EDF RENEWABLES IRELAND LIMITED

KELLYSTOWN WIND FARM

CO. LOUTH

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 4

SPOIL MANAGEMENT PLAN

NOVEMBER 2024

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DOCUMENT APPROVAL

PROJECT	Kellystown Wind Farm	
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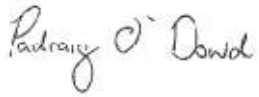
Date November 2024	Signature 	Signature 

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(CEMP)

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CONTENTS

1 INTRODUCTION

General

The plan provides an assessment of the issue of handling surplus excavated material at the Proposed Kellystown Wind Farm Site. The measures outlined in the plan will be monitored on Site by the appointed Ecological Clerk of Works and will be discussed with the Contractor before works commence on Site. This plan should be read in conjunction with the Construction Environmental Management Plan (CEMP) and Management Plans.

Site Investigations

Whitefords Geoservices Ltd has been commissioned by Jennings O'Donovan & Partners on behalf of EDF Renewables Ireland Limited (the Developer/s) to assess the geological site characteristics in relation to the planning application for Kellystown Wind Farm (the Development), Co. Louth. The Site Investigations Report (**Appendix I**) assesses ground conditions in terms of peat and slope stability risk, subsoil and geological characterisation and classification.

The Site Investigations works were completed in April 2024 of which the scope of works included:

- Trial pits, **12** No.
- Sub-soil sampling and Particle Size Distribution analysis, **5** No.
- Shear vane tests, **2** No.

General Aims and Principals of the Spoil Management Plan

The purpose of this Spoil Management Plan is:

- safety in relation to potential peat slippage risk;
- reduction in bare soil exposure and release of sediment;
- to make sure that the landscape is not adversely impacted as a result of the Development; and
- to make sure that good site management practices are carried out.

Any reinstatement and reprofiling proposals will consider and mitigate against all identified significant risks to environmental receptors.

Topsoil and surface vegetation excavated during the construction of the wind farm infrastructure will be used to finish reinstated surfaces around Turbine Foundations and

Turbine Hardstands. Reinstatement and reprofiling of, and around, infrastructure will be carried out during the construction phase.

Landscaping will allow for sympathetic restoration of the ground surface and ground profile to reduce the visual impact of new infrastructure, facilitate vegetation regrowth and reduce scour and erosion of bare surfaces prior to vegetation establishment. Reinstatement will be undertaken as work progresses. This work will be completed only by experienced personnel under guidance from the appointed Ecological Clerk of Works, and they will conduct regular inspections of the work to ensure it is completed in an appropriate manner.

All areas subjected to reinstatement will be fenced with stock-proof fencing to prevent livestock disturbance until vegetation has become established.

Excavated material is used in several ways:

- Excavated rock is used for Site Access Roads and Turbine Hardstands.
- Excavated sub-soil material will be used as fill material where suitable (e.g., back filling around and on top of Turbine Foundations) with any other sub-soil material to be placed in shallow deposition areas around the WTG foundations (always avoiding sensitive habitats).
- Excavated topsoil will be used to vegetate edges of Turbine Hardstands and Turbine Foundations.
- All surplus material will be used to reinstate the proposed borrow pits.

Management of Excavated Material

The excavated material will be stored on-site. During the construction phase, materials required for reinstatement will be stored in an environmentally safe manner, ensuring no risk of water pollution, until they are needed for reuse.

A buffer of 25m from watercourses will be implemented for storage areas of excavated materials to be re-used for reinstatement works.

Excavated material will not be stored adjacent to slopes (>15 degrees gradient). This will be subject to evaluation and approval by the Civil Contractors' geotechnical engineer and will accommodate the Site stockpiling requirements based on earthwork calculations.

The locations chosen for temporary storage are based on gradient, geotechnical data and ground stability assessment, habitat type, and the adequacy of the ground to support the

surcharge material. The Civil Contractor will be responsible for ensuring that the removal and storage of excavated material is done in accordance with the requirements of this management plan. The temporary storage area and the vegetative material will be inspected regularly from an ecological perspective.

Reinstatement

Reinstatement works will commence at an early stage of the construction works. Such reinstatement will occur following the completion of individual sections of work such as the completion of, say, a Turbine Foundation or Turbine Hardstand. Reinstatement will include grading of any slopes left by the construction works, followed by the careful placement of topsoil which had been previously excavated from this area and temporarily stored on site.

2 ESTIMATED EXCAVATION QUANTITIES

The environs of the Site are characterised by relatively complex (hilly) topography with associated elevations ranging between c. 80 to c. 125 metres above datum (m AOD) throughout the Proposed Development. Geotechnical drawings prepared by Whitefords Geoservices Ltd were used in conjunction with geotechnical trial pit logs as seen in **Appendix I – Site Investigations Report** to calculate the spoil volumes generated by the Development, as can be seen in **Tables 2.1** to **2.6**.

Road Construction

The minimum useful road width required for delivery of turbine components is 5m. **Table 2.1** tabulates the volumes of topsoil and sub-soil to be excavated for the Site access roads.

Table 2.1 Estimated Excavation for Road Construction

Road Section	Length (m)	Width (m)	Area (m^2)	Relevant Trial Pits	Average Topsoil Depth (m)	Depth to firm Sub-soil/Rock (m)	Depth of Sub soil to be excavated (m)	Total Volume to be excavated (m^3)	Vol of top soil to be excavated (m^3)	Vol of sub soil to be excavated (m^3)	Vol of rock to be excavated (m^3)
New Conventional Track	5,753	5	28,765	-	0.3	0.45	0.3	12,944	8,630	4,315	-
Upgraded Site Track	524	5	2,620	-	0.3	0.45	0.3	1,179	786	393	-
New Turning Areas, Splays, Laybys	-	-	7,471.2	-	0.3	0.45	0.3	2,262	2,241	1,121	-
Total	***6,287***		***38,856.2***					***17,485***	***11,657***	***5,828***	***0***

Trial Pit data is available in the Site Investigation Report (**Appendix I**). Average topsoil from this data was calculated to be 0.3m. Excavation for roads is required to 0.3m only. From this, the volume of top soil, subsoil and rock to be extracted was extrapolated and can be seen in **Table 2.1**.

Wind Turbine Foundations

The depth of excavation required for each wind turbine foundation will vary depending on ground conditions. The diameter of the gravity Turbine Foundations will be 27.2m diameter. Each Turbine Foundation excavation will be 3.5m deep. **Table 2.2a** provide a breakdown of the estimated total excavation volume for the Turbine Foundations.

Table 2.2a Estimated Excavation for WTG Foundations (27.2m Diameter)

Turbine No.	Area of Foundation Excavation (m^2)	Foundation Depth (m)	Topsoil Depth (m)	Mineral Soil (m)	Depth to suitable formation (m)	Rock depth (m)	Total Excavation (m^3)	Total Topsoil (m^3)	Total and Rock Soil (m^3)	Total Rock (m^3)
1	380	3.5	0.4	3.1	3.5	-	2,538	122	2,416	-
2	380	3.5	0.2	3.3	3.5	-	2,538	61	2,477	-
3	380	3.5	0.3	3.2	3.5	-	2,538	92	2,446	-
4	380	3.5	0.4	3.1	3.5	-	2,538	122	2,416	-
5	380	3.5	0.1	3.4	3.5	-	2,538	31	2507	-
Totals							***12,690***	***428***	***12,262***	**-**

Turbine Hardstands

The depth of excavation required for each crane hardstand will vary and has been calculated below. The total Turbine Hardstands area will be 4,740m² and includes the main crane hardstand (1,390m²), the component set down area (2,670m²), the assist crane hardstands (290m²), and the vehicle parking (390m²). Table 2.3 provides a breakdown of the estimated total excavation volume for the Turbine Hardstands.

Table 2.3 Estimated Excavation from Turbine Hardstands

Hardstand No	Area (m^2)	Depth to suitable formation (m)	Topsoil Depth (m)	Total Excavation (m^3)	Total Topsoil (m^3)	Total Sub-soil (m^3)	Total Rock (m^3)
1	2377	0.7	0.4	1664	951	713	-
2	2377	0.5	0.5	1189	475	713	-
3	2377	0.6	0.6	1426	713	713	-
4	2377	0.7	0.7	1664	951	713	-
5	2377	0.2	0.2	475	238	238	-
Total				**4,978**	**3,328**	**3,090**	**-**

Electrical Sub-Station and Site Compound

Table 2.4a Estimated Excavation from Sub-Station, BESS and Compounds

Infrastructure	Area (m^2)	Depth to Formation (m)	Average Sub-soil (m)	Mineral Soil (m)	Relevant Trial Pits/Bore Holes	Total Excavation (m^3)	Total Topsoil (m^3)	Total Sub-soil (m^3)	Total Rock (m^3)
Electrical Substation Building (17.5m x 7.3m)	128	0.3	1.2	0.3	TP-SUB	153.66	38.4	115.2	-
BESS & Compound	3,323	0.3	0.45	0.3	TP-SUB	1495	997	498	-
Total						**1,649**	**1,035**	**614**	

Table 2.4b Estimated Excavation from Site Compounds

Infrastructure	Area (m^2)	Depth to Formation (m)	Average Sub-soil (m)	Mineral Soil (m)	Relevant Trial Pits/Bore Holes	Total Excavation (m^3)	Total Topsoil (m^3)	Total Sub-soil (m^3)	Total Rock (m^3)
TCC 1 (23m x 25m)	875	0.3	0.45	0.15	TP-SUB	393.75	262.5	131.25	-
TCC 1 (80m x 30m)	2,400	0.3	0.45	0.15	TP-SUB	1080	720	360	-
TCC 1 (25m x 25m)	625	0.3	0.45	0.15	TP-SUB	281.25	187.5	93.75	-
Total						**1,755**	**1,170**	**585**	**-**

Grid Connection

A Grid Connection will be sought from the grid system operators by application to EirGrid. The substation will connect via underground 38kV cable. The route of this underground Grid Connection is provided in **Figure 2.9**. The overall length of the Grid Connection between the substation and the existing Drybridge 110kV substation is 11.78km, of which 823m is within the Site of the Development and 10,957m is located along the public road corridor.

Figure 2.1 Kellystown Wind Farm Grid Connection Route

The Grid Connection will be constructed to the requirements and specifications of ESB Networks Limited. The three conductors will be laid in separate ducts which will be laid in accordance with the ESBN functional specifications for 38kV Networks Ducting/Cabling (Minimum Standards). The width of a 38kV cable trench with a trefoil formation will be 600mm. The depth of the trench for 38kV cables is 1.22m. A separate duct will be provided

within the trench for fibre optic communications. Refer to ESBN Cable ducting Specifications in **Appendix 2.2.**

The cable network will be installed in trenches approximately 2,03m wide by 1.475m in depth. There will be 14 No. pre-cast concrete jointing bays measuring 4.5m by 2.03m buried approximately 1.475m deep along the grid connection route and at varying intervals from c. 850 - 1000m intervals (See **EIAR Appendix 2.4**). All extracted material along the Grid Connection Route will be disposed of at a licensed facility as per the Waste Management Plan (**CEMP**, **Management Plan 5**). In addition, Table 2.5 provides a breakdown of the estimated total excavation volume for the Turbine Hardstands.

Table 2.5 Estimated Excavation from Grid Connection

Description	Length (m)	Width (m)	Depth (m)	No.	Area (m^2)	Depth to Bedrock (m)	Depth (m)	Volume of Excavation (m^3)	Volume of Top soil Extraction (m^3)	Volume of Sub-Soil Extraction (m^3)	Volume of Rock Extraction (m^3)
Internal Cabling	5,600	0.6	1	1	3,360	-	1	3,360	1,008	2,352	-
Internal Cabling (Public Road)	545	0.6	1	1	327	-	1	327	98	229	-
38kV Circuits Trench - Along Verge of Public Roads	11827	0.6	1.22	1	7,590		1.22	9,260	2,277	6,983	
							Total	**12,947**	**3,383**	**9,564**	

Drainage

There are 18 No. Drainage Basins on site with a combined area of **3,601**m^3. The spoil generated from road side drains will be 8,234m^3. See **CEMP 3: Surface Water Management Plan** of the CEMP for further details.

Total Estimated Excavation Volume Summary

The total estimated excavation volume is 68,599m³, of which 28,313m³ is top soil and 40,286m³ is mineral subsoil. These quantities are detailed in **Table 2.6**.

Table 2.6 Summary of Estimated Excavation Quantities (m³)

Description	Total Volume to be excavated (m^3)	Vol of Topsoil to be excavated (m^3)	Vol of sub soil to be excavated (m^3)	Vol of rock to be excavated (m^3)
5 no. Turbine Hardstandings	6,418	3,328	3,090	-
5 no. Turbine Blade Set Down Areas	3,692	3,692	-	
5no. Turbine Foundation (27.2m) Diameter	12,690	428	12,262	-
On-site Access Roads (New and Upgraded)	17,485	11,657	5,828	-
Temporary Construction Compounds 3No.	1,755	1,170	585	-
Electrical Substation Building, BESS & Compound	1,649	1,035	614	-
Drainage	11,835	3,551	8,285	
Met Mast	128	69	58	-
Internal Cable Trench	3,360	1,008	2,352	-
Internal Cable Trench (Public Road 545m)	327	98	229	
38kV Grid Connection Cable Trench	9,260	2,277	6,983	-
Total	**68,599**	**28,313**	**40,286**	

3 RE-USE OF EXCAVATED MATERIAL

Excavated material will be reused on site where possible. Excess material will be placed in the permanent spoil storage areas (SP1 and SP2). These spoil areas can hold a combined volume of 49,761m³. Material excavated for the grid connection in roadways will be reused where possible and surplus material will be sent a licensed facility. The summary of the reuse of excavated material is outlined in Table 3.1.

ROAD CONSTRUCTION

The reuse of material along the Site Access Roads will be in the form of roadside berms

TURBINE AND MET MAST FOUNDATION EXCAVATIONS

Excavated subsoil will be backfilled and serve as ballast for the turbine foundations. Topsoil will be used to create landscaping berms around the base of each turbine and hardstand.

STORAGE AREAS TO THE PERIMETER OF HARDSTANDS

Topsoil and subsoil will be used in landscaping and remediation around turbines and hardstands. The balance of soil excavated for the hardstands will be placed along the hardstand edges. The landscaping berms around the perimeter of the Turbine Hardstands will measure 0.5m in height and 20m in width. However, it must be noted that the final volumes of subsoils will depend on the results of plate bearing tests. The total volume of excavated material for deposition may be reduced substantially following these Site Investigations.

GRID CONNECTION

The total volumes to be excavated for the Grid Connection Route and Internal Cable Trench (Public Road 545m) is estimated at 9,260m^3. This material if suitable will be used to backfill the trenches once the cable has been laid. Any surplus material will be disposed of at a licensed facility according to **Management Plan 5: Waste Management Plan** due to the presence of bituminous material and hydrocarbons.

Table 3.1 Management of Excavated Materials

Storage / Reuse	Volume of Storage (m^3)	Topsoil (m^3)	Sub-soil (m^3)
A. Side cast Topsoil adjacent to access tracks (2m high berm both sides (20% of network) - 4m wide at base; 2m at top; 2m high)	9,205	9,205	na
B. 20m wide Apron spreading around 5no turbine long edges of hardstand (c. 100m length: Max 0.5m thick) TILL	5,000	na	5,000
C. 20m Apron spreading around 5no turbine hardstand long edges (c. 100m length; Max 0.25m thick) TOPSOIL	2,500	2,500	na
D. Re-use of material for landscaping purposes elsewhere - remainder of topsoil (TOPSOIL)	5,004	5,004	na
E. Re-use of Till as fill above turbine foundation (TILL) Est. 750m^3 ea.	3,750	na	3,750

Storage / Reuse	Volume of Storage (m^3)	Topsoil (m^3)	Sub-soil (m^3)
F. Material from cabling works within roads that cannot be used for backfilling. Worst-case volume assumed	8,928	2,213	6,715
F. Surplus Material for Disposal at the Permanent Spoil Deposition Areas SD1 & SD2 (TILL)	34,212	9,391	24,821
Total Spoil Volume	**68,599**	**28,313**	**40,286**

4 RECOMMENDATION

Based on the available information, Jennings O'Donovan make the following recommendations:

- The estimated potential total volume of excavated material is 68,599m³. However, this volume is dependent on the results of plate-bearing tests during the construction phase.
- It is estimated that 25,459m^3 will be re-used on site, excavated material along the Grid Connection Route (8,928m^3) will be moved to a licensed waste facility and 34,212m^3 of material will be placed in the permanent spoil storage area.
- There will be surplus capacity of 15,549m^3 in the permanent spoil storage areas.

APPENDIX I

Site Investigations Report

Kellystown Wind Farm, Drogheda, Co. Louth, Ireland

Desktop Study and Walkover Survey for Preliminary Determination of Ground Conditions

Report No: 2200-23A DRAFT

4th April 2023

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

EDF Renewables Ltd

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Kellystown Wind Farm, Co. Louth

[SOILS AND GEOLOGY STUDY]

Document Control

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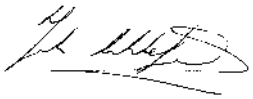
John Whiteford		4th April 2023
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APPENDICES

Appendix	Title	Pages
1	General Site Location Plans – P1 / P2 Kellystown Wind Farm Site Layout Plan P3 Priority Habitat Mapping – Local (EPA Online Environment Viewer)	1 x A4 1 x A3 1 x A3
	Plot Depicting location of sensitive receptors, as well as identified preconditions and pre-failure indicators in the immediate vicinity of wind farm development [2200-23A-PE]	1 x A3
	Geological Survey of Ireland Public Viewer Data – Solid and Structural Geology Geological Survey of Ireland Public Viewer Data – Superficial Soils and Landforms Geological Survey of Ireland Public Viewer Data – Groundwater Resources Geological Survey of Ireland Public Viewer Data – Groundwater Vulnerability Geological Survey of Ireland Public Viewer Data – Karst Groundwater Data Geological Survey of Ireland Public Viewer Data – Active Quarries Geological Survey of Ireland Public Viewer Data – Landslide Susceptibility Geological Survey of Ireland Public Viewer Data - Historic Landslide Events	1 x A4 1 x A4 1 x A4 1 x A4 1 x A4 1 x A4 1 x A3 1 x A3
2	Preliminary Peat Depth Data Classed Plot of Peat Depth	1 x A4 1 x A3
3	Preliminary Plot of Ground Elevation (10mx 10m data compiled using OSI DTM elevation data)	1 x A3
4	Preliminary Plot of Ground Slopes (compiled from OSI DTM elevation data)	1 x A3
5	Photographic Record of Site Walkover	9 x A4

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Desktop Study and Walkover Survey – Kellystown Wind Farm, near Drogheda, County Louth, Ireland

Client: EDF Renewables

Date: 4th April 2023

Report No. 2200-23A

Statement of Authority

John Whiteford BSc (Hons) Geophys AMIOSH MEAGE FGS has more than 26 years of experience in the field of earth sciences, geotechnical engineering and management. His academic qualifications are a BSc with Honours in Geophysics from Edinburgh University, with memberships of The European Association of Geoscientists and Engineers and The Institute of Safety and Health.

Commencing work with Kirk McClure Morton (Consulting Engineers) in Belfast, he has been engaged in full-time consultancy for the past 22 years and since 1996 trading as Whiteford Geoservices Ltd. The company and its staff of professional and technical personnel and has completed in excess 2100 contracts for clients within the construction and mineral exploration sectors where they have built up a recognised level of specialist experience, particularly in the field of Wind Energy. Working at home, in Europe and worldwide the company has been involved in more than 100 wind power projects where our services have been sought in relation to foundation design, peat slide risk assessment, geophysics, electrical earthing design and thermal resistivity analysis.

The following report contains an analysis of the soils and geology present at the target site and also assesses the risk presented by organic soils.

Assessment of the former draws from, 'Design Manual for Roads and Bridges ("DMRB") Volume 11, Section 3 (Environmental Assessment), Part 11: Geology and Soils, but also references, the current best practice guidance presented in the English Nature publication 'Geological conservation – a guide to good practice'.

Assessment of the latter employs guidance contained within the Scottish Executive's "*Peat Slide Hazard and Risk Assessment – Best Practice Guide for Proposed Electricity Generation Developments*", published as a Second Edition April 2017 (referred to as "the Scottish Guidance").

This Best Practice Guide was updated, in part, in April 2017, and for the purpose of clarity the protocols adopted to determine Peat Slide Hazard Ranking are consistent with the version of the report, as published in 2017. Unless otherwise stated, all assessments and conclusions contained within this report are made with reference to either the 2006 or 2017 publication. Where variations from the guidance occur the reason for this is provided, either within the text or as a footnote.

This report details the works undertaken by Whiteford Geoservices Ltd at the site of the proposed Kellystown Wind Farm near Drogheda, Co. Louth

Dated: 4th April 2023

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1.0 INTRODUCTION

1.1 Background and Purpose of Desk Study and Walkover Survey

This report relates to the first stage of an assessment into the Soils and Geology at Kellystown Wind Farm near Drogheda, Co. Louth.

In November 2022 Whiteford Geoservices Ltd was commissioned by EDF Renewables to undertake this assessment in order to the potential impact to, and from, the proposed wind farm development.

Reporting for the purposes of this Soils and Geology Assessment has been split into three (3) distinct elements, as follows:

1. Desktop Study and Walkover Survey Report 2200-23A. This report details the findings of desktop analysis and site scoping of the general area within which the proposed wind farm is to be constructed. This report identifies the existing site conditions, potential sensitive receptors, potential preconditions that increase the risk of peat instability and pre-failure indicators present at the site. The report includes with a preliminary screening assessment of the Hazard of Peat Slide occurrence.
2. Preliminary Site Investigation Works Report 2200-23B. This report presents the findings of supplementary field work undertaken following on from the preliminary assessment of hazard. These additional investigations have been employed to determine ground composition at the site of each proposed wind turbine generator, as well as to screen for the presence of “karst”.
3. Soils and Geology Report 2200-23C. This report takes the preliminary findings from Item 1 above and reviews the information in light of both the development layout plan and the site investigation works carried out and reported as Item 2. In this particular case the “Peat Stability and Hazard Assessment” element of this report. normally included in Report 2200-23C, is not required due to the absence of Peat soils.

The purpose of this reporting is to determine the potential hazards associated with the existing soils and geology environment directly attributable to the construction of new proposed turbines, tracks and infrastructure throughout the proposed lifetime of the scheme.

This portion of the soils and geology assessment consists of both a desktop review of available ground information and a walkover survey conducted at the proposed development site. Where organic or peat soils are present the report would also contain an assessment of peat stability (not applicable in this case).

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The findings of the desktop study and walkover survey have been employed to obtain a baseline overview with respect to the soils and solid geology present within the boundary of the proposed development site.

Figure 1 – General Site Location
(Reproduced courtesy of Google maps 2023)

The purpose of this stage of the assessment is as follows:

- Undertake initial scoping of the existing geology, topography, ground stability and hydrology surrounding the site.
- Identify all potential soils and geology related factors that impact upon development at the site, such as “karst” rock instability, peat instability, weak soils, groundwater, contamination, seismic activity etc.

Environmental legislation that is relevant to the hydrological aspects of this study is as follows:

- Quality of Water Intended for Human Consumption (80/778/EEC) and Quality of Water Intended for Human Consumption Directives (98/83/EC).

The Water Framework Directive (WFD) which was passed by the European Union (EU) in 2000 is a wide-reaching legislation that will eventually replace a number of the previous water quality directives (for example, those on Water Abstraction) while implementation of others (for example,

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The Integrated Pollution Prevention and Control and Habitats Directives) will form part of the 'basic measures' for the Water Framework Directive.

1.2 Timescale

Desktop based research and the scoping walkover surveys were carried out in January 2023 by Mr John Whiteford of Whiteford Geoservices Ltd.

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2.0 EXISTING ENVIRONMENT

2.1 Topography

Analysis of coarse topographic information indicates that Kellystown Wind Farm occupies undulating lands, which slope generally in a southerly direction.

Ground surface level elevations vary between approximately 91m to 126m above Ordnance Datum (Malin Head).

2.2 Land Usage

2.2.1 Current

Land usage does not appear to vary significantly across the various land holdings which make up the Kellystown Wind Farm development; these being typified typically by pastureland and rough grazing for cattle.

Figure 1A – General Site Location Annotated with Local Features
Reproduced courtesy of www.maps.google.co.uk

The closest active quarrying operations to the site, are at Gallstown Quarry operated by Kilsaran, immediately north of the proposed wind farm development.

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Surface water flowing from Kellystown Wind Farm is split into two water local catchments.

Watercourses such as the Hammondstown Stream, within the north western portion of the site (in the vicinity of WTG01 and WTG02, initially flow westwards to join the River White and then northwards to merge with the River Dee before entering the Irish Sea at Annagassan Port, approximately 10km north of the site. Watercourses within the remainder of the site (in the vicinity of WTG03, 04, 05, 06 and WTG07, such as Piperstown Stream and Drumshallon Lough Stream flow eastwards to merge with the Termonfeckin Stream, which ultimately enters the Irish Sea at Termonfeckin.

Groundwater in the vicinity of WTG03, 04, 05, 06 and WTG07 can ultimately be expected to drain through the permeable subsoils and shallow fractured rock until it enters either the Piperstown Stream, Drumshallon Lough Stream. Groundwater in the vicinity of WTG01 and WTG02 will in a similar manner ultimately enter the Hammondstown Stream.

The Geological Survey of Ireland does not record the presence of “karst” features, nor subterranean groundwater flow was identified at Kellystown Wind Farm. However, the author has noted that the underlying rock formation is described as “calcareous” and as such has the potential to be soluble and to be associated with subterranean flow systems. Further investigation is recommended to determine whether the subsurface rock formations are soluble and therefore “karstic”.

There are no residential dwellings located within the site boundary, with the closest inhabited buildings being approximately at least 700m from the development area. However, there are some buildings associated with an agricultural land use present within the development area.

2.2.2 Historic

A review of historical mapping, courtesy of OSI, suggests that the site of Kellystown Farm has not changed significantly in land use from that recorded on the 6” Second Edition Mapping, dated 1842.

2.3 Services & Utilities

Overhead electricity services where not recorded within the site boundary, however these services were recorded along the edge of the Ballymakenry Road at the site entrance via Piperstown Livery ad Equestrian Centre.

A gas transmission line runs south east to north west through the development area, and less than 300m distant from T4 and T6 at closest approach. No further underground services were identified within the site boundary, although it is anticipated that minor water services, telecoms and electricity

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may serve existing farm buildings and facilities within the site boundary. These are similarly anticipated to be present within the highway or verge of the minor road, at the site entrance.

2.4 Geology

2.4.1 Soils and Sub-soils

A study was made of available geological information for the area (GSI Online Database). This study indicated that the following natural geology is predominately present across the site of Kellystown Wind Farm.

- Thickly bedded calcareous greywacke which outcrops within the western portion of the site
- Glacial Till (derived from Lower Palaeozoic sandstones and shales)
- Alluvium (present in river valley bottoms)
- Cutover Raised Bog (isolated discrete locations)

2.4.2 Solid Geology

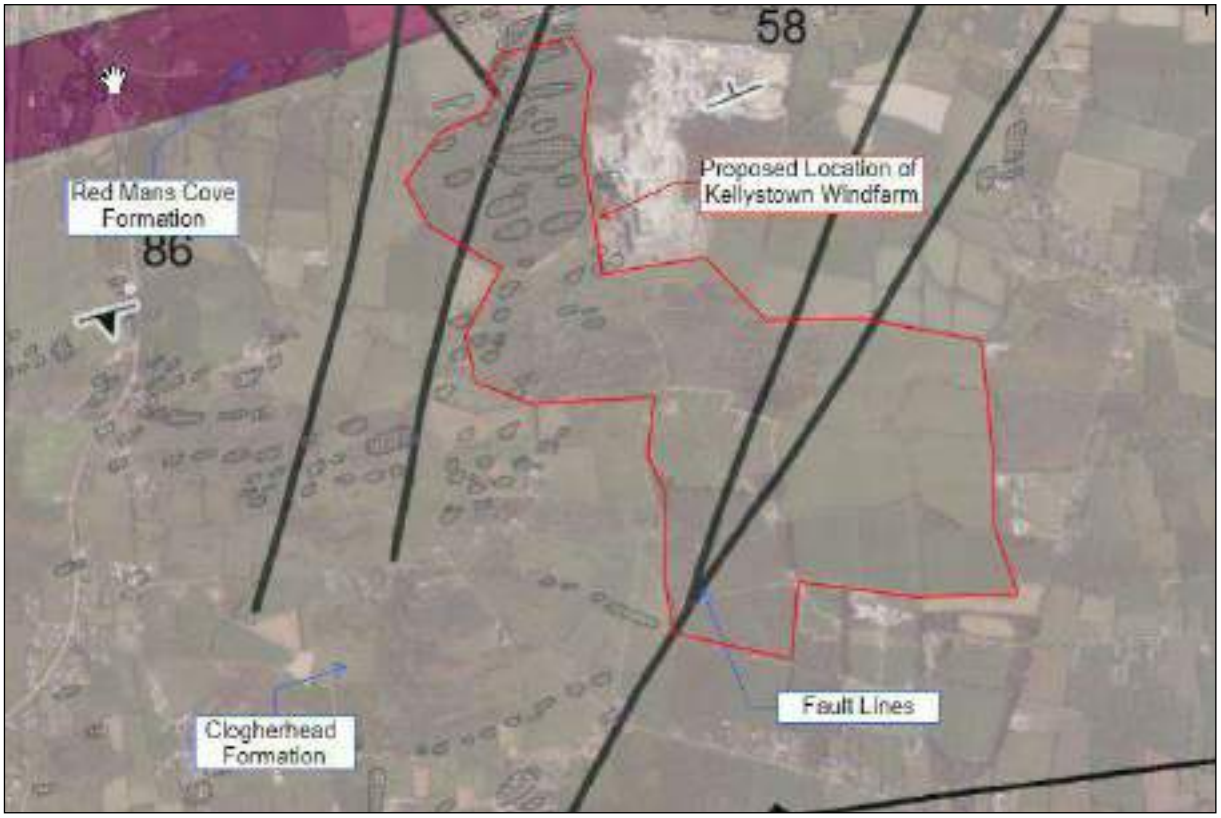

Figure 2A – Bedrock Solid Geology
Reproduced courtesy of GSI Datasets Public Viewer

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According to the GSI online database, Kellystown Wind Farm the uppermost rock strata relates to the Clogherhead Formation which consists of, thickly bedded calcareous greywacke.

Also present just north east of the site boundary is the Red Mans Cove Formation which consists of, red, green, black mudstone

2.4.3 Superficial Geology

Superficial soils present within the wind farm largely consist of thin glacial till soils overlying shallow, often outcropping greywacke rock, or glacial tills derived from Lower Palaeozoic sandstones and shales.

Alluvium is present throughout the boundary and some isolated area of peat are also indicted to be within the site boundary.

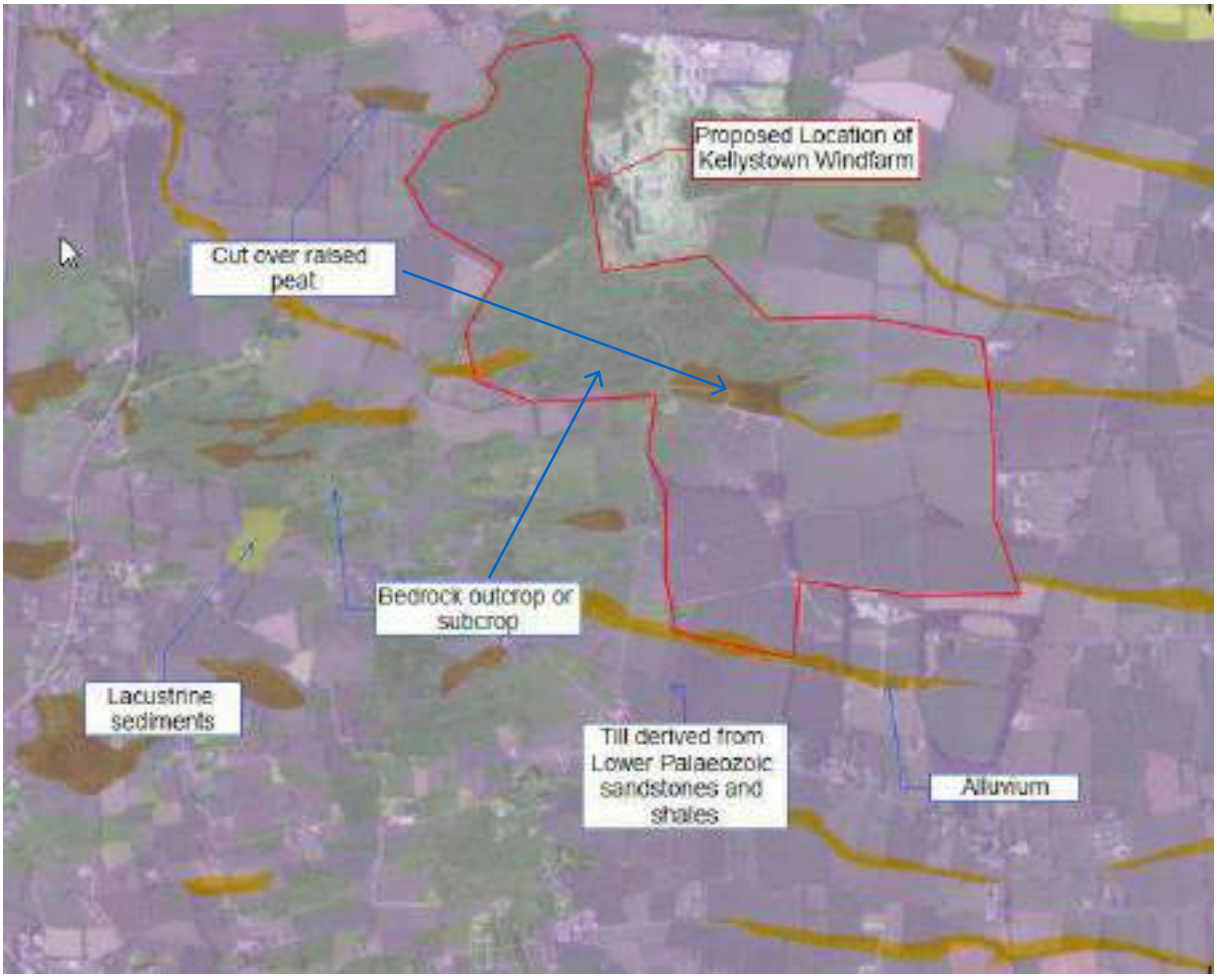

Figure 2B – Superficial Geology
Reproduced courtesy of GSI Datasets Public Viewer

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2.5 Regional Hydrogeology

2.5.1 Aquifer Classification

A review of site hydrogeology was undertaken with respect to the Geological Survey of Ireland (GSI) Database's Aquifer Bedrock Potential, Superficial Aquifers and Groundwater Vulnerability Mapping.

Surface water is anticipated to enter the subsurface where the surface is permeable and can be expected to continue vertically downwards until it comes in contact with either an impermeable stratum or the water table. At this point the surface water will migrate in the same direction as the groundwater or according to the gradient of the impermeable stratum.

GSI database mapping indicates that the site is underlain by a poor bedrock aquifer which is generally unproductive.

Potential superficial aquifers have not been identified within the site boundary. GSI mapping considers the subsoils to be of low permeability.

2.5.2 Groundwater Vulnerability

The groundwater vulnerability within the site boundary of the development is predominantly "Extreme" to "High" where rock is either covered by thin permeable tills or outcrops at the surface.

2.5.3 Well Database

The GSI database records no water wells within the site boundary. The closest recorded water wells (BH1 & BH2)) servicing the Grangebellew Group Supply Scheme are located north of the R170 and immediately west of the L2250 at Grangebellew, approximately 3.1km north of WTG04

The potential for adverse impact to this abstraction well, caused by the wind farm construction, is considered negligible.

2.6 Local Hydrology

2.6.1 Site Drainage

Across the proposed development site, a number of drainage channels and lake beds are evident. Most of these channels are generally less than 2m in width and depth and situated adjacent to field boundaries, access tracks or to effect removal of significant volumes of groundwater from fields.

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Two ephemeral lakes have been identified;

1. Drumshallon Lough (practically dry at the time of the walkover survey)
2. An un-named lake (dry and vegetated at the time of the walkover survey) immediately north of WTG06.

A low impact on the current "natural hydrology", as a result of the development, is anticipated following application of mitigation,

Please refer to the site walkover and reconnaissance section (Section 3.0) and Appendix 1, for details of site drainage features present within the site boundary.

2.6.2 Local Watercourses

For the purpose of defining watercourses as sensitive receptors these are deemed to fulfil the following criteria: -

1. Consistently contain flowing water / not ephemeral.
2. Be a natural watercourse with either a designated name or be a smaller tributary of a designated watercourse. i.e. Not man made in origin.
3. Flow underground through fissures, cavities or cave systems within limestone rock.

The development site for Kellystown Wind Farm has no major watercourses, however, there are several streams which run through the boundary and which discharge to the Irish Sea.

These are:

- Piperstown stream (Drains to the west)
- Drumshallon Lough Stream. (Drains to the east)
- Hammondstown Stream (Drains to the east)

2.6.3 Palaeo-Karst Features

Karst topography is defined as "An assemblage of topographic forms resulting from dissolution of the bedrock and consisting primarily of closely spaced sinkholes." Karst topography can form in regions of exceptionally soluble rocks, including Limestone.

Soluble rocks generally mean the presence of limestone, chalk or evaporite deposits such as gypsum that contain carbonates. These carbonates are particular susceptible to dissolution under

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the action of acid rainfall, leaving to the development of cavities and deep weathering within the rock formation.

The presence of such features has, in some cases, resulted in structural instability. The walkover survey did confirm that landforms / features consistent with a "karst" landscape are present at Kellystown Wind Farm, particularly in the vicinity of turbines T04 and T05.

In order to effectively screen for the presence of "karst", further sampling and assessment of the solid geology has been undertaken during the follow-on Site Investigation phase of the Soils and Geology study.

The results of this investigation are reporting on in Report 2200-23B/22.

GSI records do not record the presence of "karst" features within the site boundary and the closest GSI record of a "karst" features are shallow holes and enclosed depression located approximately 6km south west of site boundary.

In summary, the potential for "karstified rock" to affect the stability of installed structures and infrastructure is considered to be a Medium Hazard for the wind farm site at all Turbine locations.

Specific supplementary ground investigation is proposed prior to construction to confirm both the stability and competence of the underlying soils and rock formation and to select the most appropriate design for foundations.

2.7 Mining or Active Quarry Operations

A review of the GSI Online Database mapping indicates that there is one quarry adjunct to the northern site boundary and the next closest approximately 11km to the south of the site. These are as follows: -

1. Gallstown Quarry (Greywacke – Hard rock aggregate) immediately north of Kellystown Wind Farm. Operated by Kilsaran.
2. Mullaghcrone Quarry (Limestone – Hard rock aggregate): 11 km south of Kellystown Wind Farm. Operated by Roadstone Ltd.

No records of shafts or adits associated with mineral exploration were observed within 10km of the Kellystown Wind Farm site.

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2.8 Peat Disturbance and Soil Removal

At the site of Kellystown Wind Farm there are isolated areas of peat, which were initially identified from GSI mapping and confirmed during the walk over survey.

A total of three such areas of Cut-over Raised Bog are present in the development area (refer to Appendix 1, "GSI Superficial Geology"), as follows: -

- Depression associated with Drumshallon Lough, centred on E=708135, N=783401 – 240m south west of WTG04, 150m north of WTG05 and 170msouth of WTG03.
- Isolated depression centred on E=707668, N=782900 – 480m south west of WTG05 and 580m south west of WTG04.
- Area centred on E=708695, N=784040 – 420m north of WTG04.

Only one such area of cut-over raised peat bog, extending to c. 5.27ha, is located within the wind farm development area. This area of peat is associated with Drumshallon Lough and occupies a locally low portion of land, just north west of WTG05.

All turbine infrastructure is considered to be sufficiently distant from these fragments of bog, so as to render any negative impact to the construction works negligible.

2.8.1 Historic Landslides and Landslide Susceptibility

Records indicate no significant historic soils and rock movement within the site boundary or within 6km of the site.

GSI landslide susceptibility mapping also indicates that the site generally has a low to moderately low landslide susceptibility, although there does appear to isolated areas of Moderately High landslide susceptibility indicated by the mapping database midway between WTG03 and WTG04. A review of local ground slopes within the landholding indicates that the isolated moderately high susceptibility coincides with steeper slopes associated with outcropping rock.

The isolated area of cut-over Peat Bog coincides with slope gradients of <5 degrees to the horizontal and landslide susceptibility of Low / Moderately Low.

The Geological Survey of Ireland (GSI) records show that the closest recorded landslide event was approximately 6km, south west of the site and not related to peat instability.

Please refer to Appendix 1 for further details.

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2.9 Potential Contamination

2.9.1 Land Contamination

Other than agriculture, the site has not been subject to the action of industrial activities that would have the potential to contaminate the soils at the site, although it is adjacent to established quarrying operations.

No significant areas of filled ground have been identified within the site boundary, although some local areas of filling are present to the south of WTG05, where this extends to approximately 0.2ha. Such areas of infill can result in a negative impact on natural soils, as a result of exposure to unknown historic contamination within the fill material. Areas of imported fill material should be further analysed to determine their significance with respect to site users and potential off-site disposal.

2.9.2 Contaminated Watercourses

There is no visual or olfactory evidence to suggest that any potential contaminants have significantly affected existing watercourses at the Kellystown Wind Farm site.

An assessment of baseline surface and groundwater should be included within the contaminated land investigations.

2.10 Analysis of Existing SI Information

A search for existing site investigation information within the immediate vicinity of the proposed new development has not yielded any useful data.

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3.0 SUMMARY OF DESK STUDY

The following section summarises the findings of the desktop study carried out to determine local conditions at the site of Kellystown Wind Farm.

- The lands are classed as agricultural with no recorded significant industrial heritage associated with the site. Apart from the construction of small sections of metalled tracks, the proposed development of the wind farm will take place on natural soils, small areas of infilled ground and weak rock formations. For the purpose of construction these lands would be mainly classified as "greenfield", although isolated portions of infill are present in the vicinity of WTG05.
- Geological studies indicate that the uppermost rock formation applicable to the majority of the site is Greywacke of the Clogherhead Formation, which is in turn mantled by superficial soils consisting of sandstone and shale derived tills. This rock may be at or very close to the surface.
- Greywacke rock pertaining to Clogherhead Formation appears to outcrop within the site boundary. GSI described this rock formation as "calcareous". Where "calcareous" rocks are present typical "karst" features, such as sinkholes and subterranean chambers can potentially be present. Such features are associated with ground instability and are a recognised geo-hazard when encountered close to the surface. The landforms associated with the lake bed north of WTG05 show similarities to that exhibited by "Karst" landscape.
- The apparent absence of peat and presence of low slope gradients suggests that a peat stability assessment may not be required. Preliminary / scoping assessment of peat stability hazard carried out at Walkover Phase has confirmed this to be the case. No detailed peat assessment is anticipated to be necessary.
- Records indicate that the closest active quarrying operations are; hard rock extraction at Gallstown Quarry immediately north of the site.
- Hard rock aggregate quarries often have a requirement for rock blasting, resulting in the transmission of sonic and vibrational energy. Impacts to the proposed wind farm structures in relation to blasting at either of the closest quarries should be considered.
- No significant watercourses are present within the site boundary (refer to the Appendix for relevant mapping), although minor watercourses are present that connects with external significant watercourses. Care should be taken to ensure that any possible environmental impact caused by the construction process is minimised by implementing effective mitigation controls. There is also potential for subterranean flow to be present

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within the site and as a result further fieldwork is recommended to assess these features on site. Supplementary investigations will be presented in Report 2200-23B that accompanies this report.

- Direct impact by peat debris flow on other more significant receptors, by either construction works or operations has been ruled out. The risk of soil debris flow, given the shallow ground slopes is low. In the event of a debris flow reaching a watercourse, there is potential for the wider environment to be impacted. The mechanisms for this impact would be by:
    - siltation pollution of watercourses and those into which they flow.
    - deterioration in river water quality and that of waterways into which they flow.
    - impact to water borne flora and fauna.
    - damage to highways and third-party structures.
    - damage to overhead and underground services.
    - damage to bridge or culvert structure crossing the affected watercourse.

  For these reasons, impact on designated watercourses, or subterranean flow networks, is considered critical and directly related to the potential for impact of other sensitive receptors downstream. Once a debris flow reaches a water body its impact can be transmitted far from its initial point of entry. Consideration of designated watercourses and subterranean networks as sensitive receptors thus includes for the potential impacts detailed above. Refer to the Preliminary Risk Plot[1] for an initial screening assessment of the Hazard of Peat Instability with respect to all receptors.

- The majority of the site is of high to extreme groundwater vulnerability, where highly bedrock is close to the surface. Care must therefore be taken when carrying out works in these areas to avoid any possible contamination entering the groundwater aquifer.

[1] Finalised following walk over survey fieldwork and testing

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4.0 SITE WALKOVER SURVEY

4.1 Introduction

A reconnaissance / walk over survey was undertaken by Whiteford Geoservices Ltd at the proposed site of Kellystown Wind Farm following completion of the desk-based study. This had the general objective of identifying and assessing on-site features, which could affect both the construction and / or operation of the wind energy development.

This walkover survey (see section 4.0) has taken into account the findings of the initial desktop study and includes a preliminary investigation of the potential receptors, preconditions and failure mechanisms. Following the walkover survey further ground investigations have also been recommended (see follow on Report, 2200-23B); specified in order to aid further understanding of the subsurface in order to determine preliminary geotechnical parameters ahead of final design. The final report 2200-23C, will contain an amalgamated of the desktop study, walkover and site investigation phases.

4.2 Survey Date

The site walkover survey was carried out by John Whiteford of Whiteford Geoservices Ltd on 24th January 2022.

Weather conditions consisting of generally mild temperatures were experienced during the site walkover survey.

4.3 Survey Strategy

The site walkover survey was carried out in order to record the following general on-site information in the vicinity of the main infrastructure, and to act as a confirmatory method to the desk-based study:

- "Spot" check for presence of peat soils and thickness
- Nature of superficial deposits
- Existing bedrock geology (where exposed)
- Presence of significant landforms, evidence of past ground movement, hydrological features, other watercourses or other features of note.
- Topography – significant slopes
- Relative position of potential receptors such as buildings, roads, watercourses, etc.
- Location of any services / utilities
- Identification of any regions of sensitive ground

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Practically, this analysis was made at a series of positions in the vicinity of the proposed turbine infrastructure, in order to gain a preliminary geotechnical understanding of ground conditions that might affect the stability of lands at and immediately surrounding the wind energy development.

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5.0 PREVAILING SITE CONDITIONS

(As determined from the Desk Study)

The proposed development site has an agricultural land use where these lands consists of grazing land, semi improved grass land and coniferous forestry.

The following section details the various soils and geology characteristics encountered during the walkover survey carried out at Kellystown Wind Farm.

5.1 Superficial Deposits

Desk study analysis indicates that the superficial soils consist of thin glacial tills mantled by organic topsoil. Isolated areas of weak cut over raised peat bog are present, but considered sufficiently distant to the planned infrastructure so as to have no impact on stability.

The walkover survey generally confirms this to be the case.

5.2 Solid Geology

During the site reconnaissance survey, it was not possible to determine the depth that bedrock will be encountered across the development site, nor the rock type, as exploratory hole data collected on site terminated without reaching the bedrock level.

Regions of outcropping weathered rock were identified within the proposed development site during the desktop study, where they were restricted to the north and west of the site. In particular outcropping rock was recorded in the vicinity of WTG01, WTG02, WTG03 and WTG04.

The Author believes that the solid geology of the site is not dissimilar to what has been published by the GSI.

No further information with respect to the solid geology was added following the walkover.

5.3 Existing Slopes

An analysis of OSI topographic data was undertaken to identify the variation in gradient applicable to the existing slopes within the vicinity of the proposed wind farm infrastructure. This was primarily used to determine the susceptibility of peat soils to movement and is applied here for the propose of providing a preliminary determination of hazard with respect to peat stability.

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Both Evans and Warburton (2007) and Boylan et al. (2008) found from their analysis of recorded failures in blanket bog, that failures were often recorded for slopes of typically 4 – 8 degrees to the horizontal. In such cases the mechanism of failure is almost certainly, exclusively, by tear induced "bog burst" (i.e. peat, on average, greater than 2.5m thick) with very little to do with the surface slope gradient, where the cause is a build-up of excessive hydrostatic pressure in the peat mass.

Peat residing on slopes in excess of 8 degrees is generally thin and unlikely to accumulate to the thickness required for "bog burst" to occur. Gravity as opposed to hydrostatic pressure is the main precondition for landslide in this case.

In thick peat the peat failure mechanism is normally internal and not due to a detaching of the peat soils from the underlying mineral substrate or as a result of activation along on surface tear, as would be the case on steeper slopes and shallower peat.

A common mechanism for internal failure is increased hydrostatic pressure which occurs when significant rainfall falls on peat soils. This both increases the weight of the peat bog and can cause any minor weaknesses in the bog structure to be activated as the system attempts to reduce the internal pressure. Such internal failure is then likely to cause detachment to occur below the failure point, which in turn results in the peat mass moving under gravity along the water-lubricated basal plane; where the peat – mineral soil friction may never have been exceeded.

Friction at the base of the peat is nonetheless important and thus it is important to consider the existing slope gradient as a potential trigger and precondition for a peat slide. This is especially the case where thinner peat thicknesses are present for which "bog burst" is much less likely to occur.

For these reasons, a banded factor-based approach is advocated for the purpose of apportioning risk. The following bands are used for this purpose and are based on our experience with accidently triggered peat slides at over 100 different wind farm sites.

Existing Slope Angle (*Measured at Surface of Peat, Angle to Horizontal)*	**Risk Factor Assigned *(Using Factor Based Probabilistic Analysis)***	**Remarks**
0 - ≤5	0	Negligible influence
5 - ≤ 10	1	Low
10 - ≤ 22.5	2	Medium
>22.5	3	High

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The additional risk of internal failure relating to “bog burst”, is allowed for by apportioning an additional risk factors based on peat thickness.

5.4 Observations

The following is an appraisal of ground conditions at the site of the approved Kellystown Wind Farm. Mapping is provided which indicates the point survey locations which have informed this assessment.

Point 1 - Turbine WTG01

Nature of Assessment	Observations
Position (ITM)	E=530662.7, N=648685.3
Peat Depth	No peat was encountered
Superficial Soils	Slightly sandy, slightly gravelly SILT / CLAY with low cobble content
Solid Geology	No outcropping rock
Presence of peat landforms, evidence of past ground movement, hydrological features, other watercourses or other features of note	None evident
Topography	0 - 5 degrees to horizontal at Turbine centre; up to 10 degrees area within the anticipated construction zone. Topography is generally irregular and probably the result of shallow or frequently outcropping bedrock.
Sensitive Receptors	Within coniferous forestry. No sensitive receptors recorded within the relevant buffer
Utilities: Underground or overhead	None recorded within relevant buffer
Any other observations	Badger sett or fox den in the immediate vicinity. Borehole Standpipe identified within 200m of the Turbine

Point 2 - Turbine WTG02

Nature of Assessment	Observations
Position (ITM)	E=530315.0, N=648361.9
Peat Depth	No peat was encountered
Superficial Soils	Slightly sandy, slightly gravelly SILT / CLAY with low cobble content
Solid Geology	No outcropping rock recorded at turbine centre. Undulating surface topography suggests rock is shallow.
Presence of peat landforms, evidence of past ground movement, hydrological features, other watercourses or other features of note	None evident

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Topography	0 - 5 degrees to horizontal. Irregular surface topography – probable thin soils overlying rock.
Sensitive Receptors	Within coniferous forestry. No sensitive receptors recorded within the relevant buffer
Utilities: Underground or overhead	None recorded within relevant buffer
Any other observations	Unable to reach the centre of the turbine due to thick vegetation.

Point 3 - Turbine WTG03

Nature of Assessment	**Observations**
Position (ITM)	E=530176.2, 647991.3
Peat Depth	No peat was encountered
Superficial Soils	Slightly sandy, slightly gravelly SILT / CLAY with low cobble content
Solid Geology	Outcropping rock in vicinity of the turbine
Presence of peat landforms, evidence of past ground movement, hydrological features, other watercourses or other features of note	None evident
Topography	5 - 10 degrees to horizontal in the vicinity of the turbine. Very undulating topography suggesting thin soil cover over rock
Sensitive Receptors	None recorded within relevant buffer
Utilities: Underground or overhead	None recorded within relevant buffer
Any other observations	Quarry face within 265m of turbine centre

Point 4 - Turbine WTG04

Nature of Assessment	**Observations**
Position (ITM)	E=530195.9, N=648747.1
Peat Depth	No peat was encountered
Superficial Soils	Slightly sandy, slightly gravelly SILT / CLAY with low cobble content
Solid Geology	Outcropping rock exposed to the west of the turbine
Presence of peat landforms, evidence of past ground movement, hydrological features, other watercourses or other features of note	5 - 10 degrees to horizontal in the vicinity of the turbine. Very undulating topography on the western side suggests thin soil cover over rock. Lands to the east of the turbine are uniform in gradient, lacking the undulating form evident to the west.
Topography	5 - 10 degrees to horizontal
Sensitive Receptors	None recorded within relevant buffer

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Utilities: Underground or overhead	Major underground Gas Transmission Line within 300m of infrastructure. Minor underground water supply anticipated along the edge of the access track to the north of the turbine location.
Any other observations	Raised water trough evident immediately to the north west of turbine location.

Point 5 - Turbine WTG05

Nature of Assessment	**Observations**
Position (ITM)	E=529689.8, N=648511.6
Peat Depth	No peat was encountered
Superficial Soils	Slightly sandy, slightly gravelly SILT / CLAY with low cobble content. There is evidence to suggest that portions of the within which WTG05 is sited, have been filled with imported material.
Solid Geology	No outcropping rock
Presence of peat landforms, evidence of past ground movement, hydrological features, other watercourses or other features of note	A depression approximately 1540m to the north of WTG05 is the source for a small watercourse, Drumshallon Stream that flows east towards
Topography	5-10 degrees to horizontal Filled ground has been recorded within the south eastern corner of the filed within which WTG05 is sited. Historic aerial photography suggests more extensive infilling between 1985 and present day
Sensitive Receptors	A small lake bed, Drumshallon Lough, is present approximately 180m to the north east, within locally low-lying lands. At the time of the site visit this lake bed was dry.
Utilities: Underground or overhead	None evident
Any other observations	A track constructed on a raised “causeway skirts the southern perimeter of Drumshallon Lough and could indicate a potential flood risk within the northern and eastern portions of the field.

Point 6 - Turbine WTG06

Nature of Assessment	**Observations**
Position (ITM)	E=529581.6, N=648917.0
Peat Depth	No peat was encountered
Superficial Soils	Slightly sandy, slightly gravelly SILT / CLAY with low cobble content
Solid Geology	No outcropping rock
Presence of peat landforms, evidence of past ground movement, hydrological features, other watercourses or other features of note	The site of WTG06 is relatively low-lying and as just could indicate a potential flood risk
Topography	0 - 5 degrees to horizontal but some areas up to 10 degrees area is very undulating
Sensitive Receptors	Turbine centre is 55m south of Drumshallon Stream and another dry lake bed, identified on historic mapping, but now thickly vegetated.

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Utilities: Underground or overhead	Major underground Gas Transmission Line within 300m of infrastructure.
Any other observations	None.

Point 7 - Turbine WTG07

Nature of Assessment	**Observations**
Position (ITM)	E=529324.7, N=648643.8
Peat Depth	No peat was encountered
Superficial Soils	Slightly sandy, slightly gravelly SILT / CLAY with low cobble content
Solid Geology	No outcropping rock within immediate vicinity
Presence of peat landforms, evidence of past ground movement, hydrological features, other watercourses or other features of note	Turbine centre is within coniferous forestry, approximately 25m west of stoned access track.
Topography	Lands relatively flat and sloping at < 5 degrees to horizontal
Sensitive Receptors	Less than 100m north west of commercial building / agricultural shed
Utilities: Underground or overhead	None evident
Any other observations	None

5.5 Existing Mining Activities

The walkover survey confirms that there are no current licensed quarrying operations evident within the site boundary. Aerial photography suggests that local extraction of soils may have taken place in the north west corner of the field (c. 185m distant) occupied by WTG05.

The closest quarrying operations about the northern boundary of the wind farm site, with turbines T03 being approximately 300m from quarry workings.

5.6 Existing Services / Utilities

The main hazard at Kellystown wind farm from utilities is the underground transmission Gas Main that traverses the site. Please refer to mapping contained in Appendix 1 for details of its position within the proposed wind farm landholding.

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No additional information regarding existing services / utilities was determined from the walkover survey. However, given the area the site covers, underground services should be expected in the vicinity of local and regional roads

Minor utilities are potentially present along any of the site tracks within the site, where these provide water to service water troughs.

5.7 Potential Sensitive Receptors

Analysis of desk study resources and follow up walkover survey have identified the following receptors with the potential to be susceptible to peat instability generated by activity related to the proposed wind farm construction and / or operation.

Receptor	**Minimum distance to Development Boundary**	**Exposure Factor** *(Factor Based Probabilistic Analysis)*	**Remarks**
Peatlands / Bog	Some evident in Isolated area	1	Two areas are bog are recorded: - 1. Depression associated with Drumshallon Lough, centred on E=708135, N=783401 2. Isolated depression centred on E=707668, N=782900 3. Area centred on E=708695, N=784040
Agricultural Lands	0m (within site)	1	The majority of the site with the exception of areas of coniferous forestry at WTG01, WTG02 and WTG07.
Minor Utilities	0m (within site)	2	Water / Telecom within site boundary and assumed to be potentially present in the vicinity of tracks traversing the site to service agricultural structures.
Designated Minor Watercourses / Water Bodies	0m (within site)	2	Drumshallon Lough Drumshallon Lough Stream Minor Lake Bed north of WTG06 Piperstown Stream Hammondstown Stream
Designated Major Watercourses / Water Bodies	c. 7km to south	3	River Boyne

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Undesignated Watercourses / Drainage	0m (within site)	1 / 2	Ditches and man-made watercourses, ephemeral run-off channels and possible subterranean flow networks have been recorded within the wind farm site.
Minor Public Roads	c. 0m (at site entrance)	3	The wind farm is accessed from Ballymackenry Road. Hamlinstown Lane / Harewood Cottages runs along the south side of the land holding and is used to access turbine WTG02, via another unpaved public road.
Moderately to highly trafficked Public Road	c.1600m	4	M1 north west of site
Dwellings	<100m from site entrance	4	There are approximately thirty-five dwellings within 800m of the indicated viable development area boundary. All remaining identified residential dwellings are sited 700 metres or more from the closest sited turbine locations
Commercial Property	0m (within site)	3	Agricultural buildings within site boundary. WTG07 is < 100m north west of an existing agricultural building. No other consented nor operational wind farms within 2km of the site development area;
Significant Utilities (Overhead) / Underground	C 300m (within site boundary)	3	Underground gas transmission main. within 300m of WTG04 and WTG06[2].
Population centre / Urban area	c. 4.5km (|Dunleer) c.5.5km (Drogheda)	5	Dunleer – Population 1.822 (2016). Drogheda – Greater area population 83,000 (2016)[3]

[2] Source: Wikipedia: https://en.wikipedia.org/wiki/Dunleer
[3] Source: Wikipedia: https://en.wikipedia.org/wiki/Drogheda

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5.8 Potential Preconditions Identified within the immediate vicinity of the proposed development

Analysis of desk study resources and follow up walkover survey have identified the following static or inherited factors that could potentially act as preconditions to slope instability, especially in weak/organic soils and bog land habitats.

Precondition	Minimum distance to Development (m)	Remarks
Concentrated drainage network / presence of standing water / area of flush / springs, or rises	Identified within wind farm	In vicinity of WTG05 and WTG06
Significant slopes	Not at assessed infrastructure	Some steep slopes evident just east of WTG03 only
Presence of sensitive organic soils or peat	0m	Two small regions of raised bog are present within the development area. One area extending to
Significant peat thickness	No peat encountered	No significant peat thickness present at proposed infrastructure
Very highly decomposed peat	N/A	N/A
Very weak peat and underlying mineral soils	0m	Very weak mineral soils anticipated in vicinity of WTG06.
Potential sonic vibration or ground accelerations	<200m.	Vibrationally induced energy, e.g. from quarry blasting potentially <300m north of WTG03

5.9 Pre-Failure Indicators within the immediate vicinity of the proposed development

Pre-failure indicators are physical landforms that are “tell-tale” signs of stress within the soils and peatland environment.

The following pre-failure indicators have been considered for the proposed development at Kellystown Wind Farm: -

- Historical evidence of previous movement / Peat cutting
- Tension or compression features
- Soil creep
- Cracking / desiccation

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- Other[4]

The following pre-failure indicators are present within the immediate vicinity of the proposed development.

Pre-Failure Indicator	Minimum distance to Development (m)	Remarks
Historic peat cutting	None recorded	None evident
Evidence of historical peat / soil movement	Not at assessed infrastructure	
Evidence of tension cracking or compression features	Not at assessed infrastructure	
Evidence of soil creep	Not at assessed infrastructure	
Cracking / desiccation	Not at assessed infrastructure	

5.10 Summary of Prevailing Site Conditions

Analysis of Desk Study and Walkover Survey data allows the following preliminary geotechnical appraisal for the Kellystown Wind Farm site: -

1. Superficial soils are anticipated to be variable in thickness and composed of organic topsoils overlying tills derived from sandstones and shales. Although peat is present as cutover raised bog in isolated locations, for practical purposes any negative impact from peat can be considered absent for the purpose of the proposed development. Specific detailed Peat Stability and Landslide Hazard Assessment is not required.

   Weak, waterlogged mineral soils are anticipated within the locally low central portion of the site around WTG06 and Drumshallon Lough, where traditional gravity base foundations are unlikely to be suitable and piled foundations more so. Specific guidance regarding safe methods of construction within this area would be appropriate.

   Moderate thicknesses of soils are anticipated at WTG05 and WTG07, where there is risk that these soils may be considered of marginal competence where gravity base foundations are considered.

2. Rock outcrops at the surface within the west and north of the development area, but is considered to be extremely weak to weak in terms of local weathering and competence. Rock

[4] The Scottish Guidance notes other potential pre failure indicators such as artificial drainage, concentrated drainage networks, seeps, springs, soft clays and iron pans. The author considers these to be preconditions and not pre failure indicators.

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extraction is highly likely to be necessary to construct infrastructure in the vicinity of WTG01, WTG02, WTG03, WTG04, WTG. The hazard that this represents to construction is Medium.

3. The dominant underlying rock formation is Greywacke and is potentially "karstic" because of its calcareous content. "Karst" landscapes features such as sinkholes, cavities or subterranean drainage networks and have the ability to affect the stability of turbine infrastructure. Features typical of a "karst" landscape have been observed during the walkover surface and therefore the hazard that this represents to construction of wind turbine foundations is currently considered to be Medium, without further investigation. Supplementary investigations are required prior to construction to assess this item further.

4. Construction of the access track network, turbine hardstands and other associated infrastructure are expected to follow traditional principles, where the weak shallow soils will be removed to expose a competent formation upon which construction can commence. An allowance for excavation within rock should be made particularly when constructing within the west of the site.

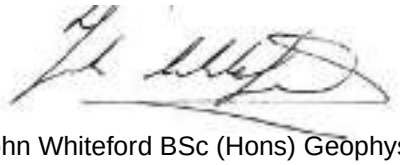
   The exception to this rule may occur in the vicinity of turbine WTG06 and Drumshallon Lough where a significant thickness of weak surface soils is expected.

5. Groundwater is anticipated to be a feature of construction design at WTG06 and to a lesser extent at WTG05 and WTG07. Groundwater is anticipated to be of minimal significance at turbines WTG01, WTG02, WTG03 and WTG04.

This report has been prepared on behalf of EDF Renewables and Jennings O'Donovan Ltd.

by

Whiteford Geoservices Ltd



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Appendices

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Appendix 1

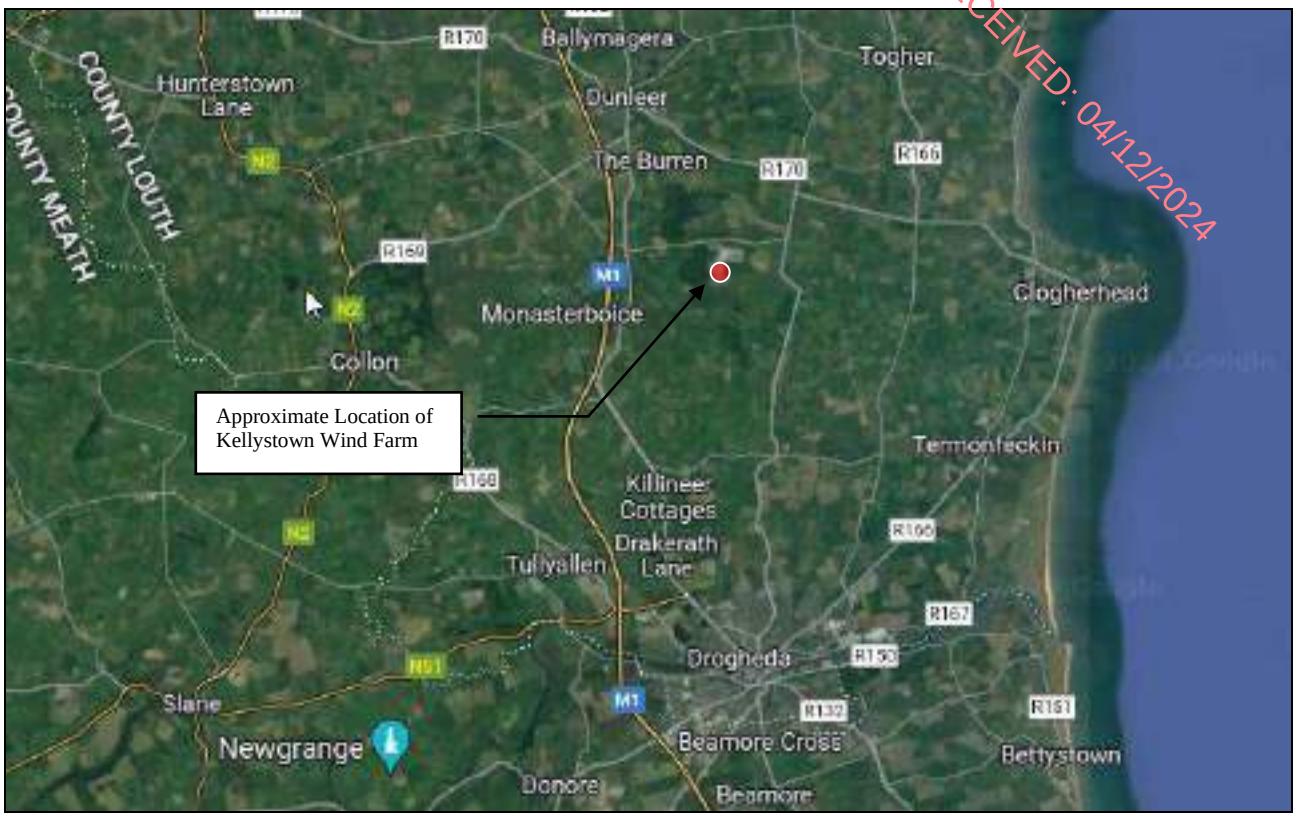
General Site Location Plans – P1 / P2
Kellystown Wind Farm Site Layout Plan P3

Priority Habitat Mapping – Local (EPA Online Environment Viewer)

Plot Depicting location of sensitive receptors, as well as identified preconditions and pre-failure indicators in the immediate vicinity of the wind farm development [2200-23A-PE]

Geological Survey of Ireland Public Viewer Data – Solid and Structural Geology
Geological Survey of Ireland Public Viewer Data – Superficial Soils and Landforms
Geological Survey of Ireland Public Viewer Data – Groundwater Resources
Geological Survey of Ireland Public Viewer Data – Groundwater Vulnerability
Geological Survey of Ireland Public Viewer Data – Karst Groundwater Data
Geological Survey of Ireland Public Viewer Data – Active Quarries

Geological Survey of Ireland Public Viewer Data – Landslide Susceptibility
Geological Survey of Ireland Public Viewer Data – Historic Landslide Events



P1 - General Location Plan (Aerial view)
(© google maps 2021)

P2 - Local Location Plan (Aerial view)
(© google maps 2021)

Kellystown Wind Farm

Soils and Geology Study

Layout Plan - Proposed Wind Turbine Locations

Key

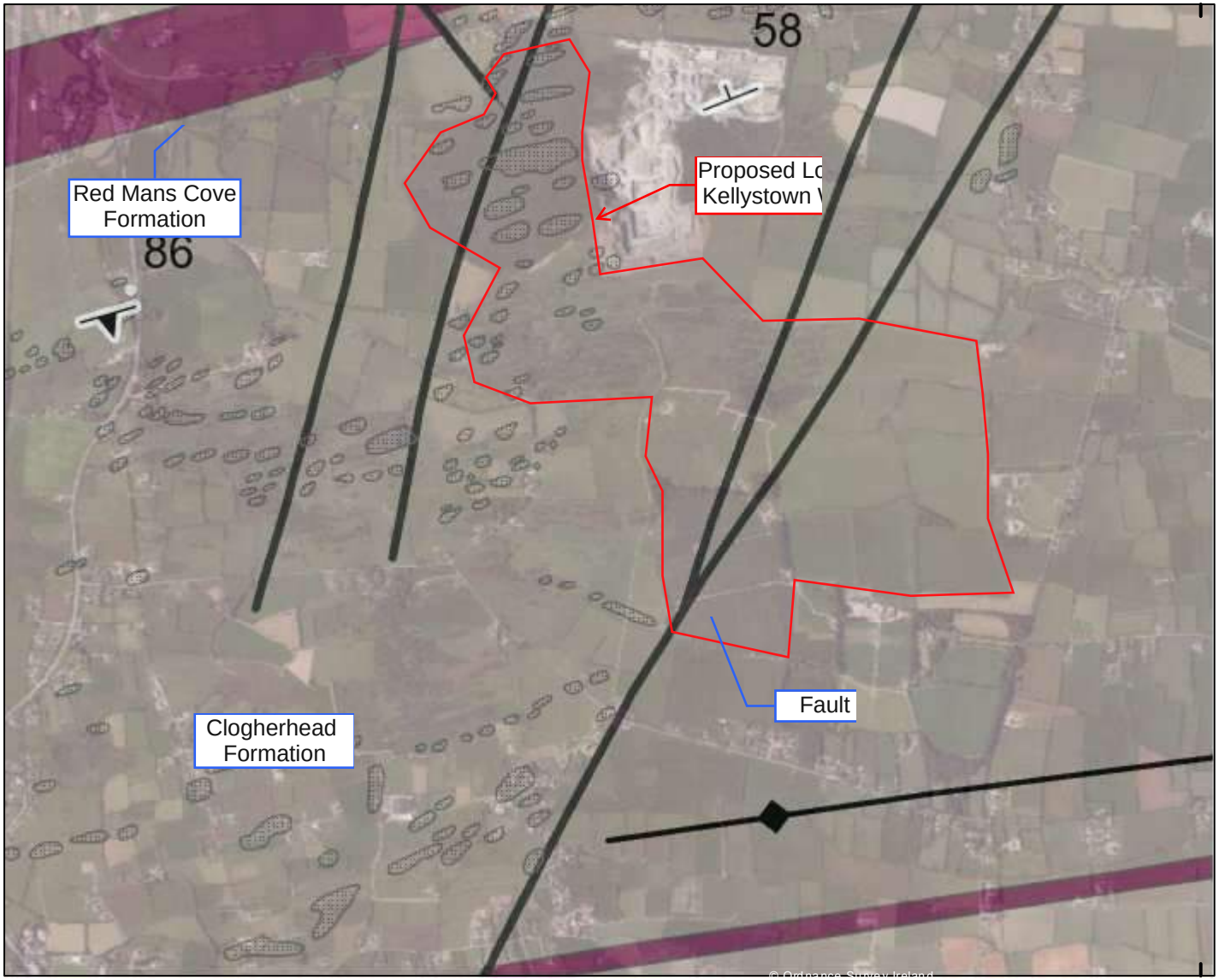
WTG01 ◎ Proposed Wind Turbine Generator

Drawing: 2200-23 P3

Not to Scale

E1 – SAC and Natural Heritage Sites
(© EPA Maps - OSi)

GSI - Solid Geology



Legend

Structural Symbols 100K ITM 2018

- Dip of bedding or main foliation, old GSI data
- First foliation parallel to bedding
- Foliation trend, Thorr and Rosses Granites
- Horizontal Bedding
- Strike and dip of bedding, right way up
- Strike and dip of bedding, way up unknown
- Strike and dip of first foliation
- Strike and dip of overturned bedding
- Strike and dip of second foliation
- Strike and dip of third foliation
- Strike and plunge of first generation fold axis
- Strike and plunge of second generation fold axis
- Strike and plunge of third generation fold axis
- Strike of vertical bedding/foliation
- Strike of vertical first foliation
- <all other values>

- Bedrock Outcrops 100 ITM 2018

Bedrock Linework 100k ITM 2018

- Anticlinal Axis
- Antiformal axis
- Aquifer Boundary
- Area
- Coal seam
- Dyke
- Fault
- Ghost Line
- Goniatite marine band (R1-R4)
- Lithological boundary offshore
- Metadolerite sheet, mainly sills
- Paleogene/ Tertiary Dyke
- Synclinal Axis
- Synformal axis
- Tectonic Slide, barbs on hanging-wall
- Thin stratigraphical unit, diagrammatic
- Thrust, barbs on hanging-wall side
- Tuff band
- Unconformity, dots on younger side
- X-Section

Bedrock Geology

- Clogherhead Formation
- Red Mans Cove Formation

Scale: 1:25,000

Geological Survey Ireland

N W E S

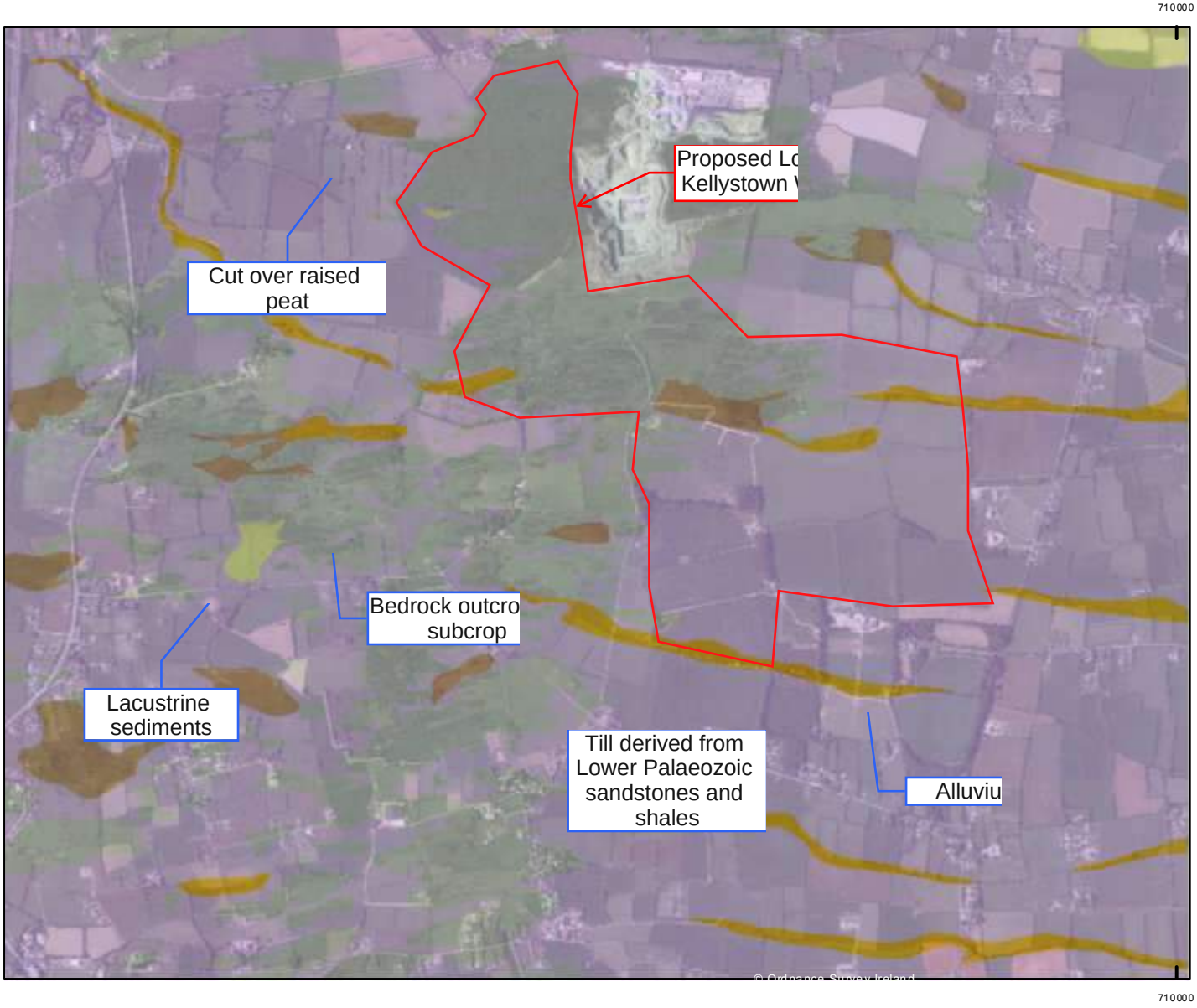
0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 707,715 783,016

16/02/2023, 11:28:44

GSI - Superficial Geology



Legend

Quaternary Sediments

- Alluvium
- Cut over raised peat
- Lacustrine sediments
- Till derived from Lower Palaeozoic sandstones and shales
- Bedrock outcrop or subcrop

Scale: 1:25,000

Geological Survey Ireland

N W E S

0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 707,715 783,016

16/02/2023, 11:29:50

GSI - Groundwater Resources

Legend

Gravel Aquifer

- Regionally important gravel aquifer
- Locally important gravel aquifer
- Bedrock Aquifer Faults

Bedrock Aquifer

- Rkc - Regionally Important Aquifer - Karstified (conduit)
- Rkd - Regionally Important Aquifer - Karstified (diffuse)
- Rk - Regionally Important Aquifer - Karstified
- Rf - Regionally Important Aquifer - Fissured bedrock
- Rf/Rk - Regionally Important Aquifer - Fissured bedrock/Regionally Important Aquifer - Karstified
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive

- Lake
- Unclassified

Scale: 1:25,000

Geological Survey Ireland

N W E S

0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 707,715 783,016

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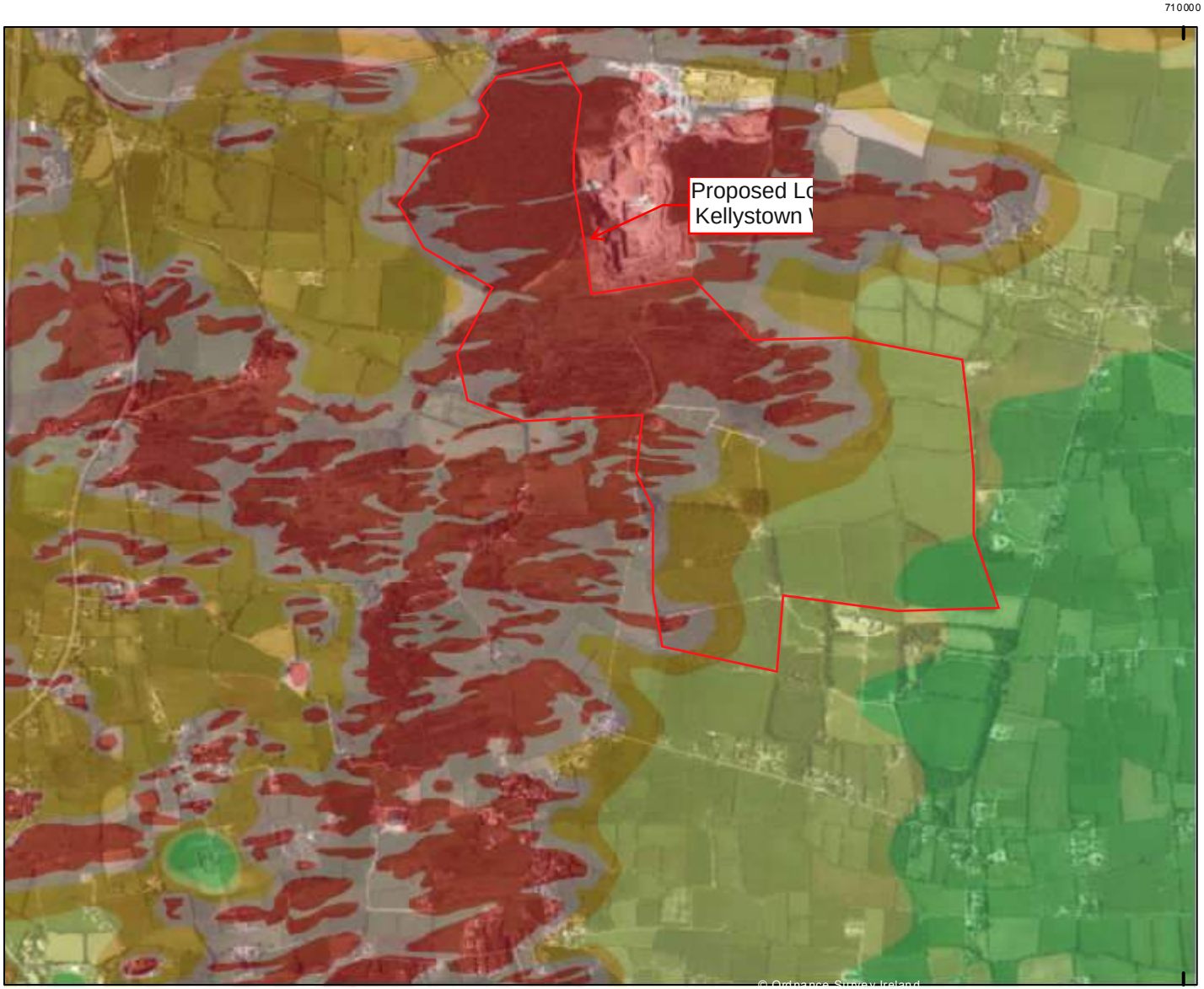
GSI - Groundwater Vulnerability



Legend

Groundwater Vulnerability

- Rock at or near Surface or Karst
- Extreme
- High
- Moderate
- Low
- Water

Scale: 1:25,000

Geological Survey Ireland

N W E S

0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 707,715 783,016

16/02/2023, 11:31:59

GSI - Karst, Wells and Springs

Legend

Karst Landforms

- Borehole
- Cave
- Dry Valley
- Enclosed Depression
- Spring
- Superficial Solution Features
- Swallow Hole
- Turlough

Traced Underground Connections

Groundwater Wells and Springs

Scale: 1:25,000

Geological Survey Ireland

N W E S

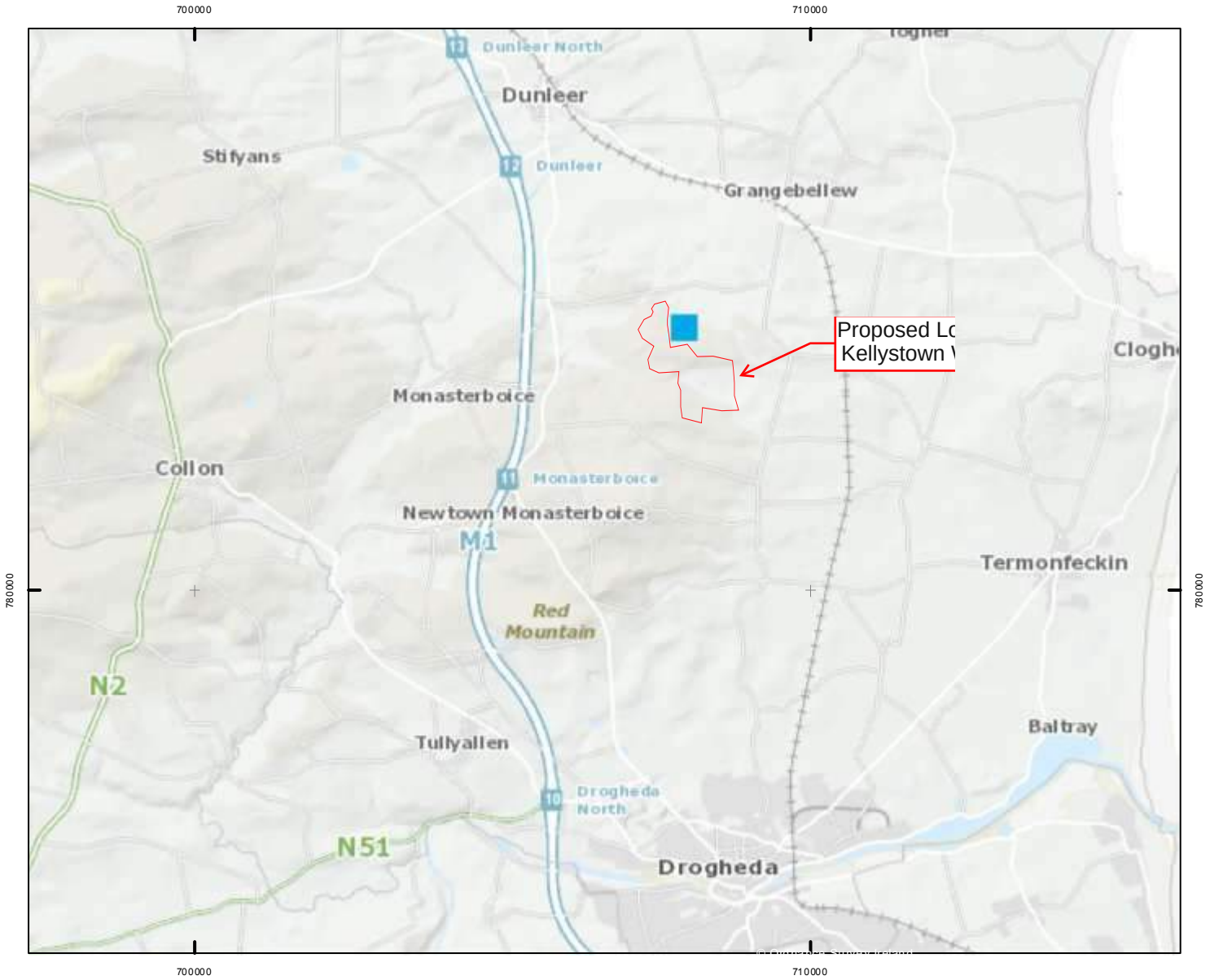
0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 707,715 783,016

16/02/2023, 11:33:10

GSI - Active Quarries



Legend

Active Quarries and Pits

- Crushed Rock
- Dimension Stone
- Sand and Gravel

RECEIVED: 04/12/2024

Scale: 1:100,000

Geological Survey Ireland

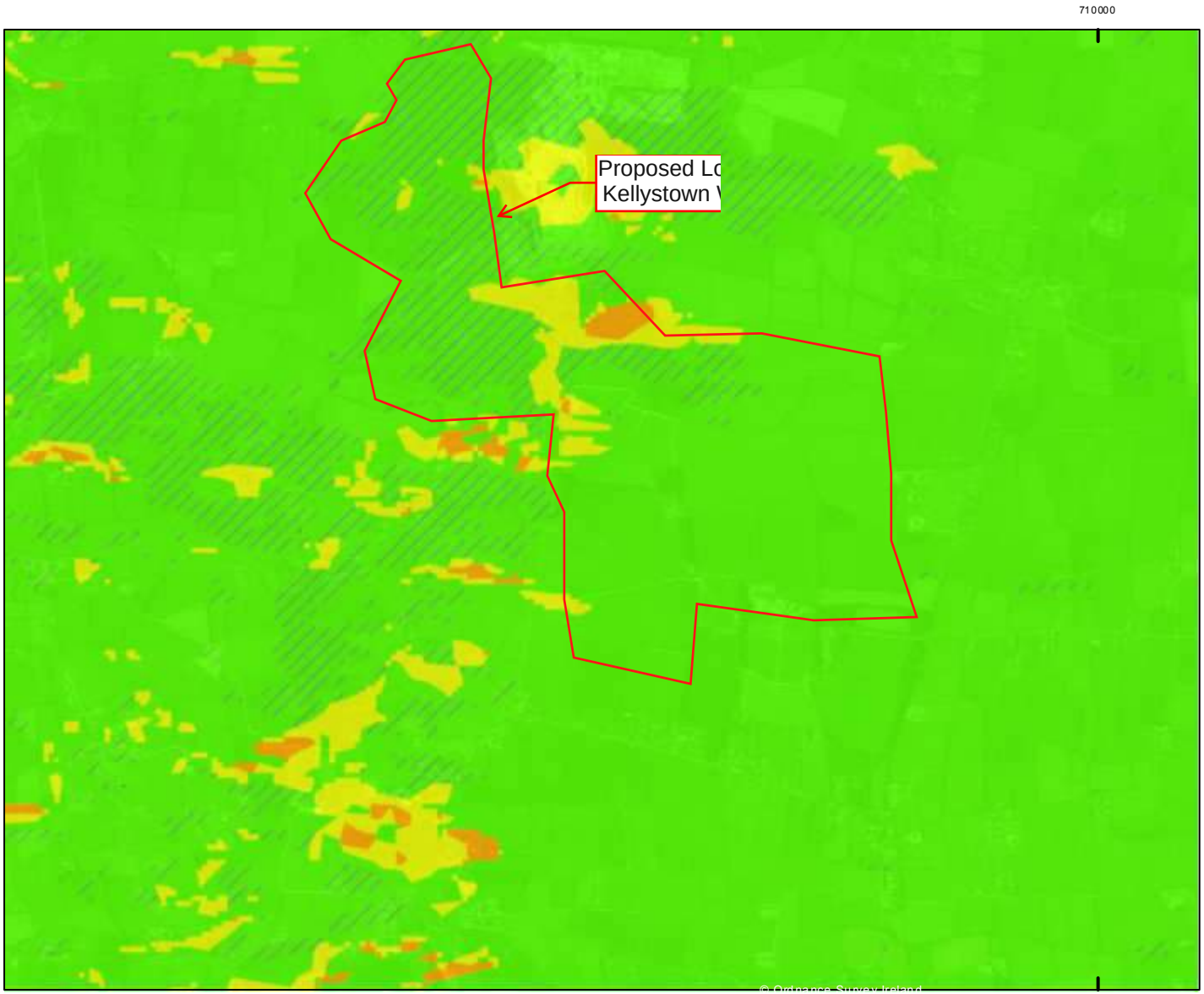
0 0.5 1 2 mi

0 1 2 4 km

Map Centre Coordinates (ITM) 706,657 781,604

16/02/2023, 11:38:02

GSI - Landslide Susceptibility Map



Legend

Landslides Susceptibility Classification

- Unclassified
- Low
- Low (inferred)
- Moderately Low
- Moderately Low (inferred)
- Moderately High
- Moderately High (inferred)
- High
- High (inferred)
- Made
- Water

Scale: 1:25,000

Geological Survey Ireland

CC-BY 4.0

N W E S

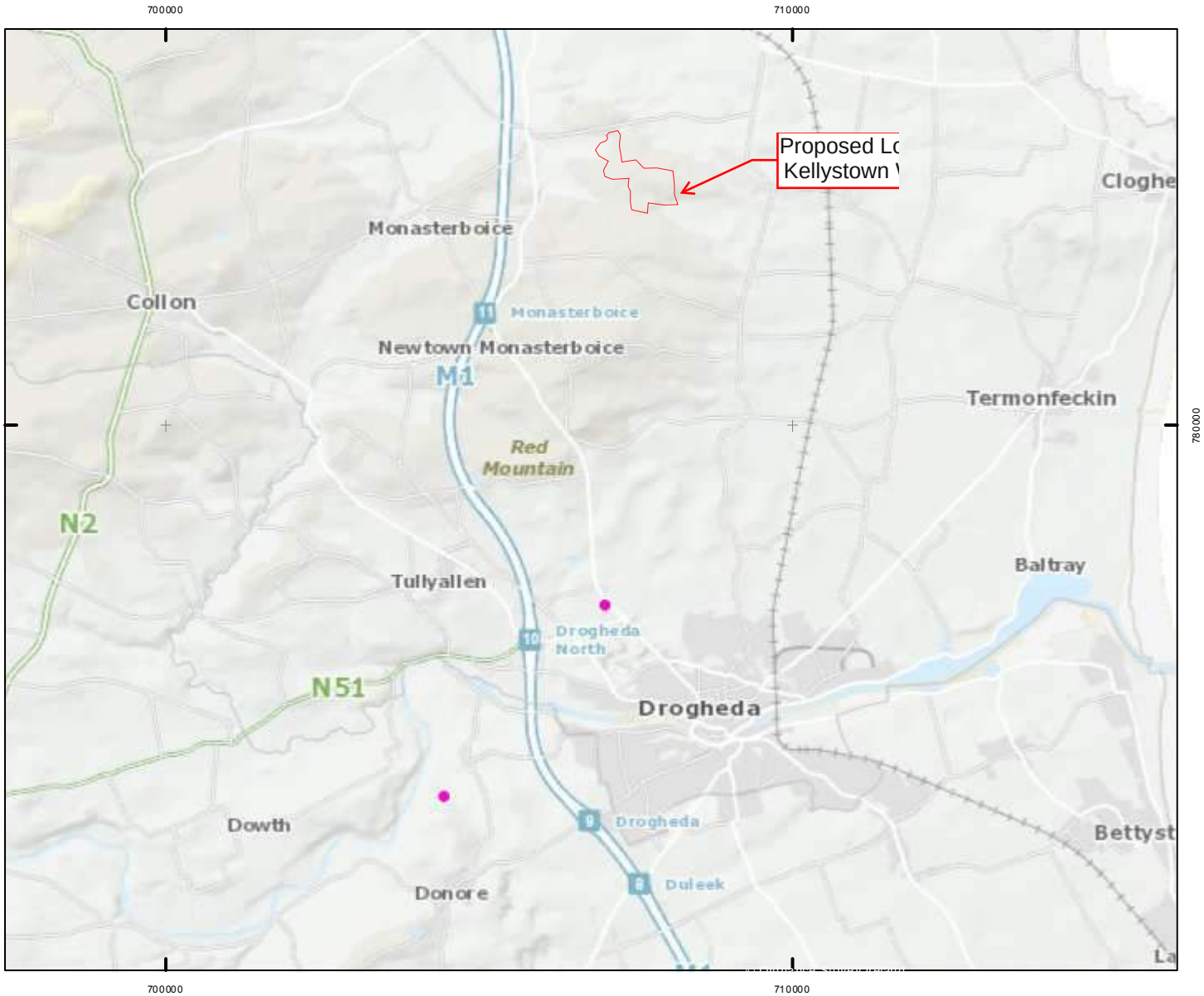
0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 708,053 782,926

16/02/2023, 11:42:59

GSI - Landslide Events Map - Regional



Scale: 1:100,000

Geological Survey Ireland

CC-BY 4.0

0 0.5 1 2 mi

0 1 2 4 km

Map Centre Coordinates (ITM) 706,777 778,815

16/02/2023, 11:40:03

Legend

- Landslide Locations Ireland ITM
- Landslide Extents Ireland ITM

Appendix 2

Preliminary Peat Depth Data
Classed Plot of Peat Depth 2200-23A-D1

2200-23 - Kellystown Wind Farm
Preliminary Data of Peat Depth at Turbines

Location	Easting	Northing	Depth
T2	707234	783588	0
T7	708325	782802	0
T5	708087	783205	0
T6	708763	783183	0
T4	708560	783584	0
T3	707981	783632	0
T1	Not accessible - within forestry. Peat depth expected to be negligible.		

2200-23 - Kellystown Wind Farm

Classed Plot of Peat Depth - Preliminary Data

4th April 2023

Classsed Plot of Peat Thickness (m)

- 0m to 0.5m
- 0.5m to 1m
- 1m to 2m
- 2m to 3m
- 3m to 4m
- 4m to 5m

Notes:

1. All depths are relative to ground level existing at the time of the survey / investigation.
2. All positions relate to the ITM coordinate system.
3. Where no depth / thickness is indicated access was not possible at time of walkover survey

DRAFT

Designed by	Checked by	Approved by - date	Drawing No.	Date	Scale
J. S.	J. W.	04/04/2023	2200-23 D1-P	04/04/2023	NTS

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

Classed Plot of Peat Depth - Preliminary Data

Kellystown Wind Farm | Edition 0 | Sheet A3

Appendix 3

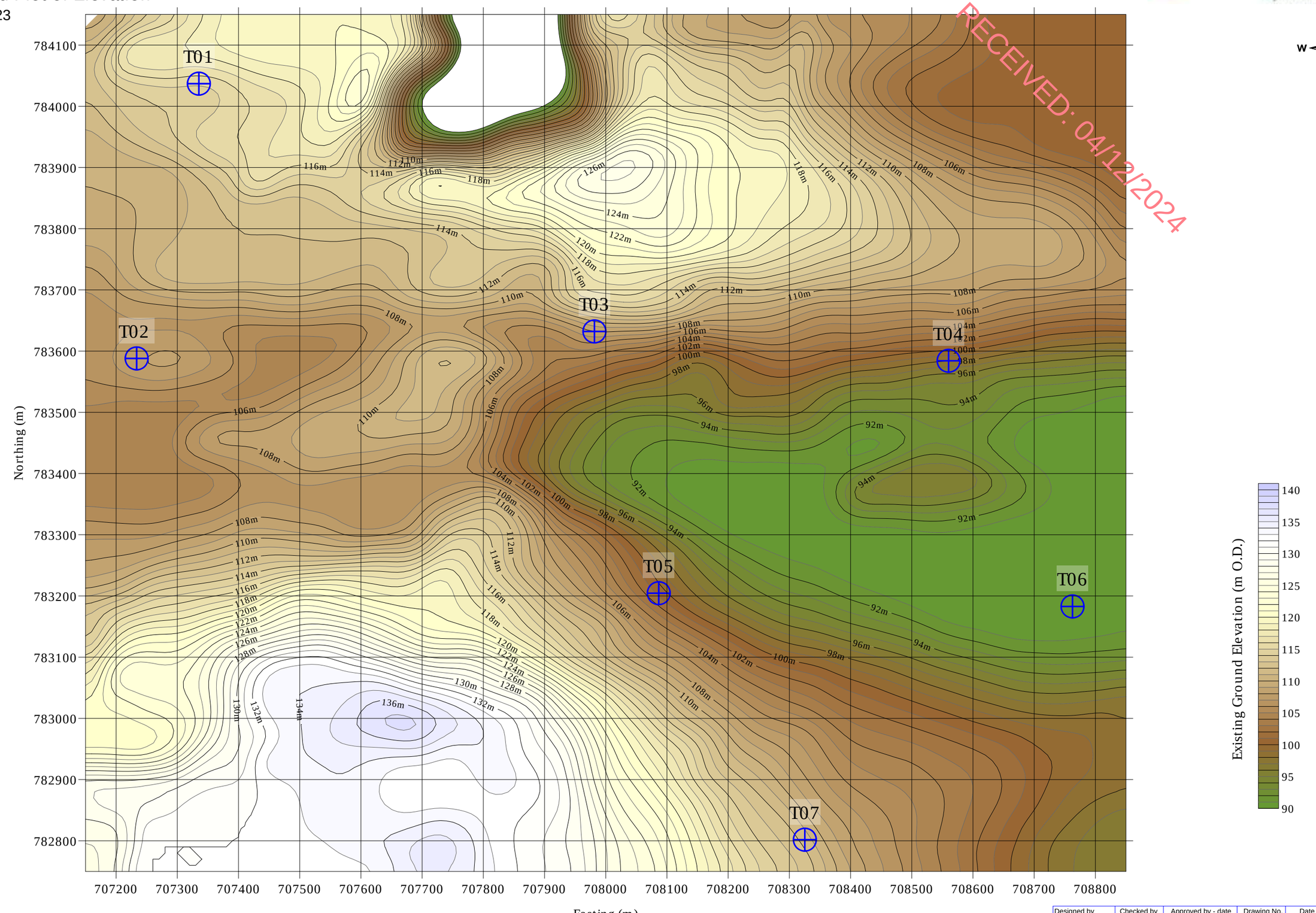
Preliminary Plot of Ground Elevation 2200-23A-D3

(10mx 10m data compiled using OSI DTM elevation data)

2200-23 - Kellystown Wind Farm

Contoured Plot of Elevation

4th April 2023



DRAFT

Notes:

1. All positions relate to the ITM coordinate system.
2. Any elevations are provided relative to Ordnance Datum Malin Head

Designed by	Checked by	Approved by - date	Drawing No.	Date	Scale
J. S.	J. W.	04/04/2023	2200-23 D3	04/04/2023	1:6,000

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Contoured Plot of Elevation

Kellystown Wind Farm

Edition	Sheet
0	A3

Appendix 4

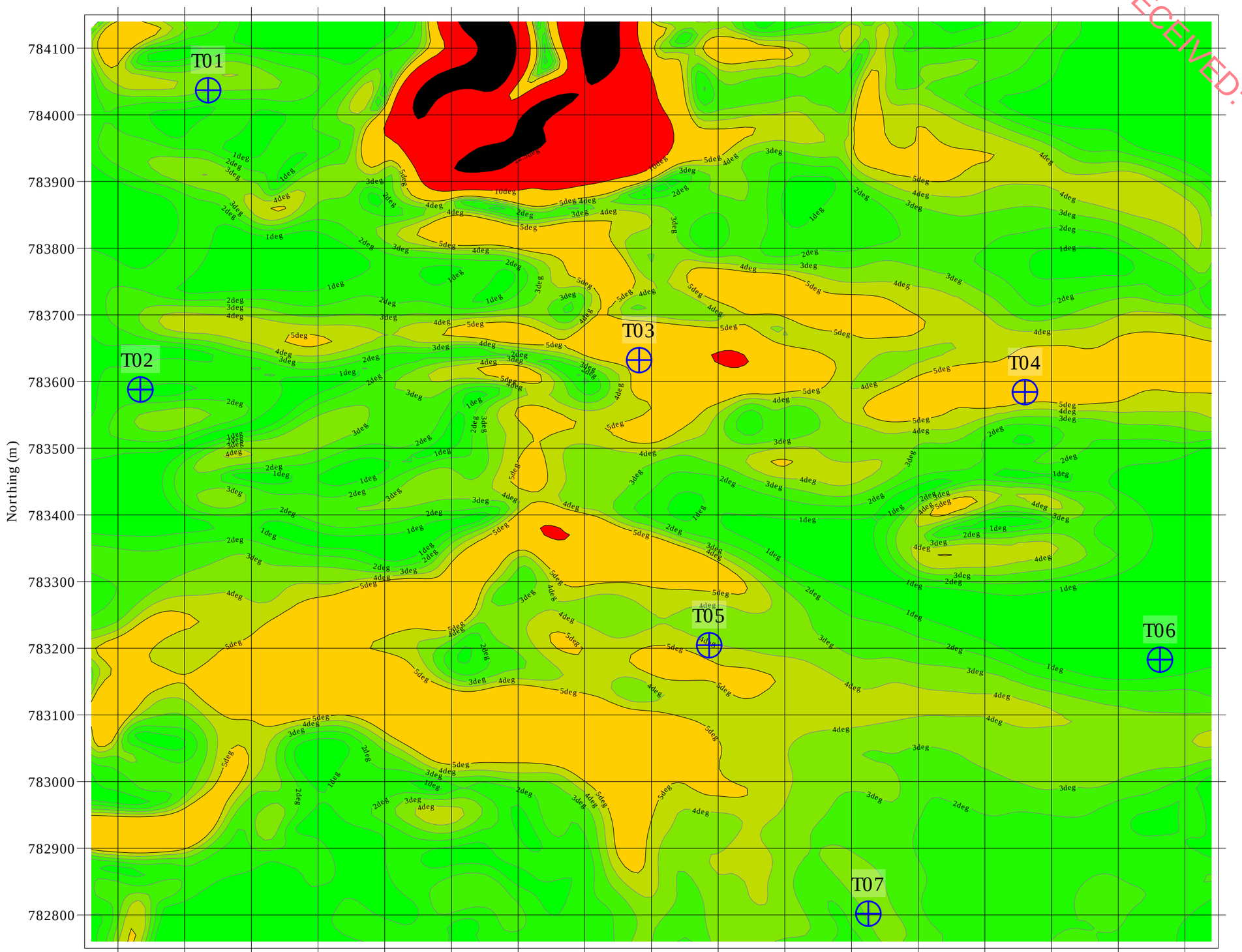
Preliminary Plot of Ground Slopes 2200-23A-D4

(Calculus applied to determine Gradient of 10m x 10m Data used to compile Ground elevation Plot – Appendix 3

2200-23 - Kellystown Wind Farm

Contoured Plot of Slope Angle

4th April 2023



N
W
E
S

Key

T01 Wind Turbine Generator

Ground Slope Angle (Degrees)

22.5
10
5
4
3
2
1
0

DRAFT

Notes:

1. All angles are relative to the horizontal.
2. All positions relate to the ITM coordinate system.

Designed by	Checked by	Approved by - date	Drawing No.	Date	Scale
J. S.	J. W.	04/04/2023	2200-23 D4	04/04/2023	1:6,000

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Contoured Plot of Slope Angle

Kellystown Wind Farm

Edition 0

Sheet A3

Appendix 5

Preliminary Screening for Peat Stability Hazard

(Compiled following analysis of site conditions and potential receptors)

2200-23 - Kellystown Wind Farm

Screening Assessment for Peat Stability and Landslide Hazard

4th April 2023

N
W E
S

Peat Stability - Hazard Ranking & Classification

HR = 0 to HR = 5	Negligible
HR = 5 to HR = 11	Significant
HR = 11 to HR = 17	Substantial
HR = 17 to HR = 25	Serious

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Notes:

1. HR represents Peat Stability HAZARD RANKING
2. All positions relate to the ITM coordinate system.
3. Where Hazard Ranking is indicated access was not possible at time of walkover survey

Designed by	Checked by	Approved by - date	Drawing No.	Date	Scale
J. S.	J. W.	04/04/2023	2200-23A D7-P	04/04/2023	NTS

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Classed Plot of Peat Depth - Preliminary Data

Kellystown Wind Farm | Edition 0 | Sheet A3

Appendix 6

Walkover Survey Photographic Record

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Plate 1—View back to farm buildings and gate accessing T4 / T3

Plate 2—View towards the west. Access track to T4 / T3

Plate 3—Typical conditions around T4, just inside gate off track

Plate 4—View towards T4, c. 50m distant

Plate 5—View towards T6 on far side of scrub zone mid frame. No accessible from this point

Plate 6—Accessing T5, T6? and T7 from Piperstown Livery Stables

Plate 7—Laneway through Livery Stables to access T7

Plate 8—Track towards T7 (which is in forestry)
Ground Conditions assessed at closest accessible position

Plate 9—T7 within trees. Exploratory hole at edge of lane

Plate 10—View towards T5

Plate 11— Humocky ground on way to T5. Possible area of filled ground.

Plate 12—View towards T5

Plate 13— View towards T5

Plate 14—Looking towards T6 in distance from T5. T6 not accessed at time, although anticipate possible from this location

Plate 15— View towards T2

Plate 16—Lands on route to T2,; site should be accessible using the track around edge of lake

Plate 17— View towards T2, within juvenile forestry

Kellystown Wind Farm, Drogheda, Co. Louth, Ireland

Preliminary Ground Investigation

Report No: 2200-23B Rev01

4th April 2024

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

EDF Renewables Ltd

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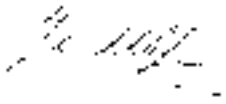
Kellystown Wind Farm, Co. Louth

[SOILS AND GEOLOGY STUDY – PRELIMINARY GROUND INVESTIGATION]

Document Control

SIGN OFF		
Name (Role)	Signature	Date
John Whiteford (Technical Director)		8th April 2024
James Whiteford (Director)		8th April 2023
Joy McNeill (Quality Manager)		9th April 2023

DOCUMENT CONTROL					
Document Number		[DOCUMENT NUMBER TO BE REQUESTED FROM EWAN WALKER]]			
Document Title		2200-23B Kellystown Wind Farm, Co. Louth - Site Investigation Report (Rev01)			
Rev.	Date [dd mmm yyyy]	Description	Prepared	Checked	Approved
0.0	04 Apr 2023	First Draft for EDF Renewables review	JW	JaW	JM
1.0	08 Apr 2024	Updated Draft following Design Freeze	JW	JaW	JM

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CONTENTS

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1 INTRODUCTION

This report should be read in conjunction with the Kellystown Wind Farm - Desktop Study and Walkover Survey for Preliminary Determination of Ground Conditions Report 2200-23A.

In January 2023 Whiteford Geoservices Ltd was commissioned by Jennings O'Donovan Ltd to undertake investigation works at Kellystown Wind Farm near Dunleer, County Louth, Ireland, on behalf of their client EDF Renewables Ltd.

This preliminary investigation was required to obtain information for the civil design of access tracks and other infrastructure; primarily with respect to the assessment of soils and geology in relation to an application for planning permission in respect to: -

A total of 7nr new wind turbine generators, associated infrastructure and turbine hardstands as well as new and upgraded site access tracks.

The results of this site investigation have been employed to determine the nature of and condition of the soils and geology underlying the proposed major wind farm infrastructure.

Prior to undertaking these investigation works a desktop study and walkover survey had been undertaken for the site to provide a broad understanding of the prevailing ground conditions along with a screening assessment for the hazard of peat instability. As part of the walkover survey preliminary peat / organic soil thickness was recorded and a Preliminary Plot of Peat Slide Risk Hazard compiled.

This analysis determined that peat / sensitive organic soils are either not present within the zone likely to be affected by wind farm construction works or of sufficient depth to cause peat instability.

The site investigation works, detailed within this report, consist of the following elements;

The scope of these works was as follows: -

Ref	SI Component	Remarks
A	Peat probing	In-situ assessment of peat thickness at wind turbine generators. (5nr).
b	Trial pitting to determine the underlying soil type, its thickness overlying rock and the relative competence of each stratum.	A total of 14nr Trial pit exploratory holes to assess ground conditions. Each trial pit was excavated to a maximum depth of 3.5m or refusal. These exploratory holes were undertaken at the following locations: 1. WTG01 2. WTG02 3. WTG03

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		4.	WTG04
		5.	WTG05
		6.	SUBSTATION
		7.	In the vicinity of WTG02 to gather additional information in respect to hydro-geological conditions
		8.	At a total of 8 further locations, as part of iterative adjustment of the wind farm layout

Table 1 – Scope of SI Works

The investigation was performed in accordance with the relevant standards (see References) and data presented within the relevant appendix to this report.

This report presents the factual records of the investigations undertaken.

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2 SITE AND GEOLOGY

2.1 The Site

Kellystown Wind Farm is situated approximately 4.5km south of Dunleer, County Louth and straddle undulating agricultural grazing lands between Gallstown Quarry in the north and Piperstown Livery and Equestrian Centre to the south.

Ground surface elevations vary between approximately 91m to 126m above Ordnance Datum (Malin Head).

The land usage does not appear to vary across the number of land holdings which make up the Kellystown Wind Farm development area and consist of agricultural grazing land for cattle.

The closest active quarrying operation to the site, is Gallstown Quarry, immediately bordering the north of the site, which is operated by Kilsaran Concrete Ltd.

2.2 Published Geology

A study was made of available geological information for the area (GSI Online Database). This study indicated that the following natural geology is present across the site of Kellystown Wind Farm;

- Thickly bedded calcareous greywacke (siltstone) which outcrops within the western portion of the site
- Glacial Till (derived from Lower Palaeozoic sandstones and shales)
- Alluvium (present in river valley bottoms)
- Cutover Raised Bog (isolated discrete locations)

2.2.1 Solid Geology

According to the GSI online database, the proposed development area for Kellystown Wind Farm site is immediately underlain by the Clogherhead Formation which consists of, thickly bedded calcareous greywacke.

Also present just outside the development area, north east of the site boundary, is the Red Mans Cove Formation which consists of, red, green, black mudstone

A series of three faults bisect the proposed development area trending in an approximately north north east – south south west direction and potentially impact the subsurface rock

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formation at WTG02, WTG04 and WTG05, where they have the potential to have caused highly fractured and deeply weathered bedrock and / or the channelling of groundwater flow.

Such conditions can have significance for foundation design of structures such as wind turbines and will be fully investigated prior to the construction phase.

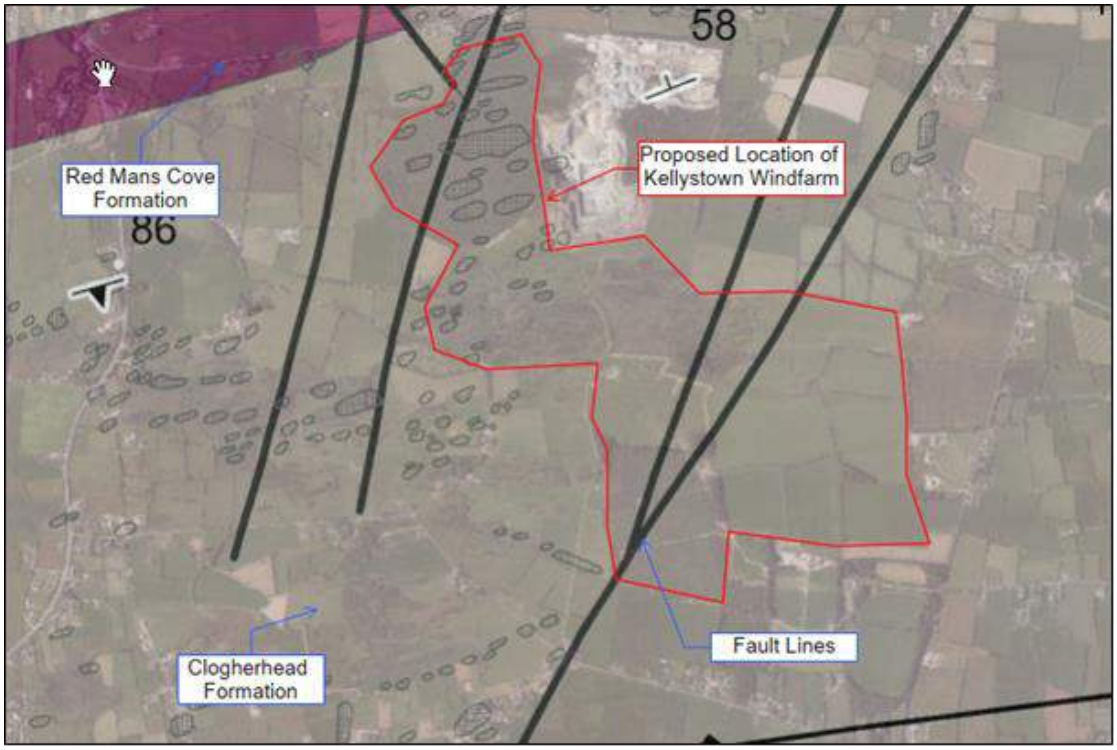

Figure 1 – Bedrock Solid Geology
Reproduced courtesy of GSI Datasets Public Viewer

Internationally, faults can often be associated with an increased hazard of ground movement. That notwithstanding, Ireland is currently located within a region of extremely low tectonic activity and well removed from regions of significant seismic activity.

The most significant event recorded in Ireland by the British Geological Survey was a low energy seismic event that occurred on 7th April 2019 more than 150km from the wind farm site. Details held for the largest and closest recorded event, within a 100km radius of the site, are contained within the table below.

yyyy-mm-dd	hh:mm:ss.ss	Lat	Lon	Depth	ML	Nsta	RMS	Intensity	Locality
27/07/1970	02:45:13.1	53.5	-5	5	2.7			.	ANGLESEY
16/09/1982	03:31:00.0	53.4	-5.8		0.5			2	W OF CANNICH
24/09/1982	16:28:26.1	53.31	-5.67	2.3	1.4				CELTIC SEA
16/10/1982	03:31:00.0	53.4	-5.8		0.5				KISH BASIN

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24/10/1982	16:28:27.0	53.38	-5.75		1.5				KISH BASIN
11/09/1983	21:46:29.0	53.41	-6.93		0.8			3	ENFIELD
19/12/1989	21:50:07.3	53.54	-4.93	9.5	0.1				IRISH SEA
15/05/1990	20:14:11.1	53.041	-5.441	11.1	1.4	17	0.4		IRISH SEA
28/04/1992	21:34:05.6	52.931	-6.177	11	1.3	12	0.2	2	WICKLOW
10/11/2004	23:35:15.2	53.175	-5.241	7.5	2.1	17	0.3		IRISH SEA
14/12/2005	03:30:25.4	53.005	-5.644	8.8	2.8	19	0.4	3	IRISH SEA
01/12/2012	10:24:16.0	53.13	-5.253	9.6	1.1	7	0.2		IRISH SEA
21/12/2013	10:37:37.7	53.15	-5.385	12.2	1	5	0.3		IRISH SEA
07/09/2015	12:15:53.3	54.521	-5.986	3.3	0.8	3	0.4		DRUMBEG
19/09/2015	20:08:28.6	53.944	-5.037	5	0.5	8	0.4		IRISH SEA
10/03/2017	05:06:26.7	53.046	-5.509	8.9	0.7	6	0.3		IRISH SEA
18/05/2017	23:04:14.6	53.042	-5.43	13.9	0.9	8	0.3		IRISH SEA
17/11/2019	14:56:09.2	53.537	-5.441	7.5	0.7	6	0.2		IRISH SEA
15/12/2019	21:19:52.9	53.636	-4.931	7.5	2.1	21	0.4		IRISH SEA
20/12/2019	09:53:44.2	53.634	-4.932	6.5	1.1	10	0.4		IRISH SEA
13/02/2020	19:13:03.3	53.017	-5.561	10.4	1	5	0.1		IRISH SEA
06/06/2020	14:19:36.0	53.636	-4.925	5.6	1	7	0.4		IRISH SEA
17/09/2020	17:31:42.2	53.585	-6.13	17.8	1.1	10	0.2		SKERRIES
17/05/2022	23:00:56.9	53.04	-5.451	6.7	1.1	6	0.4		IRISH SEA

Table 2 – Schedule of Selected Historic Earthquakes of Significance
Reproduced courtesy of BGS Earthquake Database

Nearest largest seismic event

Largest recorded seismic event (within 100km)

In light of the above an assessment has been made with regard to seismic activity. This has determined that any ground movement recorded can be expected to be negligible with respect to the development proposed; where Peak Ground Accelerations can be expected to be in the order of 0.02g[1].

2.2.2 Superficial Geology

Superficial soils present within the wind farm consist of thin glacial till soils overlying shallow, often outcropping greywacke rock to the north and west. Thicker glacial tills derived from Lower Palaeozoic sandstones are present towards the south and east of the site.

[1] Source: British Geological Survey – Search of Earthquake Database centred on Kellystown Wind Farm – search radius of 100km; time period 1st Jan 1000 to 23/12/2022.

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Alluvium is present throughout the Site with some isolated area of peat also indicted outside the proposed construction footprint.

For further information pertaining to site geology refer to the Desk Study and Walkover Survey Report (2200-23A).

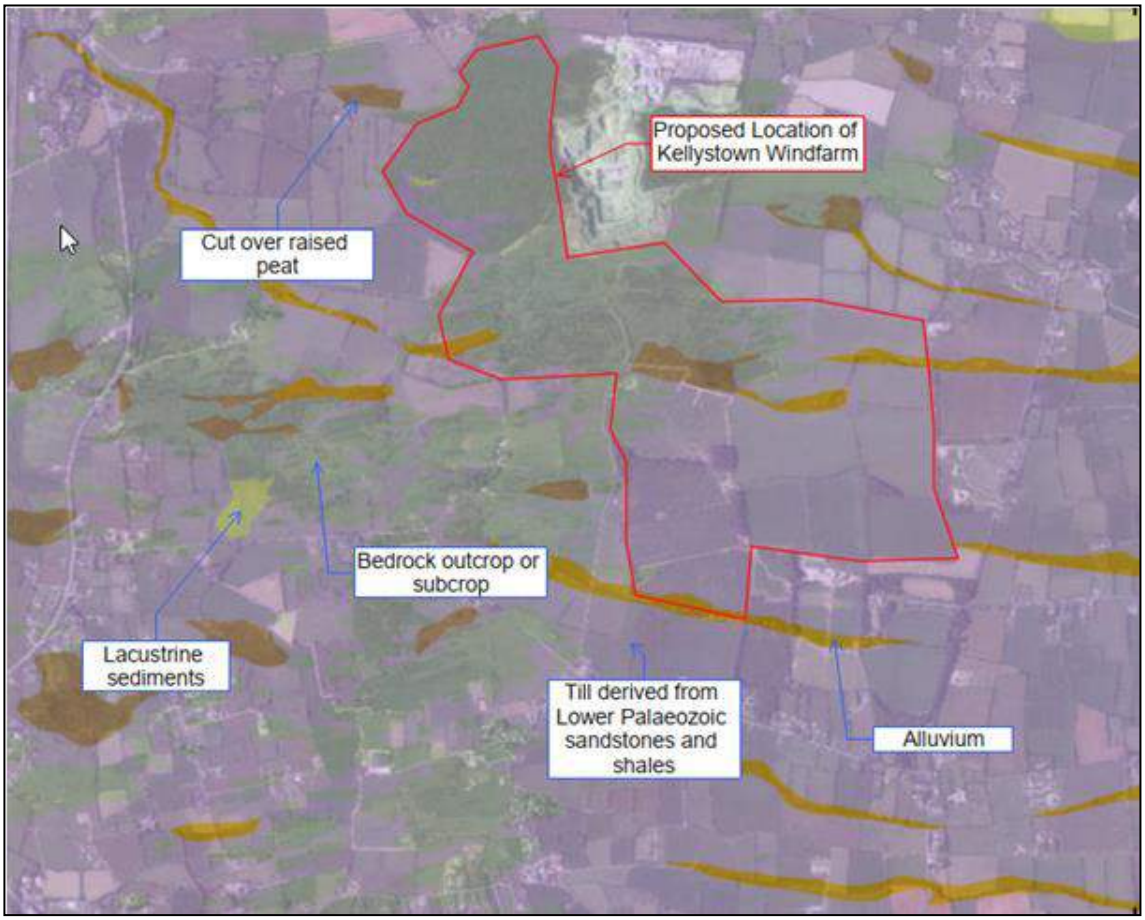

Figure 2 – Superficial Geology
Reproduced courtesy of GSI Datasets Public Viewer

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3 FIELDWORK

3.1 General

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

Please refer to Appendix A for the location of all geotechnical investigations undertaken.

3.2 Exploratory Holes

The exploratory holes are detailed within the following table.

METHOD	QUANTITY	MAXIMUM DEPTH (m)	EQUIPMENT
Trial Pit	12 Nr.	3.50	Trial pits were carried out with the use of a 13T Tracked Excavator

Table 3 – Schedule of Exploratory Holes

Refer to Appendix B for engineering logs of trial holes

3.3 In-situ Testing

The in-situ testing works carried out are detailed within the following table.

TYPE	QUANTITY	MAX. DEPTH (M)	EQUIPMENT
Peat Probing	9[2]	0.00	Rigid “depthing rods”

Table 4 – Schedule of In-Situ Tests

Refer to Appendix B for details

[2] Peat probing was undertaken at the centre-point for each wind turbine generator. Iterative layout changes have resulted in additional observations of peat thickness at TP-A, TP-B, TP-C and TP-D It was not possible to access the position of TP-T05 at the time, due to thick forestry. The assessment of peat thickness here was undertaken as close as possible to the proposed turbine position. Follow up, confirmatory, investigations will be undertaken following tree felling, ahead of construction.

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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 Hean (Ordnance Datum)

Table 5 – Topographic Surveying

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4 LABORATORY TESTING

4.1 Geotechnical Testing

Following detailed analysis soils laboratory testing was undertaken on samples collected from the site.

This testing was scheduled and carried out in accordance with BS 1377 (1990) and other standards by Whiteford Geoservices Ltd.

A schedule of this testing is summarised in the table below and the results are presented within Appendix C.

TYPE	QUANTITY	REMARKS
Bulk and Dry Density	5	BS1377:1990 Part 2
Natural Moisture Content	8	BS1377:1990 Part 2
Partial size Distribution	5	BS1377:1990 Part 2
Sulphate Content of Water Extract	4	BS 1377- Part 3 (2018)
Chloride Content of Water Extract	4	BS 1377- Part 3 (2018)
Sulphide Content of Water Extract	4	BS 1377- Part 3 (2018)
pH	4	BS 1377- Part 3 (2018)
Point Load Test	5	ASTM D5731-08
Acid Test Assessment of Calcareous Rock	5	Limestone : Dolomite Field Discrimation Test, C.J. Mitchell, BGS

Table 6 – Schedule of Laboratory Test of Recovered Samples

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5 SUMMARY OF FINDINGS

The following table summarises the main additional findings from the Site Investigation campaign in respect to Soils and Geology.

REF.	ITEM	DETAIL
1	Typical Soil Overburden	A. Topsoil overlying thin sequence of medium dense gravelly SAND. Extremely weak rock at approx. 1.00m depth. Weak rock at < 1.50m depth. (WTG01, WTG02 & WTG03. B. Topsoil overlying sequence of stiff gravelly CLAY. Extremely weak rock at 2.00m to 2.80m. Weak rock at 3.00m depth (WTG04 & WTG05) C. Topsoil overlying sequence of stiff gravelly CLAY at 0.30m depth. (SUBSTATION).
2	Typical Overburden[3] Thickness (m)	WTG01 = 1.20m WTG02 = 0.70m WTG03 = 1.50m WTG04 = 3.00m WTG05 = 3.00m SUBSTATION = > 1.80m
2	Rock Type	Non-calcareous grey Siltstone (Greywacke) pertaining to the Clogherhead Formation. Shallow siltstone / greywacke strata were found to be often extremely weak and easily rippable by the excavation plant deployed for the SI campaign.
4	Rock Competence	Rippable[4] siltstone, highly decomposed, is generally EXTREMELY WEAK (i.e. 0.6 – 1 MPa or VERY WEAK (i.e. 1 to 5 MPa) Marginally rippable, highly weathered, siltstone is generally VERY WEAK to WEAK (i.e. 1 to 5 MPa) WEAK to MODEARTELY WEAK Siltstone (i.e. 5 to 12.5MPa) is generally non rippable, unless close to a joint or bedding plane MEDIUM STRONG Siltstone (i.e. 25 - 50 MPa) is non-rippable
5	Typical Depth to Non Rippable Rock[5]	WTG01 = 1.20m WTG02 = 0.70m WTG03 = 1.50m WTG04 = >3.00m WTG05 = > 3.00m SUBSTATION = > 1.80m
6	Anticipated Wind Turbine Foundation Type	WTG01 = Gravity Base within weathered rock WTG02 = Gravity Base within weathered rock WTG03 = Gravity Base within weathered rock WTG04 = Ground Improvement / Piled Foundation WTG05 = Gravity Base within weathered rock SUBSTATION = Raft, strip or pad foundations within the stiff glacial till soils

[3] Extremely weak rock is considered to be overburden, as are soils. Weak rock is not considered to be overburden and is anticipated to be the limit of straightforward conventional excavation.
[4] Rippability is based on potential rippability by 13T machine resting on top of the rock formation.
[5] Using 9T tracked excavator

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REF.	ITEM	DETAIL
6	Groundwater Regime	Weak flow at 2.0m (WTG04 - Mobile Seepage at 2.6m (WTG05) - Mobile No groundwater encountered at WTG01, WTG02, WTG03 and SUBSTATION
7	GSI – Crushed Rock Aggregate Potential	According to Geological Survey Ireland, the Aggregate Potential for the Borrow Pit site can be summarised as follows: - Very High – Majority of development area, including all turbine locations. High – Low lying lands between WTG02 / WTG05 and public road along eastern boundary.
8	Predicted Performance as a construction fill material	**Suitable.** Siltstone (Clogherhead Formation) is more suitable for use as construction fill. The extremely weak to weak shallow soils are highly weathered and although suitable as fill, its crushed aggregate may degrade rapidly to fine material where left exposed to weather and traffic. Deeper unweathered siltstone is anticipated to produce a better-quality aggregate, although calcareous content may detract from its quality.
9	Predicted Performance as a construction aggregate	**Only Medium Strong SILTSTONE rock strata (or better) has potential.** This material was not encountered during the SI campaign, but believed to be present at depths > 3.50m below existing ground level. This material can be expected to produce significantly less fine content than the weathered strata that has been identified in the majority of the trial holes.

Table 7 - Summary of Findings

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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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APPENDICES

Appendix A	Drawings
Appendix B	Exploratory Holes and In-situ Test Results
Appendix C	Laboratory Testing Results Employed for Analysis Purposes
Appendix D	Photographic Record

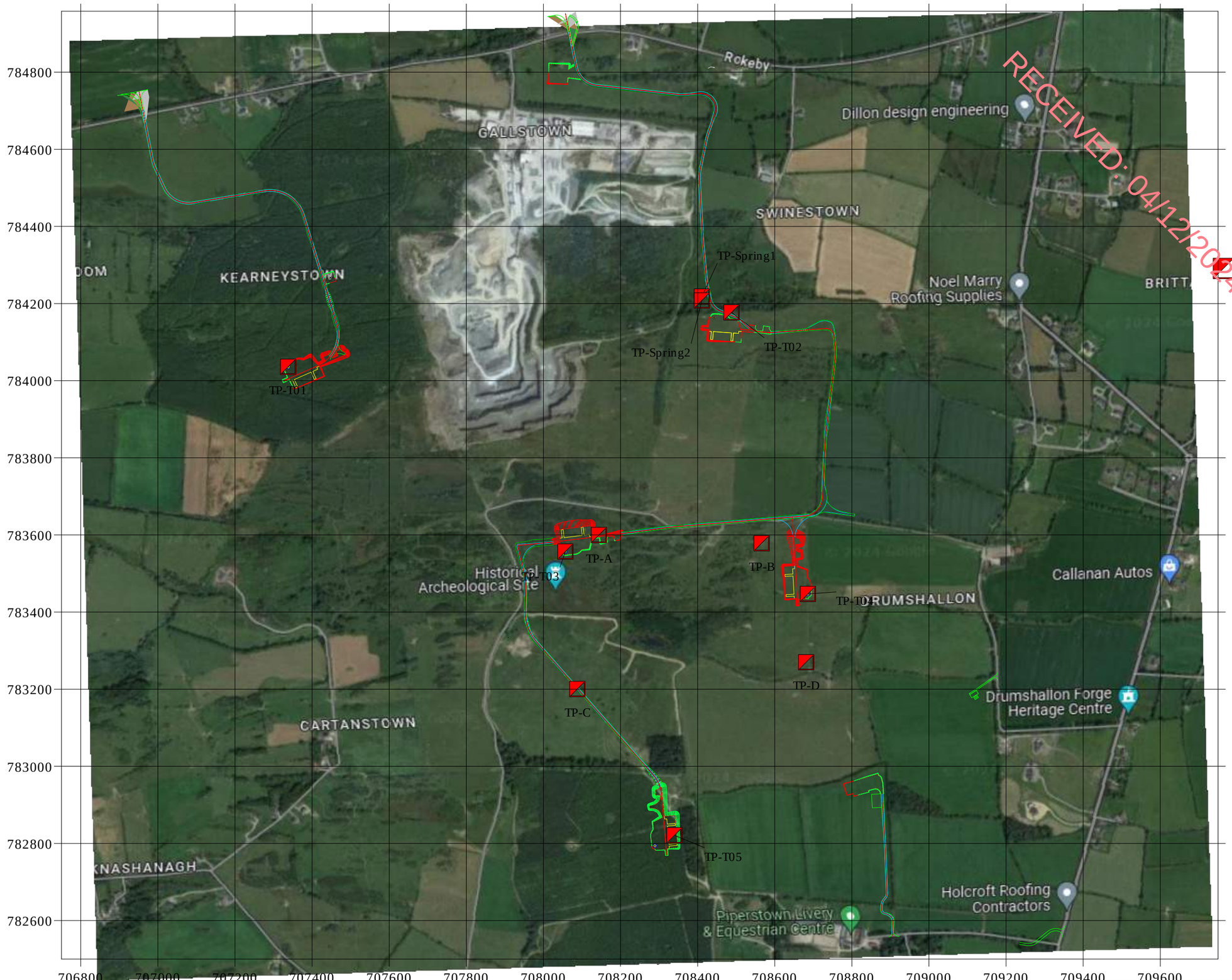
APPENDIX A

DRAWINGS

General Site Location Plan	1 x A4
Site Layout Plan showing position of Exploratory Holes and Insitu Tests (rev01) Ref: 2200/23 – L1	1 x A3
Geological Survey of Ireland Public Viewer Data – Solid and Structural Geology	1 x A4
Geological Survey of Ireland Public Viewer Data – Superficial Soils and Landforms	1 x A4
Geological Survey of Ireland Public Viewer Data – Aggregate Potential	1 x A4
Geological Survey of Ireland Public Viewer Data – Aggregate Overburden Scores	1 x A4
Geological Survey of Ireland Public Data Viewer – Aggregate Bedrock Scores	1 x A4

P1 - General Location Plan (Aerial view)
(© Google Maps 2024)

P2 - Local Location Plan (Aerial view)
(© Google Earth 2024)



RECEIVED: 04/12/2024

N

KEY

Position of Exploratory Trial Hole

Notes:

1. All Positions are relative to ITM
2. Elevation are relative to Malin Head Datum

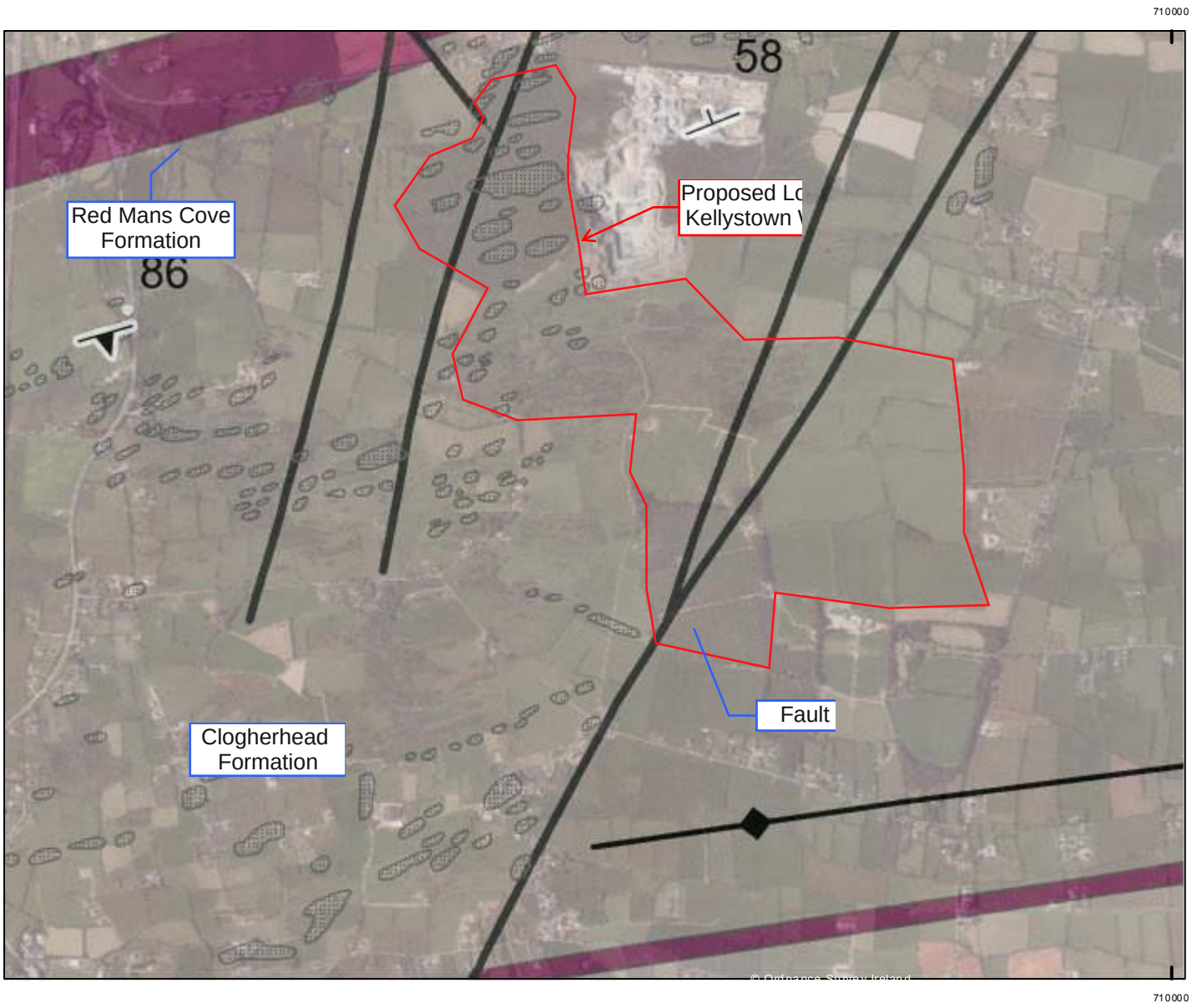
Designed by	Checked by	Approved by - date	Drawing No.	Date	Scale
JW	JW	JM 08/04/24	2200/23 - L1	08/04/2024	1 : 10,000

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

Preliminary Ground Investigations
As-built Exploratory Hole Plan
Kellystown Wind Farm

Edition	Sheet
1	A3

GSI - Solid Geology



Legend

Structural Symbols 100K ITM 2018

- Dip of bedding or main foliation, old GSI data
- First foliation parallel to bedding
- Foliation trend, Thorr and Rosses Granites
- Horizontal Bedding
- Strike and dip of bedding, right way up
- Strike and dip of bedding, way up unknown
- Strike and dip of first foliation
- Strike and dip of overturned bedding
- Strike and dip of second foliation
- Strike and dip of third foliation
- Strike and plunge of first generation fold axis
- Strike and plunge of second generation fold axis
- Strike and plunge of third generation fold axis
- Strike of vertical bedding/foliation
- Strike of vertical first foliation
- <all other values>

- Bedrock Outcrops 100 ITM 2018

Bedrock Linework 100k ITM 2018

- Anticlinal Axis
- Antiformal axis
- Aquifer Boundary
- Area
- Coal seam
- Dyke
- Fault
- Ghost Line
- Goniatite marine band (R1-R4)
- Lithological boundary offshore
- Metadolerite sheet, mainly sills
- Paleogene/ Tertiary Dyke
- Synclinal Axis
- Synformal axis
- Tectonic Slide, barbs on hanging-wall
- Thin stratigraphical unit, diagrammatic
- Thrust, barbs on hanging-wall side
- Tuff band
- Unconformity, dots on younger side
- X-Section

Bedrock Geology

- Clogherhead Formation
- Red Mans Cove Formation

Scale: 1:25,000

Geological Survey Ireland

N W E S

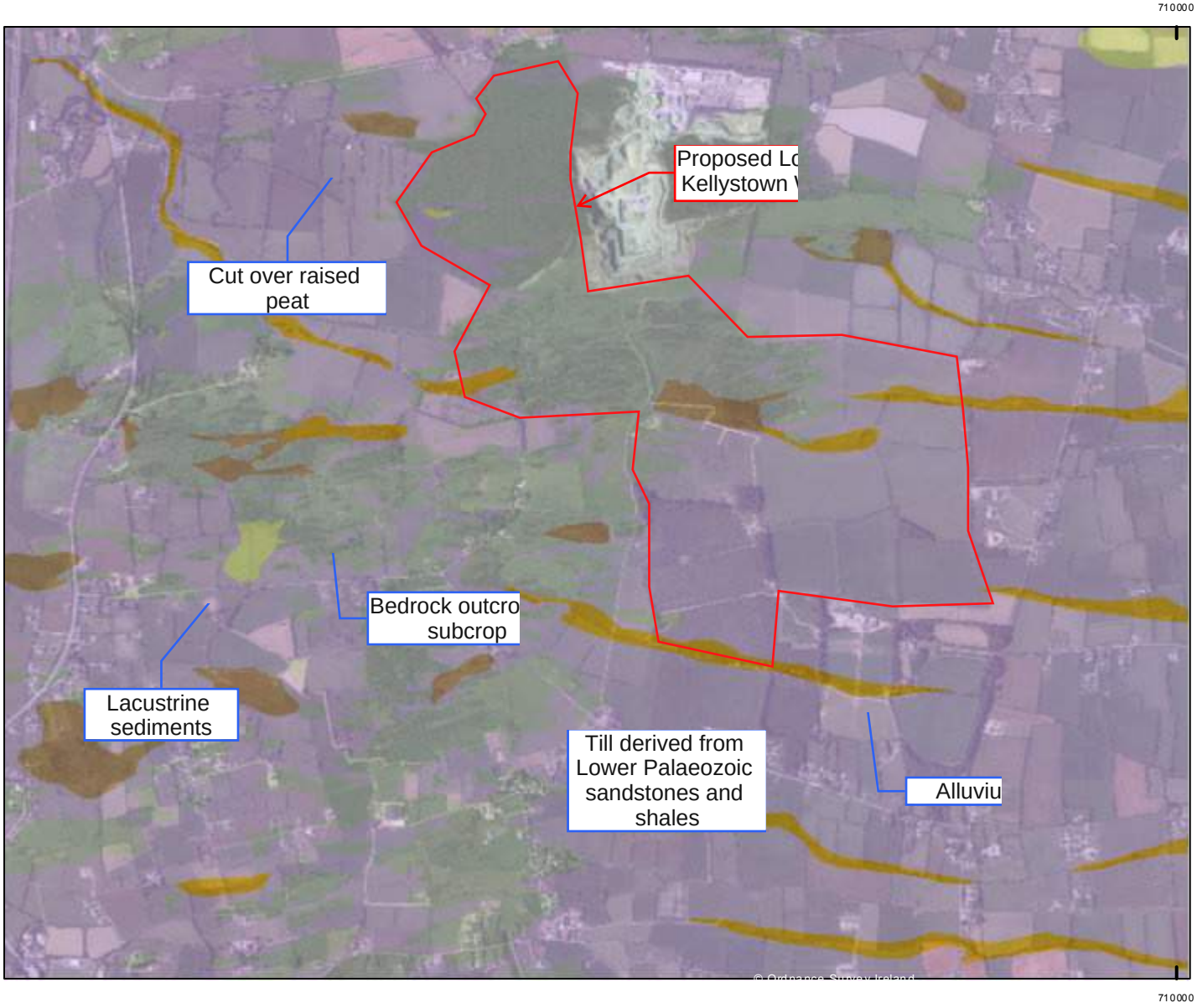
0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 707,715 783,016

16/02/2023, 11:28:44

GSI - Superficial Geology



Legend

Quaternary Sediments

- Alluvium
- Cut over raised peat
- Lacustrine sediments
- Till derived from Lower Palaeozoic sandstones and shales
- Bedrock outcrop or subcrop

Scale: 1:25,000

Geological Survey Ireland

N W E S

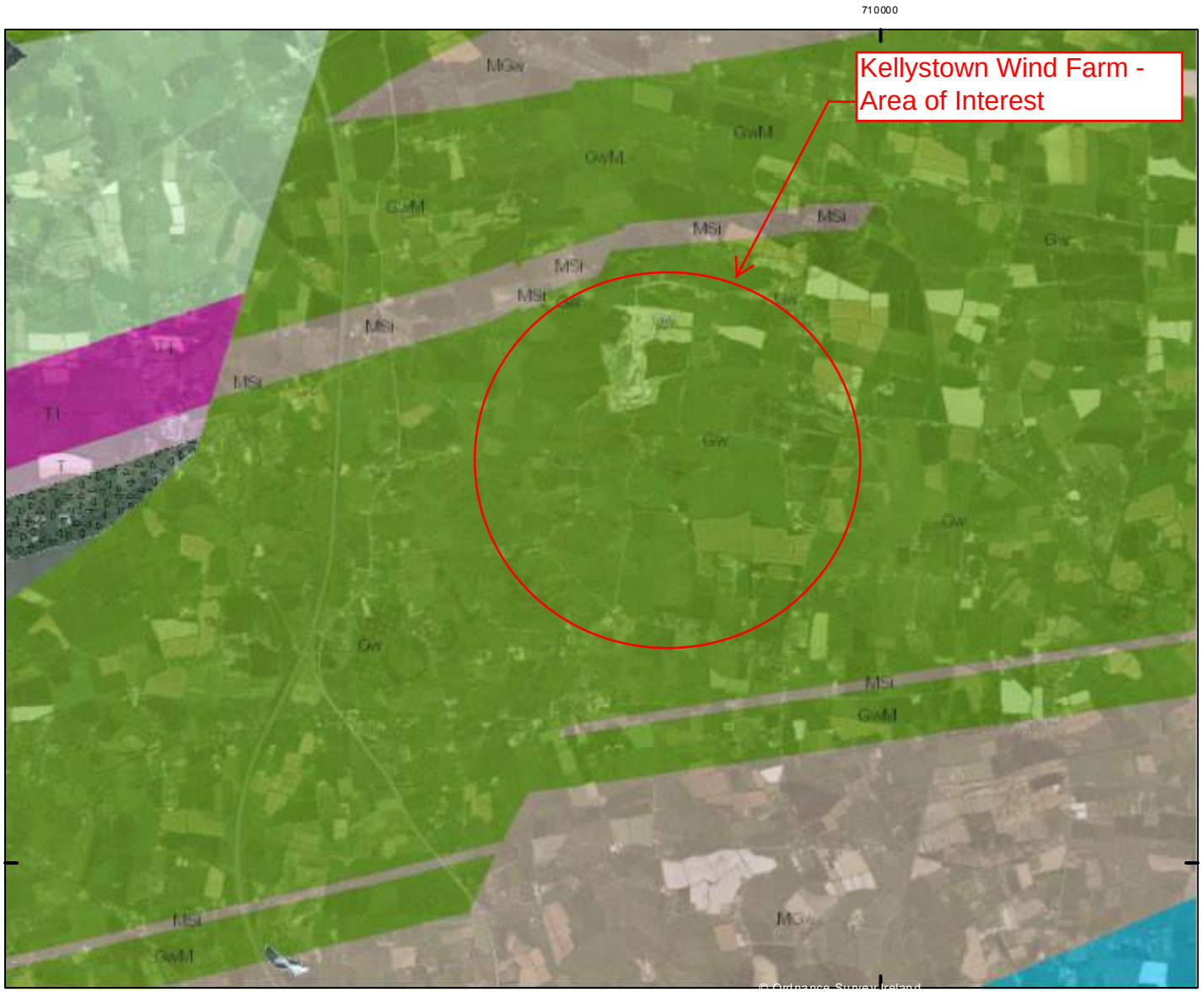
0 0.175 0.35 0.7 mi

0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 707,715 783,016

16/02/2023, 11:29:50

GSI Mapping - Aggregate Bedrock Scores



Scale: 1:54,308

Geological Survey Ireland

PSI Licence

0 0.375 0.75 1.5 mi

0 0.5 1 2 km

Map Centre Coordinates (ITM) 707,615 783,027

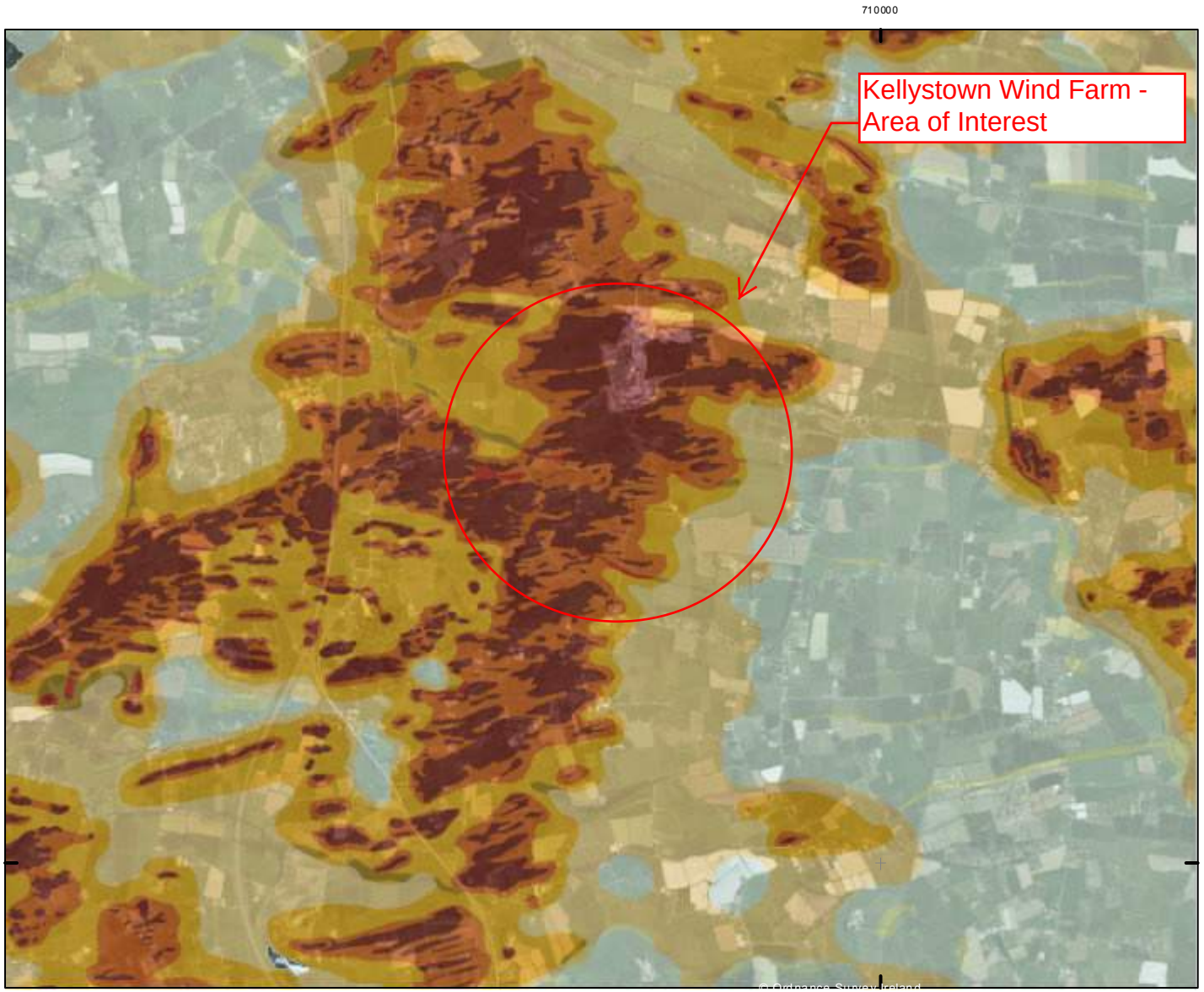
1/25/2023, 1:13:21 PM

Legend

Bedrock Scores

- A Andesite
- Am Amphibolite, hornblende schist
- B Basalt
- Br Breccia
- C Conglomerate
- Ch Chert
- D Dolerite
- Di/Ga Diorite and gabbro
- Do Dolomite, dolomitic limestone
- F Flagstone
- FV/IV Felsic and intermediate volcanics, tuff
- G Granite, granodiorite
- Gn Gneiss
- Gt Grit
- Gw Greywacke
- H Hornfels
- L Limestone
- Lbo Bouldery limestone, limestone conglomerate
- LCa Calp limestone
- LChT Limestone and chert, tuff
- Li Lithologically diverse
- Lmi Micritic or fine limestone
- LMSi Limestone and mudstone, siltstone
- Lo Oolitic limestone
- LS Limestone and sandstone
- LSh Limestone and shale
- M Mudstone
- Ma Marble, marble-schist sequences
- miG Microgranite
- meV Metavolcanics, basic and acidic
- Po Porphyry
- Ps Psammite, psammitic schist
- P/Sc Pelite, mixed schist
- Q Quartzite
- Qz Quartz rock, pegmatite
- QzS Quartzitic/siliceous sandstone
- S Sandstone
- Sh Shale
- Si Siltstone
- Sl Slate; argillite, phyllite
- sP Semi-pelitic schist
- Tu Turbidite
- Vc Volcaniclastics

GSI Mapping - Aggregate Overburden Scores



Legend

Overburden Scores

- 10 (minimal or no overburden)
- 9
- 8
- 7
- 6
- 5
- 4
- 3
- 2
- 1 (thick overburden)
- 0 (overburden inferred, below water)

Scale: 1:54,308

Geological Survey Ireland

PSI Licence

N W E S

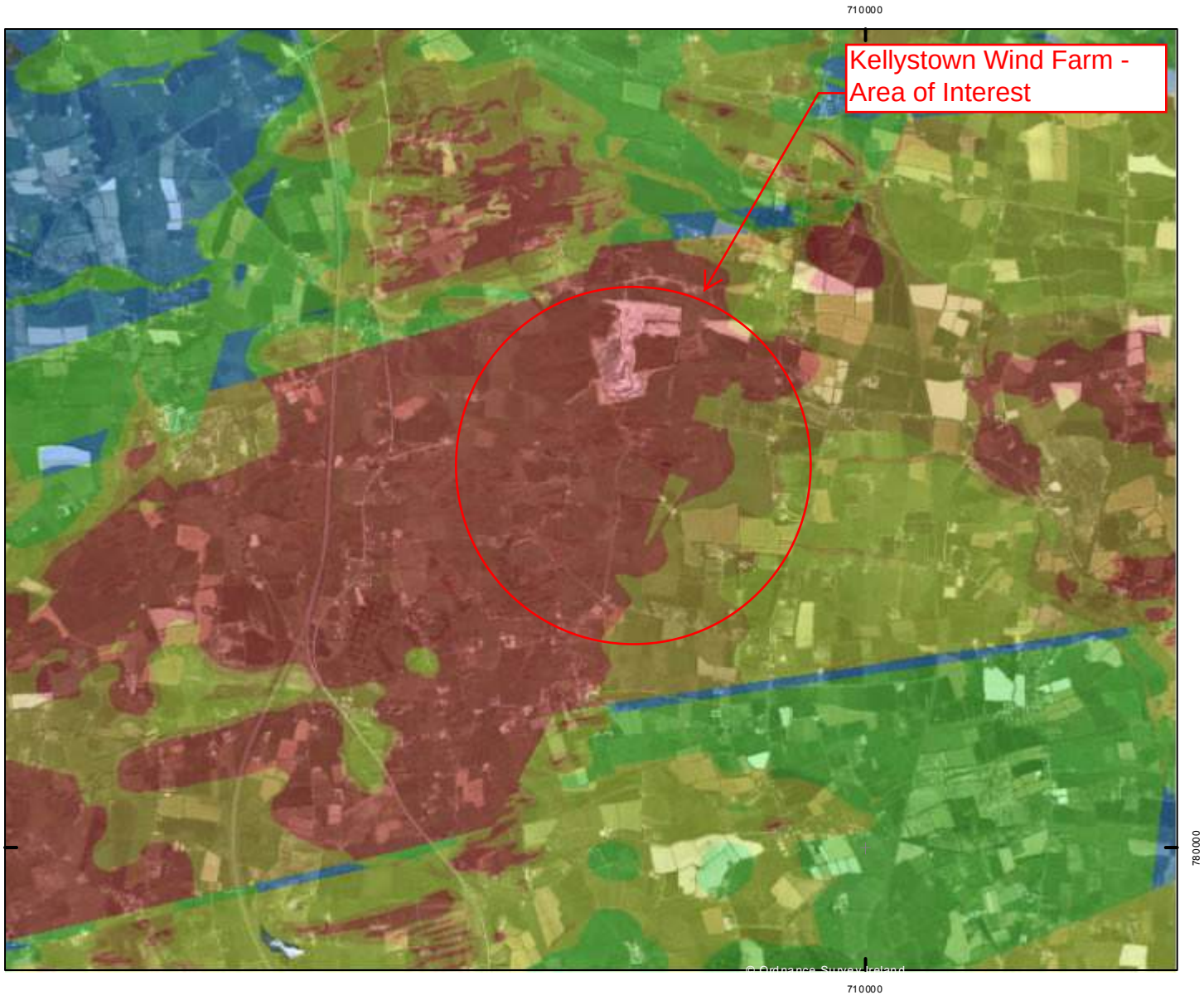
0 0.375 0.75 1.5 mi

0 0.5 1 2 km

Map Centre Coordinates (ITM) 707,615 783,027

1/25/2023, 1:12:33 PM

GSI Mapping - Aggregate Potential



Legend

Crushed Rock Aggregate Potential

- Very High potential
- High potential
- Moderate potential
- Low potential
- Very Low potential

Scale: 1:54,308

Geological Survey Ireland

PSI Licence

0 0.375 0.75 1.5 mi

0 0.5 1 2 km

Map Centre Coordinates (ITM) 707,615 783,027

1/25/2023, 1:08:41 PM

APPENDIX B

IN-SITU TEST RESULTS AND LOGS OF EXPLORATORY HOLES

Peat Thickness at Turbine Locations	1 x A4
Trial Pit Logs	12 x A4

2200-23 - Kellystown Wind Farm
Preliminary Data of Peat Depth at Turbines - Updated 08/04/2024

Location	Easting	Northing	Thickness Peat (m)	Soil Type
T-01	707338	784036	0	TOPSOIL
T-02	708488	784177	0	TOPSOIL
T-03	708057	783557	0	TOPSOIL
T-04	708686	783447	0	TOPSOIL
T-05	708340	782821	0	TOPSOIL
TP-C	708087	783205	0	TOPSOIL
TP-D	708763	783183	0	TOPSOIL
TP-B	708560	783584	0	TOPSOIL
TP-A	707981	783632	0	TOPSOIL

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Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 07/12/2022
		Contractor:	Co-ords: E708143.92 N783599.74
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-A	TP	99.13m AoD	J.Stothers	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				
								Soft, brown, sandy TOPSOIL with medium cobble content.
					0.50	98.63		
		0.75	B					Medium dense, orangish brown, clayey, gravelly, fine to coarse SAND with a medium cobble and boulder content.
					1.40	97.73		
		1.50	B					Firm to stiff, orangish brown, sandy, gravelly SILT/ CLAY with a medium cobble content.
					2.00	97.13		
		2.50	B					Probable extremely weak, grey stained orangish black, destructured SILTSTONE / GREYWACKE Excavated as; Dense orangish brown, slightly clayey, sandy GRAVEL with a high cobble and medium boulder content.
					3.50	95.63		End of Pit at 3.500m

1 2 3 4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	2.00	Sides stable upon completion	None		0.00	3.50	Arisings

Remarks

No groundwater encountered.

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Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 07/12/2022
		Contractor:	Co-ords: E708565.93 N783578.45
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-B	TP	97.15m AoD	J.Stothers	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				
								Soft, brown, sandy TOPSOIL with medium cobble content.
		0.50	B		0.40	96.75		Medium dense, orangish brown, clayey, gravelly, fine to coarse SAND with a medium cobble content.
		1.50	B		1.30	95.85		Probable extremely weak, grey stained orangish black, destructured SILTSTONE / GREYWACKE Excavated as; Dense, orangish brown, clayey, sandy, fine to coarse GRAVEL with a medium cobble and low boulder content.
		2.50	B		2.20	94.95		Probable extremely weak, grey stained orangish black, destructured SILTSTONE / GREYWACKE Excavated as; Dense COBBLES with some orangish brown, clayey, sandy, fine to coarse GRAVEL with a medium boulder content.
		3.20	B		3.00	94.15		Probable extremely weak, grey stained orangish black, distinctly weathered SILTSTONE / GREYWACKE Excavated as; Dense BOULDERS with some orangish brown, clayey, sandy, fine to coarse GRAVEL with a medium cobble content.
					3.50	93.65		End of Pit at 3.500m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	2.00	Sides stable upon completion	None		0.00	3.50	Arisings

Remarks

No groundwater encountered.

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Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 08/12/2022
		Contractor:	Co-ords: E708087.97 N783200.32
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-C	TP	100.49m AoD	J.Stothers	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				
								Soft, brown, sandy TOPSOIL with medium cobble content.
					0.30	100.19		
		0.50	B					Medium dense, orangish brown, clayey, gravelly, fine to coarse SAND with a medium cobble content.
					0.80	99.69		Probable extremely weak, grey stained orangish black, destructured SILTSTONE / GERYWACKE Excavated as; Dense, orangish brown, clayey, sandy, fine to coarse GRAVEL with a medium cobble and low boulder content.
		1.50	B					
					2.50	97.99		Probable extremely weak, grey stained orangish black, destructured SILTSTONE / GREYWACKE Excavated as; Dense COBBLES with some orangish brown, clayey, sandy, fine to coarse GRAVEL with a medium boulder content.
		3.00	B					
					3.20	97.29		Probable extremely weak, grey stained orangish black, distinctly weathered SILTSTONE / GREYWACKE
					3.50	96.99		Excavated as; Dense BOULDERS with some orangish brown, clayey, sandy, fine to coarse GRAVEL with a medium cobble content. End of Pit at 3.500m

1 2 3 4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	2.00	Sides stable upon completion	None		0.00	3.50	Arisings

Remarks

No groundwater encountered.

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Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 07/12/2022
		Contractor:	Co-ords: E708681.53 N783269.80
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-D	TP	88.92m AoD	J.Stothers	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				
								Soft, brown, sandy TOPSOIL with medium cobble content.
		0.50	B		0.40	88.52		Firm to stiff, grey mottled orange, sandy SILT with some fine rootlets.
		1.50	B		1.30	87.62		Medium dense, silty, fine to coarse SAND with pockets of stiff sandy SILT and loose fine to medium GRAVEL.
	▼				1.80	87.12		Loose, grey, fine to medium GRAVEL
					2.00	86.92		Loose to medium dense, greyish brown, slightly silty, fine to coarse SAND
		2.50	B					
		3.00	B		3.00	85.92		Stiff, greyish brown, sandy SILT with a medium boulder content.
					3.50	85.42		End of Pit at 3.500m

1 2 3 4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	2.00	Sides unstable upon completion	None		0.00	3.50	Arisings

Remarks

Groundwater encountered 1.9m b.g.l (Weak flow).

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Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 06/02/2024
		Contractor:	Co-ords: E708411.00 N784218.00
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-SPRING1	TP		J.Ardern	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				
		0.30	B		0.10			Soft, brown, silty, sandy TOPSOIL
					0.40			Weak, dark grey, fine grained, distinctly weathered SILTSTONE / GREYWACKE
								End of Pit at 0.400m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	1.50	Sides stable upon completion	None		0.00	0.40	Arisings

Remarks

No groundwater encountered.

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Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 06/02/2024
		Contractor:	Co-ords: E708411.00 N784208.00
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-SPRING2	TP		J.Ardern	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				
					0.20			Soft, brown, silty, sandy TOPSOIL
		0.50	B					Stiff, greyish brown, slightly gravelly CLAY with a low cobble and boulder content
					1.30			
		1.40	B					Extremely weak, dark grey, fine grained, distinctly weathered SILTSTONE / GREYWACKE
					1.50			End of Pit at 1.500m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	1.50	Sides stable upon completion	None		0.00	1.50	Arisings

Remarks

No groundwater encountered.

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Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 05/02/2024
		Contractor:	Co-ords: E708842.00 N782890.00
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-SUB	TP	98.10m AoD	J.Ardern	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				
					0.30	97.80		Soft, brown, silty, sandy TOPSOIL
		0.50	B					Stiff, greyish brown, slightly gravelly CLAY with a medium cobble and boulder content
		1.50	B					
					1.80	96.30		End of Pit at 1.800m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	1.50	Sides stable upon completion	None	Shear Vane at 0.50m (106,110,104) kPa at 1.00m (128,110,118) kPa	0.00	1.80	Arisings

Remarks

No groundwater encountered.

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Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 06/02/2024
		Contractor:	Co-ords: E707338.00 N784036.00
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-T01	TP	115.25m AoD	J.Ardern	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				
					0.40	114.85		Soft, brown, silty, sandy TOPSOIL
		0.50	B					Medium dense, brown, slightly gravelly, clayey SAND
					0.80	114.45		Extremely weak, dark grey, fine grained, distinctly weathered SILTSTONE / GREYWACKE
		1.00	B					
					1.20	114.05		End of Pit at 1.200m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	1.50	Sides stable upon completion	None		0.00	1.20	Arisings

Remarks

No groundwater encountered.

AGS

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Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 05/02/2024
		Contractor:	Co-ords: E708057.00 N783557.00
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-T03	TP	98.87m AoD	J.Ardern	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				
					0.20	98.67		Soft, brown, silty, sandy TOPSOIL
		0.50	B					Probable MADE GROUND: Dense, COBBLES and BOULDERS
					1.00	97.87		
		1.20	B					Extremely weak, dark grey, fine grained, distinctly weathered SILTSTONE / GREYWACKE
					1.50	97.37		End of Pit at 1.500m

1
2
3
4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	1.50	Sides stable upon completion	None		0.00	1.50	Arisings

Remarks

No groundwater encountered.

AGS

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Website: www.whitefordgeoservices.com

Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 05/02/2024
		Contractor:	Co-ords: E708686.00 N783447.00
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-T04	TP	90.60m AoD	J.Ardern	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				
					0.30	90.30		Soft, brown, silty, sandy TOPSOIL
		0.70	B					Stiff, greyish brown, slightly gravelly CLAY with a low cobble and boulder content
	▼				2.00	88.60		
		2.20	B					Extremely weak, dark grey, fine grained, distinctly weathered SILTSTONE / GREYWACKE
					3.00	87.60		End of Pit at 3.000m

1 2 3 4

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	1.50	Sides stable upon completion	None	Shear Vane at 0.50m (92,98,106) kPa at 1.00m (110,136,124) kPa	0.00	3.00	Arisings

Remarks

Groundwater encountered 2.0m b.g.l (Weak flow).

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Website: www.whitefordgeoservices.com

Trial Pit Log

Project Name: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 08/12/2022
		Contractor:	Co-ords: E708339.94 N782821.00
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-T05	TP	109.21m AoD	J.Stothers	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				
								Soft, greyish brown, sandy TOPSOIL with medium cobble content.
					0.40	108.81		Medium dense to dense, orangish brown mottled grey, gravelly, very clayey, fine to coarse SAND with a medium cobble and low boulder content.
		1.00	B					
	▼				2.80	106.41		Probable extremely weak, grey stained orangish black, distinctly weathered SILTSTONE / GREYWACKE
		3.00	B		3.00	106.21		Excavated as; Dense BOULDERS with some orangish brown, clayey, sandy, fine to coarse GRAVEL with a medium cobble content.
								End of Pit at 3.000m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	2.00	Sides stable upon completion	None		0.00	3.00	Arisings

Remarks

Groundwater encountered 2.8m b.g.l (Seepage).

AGS

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: Kellystown Wind Farm	Project No: 2200-23	Client: EDF Renewables	Date: 06/02/2024
		Contractor:	Co-ords: E780488.00 N784177.00
Location: Piperstown, Co. Louth		Sub Contractor: Gerry Kearns Plant Hire	Equipment: Takeuchi TB290-2

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP-T02	TP	105.06m AoD	J.Ardern	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				
					0.10	104.96		Soft, brown, silty, sandy TOPSOIL
		0.30	B					Weak, dark grey, fine grained, distinctly weathered SILTSTONE / GREYWACKE
					0.70	104.36		End of Pit at 0.700m

Dimensions		Trench Comments			Backfill Details		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Top	Base	Description
4.00	1.50	Sides stable upon completion	None		0.00	0.70	Arisings

Remarks

No groundwater encountered.

AGS

APPENDIX C

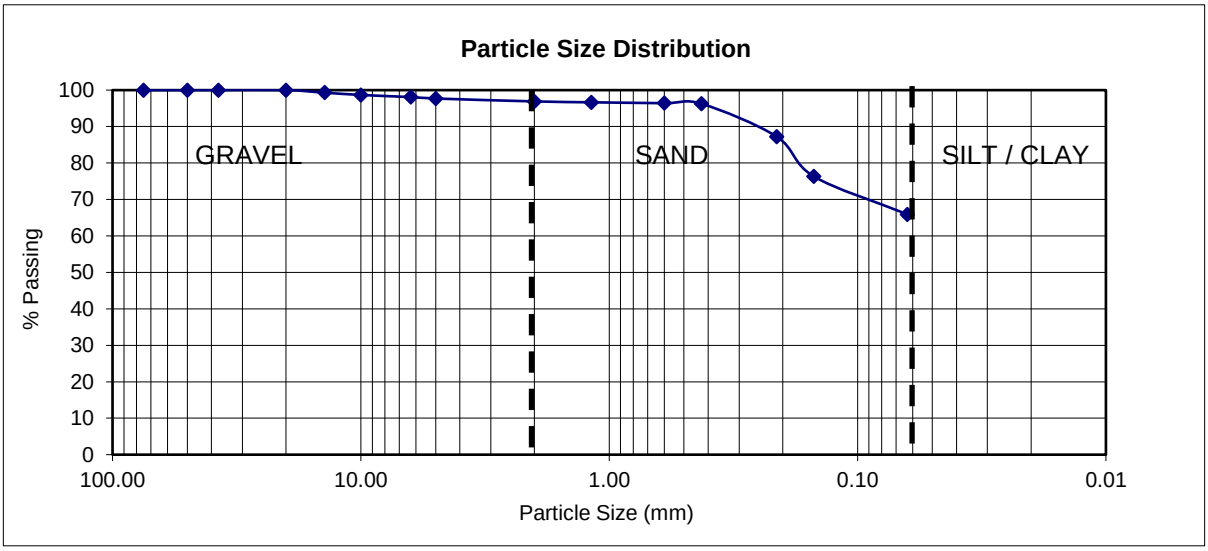
LABORATORY TESTING RESULTS

Partial Size Distribution	5 x A4
Moisture Content, Bulk and Dry Density	1 x A4
Sulphate Content of Water Extract, Chloride Content of Water Extract, Sulphide Content of Water Extract & pH	1 x A4
Point Load Tests on Rock Samples	1 x A4
Acid Test on Rock Samples	1 x A4

Particle Size Distribution

Location: Kellystown WF		**Job ref.**	2200-23
		Borehole/ Pit no.	TP-A
Soil description: Sandy, SILT / CLAY		**Sample no.**	
		Depth	1.50
Test method BS 1377-2:1990:9.2/9.3/9.4/9.5*		**Date**	24/02/2023
Initial dry mass (m1)	1847.10		
Mass of receiver (g)			

BS test sieve (mm)	Mass of dry soil + receiver (g)	Mass of dry soil retained (m2) (g)	Percentage retained (m2/m1)100	Cumulative percentage passing
75		0.00	0.00	100.00
50		0.00	0.00	100.00
37.5		0.00	0.00	100.00
20		0.00	0.00	100.00
14		12.90	0.70	99.30
10		11.70	0.63	98.67
6.3		10.70	0.58	98.09
5		7.20	0.39	97.70
2		14.80	0.80	96.90
1.18		4.50	0.24	96.65
0.6		4.50	0.24	96.41
0.425		2.90	0.16	96.25
0.212		166.00	8.99	87.27
0.15		202.30	10.95	76.31
0.063		191.90	10.39	65.92
Bottom tray		1217.70	65.92	0.00



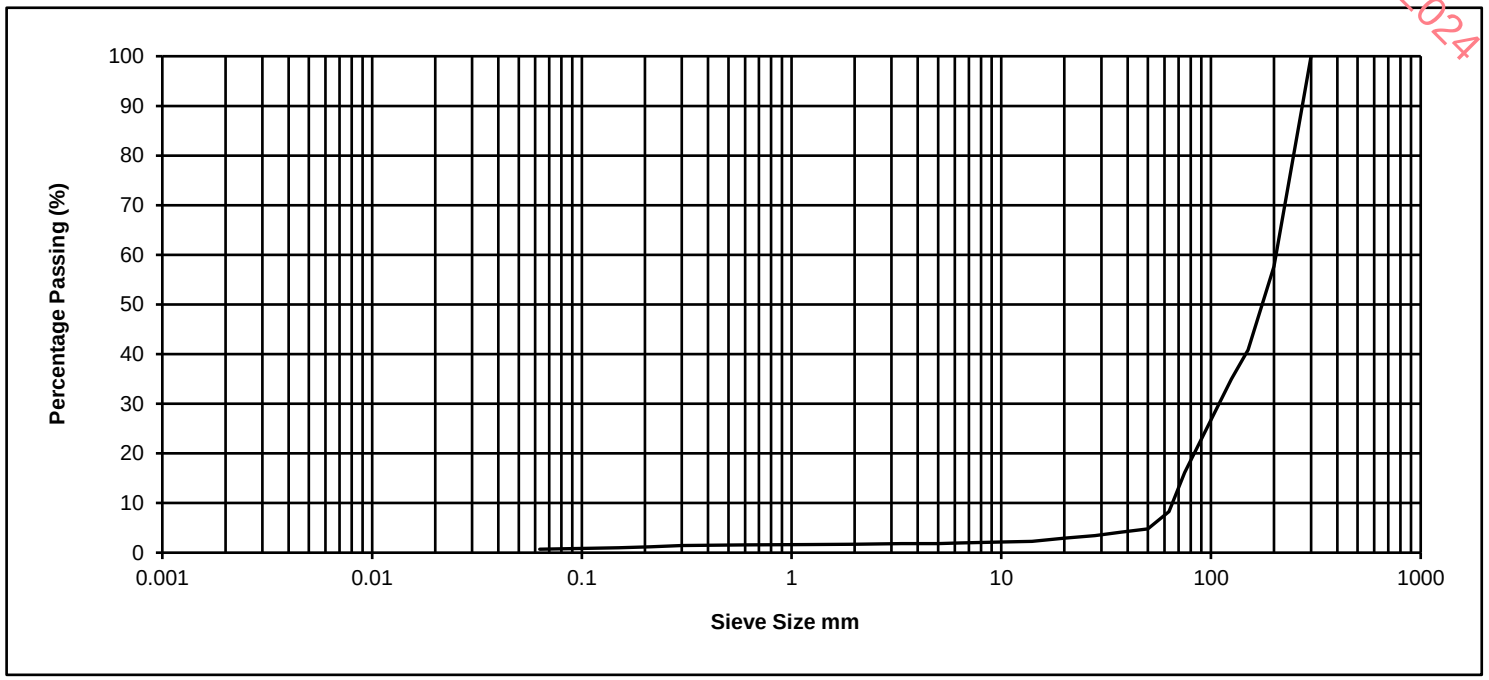
Operator	Checked	Approved
LJ	JMcN	JW

VINI Geotechnical Testing

Determination of Particle Size Distribution

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

Sieve Size mm	% Passing
300.000	100
200.000	57.6535197
150.000	40.8487269
125.000	35.0
75.000	16.1
63.000	8.3
50.000	4.8
37.500	4.2
28.000	3.4
20.000	2.9
14.000	2.3
10.000	2.2
6.300	1.9
5.000	1.8
3.350	1.8
2.000	1.7
1.180	1.7
0.600	1.6
0.425	1.5
0.300	1.4
0.212	1.2
0.150	1.0
0.063	0.7



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		0.7			1.0			6.6		91.7	0.0

Sample Description Gravel cont Cobbles

Project Kellystown

Project No. 2200-23

BH/TP No. TP-T02

Sample No.

Operator	SS	Checked	VS	Approved	VS	Date sample tested	13/03/2024	Depth	0.8m

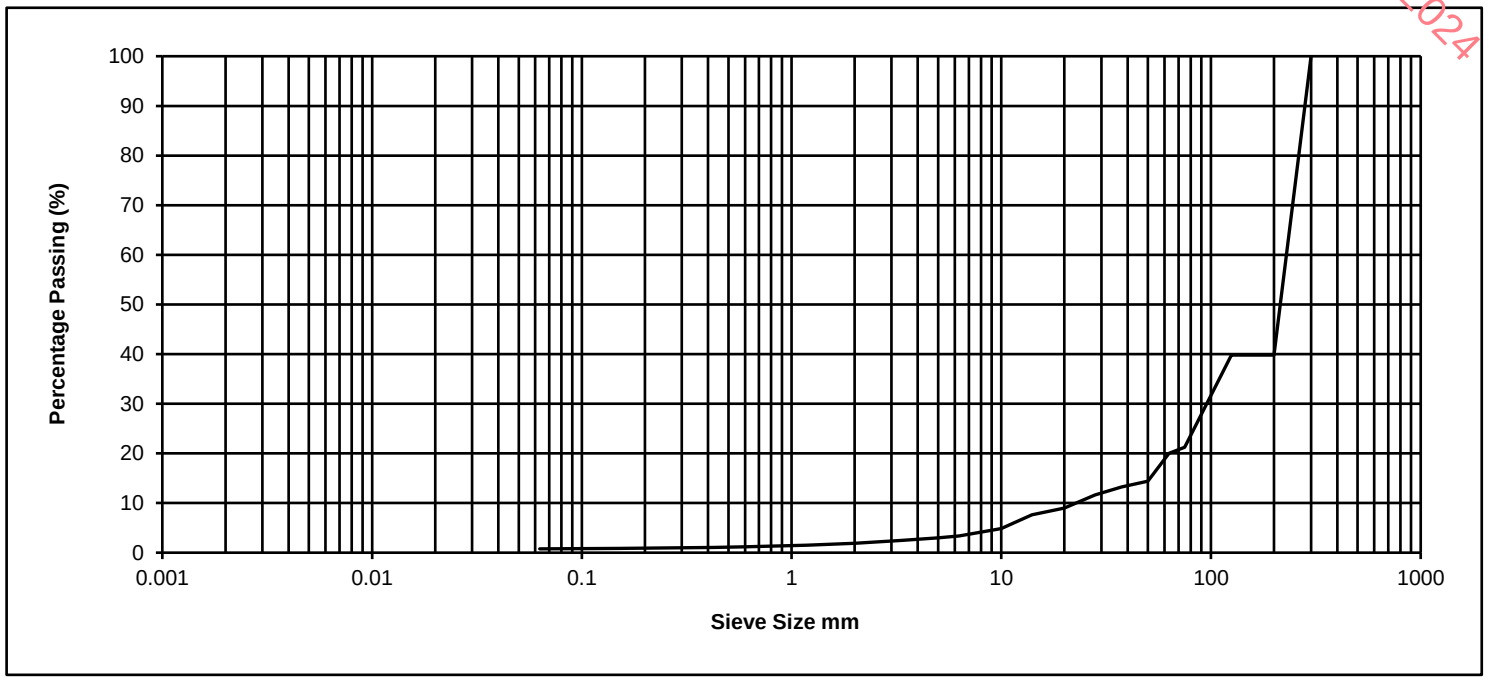
0
4241
5924
6513
8399
9188
9534

VINI Geotechnical Testing

Determination of Particle Size Distribution

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

Sieve Size mm	% Passing
300.000	100
200.000	39.7827903
150.000	39.7827903
125.000	39.8
75.000	21.2
63.000	20.0
50.000	14.4
37.500	13.3
28.000	11.6
20.000	9.0
14.000	7.6
10.000	4.8
6.300	3.4
5.000	3.0
3.350	2.5
2.000	1.9
1.180	1.5
0.600	1.2
0.425	1.1
0.300	1.0
0.212	0.9
0.150	0.9
0.063	0.8



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		0.8			1.1			18.1		80.0	0.0

Sample Description Gravel cont Cobbles

Project Kellystown

Project No. 2200-23

BH/TP No. TP-T03

Sample No.

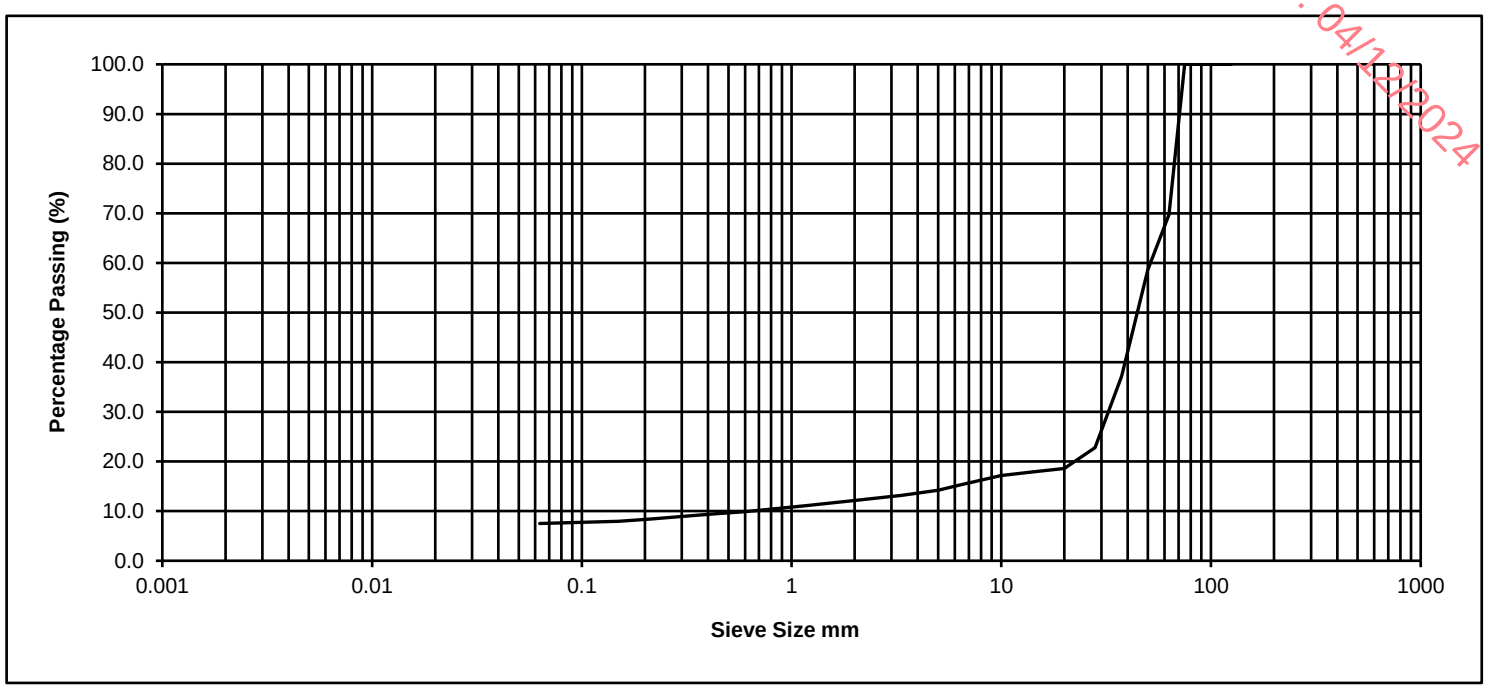
Operator	SS	Checked	VS	Approved	VS	Date sample tested	13/03/2024	Depth	1.2m

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	69.7
50.000	58.6
37.500	37.2
28.000	22.8
20.000	18.6
14.000	17.9
10.000	17.2
6.300	15.3
5.000	14.2
3.350	13.2
2.000	12.1
1.180	11.1
0.600	9.9
0.425	9.4
0.300	8.9
0.212	8.4
0.150	7.9
0.063	7.5



Percentage Particle Size

Clay	Fine Silt	Medium Silt	Coarse Silt	Fine Sand	Medium Sand	Coarse Sand	Fine Gravel	Medium Gravel	Coarse Gravel	Cobbles	Boulder
		7.5			4.6			57.6		30.3	0.0

Sample Description: Silty sandy GRAVEL cont Cobbles

Project: Kellystown

Operator	SS	Checked	VS	Approved	VS	Date sample tested	13/03/2024

Project No. 2200-23

BH/TP No. TP-T4

Sample No.

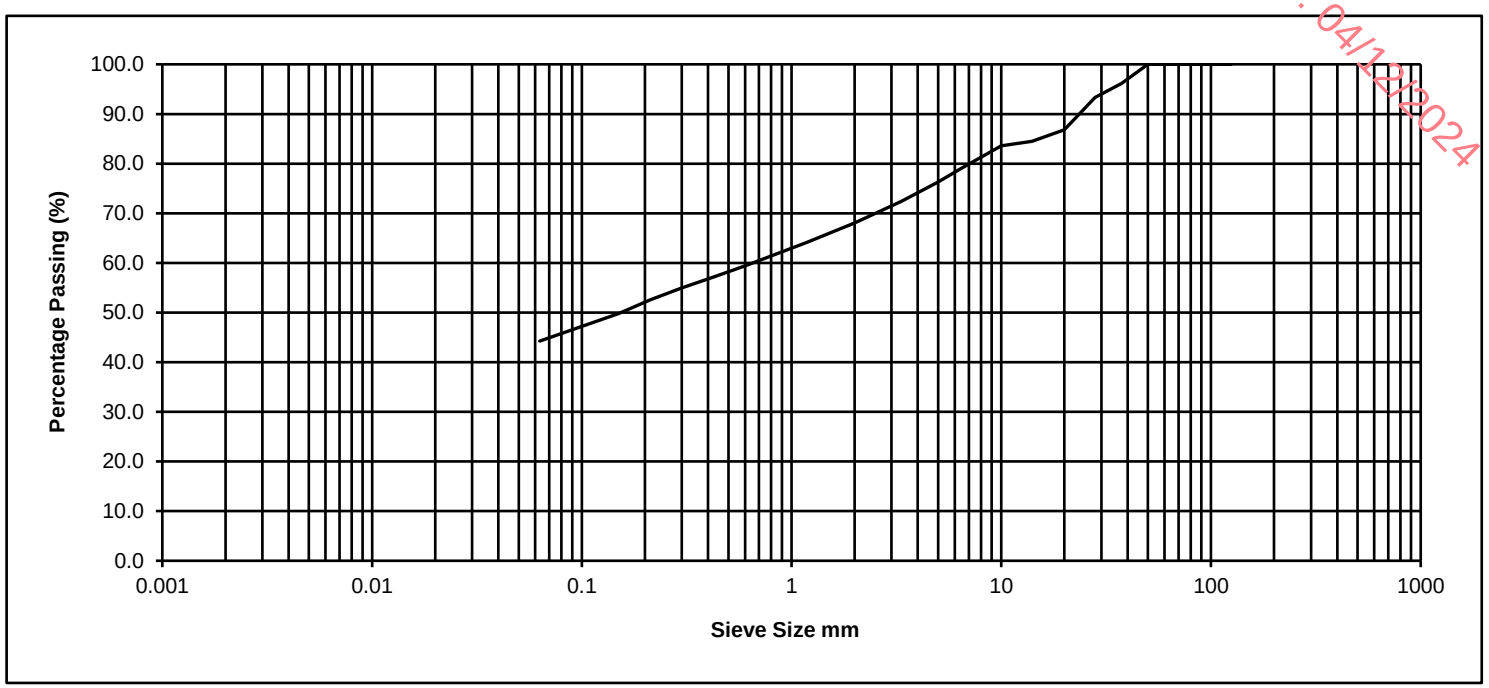
Depth 2.2m

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	96.1
28.000	93.3
20.000	86.8
14.000	84.5
10.000	83.6
6.300	78.8
5.000	76.3
3.350	72.4
2.000	68.0
1.180	64.1
0.600	59.4
0.425	57.2
0.300	55.0
0.212	52.6
0.150	49.8
0.063	44.2



Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
	44.2	23.8	32.0	0.0	0.0

Sample Description Gravelly sandy SILT

Project Kellystown

Project No. 2200-23

BH/TP No. TP-SUB

Sample No.

Operator	SS	Checked	VS	Approved	VS	Date sample tested	13/03/2024	Depth	1.5m

Laboratory Results

Location: Kellystown WF

Job No: 2200-23

Client: EDF Renewables Ltd

Date: 08-04/2024

Sample no:	Depth (m)	Water Content (%)	Bulk Density kg/m3	Dry Density kg/m3
TP-A	1.50	15.7	2267	1774
TP-C	1.50	18.9	2357	1808
TP-D	1.50	18.4	2248	1772
TP-D	3.00	17.6	2345	1828
TP-SUB	1.50	15.2	2128	-
TP-T03	1.20	N/A	-	-
TP-T04	2.20	17.3	-	-
TP-T02	0.30	4.8	-	-

Operator	Checked	Approved
Dr S. Sivakumar	JM	WGS

BS1377-Part2 (1990) Section 2

Chemical Content Results

Location: Kellystown WF

Job No: 2200-23
Client: EDF Renewables Ltd
Date: 08/04/2024

Sample ID:	Depth (m)	Sulphate (mg/l)	Chloride (mg/l)	Sulphide (mg/l)	pH
TP-D	1.50	118	160	0.32	8.78
TP-SUB	1.50	2.0	2	<0.1	7.36
TP-04	2.20	2.3	4	<0.1	7.53
TP-08	0.30	<1.5	2	<0.1	7.08

Operator	Checked	Approved
Dr S. Sivakumar	JM	WGS

BS1377-Part2 (1990) Section 2

Point Load Testing

Location: Kellystown WF

Project No: 2200-23
Date:08/04/2024

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-A	IL	0.06	0	2.23	0.56	1.00	0.56
TP-B	IL	0.07	0	5.24	1.32	1.00	1.32
TP-B	IL	0.05	0	2.22	0.56	1.00	0.56
TP-C	IL	0.05	0	5.32	1.34	1.00	1.34
TP-T05	IL	5.60	0	18.79	4.73	1.00	4.73

Operator	Checked	Approved
LJ	JMCN	JW

ASTM D5731-08

Acid test Results

Determination of carbonate mineral content and potential solubility

Operator	Checked	Approved
JS	JW	JM

Location: Kellystown Wind Farm - Soils and Geology Study

Job No: 2200-23
Date: 08/04/2024

Sample ID:	Rock Description	No reaction	Mild reaction	Strong reaction
TP-A	Grey fine grained SILTSONE / GREYWACKE (2.50m)	X		
TP-B	Grey fine grained SILTSONE / GREYWACKE (2.50m)	X		
TP-B	Grey fine grained SILTSONE / GREYWACKE (3.20m)	X		
TP-C	Grey fine grained SILTSONE / GREYWACKE (3.00m)	X		
TP-T05	Grey fine grained SILTSONE / GREYWACKE (3.00m)	X		

APPENDIX D

PHOTOGRAPHIC RECORD

Photographic Plates	
Site Visit 1 (Dec 2022)	15 x A4
Site Visit 2 (Feb 2024)	8 x A4

Plate 1—Trial Hole TP-A

Plate 2—Trial Hole TP-A

Plate 3—Trial Hole TP-A

Plate 4—Trial Hole TP-A

Plate 5—Trial Hole TP-A

Plate 6—Trial Hole TP-A

Plate 7—Trial Hole TP-B

Plate 8—Trial Hole TP-B

Plate 9—Trial Hole TP-B

Plate 10—Trial Hole TP-B

Plate 11 - Trial Hole TP-B

Plate 12—Trial Hole TP-C

Plate 13 - Trial Hole TP-C

Plate 14—Trial Hole TP-C

Plate 15— Trial Hole TP-C

Plate 16—Trial Hole TP-C

Plate 17— Trial Hole TP-C

Plate 18—Trial Hole TP-D

Plate 19— Trial Hole TP-D

Plate 20—Trial Hole TP-D

Plate 21— Trial Hole TP-D

Plate 22—Trial Hole TP-D

Plate 23— Trial Hole TP-D

Plate 24—Trial Hole TP-05

Plate 25— Trial Hole TP-05

Plate 26—Trial Hole TP-05

Plate 27— Trial Hole TP-05

Plate 28—Trial Hole TP-05

Plate 29— Trial Hole TP-05

Plate 11—TP-01

Plate 12—TP-01

Plate 13—TP-03

Plate 14—TP-03

Plate 15—TP-04

Plate 16—TP-04

Plate 17—TP-02

Plate 18—TP-02

Plate 19—TP-SUB

Plate 20—TP-SUB

Plate 21—TP-SPRING1

Plate 22—TP-SPRING1

Plate 23—TP-SPRING2

Plate 24—TP-SPRING2

Plate 25—TP-SPRING2

Plate 26—TP-SPRING2