 % Natural Moisture Content	Rock Classification
Particle Size Distribution	PSD correlation with Trial Holes (Stratum Descriptions) Glacial till between 3 – 5m in thickness is mainly classified as silty, slightly clayey, gravelly SAND or silty, slightly clayey sandy GRAVEL	Soil Classification
Bulk Density (Soils)	2054 – 2081kg/m3	Density Determination

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Bulk Density (Rock)	1754 – 2301kg/m3	Density Determination
Dry Density (Soils)	1777 – 1979kg/m3	Density Determination
Schmidt Hammer Tests	UCS = 25Mpa – 33MPa. Samples recovered from TP-D and TP-F	Rock Strength
Point Load Test	PL = <1.00 – 12.90MPa Average = 5.49MPa Carried out on small fragments recovered from TP-C, TP-D and TP-F	Rock Strength

Table 6 – Potential Targets identified following analysis of Stage 2 and 3 findings

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5 DISCUSSION

5.1 Findings of follow-up Geotechnical Trial Pitting Works

Seven of the eight target locations were investigated by excavating a trial hole using a 13T wide tracked 360° excavator.

The following is an illustration of the findings of the trial pitting works: -

1. Although the co-ordinates identified in the phase 1 report were used to identify the location of each trial hole, in all cases these had to be adjusted to avoid very soft ground, areas where peat harvesting was underway, as well as hazards such as “peat pipes” and “bog holes”.

2. Intact sandstone rock was only definitely encountered in Trial Pit TP-D at a depth of 0.20m below existing ground level. What was exposed in this pit was an isolated ridge of locally hard rock, identified as a fine-grained crystalline SANDSTON (see photographs in Appendix D)E. The ridge itself was narrow at the inspection point (c. 2 – 3m wide) and orientated on a bearing of 024° – 204° to the north.

   This rock is moderately weak to locally medium strong. As such it would be best employed as construction fill rather than crushing for dressed stone. Depending on the depth from which the rock is quarried, crushing can be expected to generate a significant amount of sand along with angular gravel aggregate.

3. The electrical resistivity of sandstone rock is generally in agreement with the results obtained from the geophysical ERT surveys.

4. Trial holes TP-C and TP-F recorded the presence of dense boulders at the base of the exploratory holes, which the author believes to be the top of a weathered rock profile. In these cases, the rock fragments recovered were weak to moderately weak and the author believes the intact sandstone rock stratum to be beyond the reach of the excavator, 5 – 7m below ground level.

5. Peat thickness varied from 1.55m to 2.20m with the exception of TP-D where only 0.20m overlaid the sandstone rock outcrop.

6. All areas where SI was undertaken coincided with domestic scale turf cutting, where the existing peat has been mechanically cut to a depth of at least 1.0m.

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This was observed to cause very unstable excavation sidewalls within the excavations which rapidly collapsed where this had been done. This low sidewall integrity meant that it was not possible to excavate to the full depth of the machine's capability, without collapse occurring first.

In summary, the following overall opinion can be formed from the borrow pit investigations: -

A. Rock is present at the Keerglen Wind Farm site. This rock is a fine-grained SANDSTONE which is moderately weak to medium strong when intact, likely to create significant sand content when crushed but useful as a construction fill material.

B. The rock was observed to be present in two forms at the site, i) as a ridge of locally hard sandstone (as in TP-D) and ii) more generally at depths of over 5m (probably 6 – 7m).

C. Exploitation of the ridge of sandstone will be relatively straightforward as this occurs at a shallow depth. However, exploitation of the deeper rock formation will involve the removal and stockpiling of large volumes of peat and granular till soils.

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6 REFERENCES

BS 1377: 1990 : Methods of test for soils for civil engineering purposes. British Standards Institution.

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BS 5930:2015 + A1:2020 Code of practice for ground investigations. British Standards Institution.

BS EN 1997-2: 2007 : Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

BS EN ISO 14688-1: 2002 : Geotechnical investigation and testing - Identification and classification of soil - Part 1 Identification and description. British Standards Institution.

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BS EN ISO 22476-2: 2005 : Geotechnical investigation and testing - Field testing - Part 2 Dynamic probing. British Standards Institution.

BS EN ISO 22476-3: 2005 : Geotechnical investigation and testing - Field testing - Part 3 Standard penetration test. British Standards Institution.

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ASTM D5731-08: Standard test method for determination of the point load strength index of rock and application to rock strength

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APPENDICES

Appendix A	Drawings
Appendix B	Exploratory Holes
Appendix C	Laboratory Testing
Appendix D	Site Photographs

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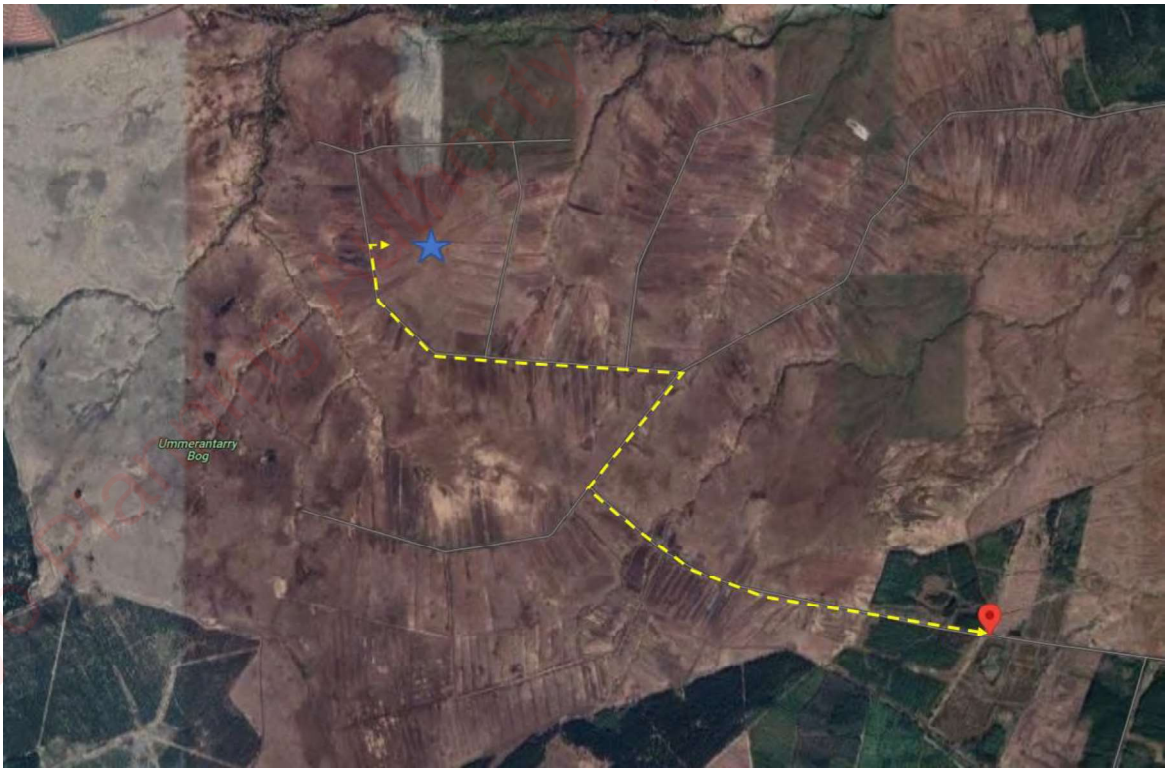
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APPENDIX A
DRAWINGS

General Site Location Plan	1 x A4
Interpreted Data – Potential Borrow Pit Locations	1 x A3
Schematic Representation of Typical Borrow Pit Required to Exploit Site "Won" Aggregate	1 x A3



P1 - General Location Plan (map view)
(© googlemaps 2023)



P2 - General Location Plan (map view)
(© googlemaps 2023)

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2225-23 Keerglen Wind Farm - Borrow Pit Assessment

Investigation Findings

22 August 2023



Key

- As-Built TP Location (Stage 2)
- Stage 1 - Target
- Stage 1 - Geophysical ERT Profiles
- Sandstone Ridge Medium weak (0.2 - 0.5m depth)
- Weathered rock encountered (3.6 - 3.7m depth)
- Antcipated extent of sandstone rock (c. 5.0 - 6.0m depth)

Notes:

1. All depths are relative to ground level existing at the time of the survey / investigation.
2. All positions relate to the Irish Transverse Mercator 75 coordinate system.
3. Any elevations are provided relative to Ordnance Datum Malin Head

Designed by	Checked by	Approved by - date	Drawing No.	Date	Scale
J. W.		22/08/2023	2225-D1	22/08/2023	NTS

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UK BT39 9 NE

Borrow Pit Assessment
Results of Investigations - Rock Occurrence

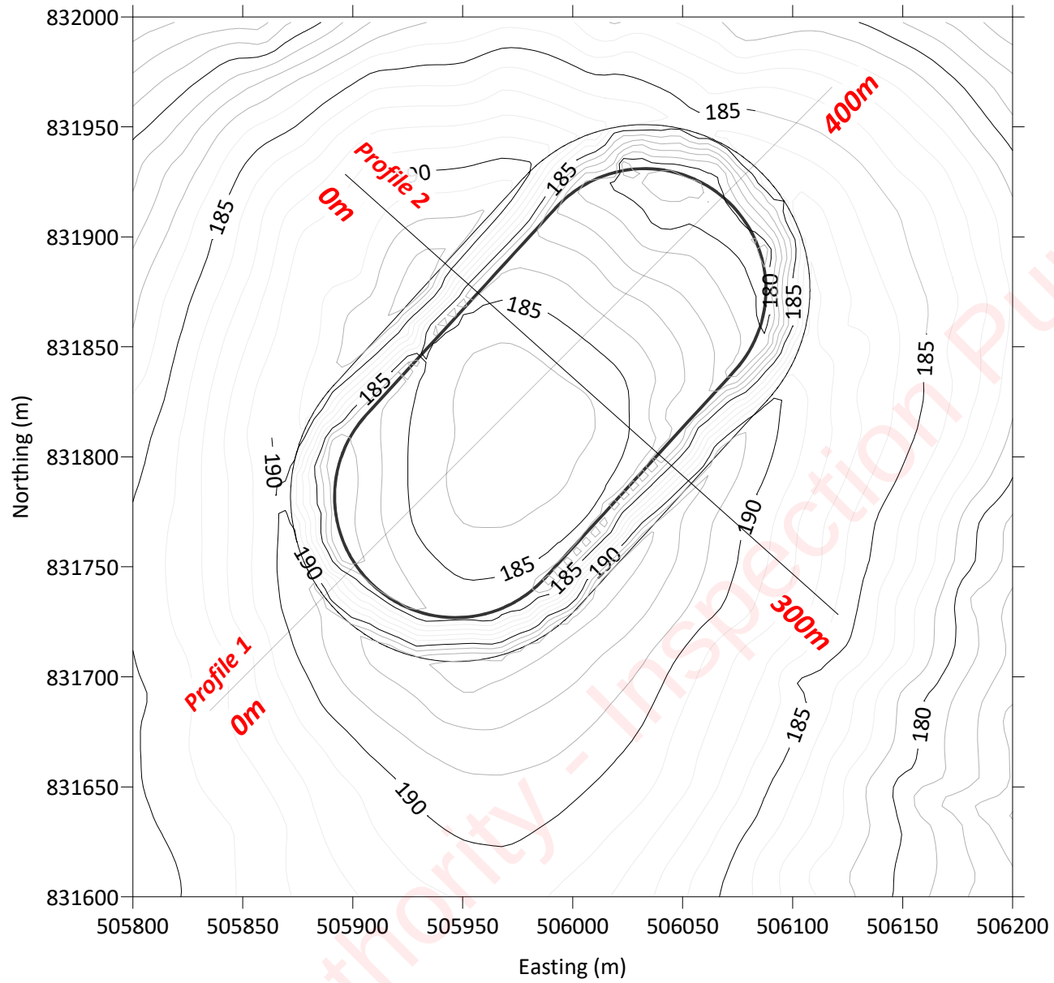
Keerglen Wind Farm | Edition 1 | Sheet A3

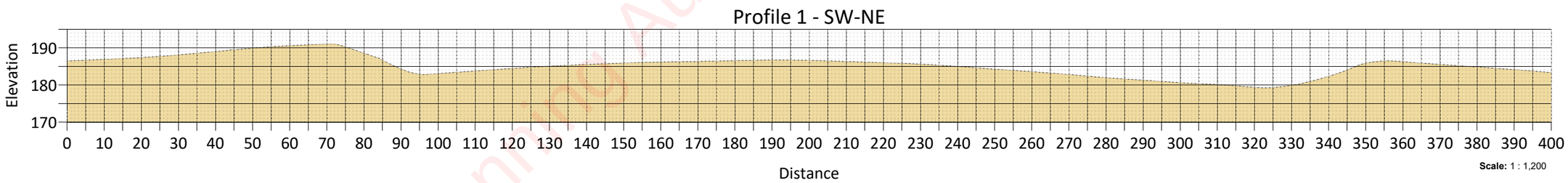
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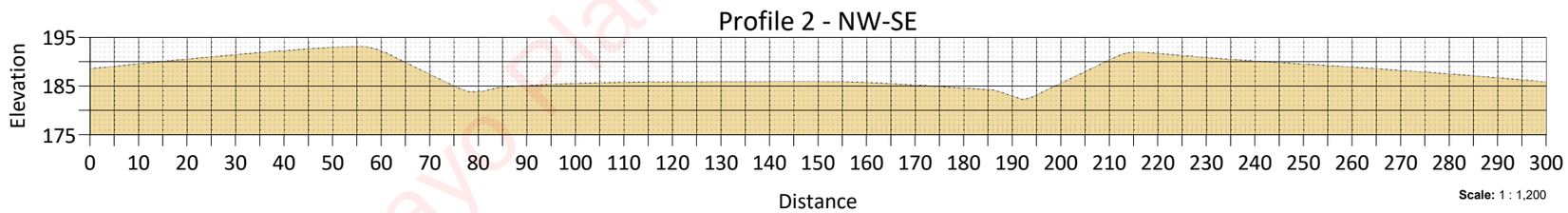
2225-23 Keerglen Wind Farm - Borrow Pit Assessment

Sections Through Purposed Borrrow Pit

28th September 2023







Notes:

1. All depths are relative to ground level existing at the time of the survey / investigation.
2. All positions relate to the Irish Transverse Mercator 75 coordinate system.
3. Any elevations are provided relative to Ordnance Datum Malin Head

Designed by	Checked by	Approved by - date	Drawing No.	Date	Scale
J. W.		28/09/2023	2225-X1	28/09/2023	NTS

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Borrow Pit Assessment
Sections Through Purposed Borrrow Pit

Keerglen Wind Farm | Edition 3 | Sheet A3

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APPENDIX B
EXPLORATORY HOLES

Trial Hole Engineering Logs	10 x A4

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506009.30 N831929.90
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-A	TP	191.50m AoD	JW	1:25	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Soft dark brown PEAT
					1.55	189.95		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					1.85	189.65		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
					3.40	188.10		Loose, brown, slightly clayey fine grained SAND
		4.10 - 4.60	B					

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
5.00	1.20	Unstable					

Remarks

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		Contractor: JJ Clifford Plant Hire	Co-ords: E506009.30 N831929.90
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-A	TP	191.50m AoD	JW	1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Sample and In Situ Testing: Type	Sample and In Situ Testing: Results	Depth (m)	Level (m)	Legend	Stratum Description
					5.10	186.40		Loose, brown, slightly clayey fine grained SAND End of Pit at 5.100m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
		Unstable			0.00	5.10	Arisings

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506065.00 N831925.70
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-B	TP	190.05m AoD	JW	1:25	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Very soft dark brown spongy PEAT
					2.20	187.85		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					2.40	187.65		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
5.10	1.20	Unstable					

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506065.00 N831925.70
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-B	TP	190.05m AoD	JW	1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Sample and In Situ Testing: Type	Sample and In Situ Testing: Results	Depth (m)	Level (m)	Legend	Stratum Description
					5.10	184.95		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
								End of Pit at 5.100m

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Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
		Unstable			0.00	5.10	Arisings

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506033.30 N831875.70
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-C	TP	194.69m AoD	JW	1:25	Sheet 1 of 1

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Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Very soft dark brown spongy PEAT
					1.80	192.89		
								Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					2.00	192.69		
		3.10 - 3.60	B					Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
					3.70	190.99		Dense, pinkish grey sandy gravelly COBBLES and BOULDERS. Angular to sub angular. Fragments of pink, tabular, sub angular fine grained sandstone recovered.
					4.60	190.09		End of Pit at 4.600m

1 2 3 4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
5.00	1.20	Unstable			0.00	4.60	Arisings

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E505914.40 N831826.10
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-D	TP	193.94m AoD	JW	1:25	Sheet 1 of 1

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Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.20 - 0.60	B		0.20	193.74		Soft dark brown PEAT
								Yellow grey stained black, discoloured to slightly discoloured, fine grained, SANDSTONE, very weak to weak. Slightly weathered.
					4.60	189.34		End of Pit at 4.600m

1
2
3
4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
8.60	2.60	Unstable			0.00	4.60	Arisings

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506105.10 N831828.20
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-E	TP	191.06m AoD	JW	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Very soft dark brown spongy PEAT
					1.80	189.26		Loose light brown silty/clayey fine grained SAND
					2.00	189.06		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					4.30	186.76		End of Pit at 4.300m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.80	1.20	Unstable			0.00	4.30	Arisings

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E505946.80 N831782.10
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-F	TP	196.00m AoD	JW	1:25	Sheet 1 of 1

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Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Very soft dark brown spongy PEAT
					1.80	194.20		Loose light brown silty/clayey fine grained SAND
					2.10	193.90		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
		3.10 - 3.60	B		2.50	193.50		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
					3.60	192.40		Dense, pinkish grey sandy gravelly COBBLES and BOULDERS. Angular to sub angular.
					3.80	192.20		End of Pit at 3.800m

1 2 3 4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.60	1.20	Unstable			0.00	3.80	Arisings

Remarks

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Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506104.40 N831784.80
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-G	TP	188.58m AoD	JW	1:25	Sheet 1 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Very soft dark brown spongy PEAT
					1.85	186.72		Loose light brown silty/clayey fine grained SAND
					2.10	186.48		Loose blue grey silty clayey fine gravelly fine to medium grained SAND. Gravel is fine grained, sub angular to sub rounded.
					3.20	185.38		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
		4.00 - 4.50	B					

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
5.50	1.20	Unstable					

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Website: www.whitefordgeoservices.com

Trial Pit Log

Project Name: Keerglen Wind Farm - Borrow Pit Assessment	Project No: 2225-23	Client: ABO Wind Ireland Ltd	Date: 02/08/2023
		Contractor: JJ Clifford Plant Hire	Co-ords: E506104.40 N831784.80
Location:		Sub Contractor:	Equipment: 13T Bogmaster Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-G	TP	188.58m AoD	JW	1:25	Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Sample and In Situ Testing: Type	Sample and In Situ Testing: Results	Depth (m)	Level (m)	Legend	Stratum Description
					5.10	183.48		Loose brown silty clayey gravelly fine to coarse grained SAND containing low cobbles and boulder content. Gravel is fine, sub angular to sub rounded.
								End of Pit at 5.100m

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Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
		Unstable			0.00	5.10	Arisings

Remarks

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APPENDIX C
LABORATORY TESTING

Soils: Moisture Content, Bulk Density & Dry Density	1 x A4
Rock: Moisture Content, Bulk Density & Dry Density	1 x A4
Soil: Particle Size Distribution	2 x A4
Rock: Point Load Test Results	1 x A4
Rock: Schmidt Hammer Test Results	1 x A4

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Moisture, Bulk & Dry Density Results

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Location: Kerrglen Wind Farm

Client: Abo Wind Ireland Ltd

Job No: 2225-23

Hole ID	*Depth*	*Moisture Content %*	*Bulk Density (kg/m^3)*	*Dry Density (kg/m^3)*
TP-G	4.50	17.10	2081	1777
TP-G	4.60	14.30	2054	1979

Operator	Checked	Approved
Dr Sivakumar - QUB	JMCN	JW

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Rock Moisture & Bulk Density Results

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Location: Kerrglen Wind Farm

Client: Abo Wind Ireland Ltd

Job No: 2225-23

Hole ID	*Depth*	*Moisture Content %*	*Bulk Density (kg/m^3)*
TP-C	3.60	6.36	2288
TP-D	0.60	14.49	1754
TP-F	3.60	2.65	2381

Operator	Checked	Approved
JMCN	JMCN	JW

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VINI Geotechnical Testing

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	90.8
28.000	88.4
20.000	88.4
14.000	87.2
10.000	85.2
6.300	83.9
5.000	80.5
3.350	77.6
2.000	72.3
1.180	63.3
0.600	47.8
0.425	40.4
0.300	34.4
0.212	28.9
0.150	24.2
0.063	16.7
0.044	15.6
0.031	14.5
0.020	11.6
0.012	9.4
0.009	7.7
0.006	6.0
0.004	4.8
0.003	3.7
0.002	3.1
0.001	1.4



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
3.1		13.6			55.6			27.7		0.0	0.0

Sample Description **Silty slightly clayey gravelly fine to coarse SAND**

Project Keerglen WF

Project No. 2225-23

BH/TP No. TP-A

Sample No.

Operator	SS	Checked	VS	Approved	VS	Date sample tested	10/08/2023	Depth	4.6 m

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VINI Geotechnical Testing

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	94.0
28.000	81.8
20.000	75.5
14.000	74.3
10.000	72.9
6.300	67.8
5.000	64.9
3.350	60.4
2.000	53.8
1.180	47.9
0.600	41.7
0.425	39.0
0.300	36.4
0.212	33.4
0.150	30.3
0.063	22.4
0.045	20.4
0.032	17.7
0.021	15.9
0.012	12.3
0.009	10.4
0.006	8.6
0.004	7.3
0.003	6.4
0.002	5.0
0.001	3.2



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
5.0		17.4			31.4			46.2		0.0	0.0

Sample Description **Silty slightly clayey sandy fine to coarse GRAVEL**

Project Keerglen WF

Project No. 2225-23

BH/TP No. TP-G

Sample No.

Operator	SS	Checked	VS	Approved	VS	Date sample tested	10/08/2023	Depth	4.5m

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Schmidt Rebound Hardness

RECEIVED: 29/08/2024

Location: Keerglen Wind Farm

Client:ABO Wind Ireland Ltd

Job no: 2225-23

Sample no:	*Sample Depth (m)*	*Diameter (mm)*	*Test Direction*	*"N" Rebound Number*	*Compressive Strength MPa*
TP-C	3.60	45	Vertical	32.4	33
TP-D	0.60	32	Vertical	0.0	0
TP-F	3.60	51	Vertical	27.7	25

Operator	Checked	Approved
JMCN	JW	JW

ASTM C805

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Point Load Testing

Location: Keerglen Wind Farm

Project No: 2225-23

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Sample no:	Postion	Sample Depth (m)	Diameter (mm) "D"	Max Load (kN) "P"	Point Load Strength (Mpa) "I_s"	Size Correction Factor (F)	Corrected Point Load Strength (MPa) "$I_{s(50)}$"
TP-C	IL	3.60	45	16.108	7.95	0.95	7.59
TP-C	IL	3.60	24	6.403	11.12	0.72	7.99
TP-C	IL	3.60	56	18.2	5.80	1.05	6.11
TP-D	IL	0.60	30	0.278	0.31	0.79	0.25
TP-D	IL	0.60	25	0.01	0.02	0.73	0.01
TP-D	IL	0.60	30	0.334	0.37	0.79	0.29
TP-F	IL	3.60	46	28.393	13.42	0.96	12.92
TP-F	IL	3.60	45	20.42	10.08	0.95	9.62
TP-F	IL	3.60	63	16.72	4.21	1.11	4.67

Operator	Checked	Approved
JMCN	JMCN	JW

AS TM D5731-08

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APPENDIX D
TRIAL HOLE PHOTOGRAPHS

Photographic Plates 15 x A4

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Trial Pit TP-A



Trial Pit TP-A

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Trial Pit TP-A



Trial Pit TP-B

RECEIVED: 29/08/2024



Trial Pit TP-B



Trial Pit TP-B

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RECEIVED: 29/08/2024

Trial Pit TP-C



Trial Pit TP-C

Mayo Planning Authority - Inspection Purposes Only!



RECEIVED: 29/08/2024

Trial Pit TP-C



Trial Pit TP-C

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RECEIVED: 29/08/2024



Trial Pit TP-D



Trial Pit TP-D

RECEIVED: 29/08/2024



Trial Pit TP-D



Trial Pit TP-D

RECEIVED: 29/08/2024



Trial Pit TP-D



Trial Pit TP-D



RECEIVED 29/08/2024

Trial Pit TP-D



Trial Pit TP-D

RECEIVED: 29/08/2024



Trial Pit TP-D



Trial Pit TP-E

Mayo Plan... - Inspection Purposes Only!

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Trial Pit TP-E



Trial Pit TP-E

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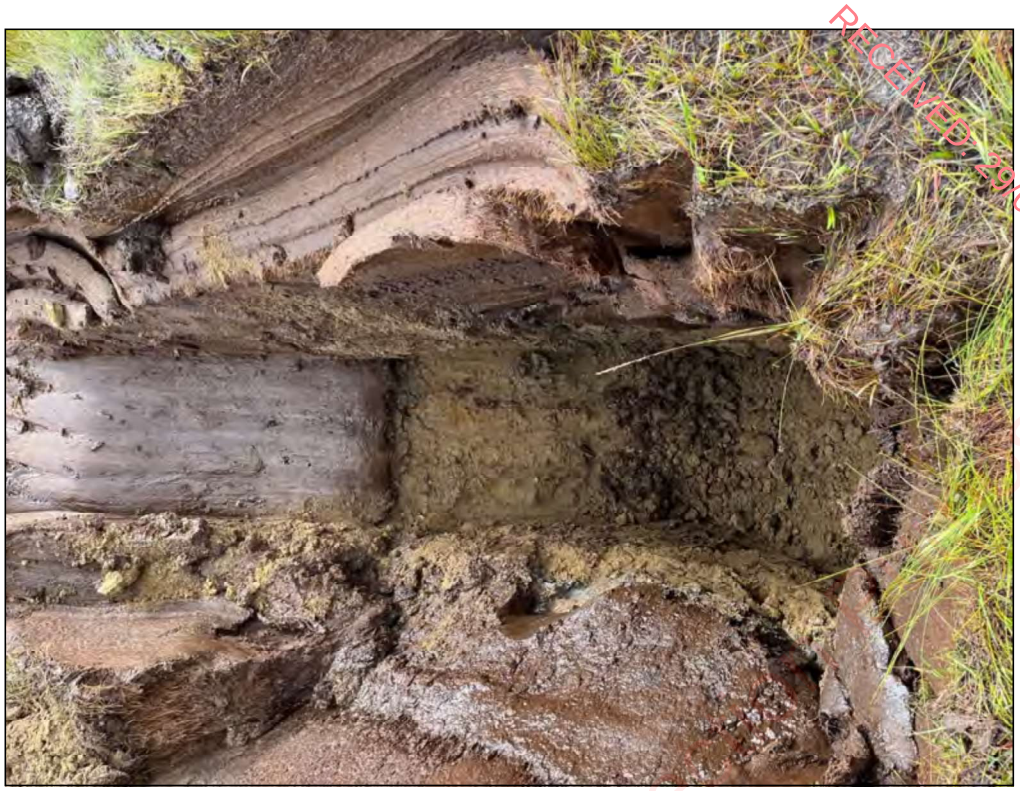
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Trial Pit TP-E



Trial Pit TP-F



RECEIVED: 29/08/2024

Trial Pit TP-F



Trial Pit TP-F



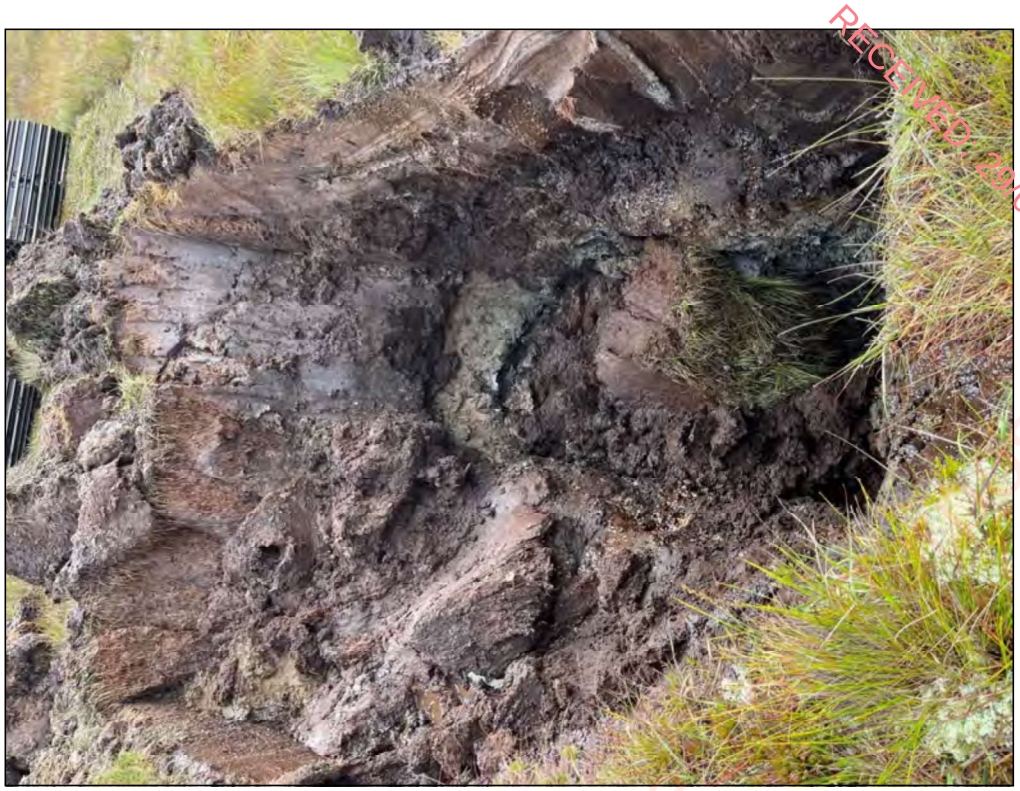
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Trial Pit TP-G



Trial Pit TP-G

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Trial Pit TP-G



Trial Pit TP-G

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